SUSSEX COUNTY

MULTI-JURISDICTIONAL ALL HAZARDS MITIGATION PLAN

2025 Update

Volume I

Prepared for:
Sussex County Sheriff's Office
Division of Emergency Management
39 High Street, Newton, NJ 07860

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TETRA TECH

EXECUTIVE SUMMARY

Hazard Mitigation Overview

Hazard mitigation is the use of long-term and short-term policies, programs, projects, and other activities to minimize the loss of life, injury, and property damage that can result from a disaster. Communities, residents, and businesses across the United States have been faced with continually increasing costs associated with natural and human-caused hazards. Hazard mitigation is the first step in reducing risk and is the most effective way to reduce costs associated with hazards.

Sussex County has developed a hazard mitigation plan (HMP) to reduce risks from disasters to the people, property, economy, and environment within the County's planning area. The County and 24 participating local jurisdictions (the Planning Partners) prepared this plan as an update to the 2021 Sussex County HMP. The updated 2025 HMP (also referred to as "the plan") includes countywide analysis and assessment of hazards, risk, and capabilities.

The plan complies with federal and state hazard mitigation planning requirements to establish the Planning Partners' eligibility for funding under Federal Emergency Management Agency (FEMA) grant programs. The federal Disaster Mitigation Act of 2000 requires state and local entities to implement pre-disaster mitigation planning and develop HMPs. FEMA has issued guidelines for the development of multi-jurisdictional hazard mitigation plans. The New Jersey Office of Emergency Management (NJOEM) supports plan development for jurisdictions in New Jersey.

The Planning Process

This HMP update documents the process and outcomes of the Planning Partners' mitigation planning efforts. To support the planning process, the Planning Partners accomplished the following:

- Developed a Steering Committee consisting of key stakeholders and a countywide Planning Partnership made up of the Steering Committee members, the Planning Partners, and other regional stakeholders
- Involved a wide range of stakeholders and the public in the plan update process
- Reviewed the 2021 Sussex County Hazard Mitigation Plan
- Identified hazards of concern to the County to be included in the update
- Profiled the hazards of concern
- Estimated the inventory at risk and potential losses associated with these hazards
- Reviewed and updated the mitigation goals and objectives
- Reviewed mitigation strategy and actions outlined in the 2021 HMP to indicate progress
- Developed new mitigation actions to reduce the vulnerability of assets from hazards of concern
- Developed mitigation plan maintenance procedures to be executed after obtaining approval of the plan from NJOEM and FEMA

Involvement by Stakeholders and the Public

The Planning Partners kept stakeholders and the general public informed throughout the planning process and provided opportunities for public comment and input. In addition, numerous agencies and stakeholders participated as core or support members of the Steering Committee or Planning Partnership, providing input and expertise throughout the planning process.

Participating Jurisdictions Involved in the Mitigation Planning Effort

The following are the local governments in Sussex County that participated as Planning Partners in this HMP update:

- County of Sussex County
- Borough of Andover
- Township of Andover
- Borough of Branchville
- Township of Byram
- Township of Frankford
- Borough of Franklin
- Township of Fredon
- Township of Green
- Borough of Hamburg
- Township of Hampton
- Township of Hardyston
- Borough of Hopatcong
- Township of Lafayette
- Township of Montague
- Town of Newton
- Borough of Ogdensburg
- Township of Sandyston
- Township of Sparta
- Borough of Stanhope
- Township of Stillwater
- Borough of Sussex
- Township of Vernon
- Township of Walpack
- Township of Wantage

The participating jurisdictions provided significant input into the preparation of the plan, in particular the preparation of jurisdiction-specific annexes included in Volume II.

Multiple Agency Support for Hazard Mitigation

Primary responsibility for the development and implementation of mitigation strategies and policies lies with local governments. However, local governments are not alone; various partners and resources at the regional, state, and federal levels are available to assist communities in the development and implementation of mitigation strategies. In New Jersey, NJOEM is the lead agency providing hazard mitigation planning assistance to local jurisdictions. In addition, FEMA provides grants, tools, guidance, and training to support mitigation planning.

In updating the HMP, the participating jurisdictions fully coordinated with and solicited participation from county and local governments, relevant organizations and groups, state and federal agencies, and the general public. This coordination ensured that stakeholders had established communication channels and relationships to support mitigation planning and mitigation actions included in the plan.

Additional input and support for this planning effort was obtained from a wide range of agencies as well as through public involvement. Under the project management of the Sussex County Division of Emergency Management, the Sussex County Hazard Mitigation Steering Committee provided oversight for the preparation of this plan. The Steering Committee includes representatives from the following:

- Sussex County Community College
- Sussex County Department of Central and Shared Services
- Sussex County Division of Community and Youth Services
- Sussex County Division of Emergency Management
- Sussex County Division of Planning and Economic Development
- Sussex County Division of Public Works

- Sussex County Division of Senior Services
- Sussex County Engineering Department
- Sussex County Facilities Management
- Sussex County Health and Human Services – Division of Health
- Sussex County Municipal Utilities Authority
- Sussex County Open Space Committee
- Sussex County Sheriff's Office
- Sussex Rural Electric Coop
- Atlantic Health System - Newton Medical Center
- New Jersey Bureau of Dam Safety
- Rutgers Cooperative Extension of Sussex County
- Upper Delaware Conservation District (former Sussex County Soil and Water Conservation District)
- Andover Township
- Hampton Township
- Wantage Township

Risk Assessment for Local Hazards of Concern

The Planning Partners evaluated each jurisdiction's risk and vulnerability due to each identified hazard of concern, based on past events, past and predicted future losses, and the expected probability of future occurrence. From these evaluations, hazards were ranked as high, medium, or low risk to each jurisdiction. The hazard rankings were used to focus and prioritize individual jurisdictional mitigation strategies. Summary overall hazard rankings for all of Sussex County are presented in Table ES-1.

Table ES-1. Countywide Ranking for Sussex County Hazards of Concern

Hazard of Concern	Hazard Ranking
Dam Failure	Medium
Disease Outbreak	Low
Drought	Low
Earthquake	Low
Flood	Medium
Geological Hazards	Low
Hazardous Materials	Medium
Hurricane	Medium
Infestation	Low
Nor'easter	High
Severe Weather	High
Severe Winter Weather	High
Wildfire	Medium

Capability Assessment and Plan Integration into Other Local Mechanisms

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. Within the County, there are many existing plans and programs that support hazard risk management. It is critical that this HMP integrate, complement, and reference those plans and programs to the extent practical in order for it to be a comprehensive resource for hazard mitigation.

The HMP includes a capability assessment to review relevant local mechanisms for each participating jurisdiction. This assessment identifies where each jurisdiction is currently able to implement hazard mitigation measures and where each would benefit from improved capabilities for such measures. The capability assessment also provides a summary and description of the existing plans, programs, and regulatory mechanisms at all levels of government (federal, state, county and local) that support hazard mitigation in the County. In the jurisdictional annexes, each participating jurisdiction identifies how it has integrated hazard risk management into its existing planning, regulatory and operational/administrative framework, and how it intends to continue to promote this integration.

Mitigation Strategy

Hazard Mitigation Plan Goals and Objectives

It is a federal requirement for hazard mitigation plans to include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards of concern.

The Sussex County HMP planning process included a review and update of mitigation goals and objectives that were previously established to guide the selection of mitigation actions addressing all hazards of concern. Mitigation goals were updated based on the updated risk assessment, discussions, research, and input from plan participants and stakeholders. The goal development process considered the goals expressed in the New Jersey State Hazard Mitigation Plan, as well as other relevant county and local planning documents.

2025 Sussex County HMP Goals

Goal 1: Protect life

Goal 2: Protect property

Goal 3: Increase public preparedness and awareness

Goal 4: Develop and maintain an understanding of increased risk from climate change impacts on natural hazards

Goal 5: Enhance mitigation capabilities to reduce hazard vulnerabilities

Goal 6: Support continuity of operations before, during, and after hazard events

Goal 7: Reduce the risk of natural hazards for socially vulnerable populations

Goal 8: Address long-term vulnerabilities from high

Implementation of the 2021 Plan

The status of the mitigation projects identified in the 2021 HMP was reviewed for this HMP. Numerous projects and programs have been implemented that have reduced hazard vulnerability of assets in the planning area. Uncompleted projects have been revaluated, modified as necessary, and incorporated into this plan. The Planning Partners' annexes describe these mitigation activities in more detail, and plan maintenance procedures have been developed to encourage thorough integration with local decisions and processes and regular review of implementation progress.

2025 Mitigation Actions

Actions included in the jurisdictional mitigation strategies had a strong focus on the following areas:

- Education and outreach for the general population and socially vulnerable populations
- Training and education of municipal officials, including floodplain administrators
- Ensuring continuity of operations for critical facilities through the installation of emergency backup generators
- Reduction of flood risk through the increase in capacity of stormwater infrastructure, including culverts, drainage systems, and catch basins
- Working to identify safety measures and procedures of dams within the various jurisdictions.

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1. INTRODUCTION

Sussex County has developed a hazard mitigation plan (HMP) to reduce risks from disasters to the people, property, economy, and environment within the County. Developed by the County and 24 participating local jurisdictions (the Planning Partners), this HMP updates the 2021 Sussex County HMP. The updated 2025 HMP (also referred to as "the plan") includes countywide analysis and assessment of hazards, risk, and capabilities.

1.1 OVERVIEW TO HAZARD MITIGATION PLANNING

1.1.1 What Is Hazard Mitigation?

Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk and effects that can result from hazards. A hazard mitigation plan documents a state or local government's evaluation of natural hazards and strategies to mitigate them.

Effective mitigation planning helps people, organizations, and government agencies to better prepare for and respond when disasters occur. It also allows local governments to remain eligible for Federal Emergency Management Agency (FEMA) grant funding for mitigation projects that will reduce the impact of future disaster events. The long-term benefits of mitigation planning and implementation include the following:

- An increased understanding of hazards faced by local communities
- A more sustainable and disaster-resistant community
- Financial savings through partnerships that support planning and mitigation efforts
- Focused use of limited resources on hazards that have the biggest impact on the community
- Reduced long-term impacts on human health and structures
- Reduced costs associated with response and recovery efforts, including repairs

The **Federal Emergency Management Agency** (FEMA) estimates that for every dollar spent on damage prevention (mitigation), twice that amount is saved by not

1.1.2 Regulatory Framework

The U.S. government encourages communities to assess their vulnerability to various hazards before disaster strikes and then take actions to reduce potential risks. This allows communities to rebound from a natural disaster more quickly, with less loss of property or human injury and at much lower cost. Effective cost benefits include reductions in the time lost from productive activity by businesses and industries.

The federal Disaster Mitigation Act of 2000 (DMA 2000) updated the mitigation planning provisions of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. Under the new requirements, communities seeking certain hazard-related federal funding must have a plan that identifies actions to mitigate hazards, risks, and vulnerabilities and establishes a strategy to implement those actions. Regulations implementing the DMA 2000 are included in Title 44 of the Code of Federal Regulations, Section 201 (44 CFR 201). In New Jersey, responsibility for fulfilling the requirements of DMA 2000 and 44 CFR 201 and administering the FEMA Hazard Mitigation Program has been delegated to the New Jersey Office of Emergency Management (NJOEM).

To be eligible for federal hazard mitigation assistance, communities must prepare and maintain an HMP and update it every 5 years. Each local jurisdiction's HMP must identify potential natural hazards to the health, safety, and well-being of its residents and identify and prioritize actions that can be taken by the community to mitigate those hazards before disaster strikes.

One goal of the federal regulations is to facilitate cooperation between state and local authorities, prompting them to work together. This enhanced planning process enables local and state governments to better articulate accurate needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects.

Table 1-1 summarizes the 44 CFR 201 requirements and where each is addressed in this hazard mitigation plan.

Table 1-1. FEMA Local Mitigation Plan Review Crosswalk

Plan Criteria	Primary Location in Plan
Prerequisites	
Adoption by the Local Governing Body: §201.6(c)(5)	Section 2.6; Appendix A
Planning Process	
Documentation of the Planning Process: §201.6(b) and §201.6(c)(1)	Chapter 2
Risk Assessment	
Identifying Hazards: §201.6(c)(2)(i)	Chapter 5
Profiling Hazards: §201.6(c)(2)(i)	Chapters 6 – 18
Assessing Vulnerability: Overview: §201.6(c)(2)(ii)	Chapters 4, 6 – 18
Assessing Vulnerability: Identifying Structures: §201.6(c)(2)(ii)(A)	Chapter 3; Section 4.1, Chapters 6 – 18
Assessing Vulnerability: Estimating Potential Losses: §201.6(c)(2)(ii)(B)	Section 4.2, Chapters 6 – 18
Assessing Vulnerability: Analyzing Development Trends: §201.6(c)(2)(ii)(C)	Section 3.8; Volume II
Mitigation Strategy	
Local Hazard Mitigation Goals: §201.6(c)(3)(i)	Chapter 21
Identification and Analysis of Mitigation Actions: §201.6(c)(3)(ii)	Chapter 21; Volume II
Implementation of Mitigation Actions: §201.6(c)(3)(iii)	Chapter 22; Volume II
Multi-Jurisdictional Mitigation Actions: §201.6(c)(3)(iv)	Volume II
Plan Maintenance Process	
Monitoring, Evaluating, and Updating the Plan: §201.6(c)(4)(i)	Chapter 22
Incorporation into Existing Planning Mechanisms: §201.6(c)(4)(ii)	Chapter 22; Volume II
Continued Public Involvement: §201.6(c)(4)(iii)	Chapter 22

1.1.3 Specialized Terms and Concepts

Like any technical field, hazard mitigation has developed over the years its own set of terms and concepts with particular meanings within the hazard mitigation practice. A full glossary and list of acronyms is provided at the front of this volume. The list below provides a quick reference for specialized terms whose use is especially prominent in this hazard mitigation plan:

- **Adaptive capacity—**the ability of a human or natural system to adjust to climate change by moderating potential damage, taking advantage of opportunities, or coping with the consequences (EPA 2023)

- **Asset—**anything that is important to the character and function of a community (e.g., people, structures, community lifelines, the economy, and natural, historic, and cultural resources) (FEMA 2023)
- **Capability assessment—**an evaluation of which authorities, policies, programs, funding and resources a participant has to accomplish hazard mitigation (FEMA 2023)
- **Cascading hazards—**a primary event, such as heavy rainfall, seismic activity, or rapid snowmelt, followed by a chain of consequences that may range from modest (lesser than the original event) to substantial (National Academies of Sciences, Engineering, and Medicine 2022)
- **Community lifelines—**the most fundamental services in a community that, when stabilized, enable all other aspects of society to function (FEMA 2023)
- **Extent—**the range of anticipated intensities of the identified hazards within a community, most commonly expressed using various scientific scales (FEMA 2022)
- **Hazard profile—**a description of a hazard's location, extent, previous occurrences and probability of future events within a community (FEMA 2023)
- **Hazard ranking—**the process of identifying the hazards that pose the greatest risk to a community, based on how likely the hazard is to occur, the potential consequences if the hazard does occur, and other relevant local factors
- **Impact—**the consequences or effects of a hazard on a community's assets identified in the vulnerability assessment. (FEMA 2023)
- **Integration—**the inclusion of hazard mitigation principles, vulnerability information and mitigation actions into other existing community planning to leverage activities that have co-benefits, reduce risk and increase resilience (FEMA 2022)
- **Mitigation action—**measures, projects, plans or activities proposed to reduce the current and future vulnerabilities identified in the risk assessment (FEMA 2023)
- **Mitigation strategy—**the long-term blueprint for reducing the potential hazard-related losses identified in the risk assessment; the strategy consists of mitigation goals, mitigation actions, and a plan for implementing the actions (FEMA 2023)
- **Natural hazard—**a source of harm or difficulty created by a meteorological, environmental or geological event (FEMA 2023)
- **Plan maintenance—**monitoring and updating a hazard mitigation plan as warranted by changing conditions, availability of new information, and progress on the proposed mitigation actions (FEMA 2023)
- **Planning process—**the procedures used to develop a hazard mitigation plan with broad acceptance across the community
- **Risk—**the potential for damage or loss when natural hazards interact with people or assets (FEMA 2023)
- **Risk assessment—**a data-driven analysis to find where a local jurisdiction is vulnerable to hazards (FEMA 2023)
- **Social vulnerability—**the potential for loss within an individual or social group, as affected by traits that influence the individual's or group's resilience, which is their ability to prepare for, respond to, cope with, or recover from an event (FEMA 2023)
- **Stakeholder—**individuals or groups that a mitigation action or policy affects, including businesses, private organizations and residents (FEMA 2023)
- **Vulnerability—**a description of which assets within locations identified to be hazard prone are at risk from the effects of the hazard (FEMA 2023)

1.2 HISTORY OF HAZARD MITIGATION PLANNING IN SUSSEX COUNTY

1.2.1 Previous Sussex County HMPs

Sussex County has been included in 28 federal disaster declarations (major disaster, fire management, and emergency) since 1954. The County prepared and adopted its first hazard mitigation plan in 2011. The plan has been regularly updated since then, with updates adopted in 2016, and 2021. The most recent update identified the following as the greatest hazards of concern in Sussex County:

- Dam failure
- Disease outbreak
- Drought
- Earthquake
- Flood
- Geological hazards
- Hazardous materials
- Infestation
- Nor'easter
- Severe weather
- Severe winter weather
- Wildfire

1.2.2 Key Changes in the Current Update

The following are the most significant changes made between the previous County HMP (2021) and the current (2025) update:

- The 2025 Sussex County HMP includes discussions on socially vulnerable populations and the planning process included outreach to socially vulnerable populations to gather their input.
- For the 2025 HMP update, the capability assessment was expanded; the discussion of capabilities in each jurisdictional annex has been expanded as well (Volume II).

1.3 PLAN ORGANIZATION

The Sussex County HMP provides a detailed review and analysis of each hazard of concern, resources, and relevant statistical information for the Planning Partners. The plan is organized into two volumes: Volume I includes all information that applies to the entire planning area (Sussex County); and Volume II includes specific information for each participating jurisdiction.

Volume I is a resource for ongoing mitigation analysis. It includes a description of the County and its jurisdictions as well as information on mitigation planning and how the risk assessment and capability assessment were performed. Volume I of the plan includes the following chapters:

- Part 1: The Planning Process and Planning Area

  - Chapter 1: Introduction
  - Chapter 2: Planning Process—A description of the plan development process, committee and stakeholder roles and activities, how the plan will be incorporated into existing programs, and the adoption of the plan by each participating jurisdiction
  - Chapter 3: County Profile—An overview of Sussex County, including general information and physical conditions, land use patterns and trends, population and demographics, economy, general building stock inventory, community lifelines, and natural, historic, and cultural resources
- Part 2: Risk Assessment
  - Chapter 4: Methodology—Description of the methodology used to assess hazard risk and the status of local data
  - Chapter 5: Hazards of Concern Identification—Documentation of the process of identifying the natural hazards of concern for further profiling and evaluation
  - Chapters 6 – 18—Hazard profiles and findings of the risk assessment (estimates of the impact of hazard events on life, safety, and health; general building stock; critical facilities; the economy; and natural, historic, and cultural resources)
  - Chapter 19: Hazard Ranking—Description and summary of the hazard ranking process
- Part 3: Capability Assessment
  - Chapter 20: Capability Assessment—A summary and description of the existing plans, programs, and regulatory mechanisms at all levels of government (federal, state, county, local) that support hazard mitigation within the County
- Part 4: Mitigation Strategy
  - Chapter 21: Mitigation Strategy—Information regarding the mitigation goals and objectives identified by the Steering Committee in response to priority hazards of concern, and the process by which County and local mitigation strategies have been developed or updated
- Part 5: Plan Maintenance
  - Chapter 22: Plan Maintenance Procedures—A system to continue to monitor, evaluate, maintain, and update the plan

Volume II consists of annexes for each participating jurisdiction. Each annex summarizes the jurisdiction's planning, regulatory, and fiscal capabilities; evaluates vulnerabilities to hazards; describes the status of past mitigation actions; and provides a specific mitigation strategy. The annexes provide each jurisdiction with an expedient resource for implementing mitigation projects and maximizing future grant opportunities.

Appendices include the following:

- Appendix A: Sample Resolution of Plan Adoption—Resolutions issued by each jurisdiction to support adoption of this HMP.
- Appendix B: Participation Matrix—A log of individual participants' contributions to the planning process
- Appendix C: Meeting Documentation—Agendas, attendance sheets, minutes, and other documentation (as available and applicable) of planning meetings convened during the development of the plan
- Appendix D: Public and Stakeholder Outreach Documentation—Documentation of the public and stakeholder outreach effort including webpages, informational materials, public and stakeholder meetings and presentations, surveys, and other methods used to receive and incorporate public and stakeholder comment and input to the plan update process

- Appendix E: Action Worksheet Template and Instructions
- Appendix F: Plan Maintenance Tools—Examples of plan review templates available to support annual plan review and example FEMA Guidance Worksheets (FEMA 386-4)
- Appendix G: Critical Facility Inventory
- Appendix H: Risk Assessment Supplementary Data—Details regarding past hazard events since those documented in the 2021 plan
- Appendix I: Mitigation Strategy Supplementary Data—Summaries of additional activities and resources provided to plan participants to support the update of the mitigation strategy
- Appendix J: NJOEM Planning Standards—Planning standards and guidelines for hazard mitigation planning in New Jersey
- Appendix K: Linkage Procedures—Description of the process for jurisdictions that did not participate in this HMP to gain future coverage under the plan
- Appendix L: Dam Supplement—Information on high hazard dams within Sussex County

2. PLANNING PROCESS

This chapter describes the planning process used to update the Sussex County HMP, including how it was prepared, who was involved in the process, and how the public was involved. The planning approach aimed to achieve the following results:

- The plan is multi-jurisdictional, including all municipalities in the County. Sussex County invited all jurisdictions in the County to join in the planning process. To date, all 24 local municipal governments in the County (the Planning Partnership) have participated in the 2025 plan update process (B indicates boroughs; Twp indicates townships):
  - Sussex County
  - Andover (B)
  - Andover (Twp)
  - Branchville (B)
  - Byram (Twp)
  - Frankford (Twp)
  - Franklin (B)
  - Fredon (Twp)
  - Green (Twp)
  - Hamburg (B)
  - Hampton (Twp)
  - Hardyston (Twp)
  - Hopatcong (B)
  - Lafayette (Twp)
  - Montague (Twp)
  - Newton (T)
  - Ogdensburg (B)
  - Sandyston (Twp)
  - Sparta (Twp)
  - Stanhope (B)
  - Stillwater (Twp)
  - Sussex (B)
  - Vernon (Twp)
  - Walpack (Twp)
  - Wantage (Twp)
- The format of the plan is such that other entities can easily join at a later date as part of the regulatory 5-year plan update process.
- The plan considers all natural hazards that pose a risk to the area, as required by 44 CFR 201. Non-natural hazards that pose significant risk were considered as well.
- The plan was developed following FEMA regulations and prevailing FEMA and state guidance. This ensures that all the requirements are met and supports plan review. In addition, the plan meets criteria for the National Flood Insurance Program (NFIP) Community Rating System (CRS) and the Flood Mitigation Assistance program.

Sussex County applied for and was awarded a multi-jurisdictional planning grant under the Hazard Mitigation Grant Program (FEMA-4488-0005-DR-NJ), which supported the development of this HMP. Grant administration was the responsibility of the Sussex County Sheriff's Office Division of Emergency Management (DEM).

2.1 GENERAL MITIGATION PLANNING APPROACH

FEMA provides hazard mitigation planning support to local communities through guidance, resources, and plan reviews. This hazard mitigation plan was prepared in accordance with the following regulations and guidance:

- FEMA Mitigation Planning How-to Series (FEMA 386-1 through 4, 2002)
- Using HAZUS-MH for Risk Assessment; How-To Guide (FEMA 433, August 2004)
- FEMA Local Mitigation Plan Review Guide, October 1, 2011
- FEMA Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards, January 2013
- FEMA Integrating Hazard Mitigation into Local Planning, March 1, 2013.
- FEMA Plan Integration: Linking Local Planning Efforts, July 2015

- FEMA Local Mitigation Planning Policy Guide, April 19, 2022
- FEMA Local Mitigation Planning Handbook, May 2023
- DMA 2000 (Public Law 106-390, October 30, 2000)
- 44 CFR 201 and 206 (including: Feb. 26, 2002, Oct. 1, 2002, Oct. 28, 2003, and Sept. 13, 2004, Interim Final Rules)
- NJOEM Hazard Mitigation Planning Standard, 2019
- State of New Jersey Hazard Mitigation Plan, 2019

2.2 ORGANIZATION OF PLANNING PROCESS

2.2.1 Planning Process Participants

Project Management and Planning Consultant

Project management was the responsibility of the Sussex County Sheriff's Office DEM. A contract planning consultant (Tetra Tech) was tasked with the following:

- Assisting with the organization of a Steering Committee and the Planning Partnership
- Assisting with the development and implementation of a public and stakeholder outreach program
- Collecting data
- Facilitating and attending meetings (Steering Committee, municipal, stakeholder, public, and other)
- Reviewing and updating the hazards of concern, hazard profiles, and risk assessment
- Assisting with the review and update of mitigation planning goals and objectives
- Assisting with the review of past mitigation strategy progress
- Assisting with the screening of mitigation actions and the identification of appropriate actions
- Assisting with the prioritization of mitigation actions
- Authoring the draft and final plan documents

Planning Partnership

In February 2023, the County notified all municipalities in the County of the pending planning process and invited them to formally participate. Jurisdictions were asked to formally notify the County of their intent to participate via a letter of intent and to identify points of contact to facilitate their participation and represent the interests of their communities. All participating jurisdictions, including the County, are recognized as Planning Partners and belong to the Planning Partnership for this HMP. Planning Partnership members were charged with the following:

- Representing their jurisdictions throughout the planning process
- Ensuring participation of all departments and functions within their jurisdiction that have a stake in mitigation (e.g., planning, engineering, code enforcement, police and emergency services, public works)
- Assisting in gathering information for inclusion in the HMP update, including the use of previously developed reports and data
- Supporting and promoting the public involvement process
- Reporting on progress of mitigation actions identified in prior or existing HMPs, as applicable

- Identifying, developing, and prioritizing appropriate mitigation actions
- Reporting on progress of integration of prior or existing HMPs into other planning processes and municipal operations
- Supporting and developing a jurisdictional annex
- Reviewing, amending, and approving all sections of the plan update
- Adopting, implementing, and maintaining the plan update

Table 2-1 shows the primary and secondary points of contact for the participating jurisdictions in the Planning Partnership as of the time of publication of this plan update.

The various jurisdictions in Sussex County have differing levels of capabilities and resources available to apply to the plan update process, as well as differing levels of vulnerability to and impacts from the natural hazards being considered in this plan. It was Sussex County's intent to encourage participation by all jurisdictions, and to accommodate their specific needs and limitations while still meeting the intent and purpose of plan update participation. Such accommodations have included establishing a Steering Committee, engaging a contract consultant to assume certain elements of the plan update process on behalf of the jurisdictions, and providing alternative mechanisms for planning participation.

Ultimately, jurisdictional participation is evidenced by a completed annex of the HMP, wherein jurisdictions identify their points of contact, evaluate their risk from the hazards of concern, identify their capabilities to effect mitigation in their community, identify and prioritize a suite of actions to mitigate their hazard risk, and adopt the updated plan via resolution. Annexes are included in Volume II of this HMP.

Appendix B (Participation Matrix) identifies how each individual who represented the jurisdictions during this planning effort contributed to the planning process.

All municipalities in Sussex County actively participate in the NFIP and have a designated NFIP floodplain administrator. All floodplain administrators have been informed of the planning process, reviewed the plan documents, and provided direct input to the plan update. Local floodplain administrators are identified as part of each jurisdiction's hazard mitigation planning team, as presented in the jurisdictional annexes in Volume II, as well as in Appendix B (Participation Matrix).

After completion of the plan, implementation and ongoing maintenance will become a function of the Planning Partnership as described in Chapter 22 (Plan Maintenance). The Planning Partnership will be responsible for reviewing the draft plan and soliciting public comment as part of an annual review and as part of the five-year mitigation plan updates.

Table 2-1. Sussex County Hazard Mitigation Planning Partnership, Primary and Secondary Points of Contact for Participating Jurisdictions

Jurisdiction[a]	Primary Point of Contact	Title	Alternate Point of Contact	Title
Andover (B)	Jessica Casella	Emergency Management Coordinator	Beth Brothman	Registrar
Andover (Twp)	Chief Eric Danielson	Emergency Management Coordinator	George Laoudis	Deputy Emergency Management Coordinator
Branchville (B)	Jeff Lewis	Emergency Management Coordinator	Kate Leissler	Municipal Clerk
Byram (Twp)	Joseph Sabatini	Township Manager	Phil Crosson	Deputy Township Manager
Frankford (Twp)	Jeff Lewis	Emergency Management Coordinator	Lori Nienstedt	Administrator, Municipal Clerk, Public Information Officer
Franklin (B)	Jim Williams	Emergency Management Coordinator	Brian VanDenBroek	Public Works Supervisor
Fredon (Twp)	Keith Festa	Emergency Management Coordinator	Carl Lazzaro	Deputy OEM Coordinator
Green (Twp)	Mark Zschack	Municipal Clerk/Administrator	Margaret Phillips	Mayor
Hamburg (B)	Keith Sukennikoff	Emergency Management Coordinator	John Ruschke	Engineer
Hampton (Twp)	Diana Juarez	Clerk / Acting Administrator	George Chattaway	Emergency Management Coordinator
Hardyston (Twp)	William Hickerson	Emergency Management Coordinator	Carrie Piccolo-Kaufer	Township Manager
Hopatcong (B)	Wade Crowley	Emergency Management Coordinator	Ron Tappan	Borough Administrator
Lafayette (Twp)	Richard Hughes	Committeeman, Emergency Management Coordinator	Jim Ando	Public Works Supervisor
Montague (Twp)	Dave Coss	Emergency Management Coordinator	Jesse Brace-Revak	Deputy Emergency Management Coordinator
Newton (T)	Dan Finkle	Emergency Management Coordinator	Jason Miller	Deputy Emergency Management Coordinator
Ogdensburg (B)	Richard Keslo	Emergency Management Coordinator	George Hutnick	Mayor
Sandyston (Twp)	Kevin Pumphrey	Emergency Management Coordinator	Amanda Lobban, RMC	Municipal Clerk
Sparta (Twp)	Jeffrey McCarrick	Emergency Management Coordinator	Tom McIntyre	Deputy Emergency Management Coordinator
Stanhope (B)	Brian McNeilly	Borough Administrator	Eric Keller	Borough Engineer
Stillwater (Twp)	Lisa Chammings	Mayor, Emergency Management Coordinator	Jim Cantelmo	Deputy Emergency Management Coordinator

Jurisdiction[a]	Primary Point of Contact	Title	Alternate Point of Contact	Title
Sussex (B)	Floyd Southard	Emergency Management Coordinator	Robert Regavich	Deputy Emergency Management Coordinator
Vernon (Twp)	Ken Clark	Emergency Management Coordinator	Dan Young	Police Chief
Walpack (Twp)	Victor Maglio	Mayor	Christine Von Oesen	Municipal Clerk
Wantage (Twp)	Joe Konopinski	Emergency Management Coordinator	Michael Restel	Township Administrator

a. (B) indicates boroughs; (Twp) indicates townships; (T) indicates towns

Steering Committee

Sussex County developed a Steering Committee to provide guidance and direction to the HMP update effort and to ensure that the resulting document will be embraced by local government leaders and all who live and work within the planning area. Steering Committee members were charged with the following:

- Providing guidance and oversight of the planning process on behalf of the general planning partnership
- Attending and participating in Steering Committee meetings
- Reviewing and updating the hazards of concern
- Developing a public and stakeholder outreach program
- Ensuring that the data and information used in the plan update process is the best available
- Reviewing and updating the hazard mitigation goals
- Identifying and screening appropriate mitigation strategies and activities
- Reviewing and commenting on plan documents prior to submission to NJOEM and FEMA.

The Steering Committee provided guidance, leadership, and oversight of the planning process and acted as the point of contact for all participating jurisdictions and various interest groups in the planning area. Table 2-2 lists the members of the Steering Committee.

2.2.2 Planning Activities

Members of the Planning Partnership (individually and as a whole), as well as key stakeholders, met and communicated as needed to share information. This included workshops to identify hazards, assess risks, update inventories of critical facilities, and assist in updating mitigation goals and strategies. All members of the Planning Partnership had the opportunity to review the draft plan, supported interaction with other stakeholders, and assisted with public involvement efforts. These activities provided continuity through the process to ensure that natural hazard vulnerability information and appropriate mitigation strategies were incorporated.

Table 2-3 summarizes meetings and other planning activities conducted during the development of the plan. It also identifies which 44 CFR 201 requirements each activity satisfies. Documentation of meetings (agendas, sign-in sheets, minutes, etc.) may be found in Appendix D (Public and Stakeholder Outreach). This table identifies only formal meetings and milestone events in the plan update process. In addition to these meetings, there was a great deal of communication between Planning Partnership members and the consultant through individual local meetings, phone, and email.

Table 2-2. Sussex County Hazard Mitigation Steering Committee Members

Affiliation	Name	Title
Sussex County Sheriff's Office	Sheriff Michael F. Strada	Sheriff, Emergency Management Coordinator
Sussex County DEM	Steven Sugar	Deputy Coordinator
Sussex County DEM	Eric Muller	Deputy Coordinator
Sussex County DEM	James Aumick	Deputy Coordinator
Sussex County Division of Public Works	Scott House	Director
Sussex County Division of Planning and Economic Development	Autumn Sylvester	Coordinator, Agricultural Development Board
Sussex County Health and Human Services Division of Health	Christine Florio	Administrator
Atlantic Health System Newton Medical Center	Manny Ayers	Senior Supervisor Protection and Security Services
Wantage Township	Joe Konopinski	Wantage OEM Coordinator
Sussex County Municipal Utilities Authority	Joe Sesto	Executive Director
Sussex County Administrator; Department of Central and Shared Services	Ron Tappan	County Administrator
Sussex County Engineering Department	William J. Koppenaal	Administrator
Sussex County Division of Planning	Tom Drabic	Planning Director
Sussex County Facilities Management	Keith Nelson	Director
Rutgers Cooperative Extension of Sussex County	Stephen Komar	Department Head
Atlantic Health System Newton Medical Center	Beata Dumala	Protection and Security Services
Sussex County Community College	Fred Mamay	Director Campus Safety & Security
Upper Delaware Conservation District	Sandra Meyers	District Manager
Andover Township	George Laoudis	Deputy Emergency Management Coordinator
New Jersey Bureau of Dam Safety	John Kale	Supervising Environmental Specialist
Sussex County Open Space Committee	Lisa Chammings	Chair
Sussex County Municipal Utilities Authority	Angelo Baron	Wastewater Superintendent
Sussex County Division of Community and Youth Services	Nick Kapetanakis	Division Director
Sussex Rural Electric Coop	Claudia Raffay	Director of Marketing & Member Services
Sussex County Division of Senior Services	Lorraine Hentz	Vision Director
Atlantic Health System Newton Medical Center	Steven Sarinelli	Emergency Manager
Sussex County Department of Public Works	Ashley Gottemoller	Purchasing Assistant
Hampton Township	Edward Hayes	Former Emergency Management Coordinator
Hampton Township	Jessica M. Caruso	Former Township Administrator

Table 2-3. Summary of Mitigation Planning Activities

Date	44 CFR 201 Requirement[a]	Description of Activity	Participants[b]
March 8, 2023	2	Pre-Kickoff Meeting with Sussex County: Plan timing and administration, data needs and sharing, hazards of concern, dates, and next steps	Sussex County, Tetra Tech
March 15, 2022	2	Steering Committee Meeting #1: Welcome and Introductions, In-Kind Tracking, Project Organization, Roles/Responsibilities, HMP Overview, Risk Assessment and Mitigation Strategy Overview, Data Collection, Public and Stakeholder Outreach Next Steps, and Schedule.	Sussex County DEM, Sussex County Division of Planning and Economic Development, Sussex County Health and Human Services Division of Health, Newton Medical Center, Wantage Township, Sussex County Municipal Utilities Authority, Sussex County DPW, Tetra Tech
March 15, 2022	2, 3c, 4a	Planning Partnership Meeting #1: Welcome and Introductions, In-Kind Tracking, Benefits of Hazard Mitigation and Overview, Project Organization and Overview, Updating the Risk Assessment, Identifying Critical Facilities, Public and Stakeholder Outreach, Capability and Mitigation Strategies, Updating the Mitigation Strategy, Sections of Plan, Worksheet Review, Next Steps and Questions.	Sussex County, Andover (B), Andover (Twp), Branchville (B), Byram (Twp), Frankford (Twp), Green (Twp), Hamburg (B), Hardyston (Twp), Lafayette (Twp), Montague (Twp), Newton (T), Ogdensburg (B), Sandyston (Twp), Sparta (Twp), Stanhope (B), Stillwater (Twp), Sussex (B), Vernon (Twp), Walpack (Twp), Wantage (Twp), New Jersey State Police, Tetra Tech
April 9, 2024	2, 3b, 3c, 3d, 3e, 4b	Steering Committee Meeting #2: Welcome and Introductions, In-Kind Tracking, Project Report and Status Review, Public and Stakeholder Outreach, Risk Assessment Review, Mitigation Strategy, Next Steps	Sussex County DEM, Sussex County Division of Senior Services, Sussex County Municipal Utilities Authority, Hampton (Twp), Tetra Tech
April 11, 2024 AM Session	2, 3c, 3d, 3e, 4a, 4b	Planning Partnership Meeting #2: Welcome and Introductions, In-Kind Tracking, Project Report and Status Review, Public and Stakeholder Outreach, Risk Assessment Overview, Schedule, Next Steps	Andover (Twp), Byram (Twp), Hamburg (B), Hampton (Twp), Lafayette (Twp), Sparta (Twp), Wantage (Twp), Tetra Tech
April 11, 2024 PM Session	2, 3c, 3d, 3e, 4a, 4b	Planning Partnership Meeting #3: Welcome and Introductions, In-Kind Tracking, Project Report and Status Review, Public and Stakeholder Outreach, Risk Assessment Overview, Schedule, Next Steps	Branchville (B), Frankford (Twp), Montague (Twp), Stillwater (Twp), Tetra Tech
May 8, 2024	2, 3c, 3d, 3e, 4a, 4b	Planning Partnership Meeting #4: Welcome and Introductions, In-Kind Tracking, Project Report and Status Review, Public and Stakeholder Outreach, Mitigation Strategy, Schedule, Next Steps	Sussex County, Andover (Twp), Branchville (B), Byram (Twp), Frankford (Twp), Hamburg (B), Hampton (Twp), Montague (Twp), Newton (T), Sparta (Twp), Stillwater (Twp), Wantage (Twp), New Jersey State Police, Tetra Tech

Date	44 CFR 201 Requirement[a]	Description of Activity	Participants[b]
November 21, 2024	2	Draft Plan Review Meeting: Overview of entire plan and sections; confirmed plan maintenance schedule; public invited to attend.	Sussex County, Sussex County Central Purchasing Office, Sussex County Open Space Committee, New Jersey Highlands Council, Andover (Twp), Branchville (B), Byram (Twp), Frankford (Twp), Fraklin (B), Fredon (Twp), Hamburg (B), Hampton (Twp), Hardyston (Twp), Hopatcong (B), Newton (T), Sparta (Twp), Stillwater (Twp), Walpack (Twp), Wantage (Twp), Tetra Tech
November 21, 2024	1b, 2	Draft HMP posted to public project website; all plan participants were notified and asked to assist with the public outreach including social media. Neighboring communities and stakeholders were notified of the posting as well.	Public and Stakeholders
December 23, 2024	2	HMP submitted to NJOEM	NJOEM
April 8, 2025	2	HMP submitted to FEMA Region II	FEMA Region II
Upon plan approval by FEMA	1a	Plan adoption by resolution by the governing bodies of all participating jurisdictions	All Plan Participants

Note: TBD = to be determined.

a. Numbers in column 2 identify specific requirements of 44 CFR 201.6, as follows:
- *1a – Prerequisite – Adoption by the Local Governing Body (201.6.a.1)*
- *1b – Public Participation (201.6.b)*
- *2 – Planning Process – Documentation of the Planning Process (201.6.c.1)*
- *3a – Risk Assessment – Identifying Hazards (201.6.c.2.i)*
- *3b – Risk Assessment – Profiling Hazard Events (201.6.c.2.i)*
- *3c – Risk Assessment – Assessing Vulnerability: Identifying Assets (201.6.c.2.ii.A)*
- *3d – Risk Assessment – Assessing Vulnerability: Estimating Potential Losses (201.6.c.2.ii.B)*
- *3e – Risk Assessment – Assessing Vulnerability: Analyzing Development Trends (201.6.c.2.ii.C)*
- *4a – Mitigation Strategy – Local Hazard Mitigation Goals (201.6.c.3.i)*
- *4b – Mitigation Strategy – Identification and Analysis of Mitigation Measures (201.6.c.3.ii)*
- *4c – Mitigation Strategy – Implementation of Mitigation Measures (201.6.c.3.iii)*
- *5a – Plan Maintenance Procedures – Monitoring, Evaluating, and Updating the Plan (201.6.c.4.i)*
- *5b – Plan Maintenance Procedures – Implementation through Existing Programs (201.6.c.4.ii)*
- *5c – Plan Maintenance Procedures – Continued Public Involvement (201.6.c.4.iii)*

b. For listed municipalities, (B) indicates boroughs, (Twp) indicates townships, and (T) indicates towns

2.3 STAKEHOLDER OUTREACH AND INVOLVEMENT

The Sussex County HMP update was written using the best available information obtained from a wide variety of sources. Throughout the HMP update process, a concerted effort was made to gather information from municipal and regional agencies and staff as well as stakeholders, federal and state agencies, and the residents of the County. A Steering Committee solicited information from local agencies and individuals with specific knowledge of natural hazards and past historical events. In addition, the Steering Committee and Planning Partnership took into consideration planning and zoning codes, ordinances, and recent land use planning decisions.

This section details the outreach to and involvement of the agencies, organizations, non-profits, districts, authorities, and other entities that have a stake in managing hazard risk and mitigation, commonly referred to as stakeholders. Efforts were made to ensure broad regional, county, and local representation in this planning process. A comprehensive list of stakeholders was developed with the support of the Steering Committee and Planning Partnership. Stakeholder outreach was performed early and throughout the planning process, including mass media notification efforts. Identified stakeholders were invited to attend the Planning Partnership risk assessment meeting, and key stakeholders were requested to participate as members of the Steering Committee or Planning Partnership. Information and input provided by these stakeholders has been included throughout this plan.

The following sections list the stakeholders who were invited to participate in the development of this plan and describe how they contributed to the plan. This summary information demonstrates the scope and breadth of the stakeholder outreach efforts during the planning process. Beyond those described here, many stakeholders were aware of and contributed to this plan through formal and informal outreach efforts by the Planning Partners.

2.3.1 Federal and State Agencies

The federal and state agencies listed in Table 2-4 were contacted during the planning process and participated as indicated.

Table 2-4. Participation of Federal and State Agencies

Agency	Participation
FEMA Region 2	Provided updated planning guidance; provided summary and detailed NFIP data for planning area; presented preliminary regulatory flood products to municipalities and the public; attended meetings; participated in a mitigation strategy workshop; conducted plan review.
• National Centers for Environmental Information (NCEI) • National Hurricane Center (NHC) • National Oceanic and Atmospheric Administration (NOAA) • National Weather Service (NWS) • Storm Prediction Center (SPC) • U.S. Army Corps of Engineers (USACE) • U.S. Census Bureau • U.S. Geological Survey (USGS)	Information regarding hazard identification and the risk assessment for this HMP update was requested and received or incorporated by reference.
NJOEM	Administered planning grant and facilitated FEMA review; provided updated planning guidance; attended meetings; participated in the mitigation strategy workshop, provided review of draft and final plan.
New Jersey Department of Environmental Protection's Watershed and Land Management Program	Was asked to provide information on the location of dams, identified issues with dams, and suggested mitigation actions to include in the mitigation strategy to address dam failure.

2.3.2 County and Regional Agencies

The county and regional agencies listed in Table 2-5 were invited to participate during the planning process and participated as indicated.

2.3.3 Stakeholders by Community Lifeline Category

FEMA defines community lifelines as fundamental services in a community that, when stabilized, enable all other aspects of society. Following a disaster event, intervention is required to stabilize community lifelines. All participating jurisdictions were asked to invite their internal agencies associated with community lifeline categories to complete a stakeholder survey. Many jurisdictions also directly involved representatives of these agencies in the planning process, as identified in Table 2-1. This section describes outreach to and participation by other stakeholders in the planning process associated with FEMA's eight designated community lifeline categories. More detailed information about community lifelines in the planning area is provided in Chapter 3.

Table 2-5. County and Regional Agencies

Agency	Participation
• Andover Township • Hampton Township • Newton Medical Center • Sussex County Department of Public Works • Sussex County DEM • Sussex County Division of Health • Sussex County Division of Planning and Economic Development • Sussex County Division of Public Works • Sussex County Engineering Department • Sussex County Municipal Utilities Authority • Sussex County Open Space Committee • Sussex County Sheriff's Office • Wantage Township	Served on steering committee, attended meetings, completed hazard of concern exercise, goals and objectives exercise, and reviewed draft plan.
• Sussex County Division of Senior Services	Served on steering committee, attended meetings, provided input, and reviewed draft plan.
• Rutgers Cooperative Extension of Sussex County • Sussex County Administrator • Sussex County Community College • Sussex County Department of Central and Shared Services • Sussex County Division of Community and Youth Services • Sussex County Facilities Management • Sussex Rural Electric Coop • Upper Delaware Conservation District	Served on the steering committee, provided input, and reviewed draft plan.
• Sussex County Fire Marshal • Sussex County Board of Agriculture • Family Promise of Sussex County • Sussex County Emergency Medical Services (EMS) • Jersey Central Power & Light • Verizon NJ • North Jersey Transportation Planning Authority • Skylands Ride Public Transportation • New Jersey American Water • Executive County Superintendent of Schools • Sussex County Chamber of Commerce	Invited to take the stakeholder survey and review the draft plan.

Safety and Security

Law Enforcement

Many municipalities directly involved law enforcement representatives in the planning process. Municipalities were asked to invite their law enforcement agencies to complete a stakeholder survey. The following law enforcement agencies were invited to complete a stakeholder survey and review the draft plan:

- Andover Township Police Department
- Byram Township Police Department
- Franklin Police Department
- Hardyston Police Department
- Hopatcong Police Department
- New Jersey State Police Sussex Station
- Ogdensburg Police Department
- Sparta Police Department
- Stanhope Police Department
- Sussex County Sheriff
- Vernon Police Department

Fire Districts and Fire Departments

Many jurisdictions directly involved fire districts or departments, hazmat teams, and rescue team representatives in the planning process. Jurisdictions were asked to invite their fire departments to complete a stakeholder survey. The following fire districts or departments, hazardous materials response teams, and rescue teams were invited to complete a stakeholder survey and review the draft plan:

- Andover Borough Fire Department
- Andover Township Fire Department
- Beemerville Fire Department
- Blue Ridge Rescue Squad
- Branchville Hose Company 1
- Byram Township Fire Department
- Colesville Fire Department
- Frankford Township Fire Department
- Franklin Fire Department
- Fredon Fire and Emergency Medical Services (EMS)
- Green Township Fire Department
- Hamburg Fire Department
- Hampton Fire and Rescue
- Hardyston Fire Department
- Lakeland Rescue Squad
- McAfee Fire Department
- Montague Township Fire Department Station 35
- New Jersey Forest Fire
- Newton Fire Department
- Ogdensburg Fire Department
- Pochuck Valley Fire Department
- Quakertown Fire Co
- Sandyston Fire Department
- Sparta Fire Department
- Stanhope Fire Department
- Stillwater Fire Department Station 42
- Sussex Fire Department Station 69
- Sussex County Fire Marshal

- Highland Lakes Fire Department Station 29
- Hopatcong Fire Department
- Lafayette Fire Department
- Vernon Township Fire Co. 1
- Wantage Township Fire Department

Dams

In order to address high hazard potential dams, outreach was conducted with dam owners and the dam safety agency. The following information was requested, however no responses were received:

- Information, data, or resources regarding the risk of dam failure as a result of deficiencies or exposure to hazards such as flooding, geologic impacts, and severe storms
- Concerns with dam safety due to changing climate conditions
- Concerns with emergency action plan deficiencies, including warning time, evacuation needs, etc.
- Completed or in progress repairs/improvements to dams
- Potential new mitigation actions that should be considered for inclusion in the HMP mitigation strategy

Food, Hydration, Shelter

Jurisdictions were asked to invite their emergency management related agencies to provide information on shelters and sheltering procedures. The following stakeholders that provide food, hydration, shelter, and agricultural activities in the County were invited to complete a stakeholder survey and review the draft plan:

- Rutgers Cooperative Extension Water Resources Program
- Sussex County Board of Agriculture
- American Red Cross
- Benny's Bodega
- Christ Church Newton
- Family Promise of Sussex County
- Ginnie's House
- Sparta Church

Health and Medical

Hospitals and Health-Care Facilities

The following health-care facility was invited to complete a stakeholder survey and review the draft plan:

- Newton Medical Center

Ambulance/Emergency Medical Services

Jurisdictions were asked to invite their ambulance and emergency medical service providers to complete a stakeholder survey. The following ambulance and emergency medical service providers in the County were invited to complete a stakeholder survey and review the draft plan:

- Blue Ridge Rescue Squad
- Fredon Fire and EMS

- Hampton Fire and Rescue
- Lakeland Rescue Squad
- Sussex County EMS
- Vernon Township Ambulance Squad
- Wantage First Aid Squad

Energy

In addition to municipal utilities, the following energy companies were invited to complete a stakeholder survey and review the draft plan:

- Jersey Central Power & Light
- Sussex Rural Electric Coop

Communications

Each jurisdiction was asked to provide information on emergency communication and warning systems. In addition, the following communications company was invited to complete a stakeholder survey and review the draft plan:

- Verizon NJ

Transportation

The following transportation companies and organizations were invited to complete a stakeholder survey and review the draft plan:

- North Jersey Transportation Planning Authority
- Skylands Ride Public Transportation

Water Systems

In addition to municipal utilities, the following water utility companies were invited to complete a stakeholder survey and review the draft plan:

- Montague Sewer Company (owned by Utilities Inc.)
- Musconetcong Sewer Authority District
- New Jersey American Water
- Stillwater Water District #1
- Sussex County Municipal Utilities Authority
- Town of Newton Wastewater Utility
- Vernon Township Municipal Utilities Authority

2.3.4 Additional Stakeholder Groups

Additional stakeholder outreach was made to academia, business and commerce, and organizations that support socially vulnerable populations and underserved populations, as listed in the sections below.

School Districts and Other Academic Institutions

Many jurisdictions directly involved school district representatives in the planning process, as identified in Table 2-1. Jurisdictions were asked to invite representatives of their local schools to complete a stakeholder survey. Additionally, the following school districts, colleges, and academic organizations were invited to complete a stakeholder survey and review the draft plan:

- Sandyston-Walpack School District
- Sparta School District
- Stanhope School District
- Stillwater School District
- Sussex County Charter School for Technology
- Sussex County Community College
- Sussex County Education Services Commission/Northern Hills Academy
- Sussex County Technical School
- Sussex-Wantage Regional School District
- Vernon School District
- Wallkill Valley Regional High School
- Executive County Superintendent of Schools

Business and Commerce

The following chambers of commerce and businesses were invited to complete a stakeholder survey and review the draft plan:

- Ames Rubber Corporation
- Greater Newton Chamber of Commerce
- Mountain Creek Resort
- Selective Insurance Group, Inc.
- Stanhope Chamber of Commerce
- Sussex County Chamber of Commerce
- Thor Labs
- Vernon Chamber of Commerce

Groups Supporting Socially Vulnerable Populations and Underserved Communities

The following groups and agencies that provide support to and work with socially vulnerable populations and underserved communities were invited to complete a stakeholder survey and review the draft plan:

- Sussex County Division of Community and Youth Services
- Domestic Abuse and Sexual Assault Intervention Services
- Sussex County Disability Services
- Sussex County Department of Public Health
- Sussex County Division of Senior Services

- Sussex County Division of Social Services

2.3.5 Adjacent Jurisdictions

The County kept surrounding jurisdictions apprised of the project, invited them to complete a neighboring community survey, and requested their review of the draft plan. The following adjoining county and jurisdictional representatives were contacted to inform them about the availability of the project website, draft plan documents, and surveys and to invite them to provide input to the planning process:

- Morris County (NJ)
  - Jefferson Township
  - Roxbury Township
  - Mount Arlington Borough
  - Mount Olive Township
  - Netcong Borough
- Orange County (NY)
  - Deer Park Township
  - Port Jervis City
  - Greenville Township
  - Minisink Township
  - Warwick Town
- Passaic County (NJ)
  - West Milford Township
- Pike County (PA)
  - Lehman Township
  - Delaware Township
  - Dingman Township
  - Milford Township
  - Milford Borough
  - Westfall Township
  - Matamoras Borough
- Warren County (NJ)
  - Hardwick Township
  - Frelinghuysen Township
  - Allamuchy Township

2.3.6 Stakeholder and Neighboring Community Survey Summaries

This section summarizes the results and feedback received by those who completed the stakeholder and neighboring community surveys, with full results provided in Appendix D of this plan. Feedback was reviewed by the Steering Committee and integrated where appropriate in the plan.

Stakeholder Survey

The stakeholder survey was designed to identify general needs for hazard mitigation and resiliency within Sussex County from the perspective of stakeholders, as well as to identify specific projects that may be included in the mitigation plan. It was distributed to identified stakeholders, including county and municipal departments and agencies.

Who Responded

As of October 25, 2024, seven stakeholders completed the survey. Following are key results about who the survey respondents are and what they do:

- Respondents represent the following sectors: academic/research, education, emergency services, non-profit organizations, public works, and utility provider.
- 42.9 percent of respondents represent groups that serve the Borough of Andover.
- 14.29 percent of respondents represent groups that serve Sussex County as a whole.
- Respondents manage the following types of facilities:
  - Buildings
  - Stormwater infrastructure
  - Roads
  - Water/sewer plants
- 28.6 percent of respondents do not manage any facilities.
- 33.3 percent of respondents work with socially vulnerable populations:
  - Working with children who have special needs
  - After school programs
  - In-class educational support
  - Free and reduced lunch services

Risk Overview

Following are key results about the survey respondents' experience with hazards and risk:

- 42.9 percent of respondents indicated that buildings, facilities, or structures their organization is involved with have been impacted by a hazard, specifically as follows:
  - Sustained damages from Superstorm Sandy (2012) and the October snow storm (2011)
  - Closure from water main breaks
  - COVID pandemic disruption of treatment centers, schools, and community access to services
- The majority of respondents are unsure whether their facilities are susceptible to impacts from hazards. However, those who indicated their facilities are susceptible noted power failures, flood, and overall bad weather as vulnerabilities.
- Four respondents identified a facility as a critical facility or community lifeline.
- Respondents identified the following hazards and impacts as their greatest vulnerabilities:

  - Water main breaks
  - Severe weather
  - Drought
  - Power and utility disruption
  - Surface water quality
  - Infestations
  - High winds
  - Disease and illnesses
  - Flooding and flash flooding
  - Wildfires
- Respondents identified the following as challenges or barriers to reducing vulnerability in Sussex County:
  - Adequate funding for the planning and implementation of hazard mitigation
  - Evacuations
  - Distribution of resources

Socially Vulnerable and Underserved Communities

Following are key results about the survey respondents' work with socially vulnerable and underserved communities:

- 71.4 percent of respondents are not aware of the location and number of socially vulnerable populations in their community/operating area.
- 60 percent of respondents provide assistance to socially vulnerable or underserved populations in Sussex County.
- Of those who provide services to socially vulnerable populations, 62.5 percent offer services during times of disaster, including the following:
  - Human rights (20 percent)
  - Personal services (20 percent)
  - Regulatory oversight (20 percent)
  - Other (33.3 percent):
    - Emergency response
    - Environmental and agricultural programs
    - Grants assistance
- Respondents indicated the following barriers and community characteristics in Sussex County that may create additional vulnerabilities to hazards:
  - Transportation
  - Broadband access
  - Economic disadvantages
  - Physical health (chronic diseases)
  - Limited physical mobility
  - Age (older adults and children)

- Rural communities

Capabilities and Mitigation Strategies

Following are key results about the survey respondents' capabilities and mitigation strategies:

- 16.7 percent of respondents are part of a continuity of operations plan or continuity of government plan.
- 66.7 percent of respondents are part of an emergency operations plan.
- Respondents maintain the following capabilities that could assist in addressing hazards:
  - Emergency Response
  - Administration and maintenance staff
  - Back-up power for vulnerable locations
  - Conducting surveys and research
  - Sustainable agriculture grants
  - Watershed restoration planning
  - Climate hazard vulnerability planning
  - Planning guidance and grants
  - Stormwater assistance grants
  - Natural resource protection and green infrastructure requirements for the development of projects
- 50 percent of respondents are not involved in conducting studies or developing programs that would further support Sussex County's hazard mitigation program. One respondent is involved in such work.

Neighboring Community Survey

The neighboring community survey was sent to the county and municipal governments that border Sussex County due to their proximity to the county and because the effects of hazard events that impact Sussex County would be similar to that of their neighbors. As of October 25, 2024, none of the surrounding counties or municipalities submitted the survey.

2.3.7 Public Outreach

In order to facilitate better coordination and communication between the Planning Partnership and all community members and to involve the public in the planning process, draft documents were made available to the public online. The Steering Committee and Planning Partnership made the following efforts toward public participation in the development and review of the Plan:

- A public website is being maintained to facilitate communication between the Steering Committee, Planning Partnership, public and stakeholders (www.sussexcountynjhmp.com). The public website contains a project overview, County and local contact information, access to the citizens survey and stakeholder survey, and sections of the HMP for public review and comment.
- All participating jurisdictions have been encouraged to distribute press releases on the project, including links to the project webpage and citizen and stakeholder surveys. The following jurisdictions posted information and supported online outreach:
  - Township of Byram
  - Township of Sandyston

- Township of Sparta

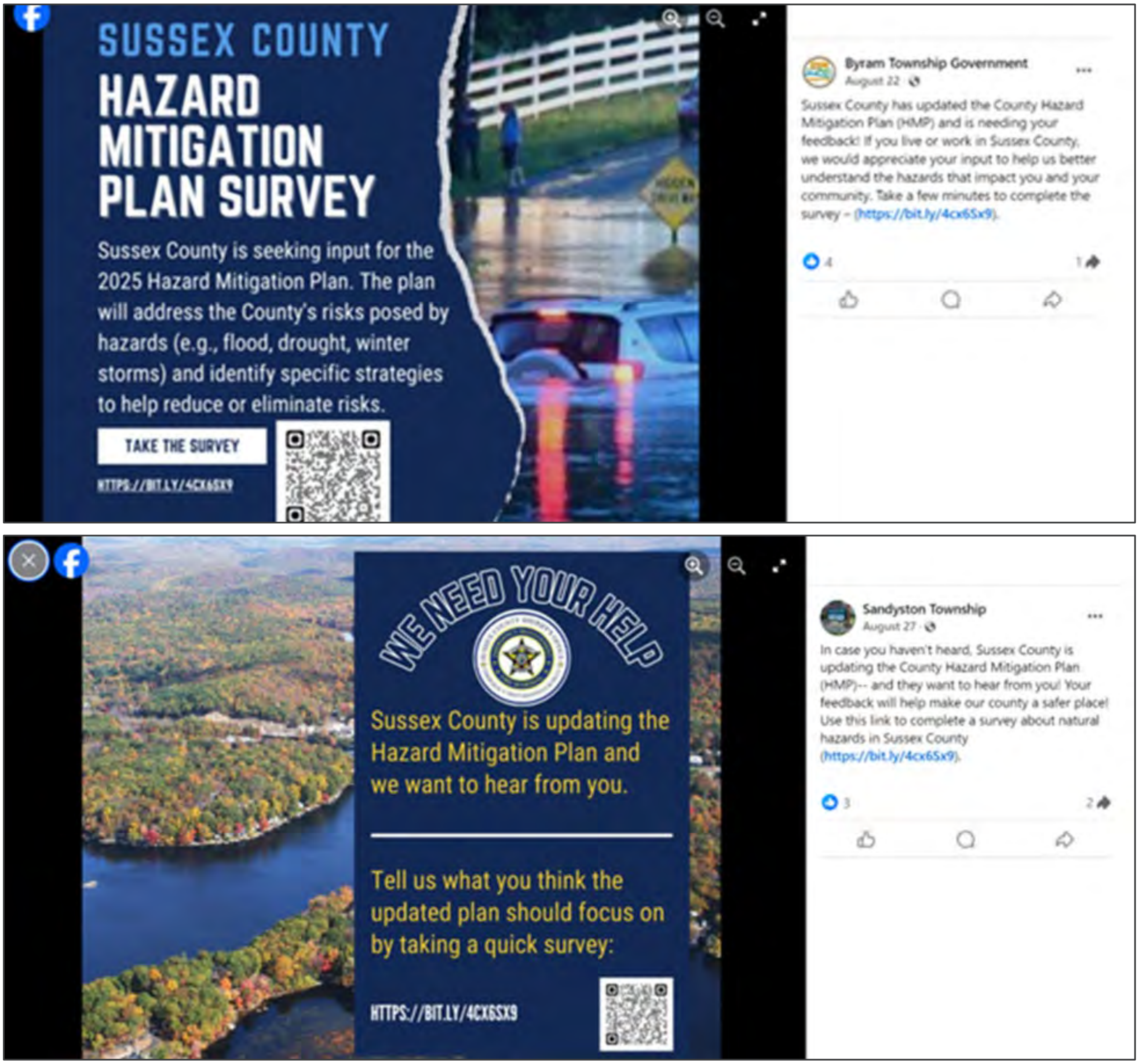
- In order to facilitate coordination and communication between the Planning Partnership and citizens and involve the public in the planning process, the updated HMP will be available to the public through a variety of venues. A printed version will be maintained at the Sussex County DEM, located within the Sheriff's Office.
- An online natural hazards preparedness citizen survey was developed to gauge household preparedness that may impact Sussex County and to assess the level of knowledge of tools and techniques to assist in reducing risk and loss of those hazards. The survey asks quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. It also asks demographic questions to help analyze trends.
- The survey was available through October 25, 2024, for public input. All participating jurisdictions have been requested to advertise the availability of the survey via local homepage links, and other available public announcement methods (e.g., Facebook, X, email blasts, etc.). Over 130 responses have been collected. A summary of survey results is provided later in this section, with full results provided in Appendix D of this plan.
- Virtual public information meetings on the HMP update process were held on March 15, 2023; April 11, 2024; and November 21, 2024.
- The draft plan was posted to the public website as of November 21, 2024, for public review and comment. All public comments were directed to the Sussex County DEM for collection and review by the Steering Committee. All public comments received were forwarded to the appropriate jurisdiction or agency and incorporated into the final plan as appropriate.
- Once submitted to NJOEM/FEMA, the final plan will be available for public review and comment in the same manner and format as the draft plan, as well as in hard-copy format as identified in Chapter 22, (Plan Maintenance).

Online Outreach Examples

Examples of outreach via websites and social media completed by the Planning Partners are provided in Figure 2-1 and Figure 2-2.

Figure 2-1. Sussex County HMP Webpage

Figure 2-2. Local Online Outreach



Public Survey Summary

The public survey was developed to assess the level of knowledge of tools and techniques to assist in reducing risk and loss associated with hazards. It asked quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. The County advertised the survey on their website and social media accounts. As of October 25, 2024, the survey received 134 responses.

Demographically, survey respondents were from 19 municipalities within Sussex County, with 58.5 percent having lived in the County for 20 years or more. The most common (45.8 percent) age of respondents was over the age of 60. The majority (65.7 percent) of residents receive information concerning a natural hazard through social media. Residents also receive information through mass notification systems (59.7 percent), television (57.5 percent), and email (56.7 percent).

Survey respondents identified the following as the top five most frequently occurring natural hazard events within Sussex County in the past five years, as shown in Figure 2-3:

- Earthquake (67.9 percent)
- Severe Weather (tornado, thunderstorm, hail) (65.7 percent)
- Pandemic (61.9 percent)
- Severe Winter Storms (blizzard, heavy snow, ice) (55.2 percent)
- Extreme Temperature (heat and cold) (50.8 percent)

The highest hazards of concern (respondents reporting somewhat concerned, very concerned, or extremely concerned) include extreme temperatures, and severe winter storms.

Respondents identified the following as desired projects to implement to reduce the damages due to natural hazards:

- Enforce the disclosure of natural hazard risks during real estate transactions (51.4 percent)
- Policies that prohibit development in areas subject to natural hazards (39 percent)
- Improve disaster preparedness of local schools (36.1 percent)
- Develop local inventory of at-risk buildings and infrastructure (29.8 percent)
- Implement steps to safeguard the local economy following a disaster (25.9 percent)

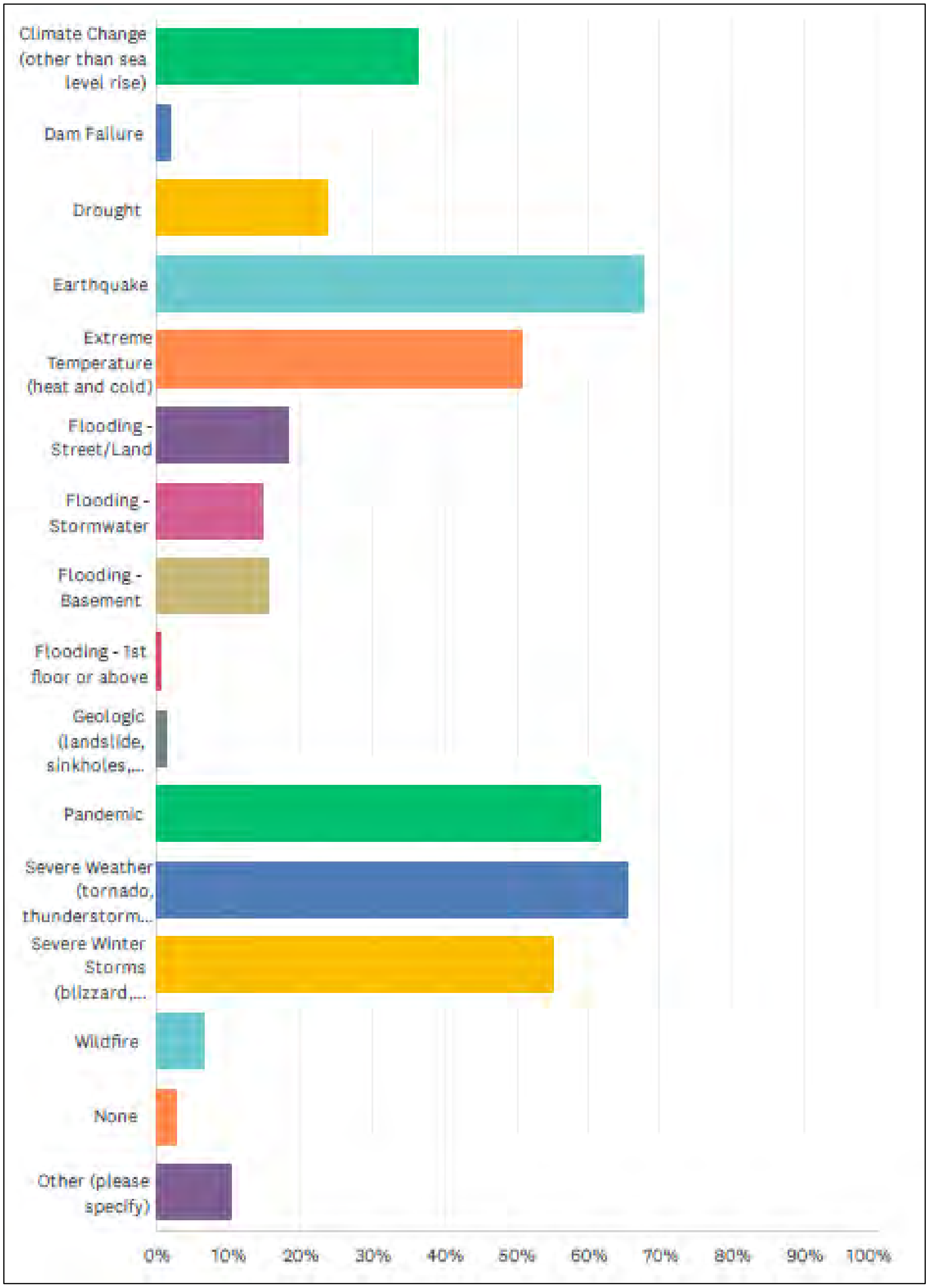
Respondents were asked which activities have been performed to mitigate hazard impacts to their homes. Approximately 99 percent of respondents have installed smoke detectors; roughly 79 percent have talked with other household members about what to do in case of a natural disaster or emergency; 56 percent have become trained in first aid and/or CPR; 30 percent have attended meetings or received information on natural disasters or emergency preparedness; 49 percent have prepared a disaster supply kit; and 57 percent have developed an emergency plan for the household to decide what will be done in the event of a disaster or emergency.

Respondents were also asked about their property's location within the floodplain, and if they have flood insurance. Of the 134 respondents who answered this question, only six (4.5 percent) indicated that their property is located in a designated floodplain. Of those residents just one indicated their home is covered by flood insurance.

The most self-selected jurisdiction respondents indicated that they live in is Byram Township (57 percent); however, there were respondents from all jurisdictions except Branchville Borough, Franklin Borough, Hampton Township, Ogdensburg Borough, and Walpack Township.

Jurisdiction-specific responses can be found in Volume II. Refer to Appendix C (Public and Stakeholder Outreach) for the full list of survey questions and responses.

Figure 2-3. Most Frequently Experienced Natural Hazard Events in Sussex County



2.4 INCORPORATION OF EXISTING PLANS, STUDIES, REPORTS AND TECHNICAL INFORMATION

The Sussex County HMP uses the best available information to support hazard profiling, risk assessment, review and evaluation of mitigation capabilities, and the development and prioritization of local mitigation strategies. Plans, reports, and other technical information were identified and accessed online through independent research by the planning consultant or provided directly by the County, participating jurisdictions, and stakeholders involved in the planning effort. Detailed sources of technical data and information used are listed in the References section.

The asset inventory data used for the risk assessment is presented in Chapter 3 (County Profile). Details of the source of this data, along with technical information on how the data was used to develop the risk assessment, are presented in Chapter 4, as well as throughout the hazard profiles in this HMP.

The County and participating jurisdictions provided relevant jurisdiction-specific planning and regulatory documents, which were reviewed to identify the following:

- Existing jurisdictional capabilities
- Needs and opportunities to develop or enhance capabilities, which may be identified in the local mitigation strategies
- Mitigation-related goals or objectives (see Chapter 21)
- Proposed, in-progress, or potential mitigation actions to be incorporated into the updated local mitigation strategies

The following regulations, codes, ordinances, and plans were reviewed to develop mitigation planning goals and objectives and mitigation strategies that are consistent across local and regional planning and regulatory mechanisms:

- Comprehensive/master plans
- Building codes
- Zoning and subdivision ordinances
- Flood insurance studies
- Flood insurance rate maps
- NFIP flood damage prevention ordinances
- Site plan requirements
- Local waterfront revitalization plans
- Stormwater management plans
- Emergency management and response plans
- Land use and open space plans
- Capital plans
- Climate smart community program
- Community rating system
- 2019 New Jersey Hazard Mitigation Plan

The County and participating jurisdictions were tasked with updating the assessment of their planning and regulatory capabilities (see capability assessment section of each jurisdictional annex in Volume II). They reviewed relevant plans contributing to their capability to integrate hazard mitigation efforts into their daily activities. The capability assessment tables in each municipal annex list plan types, names, and dates, as well as a summary of how each plan supports mitigation and resilience.

2.5 INTEGRATION WITH EXISTING PLANNING MECHANISMS AND PROGRAMS

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. Many existing plans and programs support hazard mitigation in the County. It is critical that this HMP integrate, coordinate with, and complement, those existing plans and programs.

The capability assessment presented in Chapter 20 provides a summary and description of the existing plans, programs, and regulatory mechanisms at all levels of government (federal, state, county and local) that support hazard mitigation in the County. In the jurisdictional annexes in Volume II, each participating jurisdiction identifies how it has already integrated hazard mitigation into its planning, regulatory and administrative framework (“integration capabilities”) and how it intends to improve this integration (“integration actions”).

A description of continued efforts toward a holistic approach to hazard mitigation is presented in Chapter 22.

2.6 PLAN ADOPTION

Adoption of the HMP is necessary because:

- It lends authority to the plan to serve as a guiding document for all local and state government officials.
- It gives legal status to the plan in the event it is challenged in court.
- It certifies to program and grant administrators that the plan’s recommendations have been properly considered and approved by the jurisdictions’ governing authority and citizens.
- It helps to ensure the continuity of mitigation programs and policies over time because elected officials, staff, and other community decision-makers can refer to the official document when making decisions about the community’s future.

Source: FEMA. 2003. How to Series: Bringing the Plan to Life (FEMA 386-4).

Adoption by the local governing bodies of each participating jurisdiction demonstrates the commitment of the Planning Partners to fulfill the mitigation goals and strategies outlined in this HMP. Adoption via a municipal resolution legitimizes the HMP and authorizes responsible agencies to execute their responsibilities.

All participating jurisdictions will proceed with formal adoption proceedings. Each jurisdiction must submit a copy of its formal adoption resolution or other legal instrument to the Sussex County HMP Coordinator in the Sussex County DEM. Sussex County will forward the executed resolutions to the NJOEM, after which they will be forwarded to FEMA for the record. FEMA allows two options for submitting adoption resolutions:

- **Submittal of adoption resolutions with plan**—All participating jurisdictions provide documentation of plan adoption when the plan is initially submitted to the state for review. After receiving the draft plan from the state, FEMA conducts its review and will approve the plan if it meets all requirements.
- **Approvable pending adoption**—A draft HMP is submitted to the state and FEMA for approval prior to adoption by the jurisdictions. When FEMA determines that the plan as a whole and each participating jurisdiction have met all the requirements except adoption, FEMA will inform the state that the plan is “approvable pending adoption” (APA). After that, once FEMA receives documentation of adoption resolutions from at least one jurisdiction, the status is changed from APA to approved for the entire plan and for that jurisdiction. Other jurisdictions that participated in the planning process then receive approval once they pass their own adoption resolutions. A jurisdiction with a plan in APA status does not meet the requirement for an approved mitigation plan to apply for and receive funding assistance.

FEMA will transmit acknowledgement of verification of formal plan adoption and the official approval of the plan to the Sussex County HMP Coordinator. The plan approval date begins the five-year approval period and sets the expiration date for the plan. All participating jurisdictions will have the same expiration date regardless of their own jurisdiction's adoption date. The date indicated on FEMA's approval letter is the official approval date.

The resolutions issued by each jurisdiction to support adoption of this HMP are included in Appendix A.

2.7 CONTINUED PUBLIC INVOLVEMENT

The Planning Partners are committed to the continued involvement of the public in the hazard mitigation process. This Plan update will be posted on-line (currently at www.sussexcountynjhmp.com), and jurisdictions will be encouraged to maintain links to the plan website. A notice regarding annual updates of the plan and the location of plan copies will be publicized annually after the Planning Partnership's annual evaluation and posted on the public website (currently at www.sussexcountynjhmp.com).

After completion of this plan, implementation and ongoing maintenance will continue to be a function of the Planning Partnership. The Planning Partnership will review the plan and accept public comment as part of an annual review and as part of five-year mitigation plan updates. Each jurisdiction's governing body will be responsible for receiving, tracking, and filing public comments regarding this plan.

The HMP Coordinator is responsible for coordinating the plan evaluation portion of the meeting, soliciting feedback, collecting, and reviewing the comments, and ensuring their incorporation in the 5-year plan update as appropriate. Members of the Planning Partnership will assist the HMP Coordinator. Additional meetings may be held as deemed necessary by the Planning Partnership. The purpose of these meetings would be to provide the public an opportunity to express concerns, opinions, and ideas about the plan. A notice regarding annual updates of the plan and the location of plan copies will be publicized annually after the HMP Committee's annual evaluation and posted on the public web site.

Steven Sugar of the Sussex County DEM has been identified as the ongoing County HMP Coordinator (see Chapter 22), and is responsible for receiving, tracking, and filing public comments regarding this Plan Update. Contact information is:

Mailing Address:	Sussex County Sheriff's Office Division of Emergency Management 135 Morris Turnpike Newton, New Jersey 07860
Contact Name:	Steven Sugar
Email Address:	ssugar@sussexcountysheriff.com
Telephone:	(973) 579-0380 x2530

Further details regarding continued public involvement are provided in Chapter 22.

3. COUNTY PROFILE

The planning area for this HMP is the entirety of Sussex County. This chapter presents general information about the land, people, and assets of Sussex County. This information provides a baseline for understanding the economic, structural, and population assets at risk from the hazards addressed in this HMP.

3.1 LOCATION

Sussex County is the northernmost county in New Jersey. It is bordered to the north by New York State, to the south by Warren and Morris Counties, to the east by Passaic County and to the west by the Delaware River and the Commonwealth of Pennsylvania. The County has 536 square miles of land and 1,417 miles of roads (NJDOT 2022). Today there are 24 municipalities in Sussex County—eight boroughs, 15 townships, and one town:

- Borough of Andover
- Borough of Branchville
- Borough of Franklin
- Borough of Hamburg
- Borough of Hopatcong
- Borough of Ogdensburg
- Borough of Stanhope
- Borough of Sussex
- Town of Newton
- Township of Andover
- Township of Byram
- Township of Frankford
- Township of Fredon
- Township of Green
- Township of Hampton
- Township of Hardyston
- Township of Lafayette
- Township of Montague
- Township of Sandyston
- Township of Sparta
- Township of Stillwater
- Township of Vernon
- Township of Walpack
- Township of Wantage

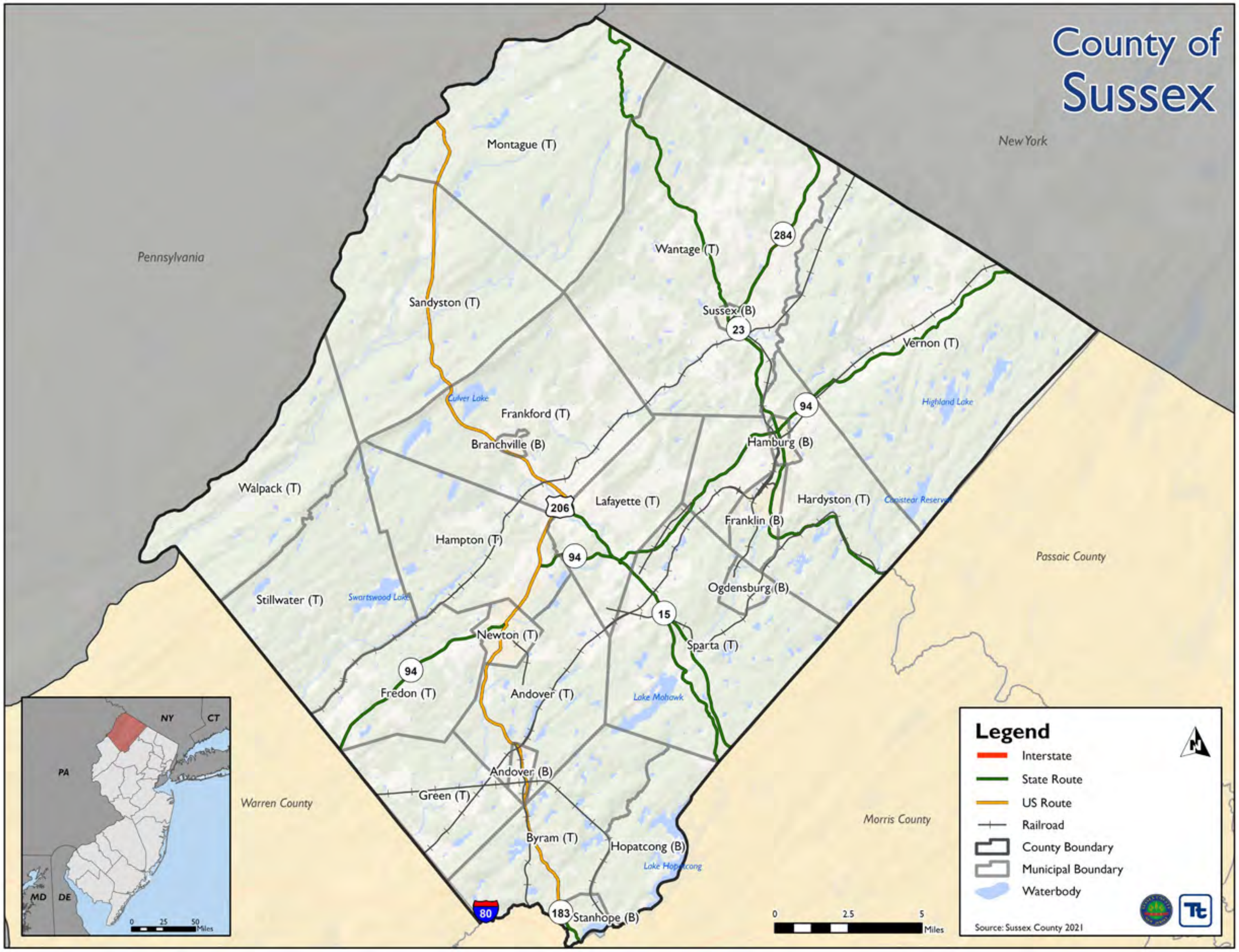
Figure 3-1 shows the County and its municipalities.

3.2 HISTORY

3.2.1 Early Inhabitants

The area now known as Sussex County was first occupied by Paleo-Indians, who moved into the area around 11,000 B.C. The Paleo-Indians lived in small groups and traveled in search of game and plants to eat. The Lenape Native Americans arrived in modern day Sussex County around the year 1000. The “Little Ice Age” that came to North America in the early 17th century caused crop failures and froze rivers, leading to many deaths. More death followed as European settlers arrived in the 17th century, who introduced infectious diseases into the area. All these factors made the Native populations decline dramatically. After 1750, very few Native Americans were left in Sussex County. The Treaty of Easton in 1758, forced what few Native Americans remained in New Jersey to move west to the Mississippi River drainage or north to Ontario or Quebec Canada, opening land for the European settlers.

Figure 3-1. Sussex County Hazard Mitigation Plan Area



3.2.2 Formation of Sussex County

Sussex County was formed in 1753 from Morris County (NJDEP 1969), when residents in the area petitioned colonial authorities for a new county to be formed. At that time, four large townships had been created in this sparsely populated area: Walpack Township, Greenwich Township, Hardwick Township, and Newtown Township. On June 8, 1753, Sussex County was created from these four municipalities, which were a large portion of Morris County. Sussex County at this time encompassed present-day Sussex and Warren Counties, and a part of present-day New York State (NJDEP 1969).

In the early 19th century, southern residents of the county sought to gain court sessions in their part of the county, suggesting alternating locations—in Newton in the north and in either Oxford or Belvidere in the south. The state legislature eventually voted to divide Sussex County in two, using a line drawn from the juncture of the Flat Brook and Delaware River in a southeasterly direction to the Musconetcong River running through Yellow Frame in present-day Fredon Township (then part of Hardwick). On November 20, 1824, Warren County was created from the southern territory of what had been Sussex County, leaving Sussex County with the boundaries it has today.

3.2.3 Industry

Dairy Farming and Agriculture

Historically, Sussex County has been a scenic, rural county with small municipalities, plenty of open space, and agriculture. Early settlers' farms were chiefly focused on subsistence agriculture. Early Sussex County agricultural production centered on dairy farming. A few farms had orchards—typically apples and peaches. Farmers typically produced enough food to feed their families and perhaps sell or exchange the remaining food and products with their neighbors. Excess fruit and grain were turned into alcoholic beverages. This was the economic model until the mid-19th century when advances in food preservation and the introduction of railroads into the area allowed Sussex County to transport farm products throughout the region (The Heritage & Agriculture Association Inc. 2023).

Mining and Metal Processing

The Highlands Region of Northwestern New Jersey was proven to possess rich deposits of iron ore. In the mid-18th century, several colonists began mining iron in present-day Sussex County and establishing forges and furnaces to create pig bar iron. By the end of the 18th century, almost all the trees in Sussex County were cut to provide charcoal to fuel the forges and furnaces in iron production (Puffer n.d.).

Iron from the Andover mines was fashioned into cable wire for the bridge built at Niagara Falls and for the beams used to rebuild Princeton University's Nassau Hall in Princeton, New Jersey after a fire undermined the structure in 1855. During the American Civil War, Andover iron found its way into rifle barrels and cannonballs just as it had during the Revolution years before (Mining Artifacts and History n.d.).

In the 1870s, Thomas Edison built one of the world's largest ore-crushing mills near Ogdensburg, New Jersey. Completed in 1889, the factory was intended to process up to 1,200 tons of iron ore every day, but technical difficulties repeatedly thwarted production. In the 1890s, richer soft-grade iron ore deposits located in Minnesota rendered Edison's Ogdensburg operation unprofitable and he closed the works in 1900 (Engineering and Technology History 2017).

The Borough of Franklin is home to the Franklin Furnace, which is famous for rare zinc, iron, and manganese minerals. The Sterling Hill Mine, a former zinc mine in Ogdensburg, began operations when it was originally thought to be a copper deposit. Declining deposits in the area, the expense of pumping groundwater from mine shafts, and misdirected investments by the owners led to the abandonment of the mines by the 1970s. Today, both Franklin Furnace and Sterling Hill Mine are operated as museums (Mining Artifacts and History n.d.).

Railroads

The Sussex Railroad was chartered in 1848 to transport iron ore and products to the Morris Canal. Construction of the line began in 1853 and the connection was completed to the Town of Newton at the end of the following year. The line was extended to Branchville Borough and Lafayette Township by 1869 and to Franklin Borough in 1871 to provide service to the zinc mines. This was the first railroad company to establish service in Sussex County and it played a role in the economic development of the dairy and mining industry in the area. The Sussex Railroad operated until 1945 when the line merged with the Delaware, Lackawanna, and Western Railroad system. Today, the right-of-way has been converted into a recreational rail trail called the Sussex Branch Trail (Wright n.d.). The Lackawanna Cut-Off, formerly a portion of the Delaware, Lackawanna, and Western Railroad system, is being restored to provide passenger rail service between Port Morris Junction (Roxbury Township, Morris County) and Andover Township (USDOT, NJ TRANSIT, USACE 2008).

From 1886 to 1962, the New York, Susquehanna, and Western Railway and Blairstown Railway operated a branch that followed the valley of the Paulins Kill. These railways' principal business was in the transport of coal from northeastern Pennsylvania to New York City. In the late 1980s, the State of New Jersey purchased the abandoned railbed and transformed it into a recreational trail. The Paulinskill Valley Trail is a 27-mile scenic trail system that is used for hiking, cycling, jogging and horseback riding (NJDEP 2015).

3.3 PHYSICAL SETTING

3.3.1 Major Surface Waters

Numerous ponds, lakes, creeks, and rivers make up the waterscape of Sussex County. Most of the lakes in the County are along the eastern slope of the Kittatinny Ridge or in the Highlands province of eastern Sussex County. These areas are where topography and geology support the development of lakes. Most of the lakes serve recreational purposes and were developed as vacation areas in the past. The following are the most prominent lakes in Sussex County (Sussex County Natural Resources Inventory 2009):

- Lake Hopatcong (largest in New Jersey)
- Culvers Lake
- Lake Owassa
- Big Swartswood Lake
- Lake Mohawk
- Highland Lake
- Wawayanda Lake

Rivers and streams in Sussex County include the following (Sussex County Natural Resources Inventory 2009):

- Delaware River
- Wallkill River
- Flat Brook
- Paulins Kill
- Pequest River
- Musconetcong River
- Clove Brook
- Mill Brook
- Kymer Brook
- Lubbers Run
- Papakating Creek
- Pochuck Creek
- Wawayanda Creek
- Black Creek
- Pequannock River
- Pacack Brook
- Russia Brook
- Rockaway River

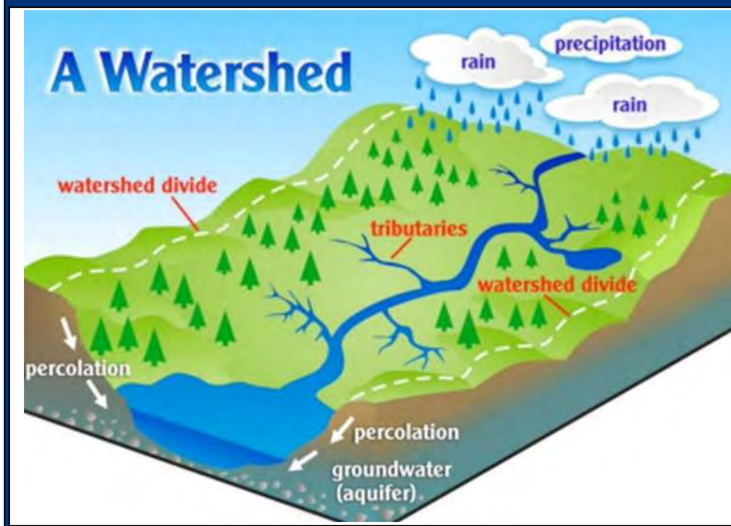
3.3.2 Watersheds

Delaware River Basin

The Delaware River extends 330 miles from the confluence of its east and west branches at Hancock, New York to the mouth of the Delaware Bay where it meets the Atlantic Ocean. It is the longest un-dammed river in the United States east of the Mississippi River, running through and draining parts of Pennsylvania, New Jersey, New York, and Delaware. (Delware River Basin Commission 2023).

The Delaware River is fed by over 2,000 tributaries and its drainage basin covers approximately 13,600 square miles, including the 782 square mile Delaware Bay. Its hydrographic regions are divided between five physiographic areas – Appalachian Plateau, Ridge and Valley, New England, Piedmont, and Atlantic Coastal Plain (Delware River Basin Commission 2023). The Sussex County portion of the Delaware River falls in the Appalachian Highlands region, which consists primarily of consolidated sedimentary rock. The area's sub-region, known as Ridge and Valley, consists of mountain ridges in the north and rolling hills in the south (Sussex County Natural Resources Inventory 2009).

A **watershed** is the area of land that drains into a body of water such as a river, lake, stream, or bay. It is separated from other systems by high points such as hills or slopes. It includes the waterway and all land area that drains to it. Drainage basins generally refer to large areas that encompass the watersheds of many smaller rivers and streams. Watersheds can cross municipal and county boundaries (NOAA 2023).



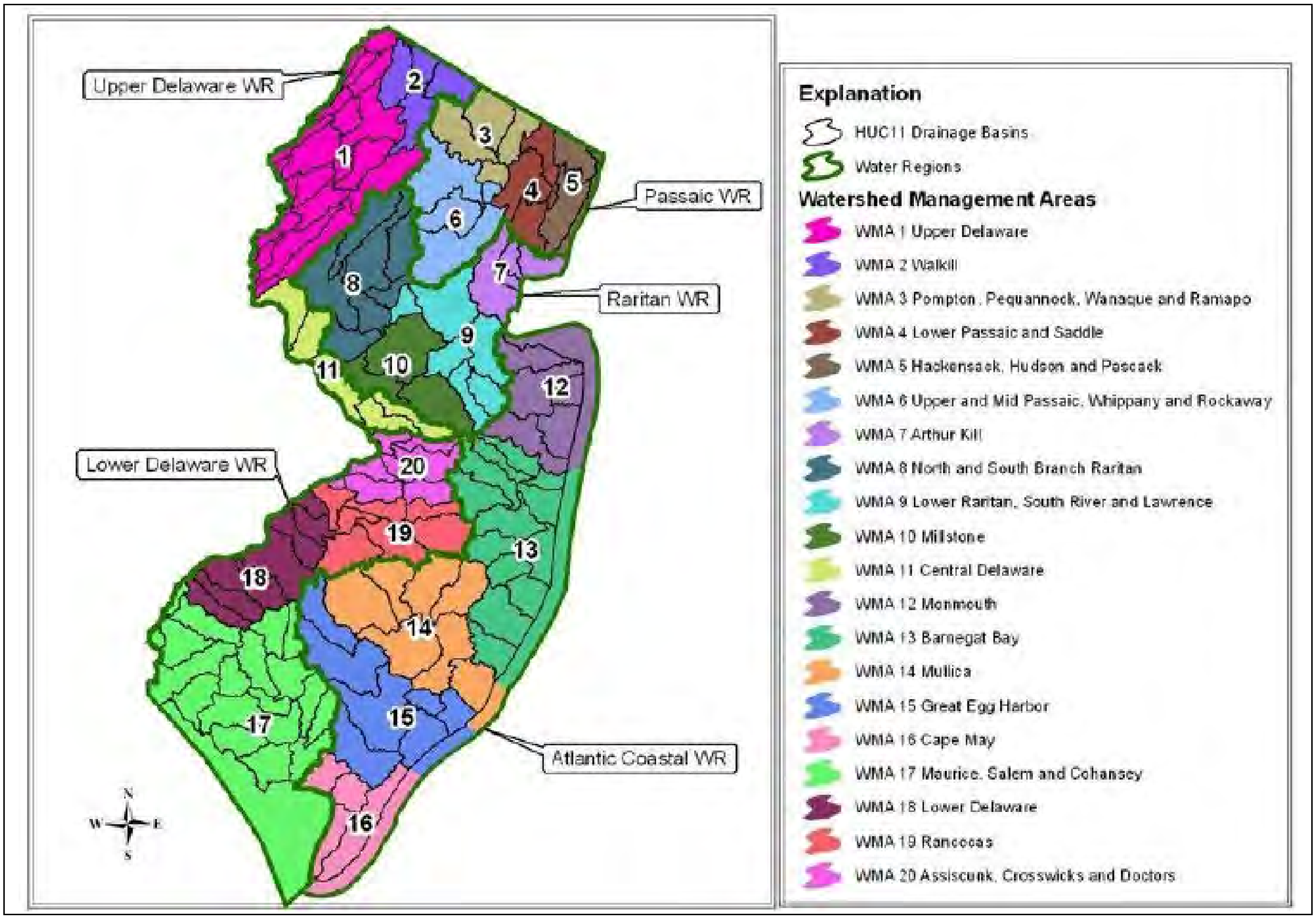
Source: RCRCD n.d.

Approximately 8.6 million people live in the Delaware River Basin, of which 23-percent reside in the State of New Jersey. The total number of people served by the Delaware River Basin Water increased from 13.3 million to an estimated 14.2 million between 2016 and 2020 (Delaware River Basin Comission 2023).

Watershed Management Areas

New Jersey is divided into 20 Watershed Management Areas (WMA), which are made up of smaller watersheds, as shown in Figure 3-2 (State of New Jersey 2019). Sussex County is located in four of the 20 WMAs, as discussed further below: Upper Delaware (WMA 1); Wallkill (WMA 2); Pompton, Pequannock, Wanaque, Ramapo (WMA 3) and Upper and Mid Passaic, Whippany and Rockaway (WMA 6).

Figure 3-2. Watersheds of New Jersey



Source: New Jersey Geological and Water Survey 2007

Watershed Management Area 1: Upper Delaware

WMA 1 includes portions of Sussex, Morris, and Hunterdon Counties and all of Warren County. This area is known as the Upper Delaware River Watershed and encompasses 746 square miles in the northwest corner of New Jersey. Within WMA 1, there are six major drainage basins: Delaware River, Flat Brook, Paulins Kill, Pequest River, Lopatcong and Pohatcong River Drainage, and the Musconetcong River (State of New Jersey 2019).

In Sussex County, WMA 1 covers the western and southern sections of the county, encompassing more than half of the county's land area. Principal waterways in Sussex County's portion of WMA 1 include: Flat Book, Paulins Kill, Pequest River, and a short stretch of the Musconectong River (State of New Jersey 2019).

Watershed Management Area 2: Wallkill River Watershed

WMA 2, the Wallkill River Watershed, includes 11 townships in Sussex County. The river's headwaters begin at Lake Mohawk in Sparta Township and the river flows north from there into New York, eventually emptying into the Hudson River. Within WMA 2, there are four subwatersheds: the Wallkill River, Pochuck Creek, Papakating Creek and Rutgers Creek Tributaries (State of New Jersey 2019).

The Wallkill Watershed is 208 square miles in area and covers a variety of land uses, including rural and centralized residential development, agriculture, commercial, recreational and industrial usage. Also located within this watershed is the Wallkill National Wildlife Refuge. The refuge watershed/wetlands complex provides migratory and nesting habitats for numerous birds and is home to several endangered species (State of New Jersey 2019).

WMA 2 occupies the northern and northeastern parts of Sussex County, extending south through Sparta and northern Byram Townships. Papakating Creek begins in Frankford Township, and Clove Brook flows south from northern Wantage Township. Pochuck Creek drains part of Vernon and Hardyston Townships east of Pochuck Mountain and enters the Wallkill River several miles into New York State (State of New Jersey 2019).

Watershed Management Area 3: Pompton, Pequannock, Wanaque, Ramapo Watersheds

WMA 3 is in the Highlands Province. The Pequannock, Wanaque and Ramapo Rivers all flow into the Pompton River, which is a major tributary to the Upper Passaic River. WMA 3 contains some of the State's major water supply reservoirs, including the Wanaque Reservoir, which is the largest surface water reservoir in New Jersey. There are four watersheds in WMA 3: Pompton, Ramapo, Pequannock and Wanaque River Watersheds. WMA 3 lies mostly in Passaic County but also includes parts of Bergen, Morris and Sussex Counties (State of New Jersey 2019).

The Pequannock River flows south out of Vernon Township and continues into Hardyston Township where it turns southeast, forming the border between Morris and Passaic Counties. The Pequannock's confluence with the Passaic River occurs at the eastern end of the Great Piece Meadows, where Morris, Passaic and Essex Counties meet. For most of its run in Sussex County, the Pequannock River flows through Newark's water supply management lands (State of New Jersey 2019).

Watershed Management Area 6: Upper and Mid Passaic, Whippany, Rockaway Watersheds

WMA 6 represents the area drained by waters from the upper reaches of the Passaic River Basin, including the Passaic River from its headwaters in Morris County to the confluence of the Pompton River. WMA 6 is characterized by extensive suburban development and reliance upon groundwater sources for water supply. WMA 6 lies in portions of Morris, Somerset, Sussex, and Essex Counties and includes the Upper and Middle Passaic River, Whippany River, and Rockaway River Watersheds (State of New Jersey 2019).

The Rockaway River begins in Jefferson Township and its system's upper reaches are in eastern Sparta Township, where several streams merge to form Russia Brook. Russia Brook flows into Jefferson Township, where it meets the Rockaway River below Lake Swannanoa. From there, the Rockaway River flows into the Passaic River (State of New Jersey 2019).

3.3.3 Topography and Geology

The topography of Sussex County is among the most diverse in New Jersey. The eastern two-thirds lies within the Highlands physiographic province, which runs northeast from Reading, Pennsylvania, across New Jersey, and into southern New York State and western Connecticut. This province is characterized by forested ridges and glacially sculpted valleys. It also contains significant water resources affecting over 11 million residents.

The remainder of Sussex County lies within the Ridge and Valley physiographic province. This province is characterized by northeast-southwest trending ridges with fertile valleys in between. The province includes the Kittatinny Ridge, which runs 40 miles across the county. The Ridge has elevations of 1,200 to 1,500 feet above sea level, and an average width of 5 miles. High Point, the northernmost extent of the Kittatinny Ridge, has an elevation of 1,803 feet, which is the highest point in New Jersey (Sussex County Natural Resources Inventory 2009).

The lowest points in Sussex County are along the Delaware River at the mouth of Flat Brook (300 feet) and along the Wallkill River at the New York State line (380 feet). Located between the Highlands and Kittatinny Ridge, the Kittatinny Valley has elevations between 600 and 700 feet (Sussex County Natural Resources Inventory 2009).

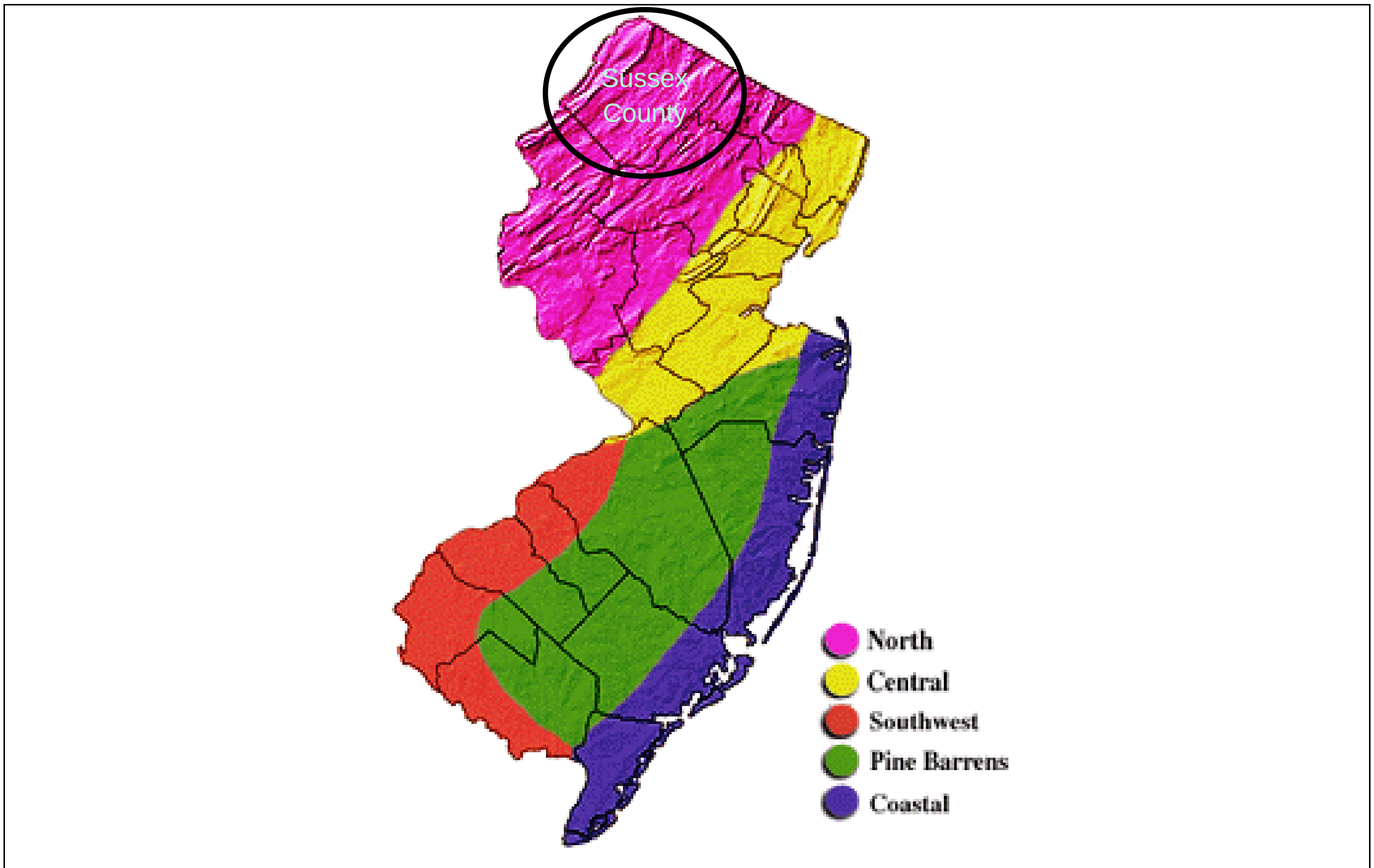
The Highlands is composed of Precambrian rock, the oldest bedrock in New Jersey. The portion that runs through Sussex County is predominately granite and gneiss, with a small portion of marble. To the west of the Highlands is the Valley and Ridge, composed of Paleozoic rock, which includes shale, siltstone, and sandstone along Kittatinny Valley and limestone, shale, and sandstone along the Delaware River Basin (NJ Geological Survey 2019).

3.3.4 Climate

Historical Climate

Sussex County has a temperate climate with warm summers and cold winters. As shown of Figure 3-3, the County is in the North Zone of New Jersey's climate zones. The North Zone has a continental type of climate with minimal influence from the Atlantic Ocean, except when the winds contain an easterly component (ONJSC 1983). The average temperatures in Sussex County range from 25 °F in January to 71 °F in July, with extremes common in the summer and winter. The average yearly precipitation is 46 inches (NOAA 2023).

Figure 3-3. Climate Zones in New Jersey



Source: ONJSC 1983

The North Zone normally exhibits a colder temperature regime than other climate regions of the state. This difference is most dramatic in winter when average temperatures can be more than 10 °F cooler than in the Coastal Zone. Annual snowfall averages 40 to 50 inches in the North Zone as compared with an average of 10 to 15 inches in the extreme south (ONJSC 1983).

Clouds and precipitation in the North Zone are enhanced by orographic effects attributable to the area's highlands and mountains. Following a cold frontal passage, air forced to rise over the mountains produces clouds, and precipitation, while the rest of the state observes clear skies. The latter is due in part to subsiding air flowing off the highlands (ONJSC 1983). In the warm season, thunderstorms are responsible for most of the rainfall. Cyclones and frontal passages are less frequent during this time. Thunderstorms spawned in Pennsylvania and New York State often move into Northern New Jersey, where they often reach maximum development in the evening. This region has about twice as many thunderstorms as the coastal zone, where the nearby ocean helps stabilize the atmosphere (ONJSC 1983).

The Northern Climate Zone has the state's shortest growing season, at about 155 days. The average date for the last killing spring frost is May 4. The first frost in fall is around October 7. The exact dates vary significantly within the region as well as from year to year. Some valley locations have observed killing frost in mid-September and as late as mid-June (ONJSC 1983).

Climate Change Projections

Climate change refers to major changes in temperature, precipitation, or wind patterns over a period of decades or longer. Due to the increase in greenhouse gas concentrations since the end of the 1890s, New Jersey has experienced a 3.5 °F increase in average temperature, which is faster than the rest of the Northeastern United States (2 °F) and the world (1.5 °F). This warming trend is expected to continue. By 2050, temperatures in New Jersey are expected to increase by 4.1 °F to 5.7 °F. Even in climate models that assume lower quantities of greenhouse gases in the future (low emissions scenario), New Jersey is predicted to experience an average annual temperature that is warmer than any to date. With higher quantities of greenhouse gases (high emissions scenario), future temperatures could be as much as 10 °F warmer. By the middle of the 21st century, 70 percent of summers in New Jersey will be hotter than the warmest summer experienced to date. The increase in temperatures is expected to be felt more during the winter months (December, January, and February), resulting in less intense cold waves, fewer sub-freezing days, and less snow accumulation (NJDEP 2020).

As temperatures increase, Earth's atmosphere can hold more water vapor, which leads to a greater potential for precipitation. Currently, New Jersey receives an average of 46 inches of precipitation each year. Since the end of the 20th century, New Jersey has experienced slight increases in the amount of precipitation it receives each year. Over the last 10 years, there has been a 7.9 percent increase in the state's annual precipitation. By 2050, annual precipitation in New Jersey could increase by 4 percent to 11 percent. However, small decreases in the amount of precipitation may occur in the summer months, resulting in greater potential for more frequent and prolonged droughts (NJDEP 2020).

With a warmer atmosphere, storms will have the potential to be more intense and occur more often. In New Jersey, extreme storms typically include coastal nor'easters, snowstorms, spring and summer thunderstorms, tropical storms, and on rare occasions hurricanes. Except for nor'easters, which occur between September and April, these events usually occur in the warmer months between April and October. Over the last 50 years, New Jersey storms that resulted in extreme rain increased by 71 percent, which is a faster rate than anywhere else in the United States. By the end of this century, heavy precipitation events are projected to occur two to five times more often and with more intensity than in the last century. New Jersey will experience more intense rain events, less snow, and more rainfall, likely increasing the number of flood events each year. (NJDEP 2020).

3.3.5 Land Cover

Table 3-1 and Figure 3-4 summarize land cover in Sussex County. More than half of the Highlands region contains rich and diverse forests, occupying 370,000 acres of land. Much of the forestland remains in large, unfragmented pieces, some larger than 5,000 acres. Most of the forestland is dominated by oak-hickory forest with northern hardwoods, hemlock, and swamp hardwoods. These forests contribute to the region's clean water and air, wildlife habitat, and recreational resources and serve as an excellent timber resource (Sussex County 2014).

Table 3-1. Sussex County Land Cover Classification

	Total Area in Category	
	Acres	% of Total
Agricultural	34,629	10.1%
Barren Land	2,125	0.6%
Forest	191,143	55.8%
Rangeland	0	0.0%
Urban Area	54,839	16.0%
Water	13,024	3.8%
Wetland	46,799	13.7%
Total	**342,558**	**100.0%**

Source: NJDEP 2015

3.4 LAND USE

3.4.1 Current Land Use

The 2014 Sussex County Strategic Growth Plan, published by the Sussex County Strategic Growth Advisory Committee, includes a build-out analysis that evaluates the resource base and the elements that affect the ability of land to sustain development. Lands that are permanently preserved or currently occupied, wetlands, excessive slopes, lands subject to regulatory restrictions (Category 1 streams and associated buffers), floodplains, etc. are not considered developable in this context. That analysis, presented in Table 3-1, indicates the amount of land that remains potentially developable (Sussex County 2014).

3.4.2 Land Use Trends

Hazard mitigation planning requires consideration of land use trends, which can impact the need for and priority of mitigation options over time. Land use trends impact hazard vulnerability and impacts. For example, significant development in a hazard area increases the building stock and population exposed to that hazard.

The New Jersey Municipal Land Use Law gives municipalities authority for zoning and land use planning. The Sussex County Economic Development Partnership facilitates the recruitment, retention, and expansion of businesses that will complement and be consistent with the character and environment of the County. The Sussex County Planning Board is responsible for approving site plan and subdivision applications within its jurisdiction. A development review committee reviews all applications and acts on behalf of the Planning Board.

Figure 3-4. Sussex County Land Use and Land Cover

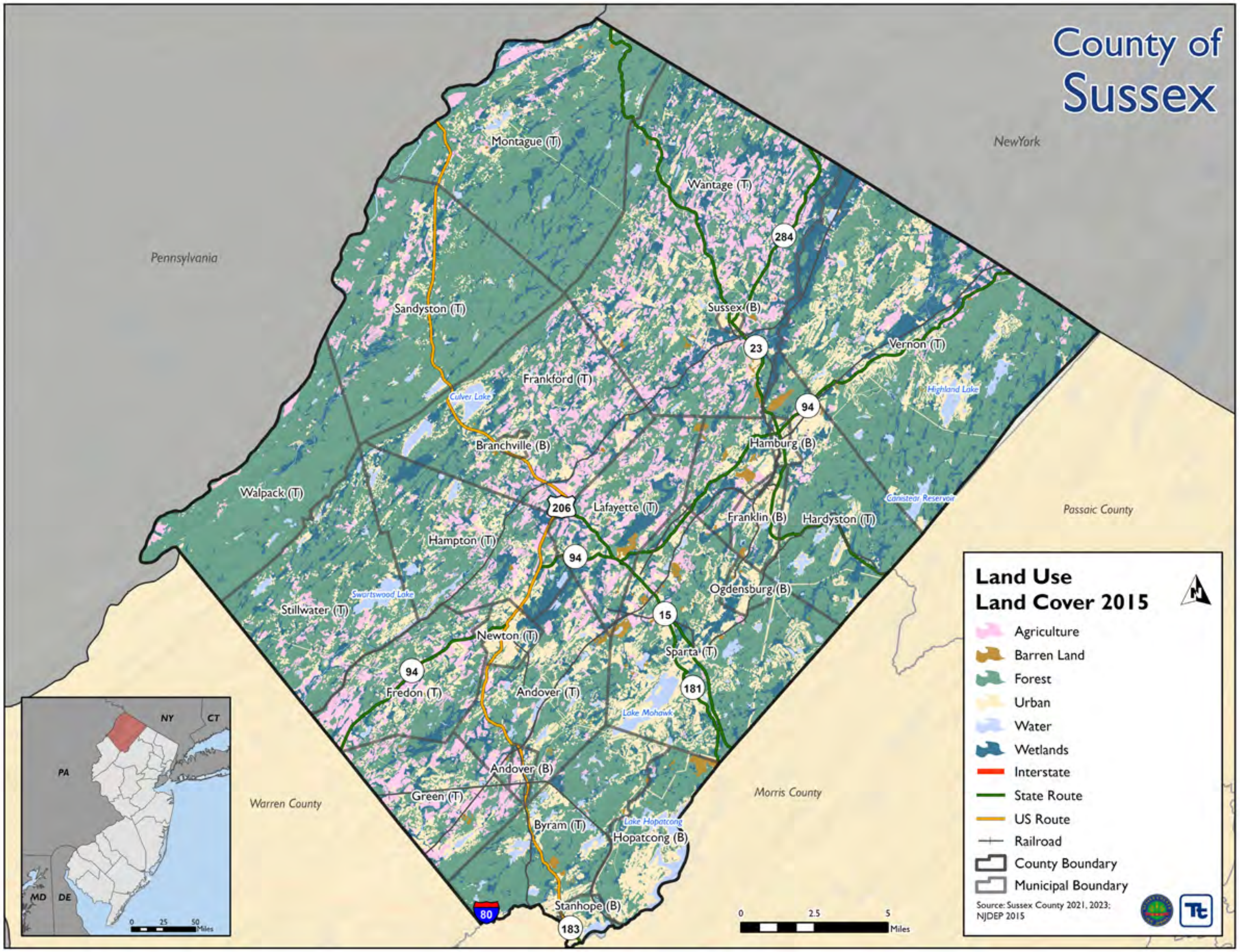


Table 3-2. Sussex County Residential Land Available for Development, by Jurisdiction

	Potential Units/Lots	% of County Total
Andover Borough	197	0.81
Andover Township	1,637	6.8
Branchville Borough	140	0.58
Byram Township	1,633	6.78
Frankford Township	1,210	5.02
Franklin Borough	1,317	5.47
Fredon Township	617	2.56
Green Township	531	2.29
Hamburg Borough	310	1.28
Hampton Township	1,808	7.51
Hardyston Township	749	3.11
Hopatcong Borough	761	3.16
Lafayette Township	576	2.39
Montague Township	1,328	5.52
Newton Town	780	3.24
Ogdensburg Borough	187	0.77
Sandyston Township	1,881	7.82
Sparta Township	1,080	4.49
Stanhope Borough	311	1.29
Stillwater Township	889	3.69
Sussex Borough	131	0.54
Vernon Township	3,316	13.77
Walpack Township	—	—
Wantage Township	2,675	11.11
Sussex County (Total)	**24,064**	**100**

Source: Sussex County 2014

Note: The Highlands is not included in this calculation as the regulations and master plan had not yet been completed when the calculations were performed. It can be assumed that development in the Highlands core will be significantly curtailed in the future. In addition, allowance was made for substandard lots in lake communities.

According to the Sussex County Department of Planning and Economic Development, 308 permits for new residential buildings were issued from 2015 to 2017, with the largest number for multi-family use; more recent data is not posted at this time (Sussex County 2018). New development in the last five years and potential future development in the next five years has been identified by each municipal Planning Partner. An exposure analysis was conducted to determine the relationship between the identified potential new development and natural hazard areas evaluated in this HMP update. The results of this analysis are reviewed with each jurisdiction's annex, and summaries are included at the end of each hazard's vulnerability assessment (Chapters 6 through 18).

Highlands Region

The Highlands Region is found in New Jersey as well as New York, Pennsylvania, and Connecticut. The New Jersey Highlands is a 1,343 square mile area in the northwest portion of New Jersey, noted for its scenic beauty and environmental significance and serving as a vital source of drinking water for over half of New Jersey residents. The Highlands stretches from Phillipsburg (Warren County) in southwest New Jersey to Ringwood (Passaic County) in the northeast. The Highlands Region lies within portions of seven counties—Hunterdon, Somerset, Sussex, Warren, Morris, Passaic, and Bergen—and includes 88 municipalities (New Jersey Highlands Council n.d.). The Highlands Water Protection and Planning Act (the Highlands Act) designates 398,000 acres as the Highlands Preservation Area, which is identified as an area of exceptional natural resource value. The remainder of the Highlands Region that is not located within the Preservation Area is designated the Highlands Planning Area. The distinction between the Preservation and Planning Area is that municipal and county conformance with the Highlands Regional Master Plan is required in the Preservation Area, and voluntary in the Planning Area (NJDEP 2022).

Sussex County is partially in the New Jersey Highlands Region Preservation Area. The County recognizes the unique value of the Highlands Region and seeks to protect and enhance it, ensuring that land use and development activities occur in a manner and location that is consistent with the Highlands Regional Master Plan. The Highlands Area in Sussex County covers 129,749 acres in the eastern portion of the County: 70,769 acres in the Preservation Area and 58,980 acres in the Planning Area, as seen in Figure 3-5 (New Jersey Highlands Council 2010). The Townships of Byram, Green, Hardyston, Sparta and Vernon, and the Boroughs of Franklin, Hamburg, Hopatcong, Ogdensburg, and Stanhope are within the Highlands boundary.

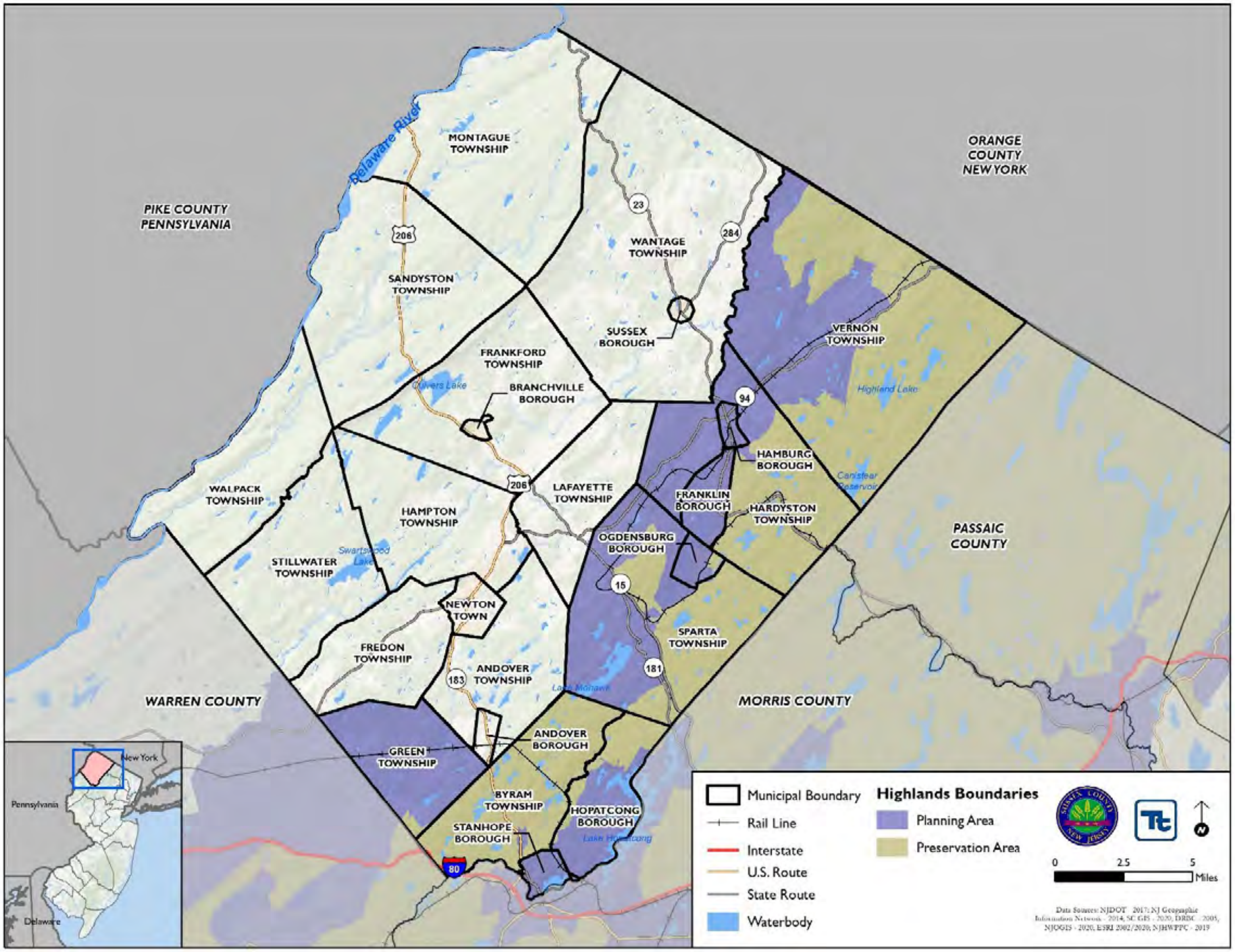
The New Jersey Highlands Council is a regional planning agency that works with the municipalities and counties in the Highlands Region to encourage a comprehensive regional approach to implementing the Highlands Act. The Highlands Council has identified areas of existing development as well as areas of potential growth for the Highlands Region. These areas include the Existing Community Zone (both in-fill of new development and re-development) and Designated Centers. The New Jersey Highlands Council considers hazard areas such as floodplains when evaluating new and re-development in the region. In addition, the New Jersey Department of Environmental Protection (NJDEP) Sewer Service Areas indicate the planned method of wastewater disposal for specific areas; i.e., whether wastewater will be collected to a regional treatment facility or treated on site and disposed of through a surface water or groundwater discharge.

Open Space and Parkland

Public and conservation open space accounts for more than one-third of the County’s total land area. Overall, open space in Sussex County includes federal, state, county, municipal, and water supply management land (Sussex County 2016):

- Federal:
  - The National Park Service manages 5,354 acres (federal land) in western Sussex County in the municipalities of Sandyston and Stillwater. This area is part of the Delaware Water Gap National Recreation Area, a 55,857-acre unit of the National Park System located in New Jersey and Pennsylvania.
  - The U.S. Fish and Wildlife Service manages 21,924 acres of land in the County, known as the Wallkill River National Wildlife Refuge, located in the Townships of Vernon and Wantage.

Figure 3-5. Highlands in Sussex County, New Jersey



- State:
  - The New Jersey Division of Fish and Wildlife manages 12 Wildlife Management Areas in Sussex County, totaling 23,019 acres.
  - The New Jersey Division of Parks and Forestry has six state parks, one state forest, and three long-distance trails (Paulinskill Valley Trail, Sussex Branch Trail, and Appalachian Trail) in Sussex County.
  - The New Jersey Natural Lands Trust, an independent agency within NJDEP, manages 15 Natural Lands Trust properties in Sussex County, focused on fish and wildlife habitat conservation.
- County and Municipal
  - Sussex County owns 441 acres of open-space land in Franklin, Frankford, Hardyston, Newton, Sparta, and Vernon municipalities.
  - On the municipal level, there are 4,499 acres of land used for parks, recreation areas, municipal buildings, and support services.
- Private:
  - The County includes 1,274 acres of private land that is used as open space or protected via conservation easements.
  - There are 10,175 acres of open space used for utilities in Sussex County. This land is primarily in Hardyston Township and Vernon Township, with the largest parcel being a 2,223-acre watershed in Vernon.
  - Various non-profit organizations also own open space in Sussex County, totaling 5,599 acres, including The Nature Conservancy (1,755 acres), New Jersey Audubon (570 acres), and The Orange YMCA (607 acres).
  - There is 18,202 of acres of preserved farmland in the County.

Agriculture

Agriculture is an integral part of the natural landscapes that make up the County. Agricultural land includes pasturelands and grazing lands associated with horse or cattle raising operations; orchards, vineyards, nurseries, and other horticultural areas; and lands used in support of agricultural activities, such as farmsteads, associated barns, stables, and corrals (NJDEP 2012).

The U.S. Department of Agriculture's 2022 Census of Agriculture reports 71,688 acres of farmland in Sussex County, a significant increase from the 59,766 acres of farmland reported in the 2017 survey. In 2022, there were 1,052 active farms in the County, an increase of 4 percent from 2017. Table 3-3 outlines the top crop items grown in Sussex County in 2017 and 2022, along with the number of acres devoted to these crops. Soybeans for beans are the predominant crop in the County. Sussex County ranks second in the state for total acres of soybeans.

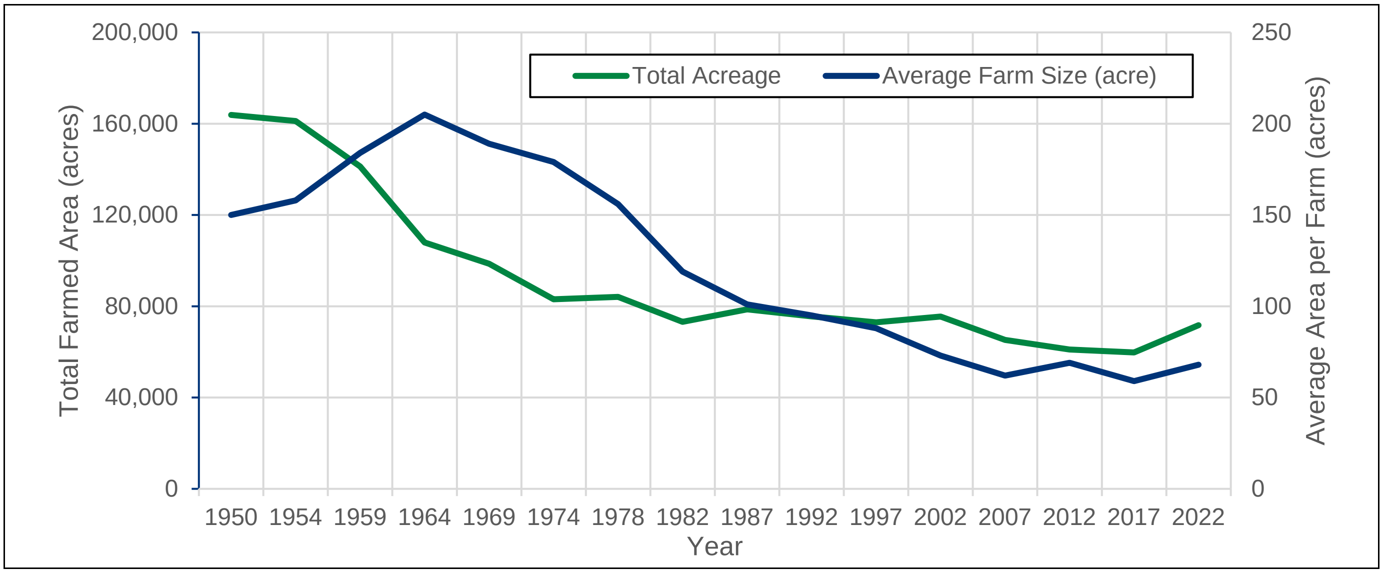
Table 3-3. Sussex County Farmland by Crop (Acres): 2017 and 2022

Crop Type	Area Devoted to Crop (acres)	
	2017	2022
Soybeans for beans	666	3,310
Corn for grain	2,697	4,788
Forage - land used for all hay and haylage, grass silage, and green chop	13,944	18,028
Corn for silage/greenchop	1,193	1,134
Vegetables harvested for sale	564	955

Source: USDA 2024

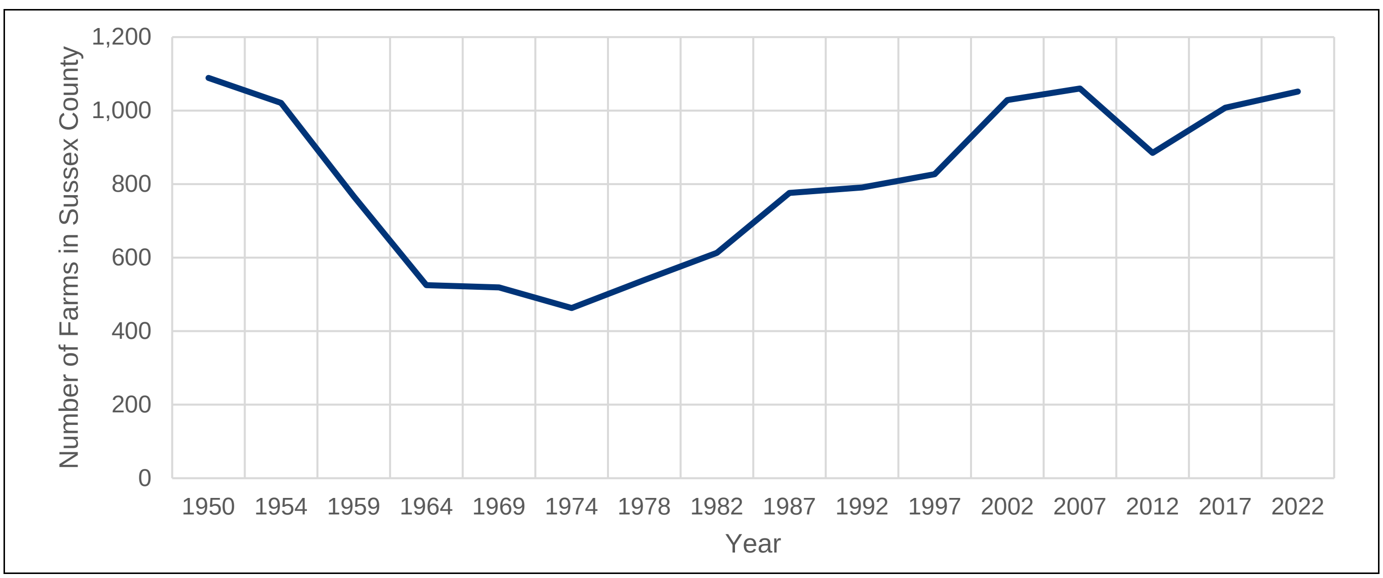
The agricultural industry in Sussex County continues to face many threats to its long-term sustainability. The dairy industry—long the cornerstone of Sussex County's farms—is experiencing an extended and steady decline. A growing number of dairy farmers must find other sources of revenue to supplement their agricultural activities. While many have adjusted their operations to produce different livestock products or crops, such as cattle and nursery goods, others find selling their lands to be a more attractive option. Consequently, the County's stock of cropland and pastureland has decreased for several decades (Sussex County 2008). Figure 3-6 and Figure 3-7 show the average farm size, total acreage of farms, and number of farms in Sussex County from 1950 to 2022 (USDA 2024).

Figure 3-6. Historical Farmed Area in Sussex County (Total and Average)



Source: USDA 2024

Figure 3-7. Historical Number of Farms in Sussex County



Source: USDA 2024

Sussex County has adopted a Comprehensive Farmland Preservation Plan that lays out a strategy for preservation of this vital resource. Since 1983, over 12,000 acres have been permanently protected from conversion to nonagricultural uses through permanent deed-restrictions (Sussex County 2008).

3.5 POPULATION AND DEMOGRAPHICS

3.5.1 Current Population

According to the 2020 U.S. Census, Sussex County has a population of 144,221. Vernon Township accounts for 15.5 percent of the population.

3.5.2 Population Trends

Population trend information was evaluated to estimate future shifts that could significantly change the character of the area. Population trends can provide a basis for making decisions on the type of mitigation approaches to consider and the locations in which these approaches should be applied. This information can also be used to support planning decisions regarding future development in vulnerable areas.

As seen in Table 3-4, Sussex County's population increased from 1960 through 2010 then declined between 2010 and 2020. Forecasts from the New Jersey Department of Labor project an ongoing decline in the County's population through 2034 as seen in Table 3-5. Changes in population have not been geographically uniform throughout the County, with some areas having experienced a decline in population prior to 2010. The 2020 U.S. Census data included in the Hazus hazard-simulation model are believed to be sufficient and appropriate to support the risk assessment and mitigation planning efforts of this HMP. Figure 3-8 shows the 2020 U.S. Census population density in Sussex County.

3.5.3 Socially Vulnerable Populations

Hazard mitigation planning needs to consider socially vulnerable populations. These populations can be more susceptible to hazard events based on a number of factors including their physical and financial ability to react or respond during a hazard, and the location and construction quality of their housing. This HMP considers several socially vulnerable population groups: persons over the age of 65, persons under the age of 5, non-English speaking households, people with disabilities, and people living below the poverty level. Table 3-6 and Table 3-7 show population statistics for these socially vulnerable populations, for each municipality in the County based on the 2010 and 2020 Census data. Distributions of population density (persons per square mile) for social vulnerability metrics are shown in Figure 3-9.

Table 3-4. Historical Population Change in Sussex County

	Population						
	1960	1970	1980	1990	2000	2010	2020
Andover Borough	734	813	892	700	658	606	595
Andover Township	2,177	3,040	4,5056	5,438	6,033	6,319	5,996
Branchville Borough	963	911	870	851	845	841	791
Byram Township	1,616	4,592	7,502	8,048	8,254	8,350	8,028
Frankford Township	2,170	2,777	4,654	5,114	5,420	5,565	5,302
Franklin Borough	3,624	4,236	,4,486	4,977	5,160	5,045	4,912
Fredon Township	804	1,372	2,281	2,763	2,860	3,437	3,235
Green Township	854	1,343	2,450	2,709	3,220	3,601	3,627
Hamburg Borough	1,532	1,820	1,832	2,566	3,105	3,277	3,266
Hampton Township	1,174	2,091	3,916	4,438	4,943	5,196	4,893
Hardyston Township	2,206	3,499	4,553	5,275	6,171	8,213	8,125
Hopatcong Borough	3,391	9,052	15,531	15,586	15,888	15,147	14,362
Lafayette Township	1,100	1,202	1,614	1,902	2,300	2,538	2,358
Montague Township	879	1,131	2,066	2,832	3,412	3,847	3,792
Newton Town	6,563	7,297	7,748	7,521	8,244	7,997	8,374
Ogdensburg Borough	1,212	2,222	2,737	2,722	2,638	2,410	2,258
Sandyston Township	1,019	1,303	1,485	1,732	1,825	1,998	1,977
Sparta Township	6,717	10,819	13,333	15,157	18,080	19,722	19,600
Stanhope Borough	1,814	3,040	3,638	3,393	3,584	3,610	3,526
Stillwater Township	1,339	2,158	3,887	4,253	4,267	4,099	4,004
Sussex Borough	1,656	2,038	2,418	2,201	2,145	2,130	2,024
Vernon Township	2,155	6,059	16,302	21,211	24,686	23,943	22,358
Walpack Township	248	384	150	67	41	16	7
Wantage Township	3,308	4,329	7,268	9,487	10,387	11,358	10,811
Sussex County	49,255	77,528	116,119	130,943	144,166	149,265	144,221

Source: New Jersey Department of Labor 2001; U.S. Census 2023

Table 3-5. Historical and Projected Population Change in Sussex County

Historical Sussex County Population							Projected Sussex County Population	
1960	1970	1980	1990	2000	2010	2020	2029	2034
49,255	77,528	116,119	130,943	144,166	149,265	144,221	137,300	136,600

Source: State of New Jersey 2017; U.S. Census 2020; U.S. Census 2010; New Jersey Department of Labor 2001

Figure 3-8. Population Density in Sussex County

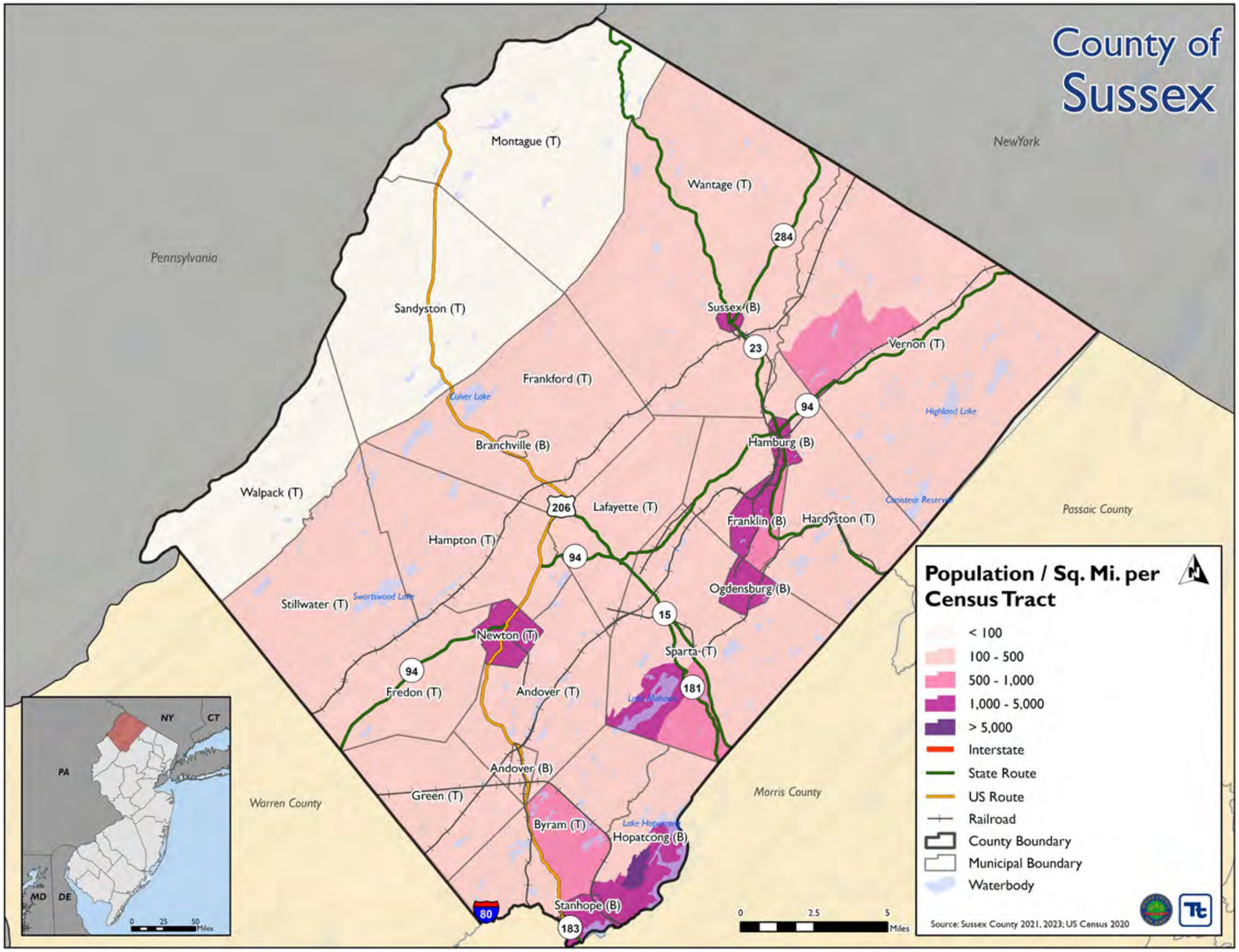


Table 3-6. Sussex County Population and Demographic Statistics 2010 Census

	Total Population	65 and Older		Below Poverty Level	
		Population	% of Total Jurisdiction Population	Population	% of Total Jurisdiction Population
Andover Borough	606	73	12.0%	28	4.6%
Andover Township	6,319	1,012	16.0%	91	1.4%
Branchville Borough	841	141	16.8%	46	5.5%
Byram Township	8,350	843	10.1%	104	1.2%
Frankford Township	5,565	921	16.5%	124	2.2%
Franklin Borough	5,045	659	13.1%	323	6.4%
Fredon Township	3,437	469	13.6%	52	1.5%
Green Township	3,601	388	10.8%	50	1.4%
Hamburg Borough	3,277	385	11.7%	212	6.5%
Hampton Township	5,196	768	14.8%	142	2.7%
Hardyston Township	8,213	1,194	14.5%	348	4.2%
Hopatcong Borough	15,147	1,489	9.8%	262	1.7%
Lafayette Township	2,538	325	12.8%	52	2.0%
Montague Township	3,847	536	13.9%	140	3.6%
Newton Town	7,997	1,481	18.5%	810	10.1%
Ogdensburg Borough	2,410	275	11.4%	104	4.3%
Sandyston Township	1,998	234	11.7%	57	2.9%
Sparta Township	19,722	2,198	11.1%	251	1.3%
Stanhope Borough	3,610	374	10.4%	74	2.0%
Stillwater Township	4,099	459	11.2%	199	4.9%
Sussex Borough	2,130	261	12.3%	176	8.3%
Vernon Township	23,943	2,019	8.4%	403	1.7%
Walpack Township	16	4	25.0%	0	0.0%
Wantage Township	11,358	1,342	11.8%	163	1.4%
Sussex County	**149,265**	**17,850**	**12.0%**	**4,211**	**2.8%**

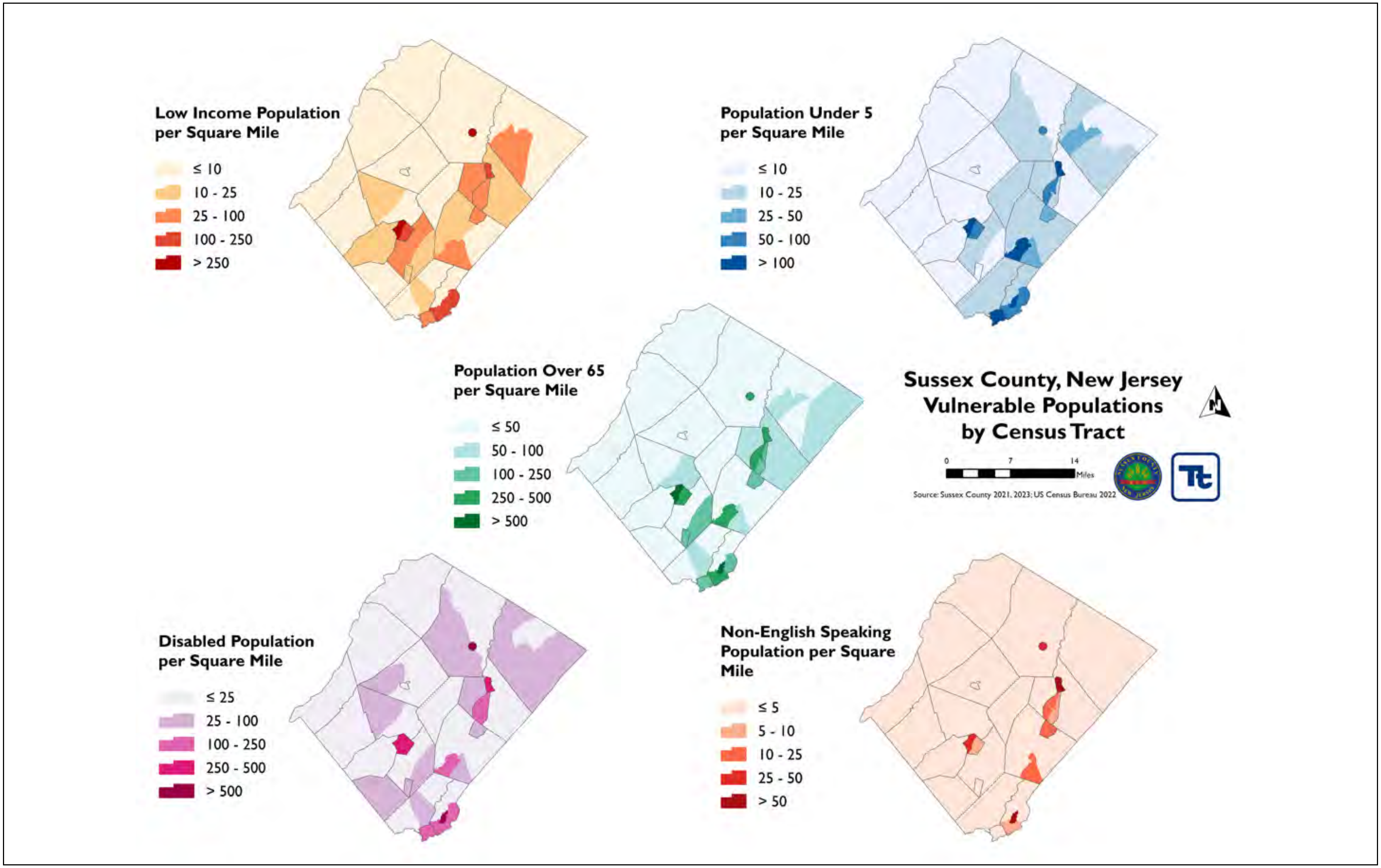
Source: U.S. Census Bureau, Census 2010

Table 3-7. Sussex County Population and Demographic Statistics 2020 Census, American Community Survey 5-Year Estimates

	Total	65 and Older		5 and Younger		Non-English-Speaking		Disability		Below Poverty Level	
	Population	Population	% of Total	Population	% of Total	Population	% of Total	Population	% of Total	Population	% of Total
Andover Borough	595	81	0.3%	27	0.4%	13	0.7%	62	0.4%	32	0.4%
Andover Township	5,996	1,370	5.4%	243	3.7%	0	0.0%	525	3.3%	266	3.6%
Branchville Borough	791	163	0.6%	39	0.6%	28	1.5%	84	0.5%	35	0.5%
Byram Township	8,028	1,112	4.4%	445	6.8%	103	5.3%	610	3.9%	178	2.4%
Frankford Township	5,302	1,000	3.9%	235	3.6%	0	0.0%	552	3.5%	148	2.0%
Franklin Borough	4,912	1,174	4.6%	228	3.5%	131	6.8%	851	5.4%	285	3.9%
Fredon Township	3,235	638	2.5%	131	2.0%	28	1.5%	294	1.9%	176	2.4%
Green Township	3,627	739	2.9%	125	1.9%	49	2.5%	471	3.0%	150	2.0%
Hamburg Borough	3,266	451	1.8%	143	2.2%	332	17.2%	240	1.5%	174	2.4%
Hampton Township	4,893	1,155	4.5%	202	3.1%	98	5.1%	737	4.7%	348	4.8%
Hardyston Township	8,125	1,642	6.5%	322	5.0%	100	5.2%	925	5.9%	463	6.3%
Hopatcong Borough	14,362	2,003	7.9%	601	9.2%	339	17.6%	1,518	9.7%	631	8.6%
Lafayette Township	2,358	511	2.0%	170	2.6%	33	1.7%	253	1.6%	200	2.7%
Montague Township	3,792	843	3.3%	211	3.2%	82	4.3%	395	2.5%	176	2.4%
Newton Town	8,374	1,787	7.0%	261	4.0%	203	10.6%	1,196	7.6%	733	10.0%
Ogdensburg Borough	2,258	374	1.5%	72	1.1%	41	2.1%	194	1.2%	127	1.7%
Sandyston Township	1,977	319	1.3%	110	1.7%	0	0.0%	225	1.4%	76	1.0%
Sparta Township	19,600	2,622	10.3%	1,160	17.8%	134	7.0%	1,550	9.9%	754	10.3%
Stanhope Borough	3,526	484	1.9%	225	3.5%	0	0.0%	304	1.9%	30	0.4%
Stillwater Township	4,004	1,037	4.1%	97	1.5%	0	0.0%	555	3.5%	274	3.7%
Sussex Borough	2,024	298	1.2%	87	1.3%	8	0.4%	348	2.2%	365	5.0%
Vernon Township	22,358	3,687	14.5%	992	15.3%	95	4.9%	2,318	14.8%	877	12.0%
Walpack Township	7	7	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Wantage Township	10,811	1,954	7.7%	374	5.8%	105	5.5%	1,490	9.5%	822	11.2%
Sussex County	**144,221**	**25,451**	**100.0%**	**6,500**	**100.0%**	**1,922**	**100.0%**	**15,697**	**100.0%**	**7,320**	**100.0%**

Source: U.S. Census Bureau 2020 Decennial Total Population; U.S. Census Bureau 2021 ACS Vulnerable Population Totals
Note: Persons per household = 2.57. Number used to calculate Non-English Speaking population.

Figure 3-9. Socially Vulnerable Populations in Sussex County



Age

Children are considered vulnerable to hazard events because they are dependent on others to safely access resources during emergencies and may experience increased health risks from hazard exposure. Older people are more likely to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences. Those living on their own may have more difficulty evacuating their homes. Older people are more likely to live in senior care and living facilities where emergency preparedness occurs at the discretion of facility operators.

According to the 2021 American Community Survey 5-Year Estimates, the median age in Sussex County was 44.9 years. The 2021 American Community Survey reports 4.5 percent of the population of Sussex County is under the age of 5 and 17.6 percent is 65 or older.

Income

Economically disadvantaged populations are more vulnerable because they may not have funds to evacuate during a hazard event. The U.S. Census Bureau identifies households with two adults and two children with an annual household income below $25,926 per year as *low income* (Census 2021). The 2021 American Community Survey 5-Year Estimates indicates that 5.07 percent of persons live below the poverty level within the County.

The spatial U.S. Census data for household income provided in Hazus includes two income ranges (less than $10,000 per year and $10,000 to $20,000 per year) that were totaled to provide the low-income data used in this study. This does not correspond exactly with the poverty thresholds based on U.S. Census Bureau data, but the difference is not believed to be significant for the purposes of this planning effort.

While the poverty threshold is typically used as a standard for identifying low-income populations, some households above the poverty threshold still struggle financially, making them socially vulnerable to hazard events. Therefore, this HMP also considers data available from United for ALICE (ALICE stands for Asset Limited, Income Constrained, Employed). This dataset identifies households with income above the federal poverty threshold but below the basic cost of living. It represents the growing number of families who are unable to afford the basics of housing, childcare, food, transportation, health care, and technology (United For ALICE 2024). Costs associated with hazard events could exceed the financial capacity of these households, making them highly vulnerable to hazard events. According to 2021 point-in-time-data from ALICE, 21 percent of households in Sussex County are ALICE households (compared to the state average of 26 percent). Table 3-8 presents ALICE data by jurisdiction.

People With Disabilities

A disability is any impairment of the body or mind that makes it more difficult for the person with the condition to do certain activities and interact with the world around them (CDC 2024) Cognitive impairments can increase the level of difficulty that individuals might face during an emergency and reduce an individual's capacity to receive, process, and respond to emergency information or warnings. Individuals with a physical or sensory disability can face issues of mobility, sight, hearing, or reliance on specialized medical equipment. According to the 2021 American Community Survey 5-Year Estimates, 15,697 residents in Sussex County are living with a disability. This includes individuals with hearing, vision, cognitive, ambulatory, self-care, and independent living difficulties.

Table 3-8. Sussex County ALICE Data

Name	% Below ALICE Threshold	# of Households Below ALICE
Andover Borough	42%	119
Andover Township	25%	530
Branchville Borough	28%	90
Byram Township	19%	555
Frankford Township	21%	422
Franklin Borough	40%	880
Fredon Township	18%	201
Green Township	14%	172
Hamburg Borough	38%	529
Hampton Township	31%	608
Hardyston Township	27%	906
Hopatcong Borough	23%	1,301
Lafayette Township	23%	193
Montague Township	33%	490
Newton Town	44%	1,597
Ogdensburg Borough	25%	207
Sandyston Township	24%	179
Sparta Township	16%	1,121
Stanhope Borough	24%	302
Stillwater Township	25%	394
Sussex Borough	48%	383
Vernon Township	21%	1,833
Walpack Township	Unavailable	Unavailable
Wantage Township	36%	1,416
Sussex County	**21%**	**14,428**

Source: United For ALICE 2024

Non-English Speakers

Individuals who lack a working proficiency in English are vulnerable because they can have difficulty with understanding information being conveyed to them. Cultural differences also can add complexity to how information is being conveyed to populations with limited proficiency of English. According to the 2021 American Community Survey 5-Year Estimates, 14,191 individuals over the age of 5 primarily speak a language other than English at home; within that group 3,808 individuals are reported as speaking English "less than very well." Of the population speaking a language other than English at home, 7,306 speak Spanish, 1,500 speak Asian and Pacific Island languages, and 4,637 percent speak other Indo-European languages.

Social Vulnerability Index

The U.S. Centers for Disease Control and Prevention (CDC) Social Vulnerability Index ranks counties and U.S. Census tracts on socioeconomic status, household composition and disability, minority status and language, and housing and transportation. Sussex County's overall score for 2022 is 0.0458, indicating a low level of social vulnerability (CDC 2020). Only one census tract in the County, near the Town of Newton, has a high vulnerability, indicating that some residents may not have enough resources to respond to hazard events.

3.6 ECONOMY

3.6.1 Major Institutions

Sussex County has evolved from its early agricultural and milling start and now has an economy that features health and wellness, hospitality, and educational institutions. The County is a travel destination, with major resorts such as the Mountain Creek and Crystal Springs resorts. Furthermore, the County is home to two higher education institutions: the Sussex County Community College and Sussex County Technical School.

3.6.2 Employment

The U.S. Census Bureau's County Business Pattern provides an annual series of economic data by industry covering the majority of the country's economic activity. According to the 2021 Sussex County Business Pattern, the county had 3,133 business establishments providing more than $1.5 million in payroll. Three industries dominate private employment in the County: health care & social assistance (9,372 people), retail trade (9,357 people), and educational services (8,694 people) (U.S. Census 2021). Table 3-9 summarizes labor force and employment data for Sussex County between 2020 and 2023.

Table 3-9. Sussex County Labor Force Estimates, 2020-2023

Year	Sussex County				New Jersey Unemployment Rate
	Labor Force	Employment	Unemployment	Unemployment Rate	
2020	76,200	69,300	6,900	9.0%	9.4%
2021	76,100	71,300	4,800	6.3%	6.7%
2022	77,600	74,600	3,000	3.9%	3.9%
2023	79,000	75,700	3,400	4.3%	4.4%

Source: NJ Department of Labor and Workforce Development 2024

Note: The COVID-19 Pandemic reached its height in 2020, which greatly impacted the unemployment rates in the county and state and nationwide.

3.6.3 Income

The median household income in the County, according to the 2021 ACS 5-year estimates, was $111,308, which is above the state ($96,341) and national ($74,755) figures. Table 3-10 shows County, state, and national median household incomes between 2018 and 2022, as calculated by the U.S. Census Bureau.

3.6.4 Economic Trends

Sussex County originally developed as an agricultural, mining and manufacturing area and later as an area for summer recreation. For much of the last 50 years, the County's growth has been due to the automobile-driven suburbanization fueled by the migration of the middle-class population from New York City and New Jersey's urban centers. This migration led Sussex County to experience the highest rate of population growth of any county in the 13-county North Jersey region, with the population increasing 320% between 1950 and 2000. However, recent evidence suggests that the 50-year period of growth has ended. These changing patterns will continue to contribute to changing economic dynamics for the County (Sussex County 2014).

Table 3-10. Sussex County Median Household Income, 2018-2022

Year	Sussex County Median Household Income	New Jersey Median Household Income	National Median Household Income
2018	$92,284	$81,777	$61,937
2019	$100,281	$85,786	$65,712
2020	$92,739	$87,095	$67,340
2021	$99,695	$89,227	$69,717
2022	$111,308	$96,341	$74,755

Source: U.S. Census 2023

3.7 GENERAL BUILDING STOCK

3.7.1 Existing Development

For the purposes of this plan, 71,937 structures were identified from available tax data and spatial data. These structures account for a replacement cost value (RCV) of $68.5 billion. This total includes $38.9 billion for replacement of building structures and $29.5 billion for replacement of content. Residential buildings account for 86.8 percent of the total number of buildings in the County and 43.9 percent of the total building stock value. Table 3-11 presents building stock statistics by occupancy class for Sussex County.

According to 2020 Census data, 55,915 households are located in Sussex County. A household includes all the people who occupy a housing unit as their usual residence. The Census data identified 62,709 housing units in the county. A housing unit is a house, apartment, mobile home or trailer, a group of rooms, or a single room occupied as separate living quarters (or if vacant, intended for occupancy as separate living quarters). According to the 2020 Census, there are 6,794 vacant housing units in the County (U.S. Census 2020).

Figure 3-10 through Figure 3-12 show the distribution of value density for residential, commercial, and industrial buildings in Sussex County. Value density is the dollar value of structures per unit area, including building content value. The densities are shown in units of $1,000 per square mile. Value distribution maps can assist communities in visualizing areas of high loss potential and in evaluating aspects of the study area in relation to hazard risks.

3.7.2 New Development

Sussex County examined recent development over the last 5 years and anticipated new development in the next 5 years. Each Planning Partner provided a list by address of major development that has taken place within these timeframes. Identifying these changes and integrating new development into the risk assessment provides communities information to consider when developing a mitigation strategy to reduce hazard vulnerabilities in the future. Figure 3-13 shows the major development projects in 2019, 2020, 2021, 2022, and 2023. Individual development projects are detailed in Volume II in each jurisdictional annex.

An analysis was conducted to determine hazard exposure of these development sites. Projects built on multiple parcels were assessed as one unit. If one parcel identified within the project boundary intersected a spatial hazard layer, the entire project was considered “exposed” to the hazard area of concern.

Table 3-11. Building Stock Count and Replacement Cost Value by Occupancy Class

Jurisdiction	Residential		Commercial		Industrial		Other[a]	
	Building Count	Total RCV	Building Count	Total RCV	Building Count	Total RCV	Building Count	Total RCV
Andover Borough	234	$142,263,689	69	$498,237,303	2	$2,017,529	21	$51,089,264
Andover Township	2,146	$1,245,225,989	157	$2,039,145,588	14	$71,509,962	260	$657,011,182
Branchville Borough	339	$155,612,477	71	$379,204,591	1	$27,822,150	15	$35,748,807
Byram Township	3,345	$1,483,046,989	111	$1,356,919,630	2	$4,451,182	218	$317,726,421
Frankford Township	2,779	$1,484,519,098	179	$893,680,202	6	$30,961,282	565	$1,082,632,420
Franklin Borough	1,807	$903,170,006	166	$1,015,308,039	10	$82,537,735	75	$226,961,358
Fredon Township	1,215	$734,104,099	43	$96,238,972	6	$46,009,669	351	$666,070,175
Green Township	1,376	$980,692,255	29	$141,599,251	4	$96,523,717	288	$602,767,644
Hamburg Borough	1,473	$598,295,772	94	$918,837,503	8	$103,211,784	18	$188,890,852
Hampton Township	2,307	$1,081,973,396	104	$664,961,317	1	$8,158,893	349	$718,930,004
Hardyston Township	3,963	$1,780,399,976	190	$1,283,877,956	19	$116,665,959	229	$500,514,731
Hopatcong Borough	7,643	$2,401,316,005	184	$702,463,546	0	$0	177	$328,840,378
Lafayette Township	960	$627,400,911	98	$533,647,550	25	$73,543,576	380	$908,036,672
Montague Township	1,870	$790,954,372	94	$454,119,286	7	$16,027,928	204	$398,574,062
Newton Town	2,245	$1,685,402,594	286	$3,078,695,919	19	$284,072,385	126	$650,949,129
Ogdensburg Borough	910	$435,539,309	52	$392,012,851	0	$0	30	$126,857,443
Sandyston Township	1,093	$472,194,510	89	$312,853,723	7	$40,886,148	337	$524,137,122
Sparta Township	7,366	$3,993,793,883	427	$5,199,126,279	41	$234,946,801	293	$889,033,327
Stanhope Borough	1,448	$683,497,404	66	$268,451,804	7	$151,246,067	31	$125,558,353
Stillwater Township	1,978	$875,599,201	141	$218,518,520	0	$0	368	$517,491,054
Sussex Borough	554	$523,480,774	80	$1,466,945,703	6	$48,324,309	37	$148,341,398
Vernon Township	11,176	$4,561,668,158	402	$1,111,839,958	36	$128,880,414	425	$1,014,475,046
Walpack Township	11	$3,552,150	21	$15,836,396	0	$0	19	$48,627,166
Wantage Township	4,174	$2,430,988,341	192	$957,518,461	6	$13,327,010	1,137	$2,125,969,991
Sussex County (Total)	62,412	$30,074,691,358	3,345	$24,000,040,348	227	$1,581,124,500	5,953	$12,855,233,999

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; RS Means 2022

a. "Other" includes government, religion, agriculture, and education occupancies

Figure 3-10. Distribution of Residential Building Stock Value Density in Sussex County

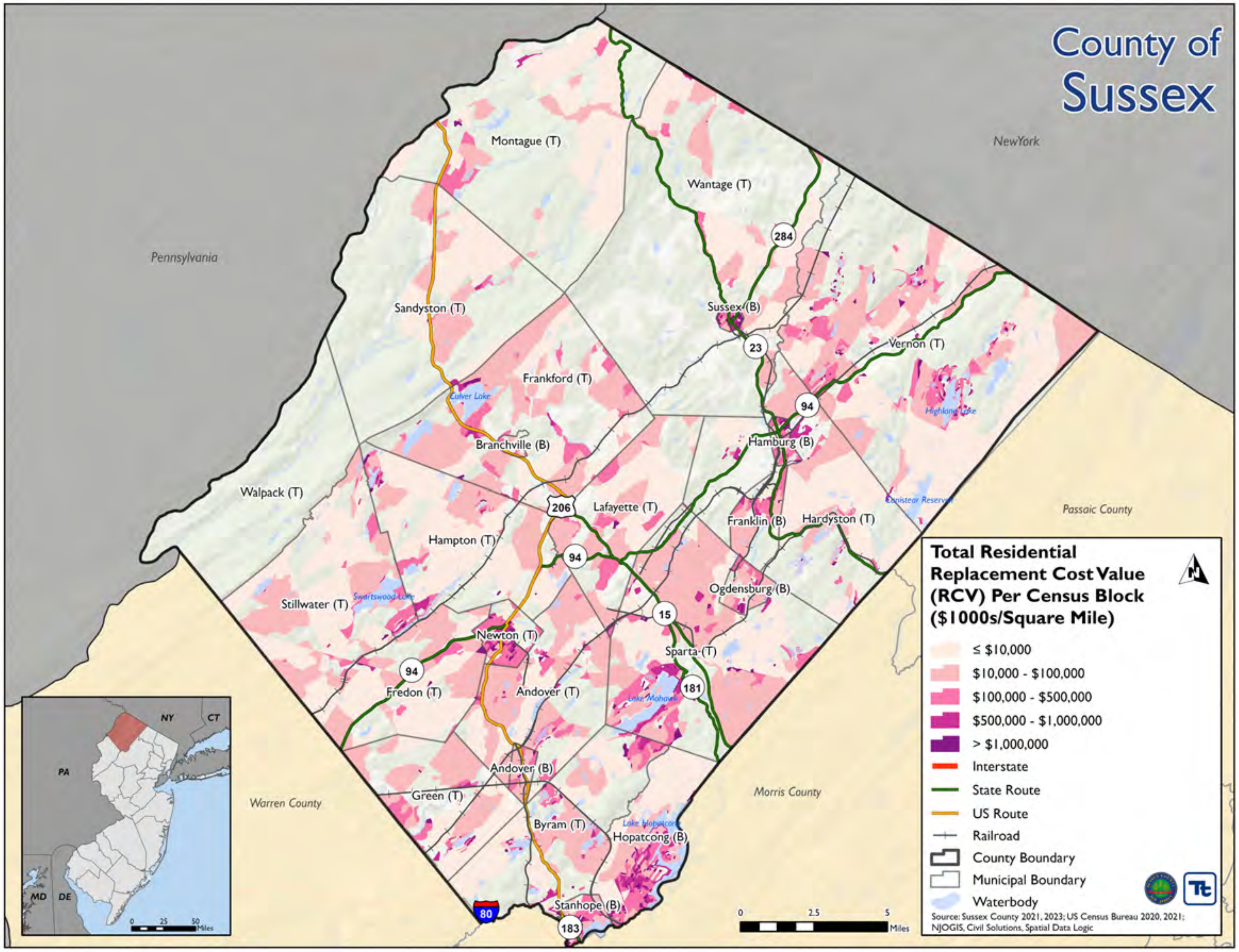


Figure 3-11. Distribution of Commercial Building Stock Value Density in Sussex County

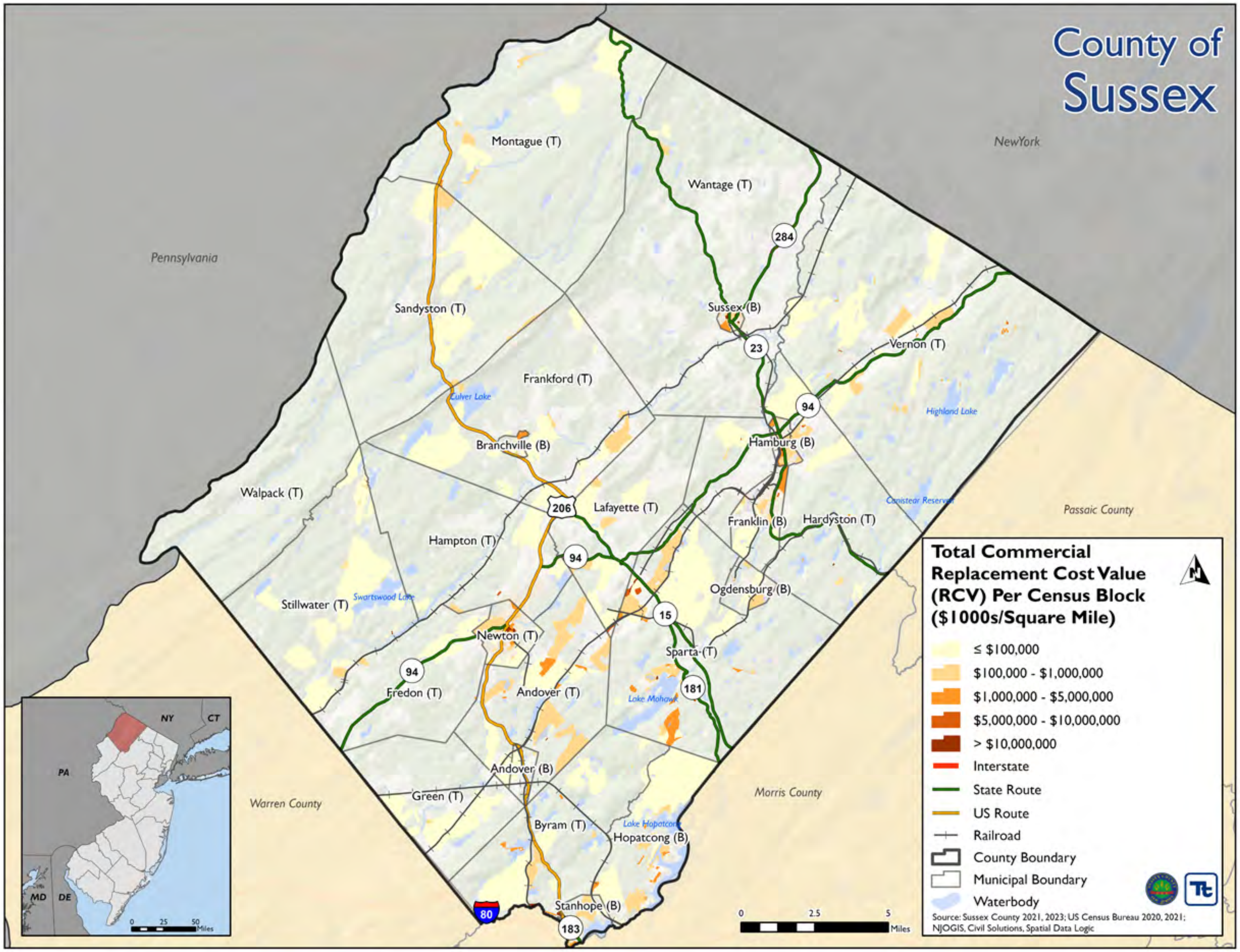


Figure 3-12. Distribution of Industrial Building Stock Value Density in Sussex County

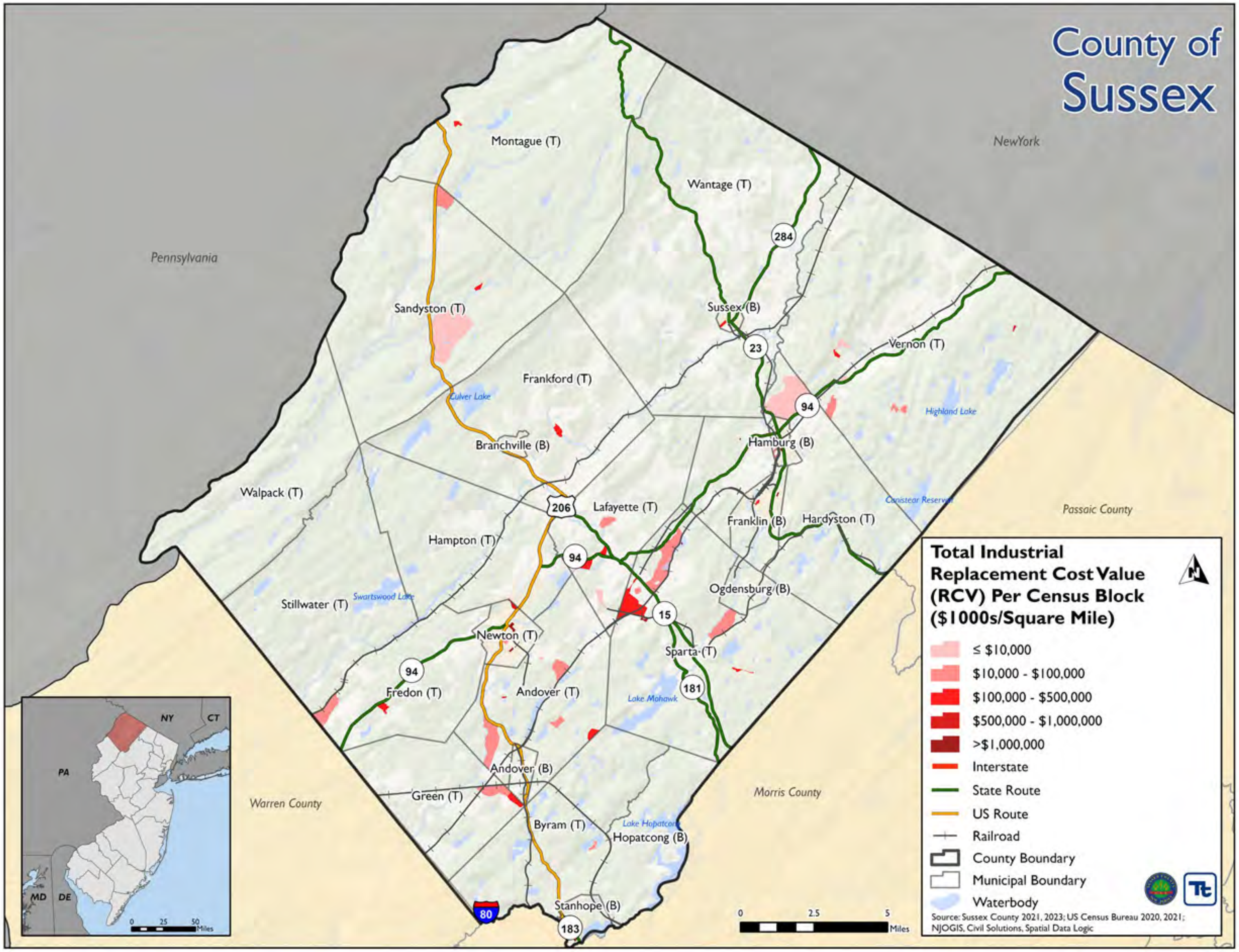
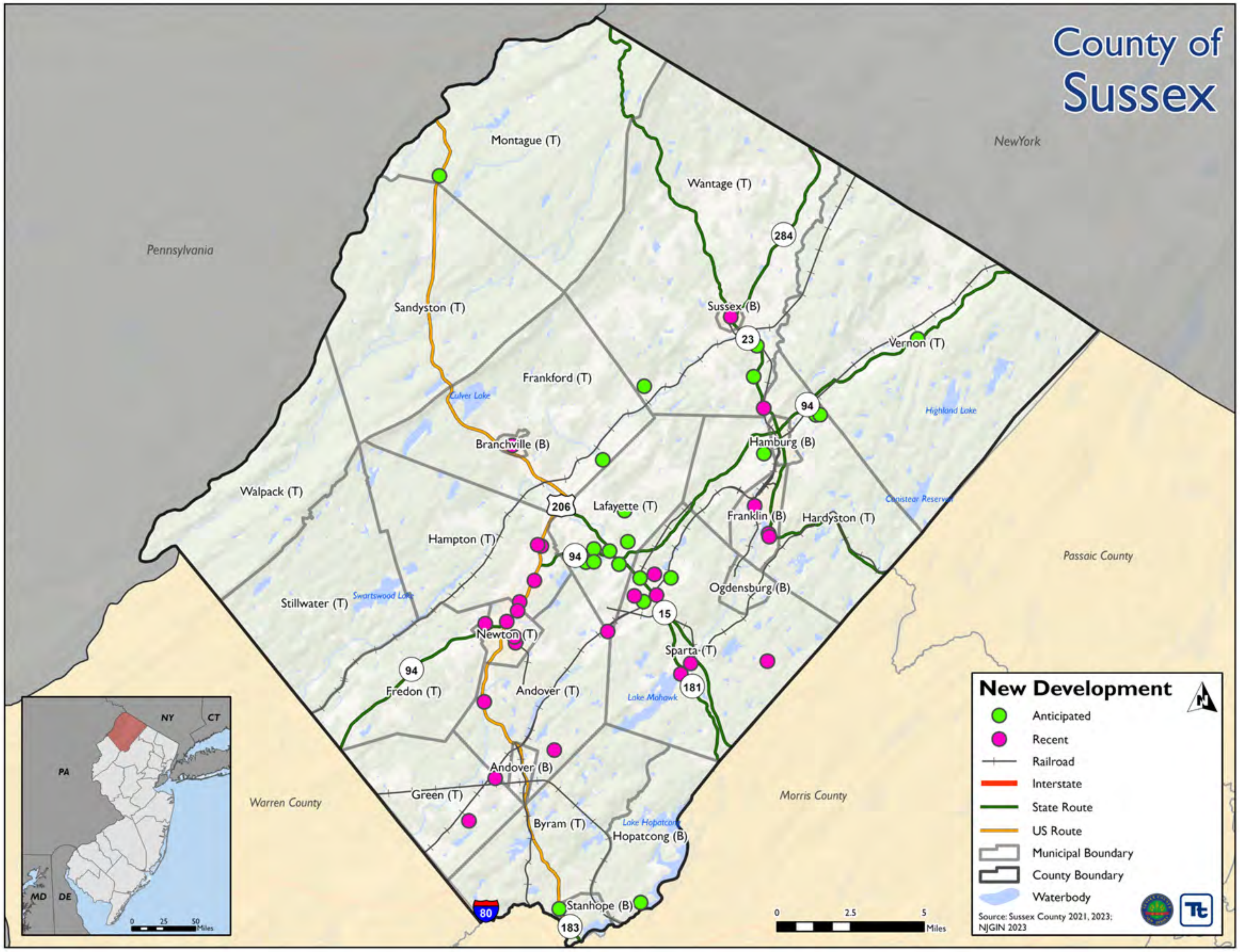


Figure 3-13. Sussex County New Development



3.8 COMMUNITY LIFELINES

Facilities that are essential to the health and welfare of the population and that maintain essential and emergency functions are designated as critical facilities. These typically include police and fire stations, schools, emergency operations centers, and infrastructure such as roads, bridges and utilities that provide water, electricity, and communications. Facilities that use or store hazardous materials are designated as critical facilities as well. All of these facilities are especially important after any hazard event (FEMA 1997).

FEMA defines some types of critical facilities, as well as public services or activities, as "community lifelines." Community lifelines provide the fundamental services in a community that, when stabilized, enable all other aspects of society. Following a disaster event, intervention is required to stabilize lifelines. FEMA defines eight categories of community lifelines as summarized in Table 3-12.

A comprehensive inventory of community lifelines in Sussex County was developed from various sources, including input from the Steering Committee and Planning Partnership. The following sections describe the inventory of community lifelines that was used for the risk assessment in this HMP. Although many lifeline facilities could fall within numerous categories, the lifeline facilities identified for this planning effort have been categorized according to their primary function.

3.8.1 Safety and Security

Figure 3-14 shows the location of safety and security facilities. Table 3-13 lists the number of each facility type.

Emergency Facilities

Sussex County has a highly coordinated and interconnected network of emergency facilities and services at the County and municipal level. The Sussex County Sheriff's Office Division of Emergency Management (DEM) serves as the primary coordinating agency between local, state, and federal agencies. In response to an emergency event, the Sussex County DEM will work with county and municipal health agencies, healthcare providers, emergency facilities, and first responders to provide aid to residents of the County.

The DEM develops, maintains, and executes Sussex County's Emergency Operations Plan for disaster relief before, during, and after any type of natural or human-caused disaster. The DEM also assists municipalities in preparing emergency response plans.

There are 44 fire department facilities in Sussex County. Law enforcement and public safety are maintained by the New Jersey State Police Department, Sussex County Sheriff's Office, and local police departments. In 2019, Sussex County and Morris County entered into a shared service agreement allowing for all Sussex County inmates to be housed at the Morris County Correctional Facility. The Sussex County Bureau of Corrections personnel supervise inmates during transports for admission at the Morris County Correctional Facility, court hearings and medical appointments.

Table 3-12. FEMA-Defined Categories of Community Lifelines

Community Lifeline Category	Types of Facilities and Services Included
Safety and security	Law enforcement/security, fire service, search and rescue, government service, community safety
Food, hydration, shelter	Food, hydration, shelter, agriculture
Health and medical	Medical care, public health, patient movement, medical supply chain, fatality management
Energy	Power grid, fuel
Communications	Infrastructure, responder communications, alerts warnings and messages, finance, 911 and dispatch
Transportation	Highway/roadway/motor vehicle, mass transit, railway, aviation, maritime
Hazardous materials	Facilities, hazmat, pollutants, contaminants
Water systems	Potable water infrastructure, wastewater management

Figure 3-14. Safety and Security Community Lifelines In Sussex County

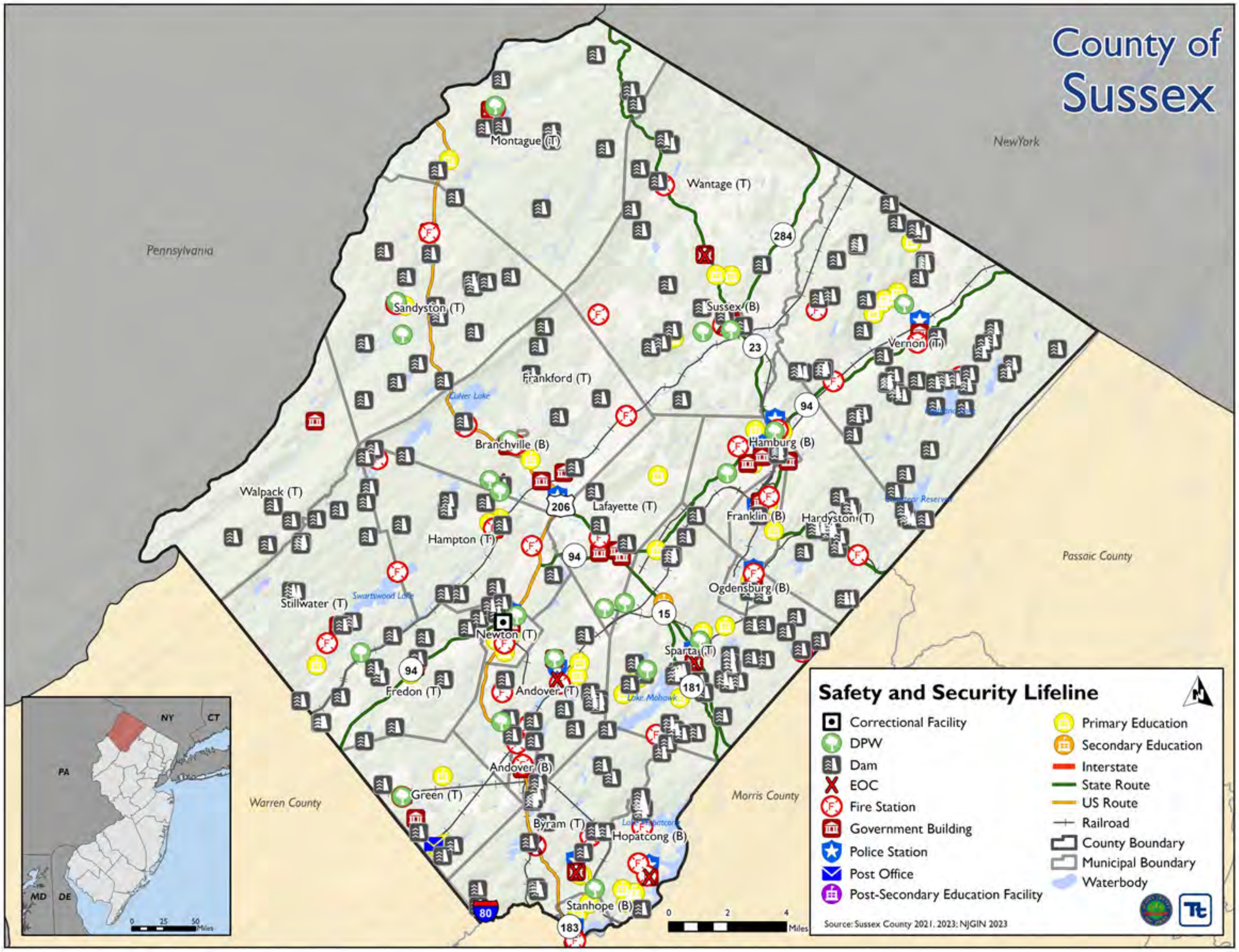


Table 3-13. Sussex County Safety and Security Community Lifelines

Facility Type	Number of Facilities
Correctional Facility	1
Dam	239
Public Works Facility	21
Emergency Operations Center	9
Fire Station	44
Government Building	37
Police Station	12
Post Office	3
Post-Secondary Education Facility	1
Primary Education	51
Secondary Education	3
Total	**421**

Note: This table may not include all facilities in the County. Some facilities may have been missed in the data collection process.

Dams

Table 3-14 lists the number of dams in Sussex County by hazard class, as identified in the U.S. Army Corps of Engineers (USACE) National Inventory of Dams.

Table 3-14. Dams in Sussex County

	Definition	Number of Dams in Sussex County
Class I	High-Hazard Potential—Failure of the dam may result in probable loss of life and/or extensive property damage	40
Class II	Significant-Hazard Potential—Failure of the dam may result in significant property damage; however, loss of life is not envisioned.	39
Class III	Low-Hazard Potential—Failure of the dam is not expected to result in loss of life and/or significant property damage.	60
Class IV	Small-Dam Low-Hazard Potential—Failure of the dam is not expected to result in loss of life or significant property damage.	0
Total		139

Source: USACE 2023

a. Class definitions per NJDEP

Schools

More than 50 schools, ranging from elementary to post-secondary education, service the County. Several municipalities have their own school systems, and others are serviced by regional school districts. The primary higher education school in Sussex County is Sussex County Community College in Newton. In times of need, schools can function as shelters and are an important resource to the community.

3.8.2 Food, Hydration, Shelter

Figure 3-15 shows the location of food, hydration, and shelter facilities in Sussex County. Table 3-15 lists the number of each facility type.

Table 3-15. Sussex County Food, Hydration, Shelter Community Lifelines

Facility Type	Number of Facilities
Food Pantry	7
Shelter	29
Total	**36**

Note: This table may not include all facilities in the County. Some facilities may have been missed in the data collection process.

Shelters

Sussex County has 29 sheltering facilities, many of which are schools. With support of the American Red Cross and local jurisdictions, the County maintains an inventory of suitable shelter locations and can assist with the coordination of shelter availability as necessitated by local emergency operation plans. County-wide sheltering policies and procedures are documented in the following plans, which are maintained by the Sussex County DEM:

- Sussex County Emergency Operations Plan
- Sussex County Emergency Operations Plan, Mass Sheltering Plan Annex

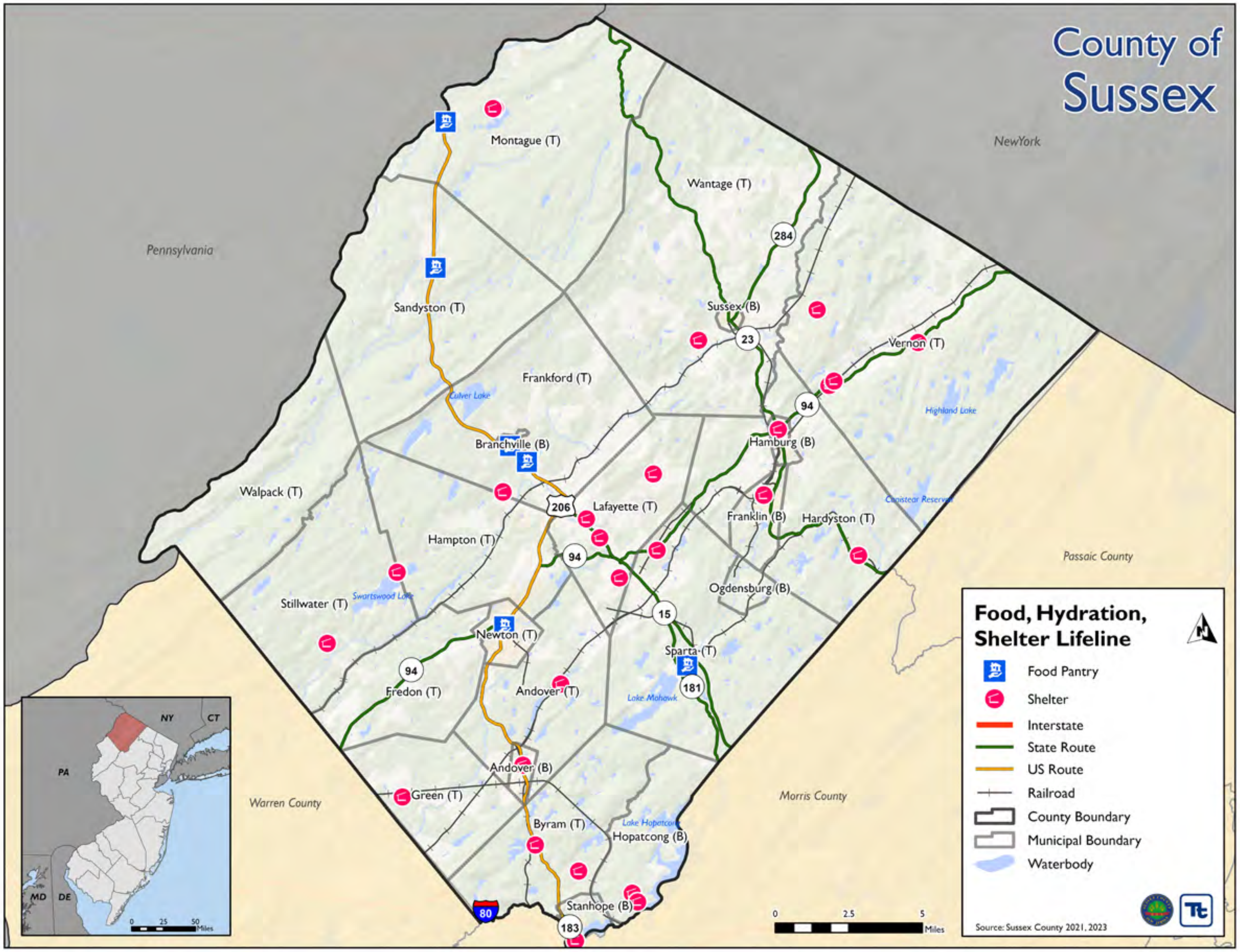
Support Agencies for Socially Vulnerable Populations

Sussex County and partnering agencies offer assistance to socially vulnerable populations and underserved communities. The list below identifies relevant programs and agencies (Sussex County n.d.).

- Adult Protective Services
- Advance Housing, Inc.
- AMTRAK - Office of AMTRAK Access
- Assisted Transportation
- Assurance Wireless
- Birth Haven
- Bridgeway Rehabilitation Services
- Bridging Health & Human Services
- Byram Senior Transportation
- Capitol Care
- Catastrophic Illness in Children Relief Fund
- Catholic Charities – SSVF (Supportive Service for Veteran Families)
- Family Partners of Morris/Sussex
- Family Promise of Sussex County
- Food Bank
- Ginnie’s House, Sussex County Children’s Advocacy Center
- Greyhound Customers with Disabilities Travel Assistance Line
- Hopatcong Senior Transportation
- Hope and Serenity Recovery Community Center
- Intensive Family Support Services of Sussex County
- KEEP, Inc.
- Kinship Navigator/Kinship Care
- Legal Services of New Jersey
- Legal Services of New Jersey Hotline
- Office of Special Education Programs
- Pass it Along
- Pathstone Senior Community Service Employment Program
- Pathways 2 Prosperity
- People Help of Sussex County
- PerformCare
- Project Child Find
- Project Self-Sufficiency
- Residential Recovery Program
- Safe Haven
- Samaritan Inn, Inc.
- SEPTA (Pennsylvania)

- Center for Evaluation and Counseling
- Center for Prevention & Counseling
- Child & Family Resource Services
- Community Health Law Project - North Jersey Office
- Community Hope
- Community Justice Center
- Court Appointed Special Advocate (CASA)
- DASI - Domestic Violence & Sexual Assault Services
- DASI Cell Phone Program
- DASI Safe House
- DAWN Center for Independent Living (Denville)
- Daytop New Jersey
- Department of Community Affairs, Workforce 55+ Senior Citizen
- Department of Health (Division of HIV, STD and TB Services)
- Department of Health (Office of Minority and Multicultural Health)
- Division of Aging Services (PAAD & Senior Gold)
- Division of Child Protection and Permanency (formerly DYFS)
- Division of Family Health Services
- Division of Housing and Community Resources
- Division of Housing and Community Resources - Local Homeless Prevention
- Division on Civil Rights
- Early Head Start
- Energy Assistance Programs
- Equal Employment Opportunity Commission (EEOC)
- Family Intervention Services - A division of Center for Family Services
- Legal Services of Northwest Jersey
- LogistiCare Complaint Line
- LogistiCare Medicaid Transportation Services
- LogistiCare Where's my ride line
- Medicare.Gov
- Morris/Sussex/Warren Employment & Training Services
- MTA - New York (Accessible Transportation)
- NAMI-Sussex
- National Academy of Elder Law Attorneys, Inc.
- New Jersey Child Care Helpline
- New Jersey Higher Education Student Assistance Authority
- New Jersey Housing and Mortgage Finance Agency
- New Jersey Housing Resource Center
- New Jersey State Bar Association
- New Jersey State Parent Information & Resource Center
- New Jersey Task Force on Child Abuse and Neglect
- New Jersey's Specialized Child Study Team
- NewBridge Services
- Newton Medical Center
- Newton Medical Center Behavioral Health
- Newton Senior Shuttle
- NJ Find a Ride
- NJ Parent Link
- NJ TRANSIT
- NJ Transit Reduced Fare Program
- Skylands Ride
- Social Security Administration
- Sparta Senior Transportation
- Special Child Health Services,
- Special Supplemental Nutrition Program for Women, Infants and Children (WIC)
- Summit Oaks Hospital
- Sussex County Division of Senior Services
- Sussex County Office of the Public Defender
- Sussex County Probation Department
- Sussex County Prosecutor's Office
- Sussex County Public Health Nursing
- Sussex County Recovery Community Center
- Sussex County Surrogate
- Sussex Division of Social Services
- Today's Choice Pregnancy Resource Center
- United Way of Northern New Jersey
- U.S. Department of Justice, Civil Rights Division
- Veterans & Veteran Family Services
- Weatherization Assistance Program
- Women, Infants and Children Program - WIC
- YMCA
- Youth Advocate Program (YAP)
- Zufall Health Center

Figure 3-15. Food, Hydration, and Shelter Community Lifelines in Sussex County



3.8.3 Health and Medical

Sussex County has a dynamic health care industry that includes hospitals, adult day care centers, and long-term care facilities. The two major health centers in the County are Newton Memorial Hospital in the Town of Newton and Saint Claire's Hospital in Sussex Borough. Figure 3-16 shows the location of health and medical facilities. Table 3-16 lists the number of each facility type.

Table 3-16. Sussex County Health and Medical Community Lifelines

Facility Type	Number of Facilities
EMS	21
Medical Center	8
Total	**29**

Note: This table may not include all facilities in the County. Some facilities may have been missed in the data collection process.

3.8.4 Energy

Jersey Central Power & Light is the primary electric and gas utility company in Sussex County. Sussex Rural Electric Cooperative also provides electric to many of the communities. A portion of the Susquehanna-Roseland line, owned by Public Service Electric & Gas, runs through Fredon, Andover Township, Byram, and Hopatcong in southern Sussex County. Figure 3-17 shows the location of energy facilities. Table 3-17 lists the number of each facility type.

Table 3-17. Sussex County Energy Community Lifelines

Facility Type	Number of Facilities
Fuel	3
Public Solar Facility	41
Substation	9
Total	**53**

Note: This table may not include all facilities in the County. Some facilities may have been missed in the data collection process.

3.8.5 Communications

Figure 3-18 shows the location of communications facilities. Table 3-18 lists the number of each facility type.

Table 3-18. Sussex County Communication Community Lifelines

Facility Type	Number of Facilities
Communication Facility	5
Radio Tower	3
Total	**8**

Note: This table may not include all facilities in the County. Some facilities may have been missed in the data collection process.

Figure 3-16. Health and Medical Community Lifelines in Sussex County

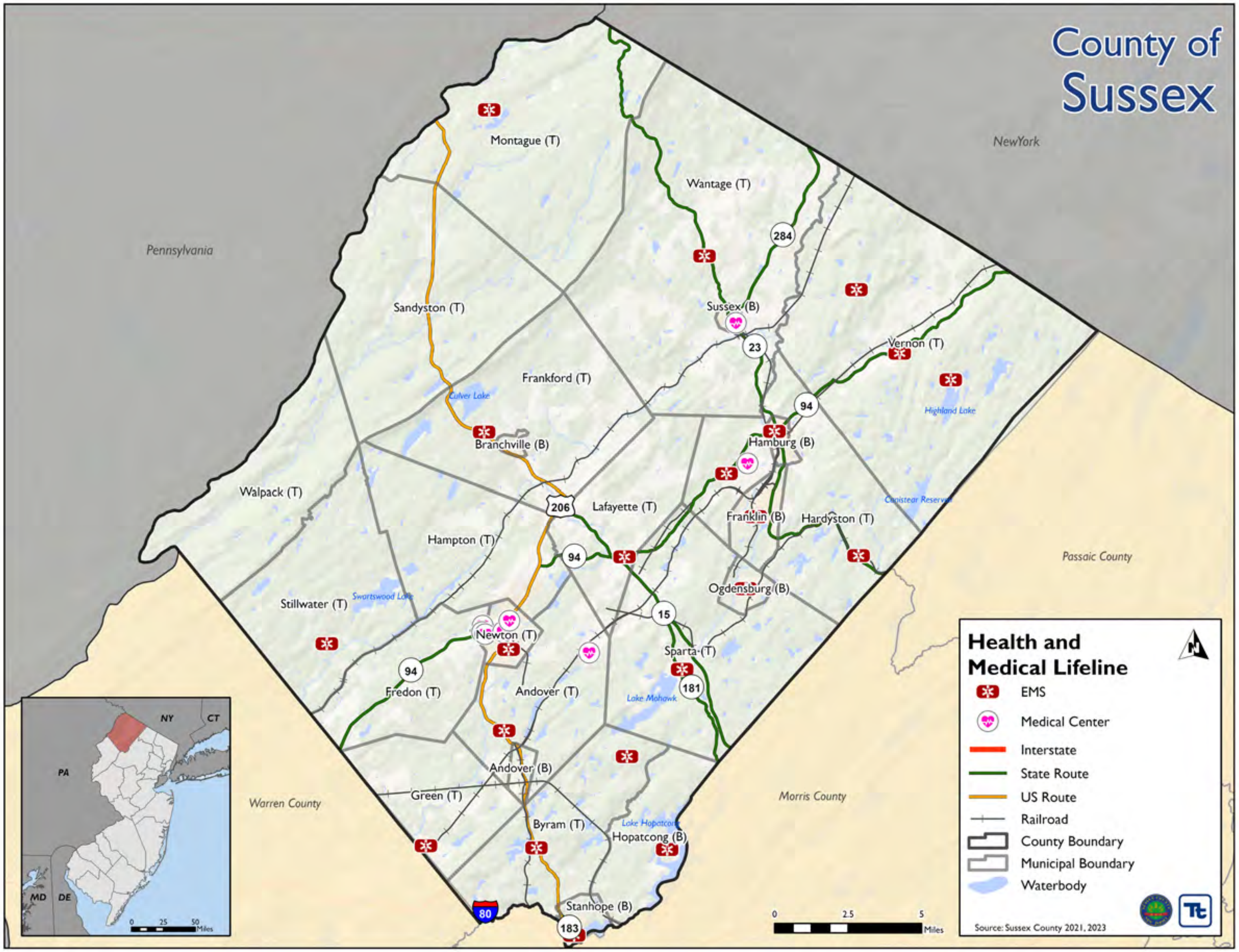


Figure 3-17. Energy Community Lifelines in Sussex County

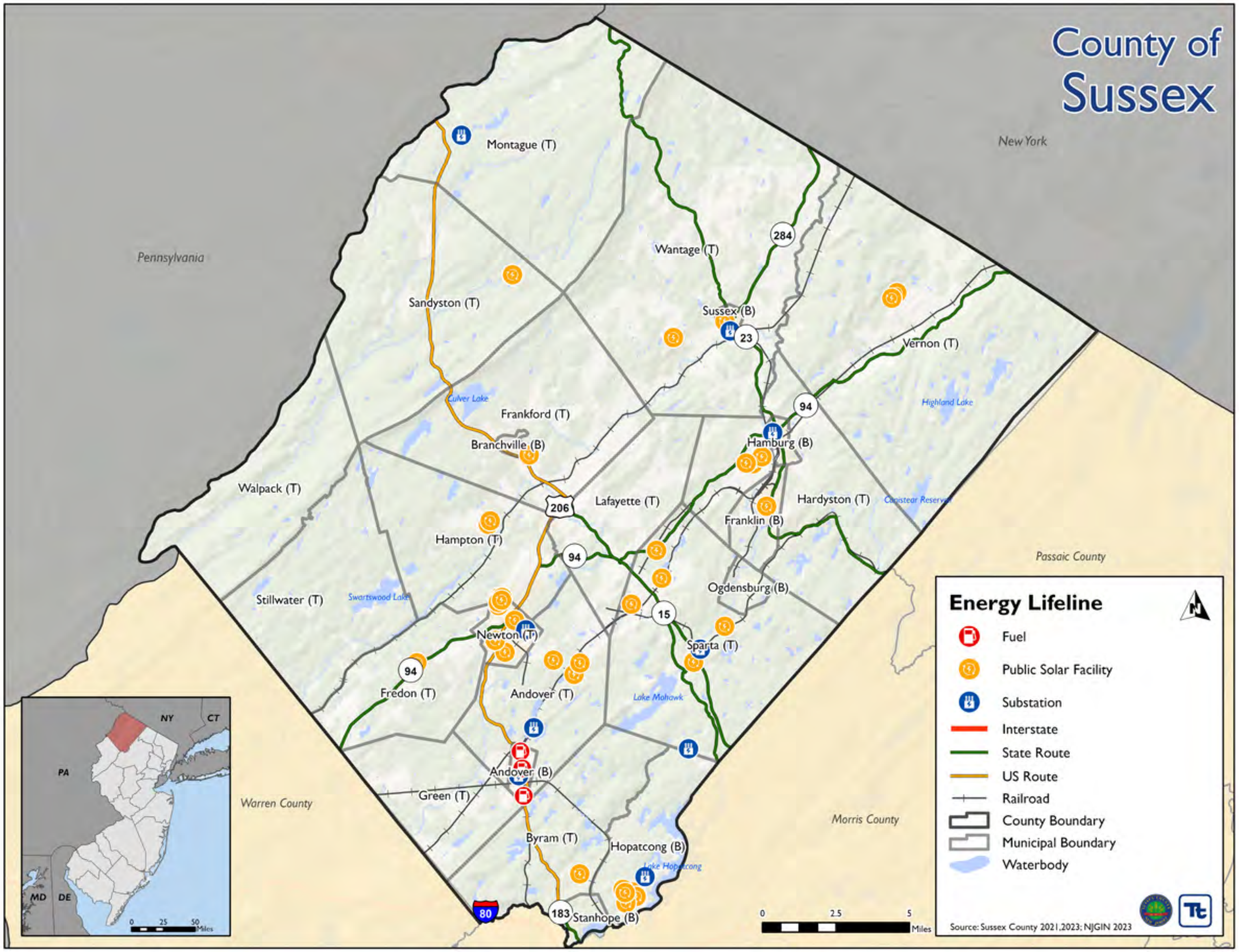
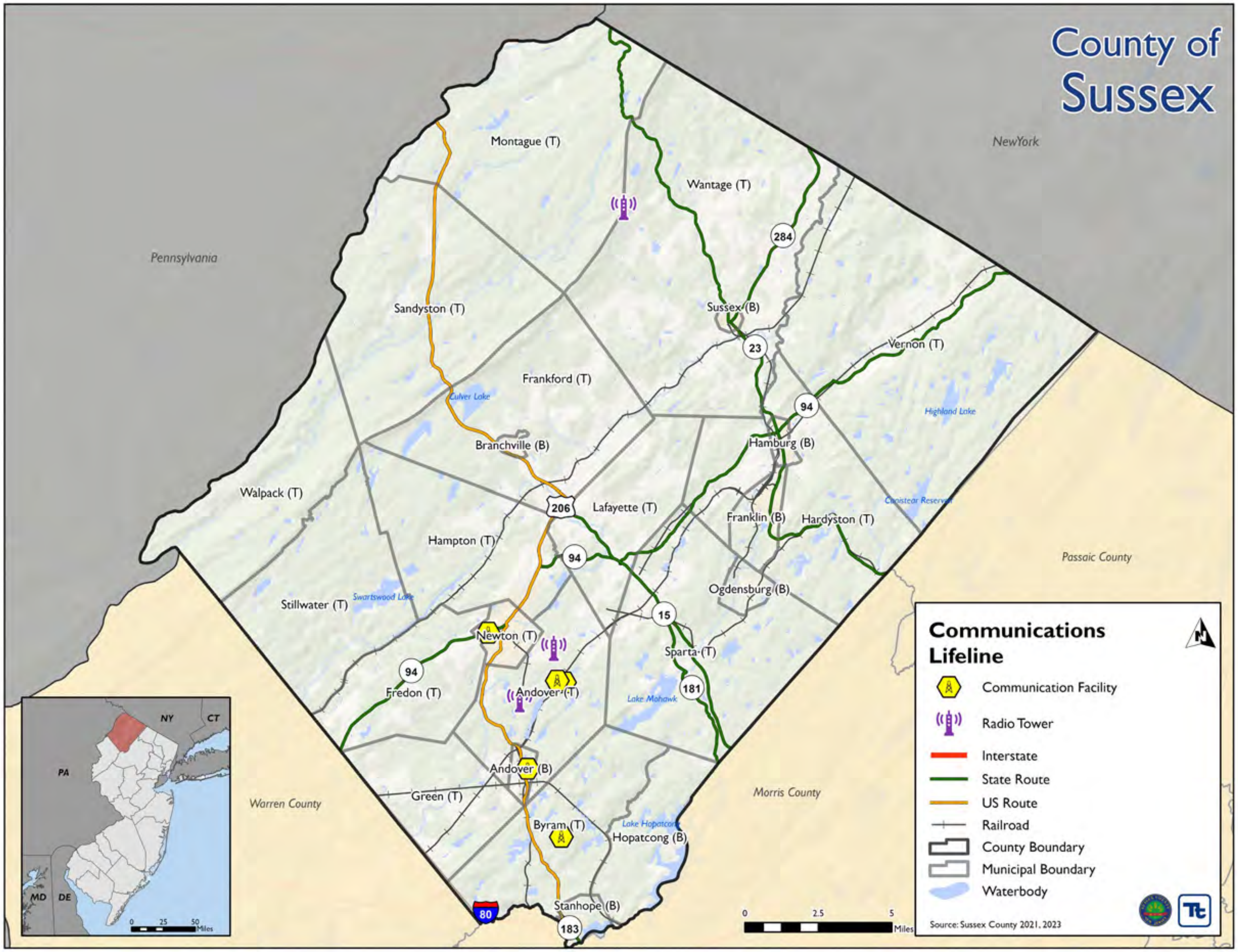


Figure 3-18. Communications Community Lifelines in Sussex County



Emergency Warnings and Responder Communications

Sussex County DEM operates an emergency operations center in the Borough of Branchville, which is a specially designed facility where public organizations and private-sector agencies meet to decide and coordinate emergency response to community-wide disasters. Additionally, the Sheriff's Department operates a 24-hour 9-1-1 center. The communications center provides regular dispatch services for the sheriff's office and serves as a public-safety answering point for enhanced 911 calls. The center serves 13 municipalities with 911 answering/emergency dispatch service.

Communications

Sussex County is served by a variety of communications systems, including traditional land line, fiber optic, and cellular service provided by multiple companies, such as Verizon, Direct TV, Comcast, and AT&T. Each carrier has individual plans for emergency situations during hazard events and post-disaster recovery efforts. Sussex County has an extensive radio communications network that is utilized by emergency services agencies, hospitals, law enforcement, public works, transportation, and other supporting organizations.

3.8.6 Transportation

Figure 3-19 shows the location of transportation facilities in Sussex County. Table 3-19 lists the number of each facility type. In 2020, an estimated 11.9 million tons of domestic freight moved into, out of, or within Sussex County, by all modes of transportation (truck, rail, pipeline, water, and air). For domestic freight traveling to, from, or within Sussex County, 97 percent travels by truck, 2 percent by rail, and 1 percent by other modes (NJTPA 2020).

Table 3-19. Sussex County Transportation Community Lifelines

Facility Type	Number of Facilities
Airport	2
Total	**2**

Note: This table may not include all facilities in the County. Some facilities may have been missed in the data collection process.

Highway, Roadways, and Associated Systems

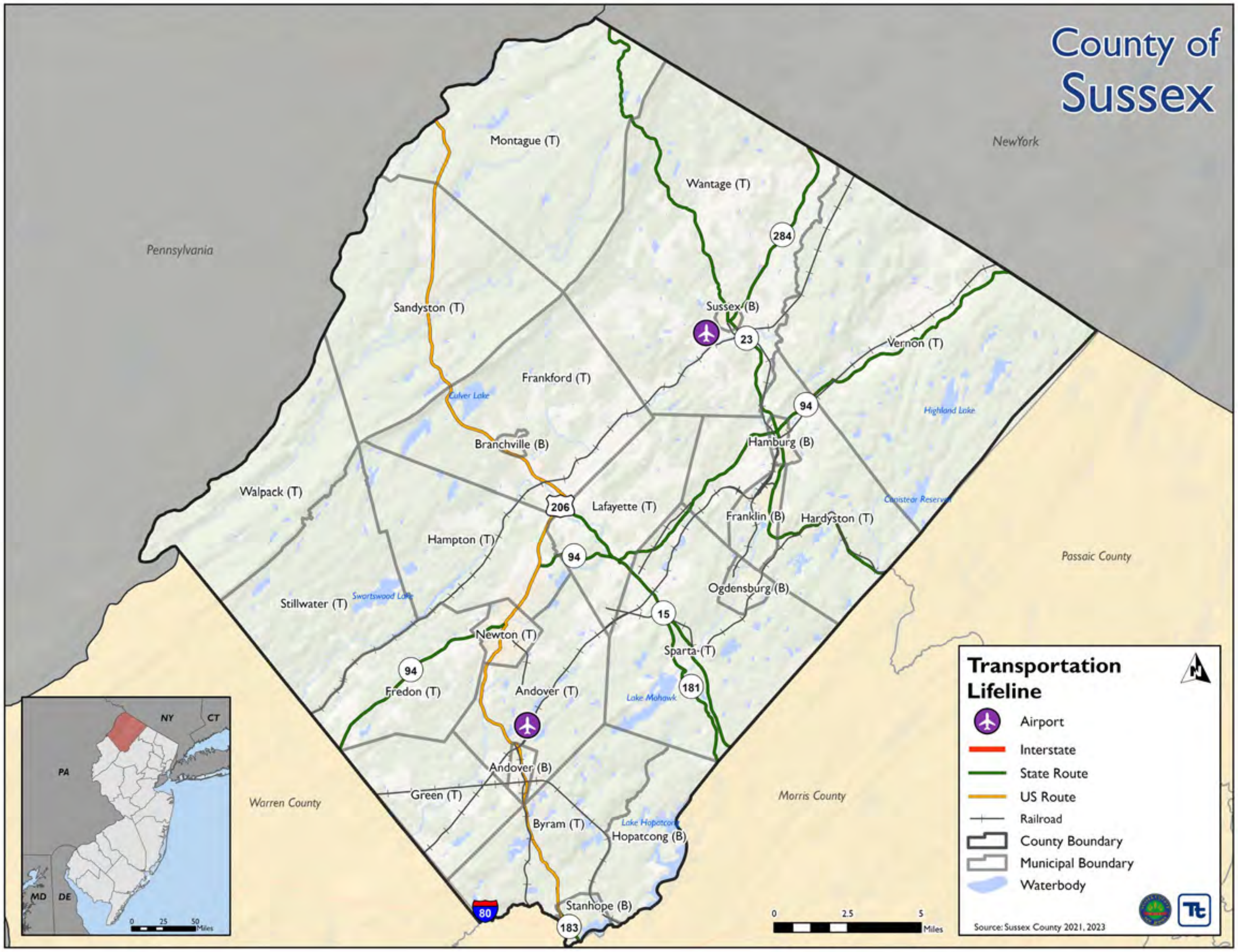
Interstate 80, State Routes (SR) 15, 23, 94, 181, and 284, and U.S. Route 206 are all major highways in Sussex County. Heavily traversed County roads include County Routes (CR) 605, 607, 611, 613, 616, 617, 620, 622, 629, 650, 661, and 669. Many of the County roads connect to state or U.S. routes, including CR 602 to U.S. 206, CR 616 to SR 94, CR 661 to SR 15, and CR 650 to SR 23 (NJ DOT 2017).

There are 1,417 miles of roadway in Sussex County—911 miles are maintained by local municipalities, 311 miles are maintained by Sussex County, 111 miles are maintained by the New Jersey Department of Transportation, 70 miles are maintained by a state or local park services, and 13 miles are maintained by a federal agency. The County Division of Public Works Office of Roads is responsible for the county-owned highways (NJ DOT 2022).

Evacuation Routes

The County has identified evacuation routes for severe weather and can assist with the coordination and communication of evacuation routing as necessitated by the execution of local emergency operation plans.

Figure 3-19. Transportation Community Lifelines in Sussex County



Bus and Other Transit Facilities

Transportation services provided by the County are offered through the Sussex County Skylands Ride program. Skylands Ride provides deviated fixed route, demand response, and assisted transportation services, as described below (Sussex County 2021, Sussex County n.d.):

- Assisted transportation
  - Target population is senior citizens ages 60 and over
  - Transportation services available Monday through Friday in Sussex County
  - Services include medical transportation, shopping and vital errands for seniors who require a higher level of assistance and meet eligibility criteria
- Employment transportation
  - Demand-response bus service to and from work, training and post-secondary education for the general public including senior citizens and people with disabilities
  - Alternative for all commuters not served by regularly scheduled public transit
  - In-County trips
  - Monday – Friday, 5:30 a.m. – 6 p.m.
  - Fully accessible fleet, all lift-equipped
- Veterans
  - Service available Thursdays, excluding County holidays
  - Trips provided for medical appointments to out-of-county Veterans Administration facilities (East Orange, Morristown and Lyons, NJ, Castle Point, NY) and state veteran services offices
  - Available to Sussex County veterans with a minimum of 90 days of active U. S. military service
  - Fully accessible fleet, all lift-equipped
- Hardyston and Vernon paratransit service
  - Service available Monday – Friday, excluding County holidays
  - Service area includes intra-county, and out-of-county
  - Target populations are senior citizens age 60+ and persons with disabilities of any age
  - Trip destinations include senior center and nutrition sites, shopping, medical appointments, community services, and other local errands
  - Fully accessible fleet, all lift-equipped

Railroad Facilities

Passenger rail service does not enter Sussex County; residents travel to Morris and Warren Counties to use rail service. However, the Lackawanna Cut-Off, formerly a portion of the Delaware, Lackawanna, and Western Railroad system, is being restored to provide passenger rail service between Port Morris Junction (Roxbury Township, Morris County) and Andover Township (USDOT, NJ TRANSIT, USACE 2008).The County maintains a freight rail that is operated by regional and short line railroads.

Airports

There are two airports in Sussex County. The Aero-Flex Airport is owned by the New Jersey Forest Fire Service as a base for aerial firefighting. The Sussex Airport is a small public use airport, which can be used for private events, skydiving activities, or operational procedures.

3.8.7 Hazardous Materials

Figure 3-20 shows the location of hazardous material facilities. Table 3-20 lists the number of each facility type.

Table 3-20. Sussex County Hazardous Materials Community Lifelines

Facility Type	Number of Facilities
Hazardous Material Facility	21
Solid Hazardous Waste Facility	6
Total	**27**

Note: This table may not include all facilities in the County. Some facilities may have been missed in the data collection process.

Hazardous Materials Facilities

Abandoned hazardous waste sites on the U.S. Environmental Protection Agency's (EPA's) National Priorities List (NPL) are those that the EPA has determined present "a significant risk to human health or the environment." These sites ae eligible for remediation under the Superfund Trust Fund Program. Superfund sites are polluted locations requiring a long-term response to clean up hazardous material contaminations. The EPA's Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) reports that Sussex County has 10 Superfund sites. Three of these are on the NPL, located in Sparta Township, Byram Township, and Franklin Borough (EPA 2023, CERCLIS 2021).

The biennial EPA Hazardous Waste Report collects data on the generation, management, and minimization of hazardous waste. This report details data on the generation of hazardous waste from large quantity generators and data on waste management practices from treatment, storage, and disposal facilities. The 2021 biennial report lists seven facilities in Sussex County (EPA 2023).

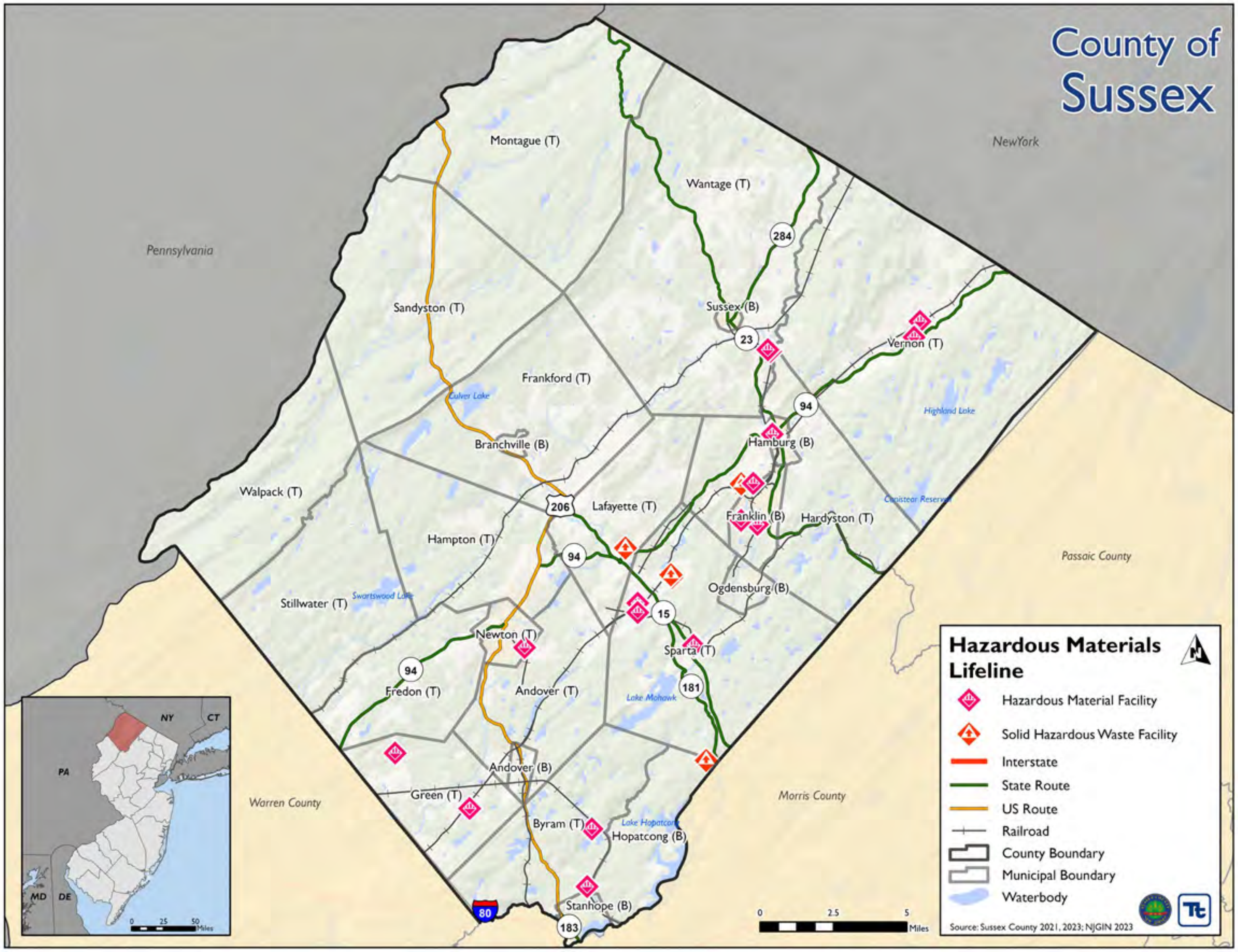
Nuclear Facilities

Although there are no nuclear facilities within Sussex County limits, the County is within 50 miles of Indian Point Energy Center, located in Buchanan, New York. Indian Point Energy Center provided about 25 percent of the power for New York City and Westchester County in the State of New York before it permanently stopped generated electricity on April 30, 2021 (U.S. EIA 2021).

Hazardous Substances In-Transit

Incidents involving hazardous substances in transit can occur anywhere in Sussex County. Major highways in the County over which hazardous materials are transported daily include U.S. Route 206 and State Highway 15. A portion of Interstate 80 runs through and near the southern portion of the County. U.S. Route 209 runs parallel and close to the northwestern border of Sussex County although it does not enter County. Freight rail in Sussex County is operated by regional and short line railroads.

Figure 3-20. Hazardous Materials Community Lifelines in Sussex County



3.8.8 Water Systems

Figure 3-21 shows the location of water system facilities. Table 3-21 lists the number of each facility type.

Table 3-21. Sussex County Water System Community Lifelines

Facility Type	Number of Facilities
Potable Pump Station	10
Potable Water Treatment	2
Wastewater Pump	14
Wastewater Treatment	3
Water Tower	1
Well	13
Total	**43**

Note: This table may not include all facilities in the County. Some facilities may have been missed in the data collection process.

Potable Water

There are community water supply systems in Sussex County that serve municipalities, places with higher density development, and some lake communities. Twenty-one of the County's municipalities are partially or fully served by public water. The Townships of Lafayette, Sandyston, and Walpack do not have public water supply systems (Sussex County 2017).

Approximately 95 percent of Sussex County residents rely on groundwater for domestic water. It is pumped to residents from aquifers through private on-site wells, community wells, or municipal wells (Sussex County 2014). The following surface water bodies are used for potable water supply in Sussex County (Sussex County 2014):

- Morris Lake in Sparta Township – used by the Town of Newton
- Lake Rutherford in Wantage Township – used by the Borough of Sussex
- Branchville Reservoir in Frankford Township – used by the Borough of Branchville
- Franklin Pond in the Borough of Franklin – used by the Borough as an emergency water supply
- Lake Hopatcong – used as emergency water supply for several municipalities
- Canistear Reservoir in Vernon Township – located on the Newark water supply management lands
- Heaters Pond in Ogdensburg – used as an emergency water supply

Wastewater Facilities

The Sussex County Municipal Utilities Authority (SCMUA) operates the County's largest sewer treatment plant, located in Hardyston Township. The SCMUA also operates other wastewater facilities in the County, including the Hampton Commons facility in Hampton Township. The Town of Newton owns and operates its own wastewater treatment plant. The Musconetcong Sewer Authority owns and operates a wastewater treatment plant in Mount Olive (Morris County), which provides sewer service into Stanhope, Byram, and Hopatcong in Sussex County as well as portions of Morris County. Smaller treatment plants throughout the County serve schools and commercial and industrial sites. There are no combined sewers in Sussex County (Sussex County 2017). Table 3-22 lists the wastewater districts, franchise areas, and served municipalities

Figure 3-21. Water System Community Lifelines in Sussex County

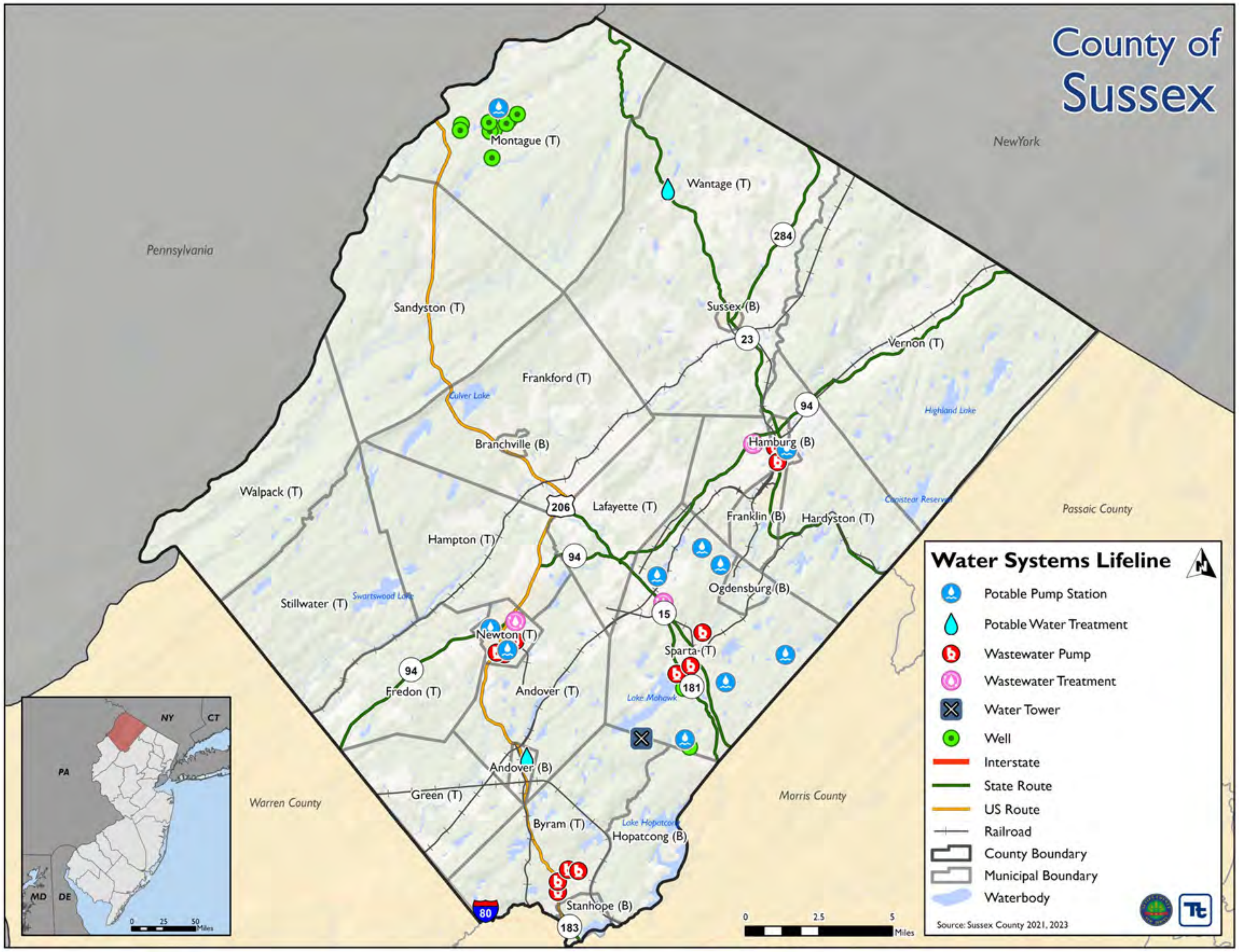


Table 3-22. Sussex County Wastewater Districts, Franchise Areas, and Served Municipalities

Wastewater Utility	Municipalities Served
Sussex County Municipal Utilities Authority	Andover Borough, Andover Twp., Branchville, Frankford, Franklin, Green, Hamburg, Hardyston, Lafayette, Montague, Ogdensburg, Sandyston, Sparta, Stillwater, Sussex, Vernon, Walpack, Wantage
Musconetcong Sewer Authority District	Byram, Hopatcong, Stanhope
Hardyston Township Municipal Utilities Authority	All of Hardyston Township, except Aqua NJ area
Town of Newton	Newton
Aqua NJ – Wallkill (owns Wallkill Sewer Company)	Portion of Hardyston Township
Andover Utility Company Inc.	Portion of Andover Township
Montague Sewer Company (owned by Utilities Inc.)	Portion of Montague
Vernon Township Municipal Utilities Authority	Portion of Vernon Township

Source: Sussex County 2017

3.8.9 Lifeline Distribution by Jurisdiction

Table 3-24 summarizes the inventory of all community lifelines in Sussex County by jurisdiction.

3.9 OTHER CRITICAL FACILITIES

Some facilities that are identified as critical for hazard mitigation in Sussex County do not fit in any of FEMA's community lifeline categories. These include senior centers and religious centers. Figure 3-22 shows the location in Sussex County of these other critical facilities. Table 3-23 lists the number of each facility type.

Table 3-23. Sussex County Other Critical Facilities

Facility Type	Number of Facilities
Senior Center	4
Religious Center	2
Total	**6**

Note: This table may not include all facilities in the County. Some facilities may have been missed in the data collection process.

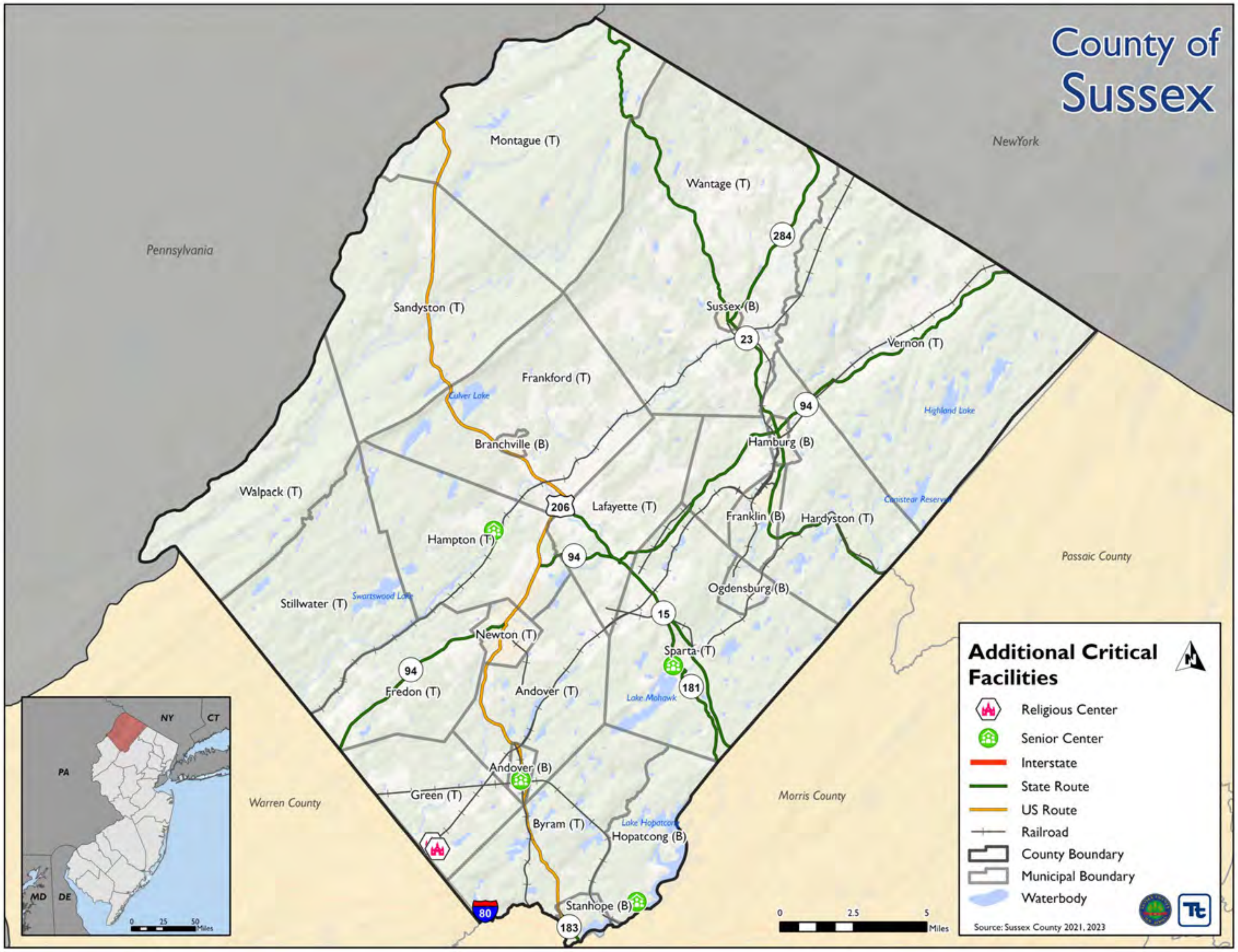
Senior facilities are highly vulnerable to the potential impacts of disasters. Understanding the location and numbers of these types of facilities can help manage effective response post-disaster. There are four senior facilities located in the inventory for the risk assessment. Adult care and long-term care facilities are located in Andover Borough, Andover Township, Hampton Township, Hopatcong Borough, Newton Town, and Sparta Township.

Table 3-24. Number of Critical Facilities in Sussex County, by Jurisdiction

	Number of Facilities in Jurisdiction									
	Communications	Energy	Food, Hydration, Shelter	Hazardous Materials	Health & Medical	Safety & Security	Transportation	Water Systems	Other Critical Facilities	Total
Andover (B)	1	4	1	0	0	3	0	1	1	11
Andover (T)	4	4	1	0	2	24	1	0	0	36
Branchville (B)	0	0	1	0	0	3	0	0	0	4
Byram (T)	1	1	3	2	2	24	0	7	0	40
Frankford (T)	0	1	2	0	1	19	0	0	0	23
Franklin (B)	0	1	1	2	1	6	0	0	0	11
Fredon (T)	0	1	0	0	0	16	0	0	0	17
Green (T)	0	0	1	2	1	15	0	0	2	21
Hamburg (B)	0	1	1	4	1	8	0	4	0	19
Hampton (T)	0	6	0	0	0	18	0	0	1	25
Hardyston (T)	0	3	1	3	3	22	0	1	0	33
Hopatcong (B)	0	8	2	1	1	17	0	0	1	30
Lafayette (T)	0	0	4	1	1	9	0	0	0	15
Montague (T)	0	1	3	0	1	17	0	10	0	32
Newton (T)	1	8	3	1	6	22	0	6	0	47
Ogdensburg (B)	0	0	0	0	1	6	0	0	0	7
Sandyston (T)	0	2	1	0	0	22	0	0	0	25
Sparta (T)	0	7	2	7	1	52	0	13	1	83
Stanhope (B)	0	0	1	0	1	5	0	0	0	7
Stillwater (T)	0	0	3	0	1	18	0	0	0	22
Sussex (B)	0	2	0	0	1	6	0	0	0	9
Vernon (T)	0	2	4	2	3	62	0	0	0	73
Walpack (T)	0	0	0	0	0	5	0	0	0	5
Wantage (T)	1	1	1	2	1	22	1	1	0	30
Sussex County (Total)	8	53	36	27	29	421	2	43	6	625

Source: NJGIN 2023; Sussex County 2021, 2023

Figure 3-22. Other Critical Facilities in Sussex County



3.10 NATURAL, HISTORIC AND CULTURAL RESOURCES

3.10.1 Natural Resources

Sussex County created a Natural Resources Inventory (NRI) in 2014 as part of its Strategic Growth Plan and Open Space and Recreation Plan. The NRI addresses various natural resources, including geology, water, land use, endangered species, and topography.

Natural Heritage Priority Sites

There are 77 Natural Heritage Priority Sites in Sussex County, about 20 percent of the total sites in the state. The sites in Sussex County are among the largest geographically, indicating the extent to which the county's natural communities are still intact. Sussex County has six large Natural Heritage Priority Sites (Sussex County 2014):

- The Kittatinny Mountain Macrosite and High Point Macrosite occur along the Kittatinny Ridge and are largely contained in already preserved lands.
- The Wallkill River Macrosite, much of which falls within preserved lands, and the adjacent Papakating Creek, an unpreserved region, fall in the central valley.
- Wawayanda Macrosite and the adjoining Bearfort Mountain Macrosite are located in northeastern Sussex County in the Highlands. These sites are partly contained in already preserved areas and watershed lands.

The state has given each priority site a biodiversity ranking from B1 to B5, indicating the relative importance of that area. Table 3-25 defines each biodiversity ranking and indicates the number of Natural Heritage Priority Sites in Sussex County with each ranking (Sussex County 2014).

Table 3-25. Biodiversity Rank Definition of Rank Number in Sussex

Rank	Rank Description	Number of Sites
B1	Outstanding significance, such as the only known occurrence of a species or ecological community, the best or an excellent occurrence of a globally critically imperiled species or community, or a concentration of four or more good or excellent occurrences of a globally critically imperiled species or community	2
B2	Very high significance, most outstanding occurrence of something	6
B3	High significance, viable occurrence of globally imperiled community	17
B4	Moderate significance, viable occurrence of globally rare community	36
B5	Of general biodiversity interest	16
Total		**77**

Source: Sussex County 2014

There is one large area of the highest-ranking critical forest habitat for federal threatened and endangered species. This area is located in the eastern region of Sparta and the southern region of Hardyston. Much of this region is encompassed by Sparta Mountain Wildlife Management Area, the Wallkill River Preserve and Weldon Brook Wildlife Management Area (Sussex County 2014).

The second highest ranking critical forest habitat for state endangered species encompasses a large portion of the county. The largest area of this ranking runs in a large swathe along the Kittatinny Ridge and falls within the Delaware Gap National Recreation Area, High Point State Park, Stokes State Forest, Flatbrook Wildlife Management Area, and Walpack Wildlife Management Area. Another area of this ranking is located in eastern Vernon and Hardyston, parts of which are included within Wawayanda State Park and Hamburg Mountain Wildlife Management Area. A third area of critical habitat for state endangered species is located at the southern tip of the county, centered around Byram. A fourth area is located in western Vernon Township near the Wallkill River National Wildlife Refuge. Other smaller areas of this ranking are scattered through the Kittatinny Valley in central Sussex County (Sussex County 2014).

Other Sussex County Natural Resources

Below are a number of additional natural resources in (Sussex County 2014):

- Lakes, rivers, ponds and reservoirs account for 12,827 acres of the county. Most of Sussex County's lakes serve recreational purposes.
- Approximately 95 percent of Sussex County residents rely on groundwater for consumption.
- Sussex County had 194,259 acres in upland forest; this amounts to 57 percent of the County's land area.
- Wetlands total 47,670 acres, or 14 percent of the County land area. Of this, 30,744 acres, or 9 percent of the County, is forested wetland, and 16,926 acres, or 5 percent of the County, is other wetland such as herbaceous wetland, disturbed wetland, or agricultural wetland.

3.10.2 Historic and Cultural Resources

Throughout Sussex County, numerous state and federally listed historic sites pay visual tribute to the County's rich cultural heritage. In addition to sites currently on the state and national registers, many more have been made eligible for listing, but have not yet been listed. To be eligible for listing on the state and national register a site must meet several "criteria for significance in American history, archeology, architecture, engineering or culture, and possessing integrity of location, design, setting, materials, workmanship, feeling and association".

Historic sites in Sussex County range from barns to cabins to archeological sites to schoolhouses to the Morris Canal. There are 36 state or federally registered historic sites and districts across 14 of the County's 24 municipalities. An additional 58 sites in the County have been deemed eligible for listing but are not currently on the state or federal register. Only three municipalities—Branchville Borough, Hampton Township, and Lafayette Township—contain no properties on the register or eligible for listing.

4. RISK ASSESSMENT METHODOLOGY AND TOOLS

A risk assessment is the process of evaluating the potential loss of life, personal injury, and economic and property damage that could result from identified hazards. Identifying potential hazards and vulnerable assets allows planning personnel to address and reduce hazard impacts and allows emergency management personnel to establish early response priorities. Results of the risk assessment are used in subsequent mitigation planning processes, including determining and prioritizing mitigation actions that reduce each jurisdiction's risk from each hazard. Past, present, and future conditions must be evaluated to assess risk most accurately for all participating jurisdictions. The process focuses on the following elements:

- **Identify Hazards of Concern**—Use all available information to determine what types of hazards may affect a jurisdiction.
- **Profile Each Hazard**—Understand each hazard in terms of:
  - Extent—The potential severity of each hazard
  - Location—Geographic area most likely to be affected by the hazard
  - Previous occurrences and losses
  - Impacts of climate change
  - Probability of future hazard events
- **Assess Vulnerability and Impacts**—Use all available information to estimate to what extent populations and assets may be adversely affected by a hazard now and in the future:
  - Determine vulnerability—Estimate the total number of assets in the jurisdiction that are likely to experience a hazard event if it occurs by overlaying hazard maps with the asset inventories.
  - Estimate potential impacts/losses—Assess the impact of hazard events on the people, property, economy, and lands of the region, including estimates of the losses associated with potential damage or cost that can be avoided by mitigation.
  - Evaluate future changes that may affect vulnerability and impacts—Analyze how demographic changes, projected development, and climate change impacts can alter current vulnerability and potential impacts.

The Sussex County risk assessment was updated using the following best-available information:

- The previous HMP's building stock was utilized as the foundational database and was upgraded with updated tax assessor data from MOD-IV, parcel data from Sussex County, building footprints from Microsoft; and 2022 RSMeans cost adjustment values.
- 2020 Decennial Census population data and 2017-2021 American Community Survey 5-year Population Estimates were utilized.
- Critical facilities were updated and reviewed by the Planning Partners.
- Lifelines were identified in the critical facility inventory to align with FEMA's community lifeline definition.
- FEMA's Hazus program was used to estimate potential impacts from the flood, wind, and seismic hazards.
- Best-available hazard data were used, as described in this section.

4.1 RATING PROBABILITY OF OCCURRENCE

Based on records of previous hazard events and consideration of potential future changes that could affect the frequency of future events, the risk assessment assigns a rating for the probability of occurrence of each hazard in the future. These ratings were assigned as follows:

- Unlikely—not likely to occur or less than 1 percent annual chance of occurring
- Rare—between 1 and 10 percent annual chance of occurring
- Occasional—between 10 and 100 percent annual chance of occurring
- Frequent—occurs multiple times a year

4.2 ASSET INVENTORIES

Sussex County assets were identified to assess potential vulnerability and impacts associated with the hazards of concern. The HMP update assesses vulnerability and potential hazard impacts for the following types of assets: population, buildings, critical facilities, community lifelines, the environment, and new development. Each asset type is described below. To protect individual privacy and the security of critical facilities, information on properties assessed is presented in aggregate, without details about specific individual properties.

4.2.1 Population

Statistics from the 2020 Decennial Census population estimate and 2017-2021 American Community Survey (ACS) 5-year estimate were used to estimate the vulnerability of and potential impacts on the County's population. Socially vulnerable populations included in the risk assessment are people under 5 years old or over 65 years old, people living below the poverty level, non-English speaking individuals, and people with a disability.

FEMA's Hazus program was used to estimate potential impacts on people from flood, seismic, and wind hazards. The Hazus model estimates sheltering requirements and potential deaths and injuries.

4.2.2 Buildings

The risk assessment included the collection and use of an expanded and enhanced asset inventory to estimate hazard

The general building stock from the last hazard mitigation plan was utilized as the initial building stock dataset. This dataset was reviewed for accuracy and was upgraded where change was identified in the most-recent MOD-IV tax assessor data, 2023 parcel data from Sussex County, and 2022 building stock footprints sourced from Microsoft. The building inventory attributes were updated using updated parcels and tax assessor information. Attributes provided in the associated files were used to further define each structure, such as year built, number of stories, basement type, occupancy class, and square footage. The centroid of each building footprint was used to estimate the building location.

Buildings were assigned to occupancy classes define in Hazus. To facilitate analysis and presentation of results, the Hazus classes were condensed into the categories of residential (including multi-family and single-family), commercial, industrial, and other (agricultural, religious, governmental, and educational).

Structural and content replacement cost values (RCV) were calculated for each building using the available assessor data, the building footprint, and RSMeans 2022 values. RCV is the cost of returning a destroyed asset to its pre-damaged condition using present-day cost of labor and materials. Total RCV consists of both the structural cost to replace a building and the estimated value of contents of the building. Content value was estimated as 50 percent of the structure value for residential buildings, and 100 percent of the structure value for non-residential buildings. The analysis used a location factor associated with zip-code, as follows:

- Zip Codes starting with 74:
    - Residential: 1.16
    - Non-Residential: 1.12
- Zip Codes starting with 78:
    - Residential: 1.14
    - Non-Residential: 1.11

4.2.3 Critical Facilities and Community Lifelines

A critical facility inventory, which includes essential facilities, utilities, transportation features and user-defined facilities, was created by the Planning Partnership. The development involved a review for accuracy, additions, or deletions of new or moved critical assets, identification of backup power for each asset (if known) and whether the critical facility is considered a lifeline in accordance with FEMA's definition (refer to Appendix G, Critical Facilities).

A lifeline provides indispensable service that enables the continuous operation of critical business and government functions, and is critical to human health and safety, or economic security (FEMA).

4.2.4 Environment and Land Use

Land cover data created by NJDEP (2015) was converted from a raster to a vector polygon, which informed spatial mapping of built and natural land use areas. The built land use areas were defined as urban areas and include developed open space, and low, medium, and high intensity locations. Non-urban areas were classified as agricultural, barren land, forest, rangeland, water, and wetlands land use categories.

4.2.5 New Development

New development in the planning area was defined as development that occurred over the last 5 years and development that is expected to occur over the next 5 years. Each jurisdiction was asked to provide a list by address of major development that has taken place within these timeframes. The location of new development projects was submitted via ArcGIS Survey123. The new development is listed in Chapter 3, and hazard vulnerability analysis results are presented as a table in each annex in Volume II.

A geographic information system (GIS) analysis was conducted to determine hazard exposure of these development sites. Projects built on multiple parcels were assessed as one unit. If one parcel identified within the project boundary intersected a spatial hazard layer, the entire project was considered "exposed" to the hazard area of concern.

4.3 METHODOLOGY

Sussex County used standardized tools, combined with local, state, and federal data and expertise to assess potential vulnerability and losses associated with hazards of concern. Three levels of analysis were used, depending upon the data available for each hazard:

- **Qualitative Review—**This analysis includes an examination of historical impacts to understand potential impacts of future events of similar size. Potential impacts and losses are discussed qualitatively using best-available data and professional judgment.
- **Vulnerability Analysis—**This analysis involves overlaying available spatial hazard layers, for hazards with defined locations, on asset mapping in GIS to determine which assets are located in the hazard area.
- **Loss Estimation**—The FEMA Hazus modeling software was used to estimate impact in terms of potential losses for the following hazards: flood, earthquake, and hurricane.

Table 4-1 summarizes the type of analysis conducted by hazard of concern.

Table 4-1. Summary of Risk Assessment Analyses

Hazard	Population	General Building Stock	Critical Facilities
Dam Failure	Q	Q	Q
Disease Outbreak	Q	Q	Q
Drought	Q	Q	Q
Earthquake	V, L	V, L	V, L
Flood	V, L	V, L	V, L
Geological Hazards	V	V	V
Hazardous Materials	V	V	V
Hurricane	L	L	L
Infestation	Q	Q	Q
Nor’easter	Q	Q	Q
Severe Weather	Q	Q	Q
Severe Winter Weather	Q	Q	Q
Wildfire	V	V	V

Notes: V = vulnerability analysis; L = loss estimation; Q = qualitative review

4.3.1 Hazus

Hazus is a GIS-based software tool developed by FEMA that uses engineering and scientific risk calculations to estimate damage and loss. Its use is accepted by FEMA and provides a consistent framework for assessing risk across a variety of hazards. Hazus uses GIS technology to produce detailed maps and analytical reports that estimate direct physical damage to building stock, critical facilities, transportation systems and utility systems. To generate this information, Hazus uses default data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. Table 4-2 lists the levels of analysis that can be conducted using the Hazus software depending on the hazard and inventory data provided.

Table 4-2. Summary of Hazus Analysis Levels

Level 1	Hazus provides hazard and inventory data with minimal outside data collection or mapping.
Level 2	Hazus-provided hazard and inventory data are augmented with more recent or detailed data for the study region, referred to as “local data”
Level 3	The built-in Hazus loss estimation models are adjusted for the hazard loss analyses, usually in conjunction with the use of local data.

Hazus damage reports can include induced damage (inundation, fire, threats posed by hazardous materials and debris) and direct economic and social losses (casualties, shelter requirements, and economic impact) depending on the hazard and available local data. Hazus’ open data architecture can be used to manage community GIS data in a central location. The use of this software also promotes consistency of data output now and in the future and standardization of data collection and storage.

For this HMP, losses were estimated in Hazus using depth grids for the flood analysis and probabilistic (mean return period) analyses for hurricane wind and seismic hazards. The probabilistic model generates estimated damage and losses for specified return periods (e.g., 100- and 500-year).

4.3.2 Hazard-Specific Methodologies

Dam Failure

To assess the vulnerability of Sussex County to dam failure and its associated impacts, a qualitative review was conducted.

Disease Outbreak

All of Sussex County is at risk from the impacts of disease outbreak events. A qualitative review was conducted to assess the county’s vulnerability to this hazard of concern.

Drought

All of Sussex County is at risk from the impacts of drought events. A qualitative review was conducted to assess the county’s vulnerability to this hazard of concern.

Earthquake

Vulnerability Analysis

Ground shaking is the primary cause of earthquake damage to structures, and soft soils amplify ground shaking. The National Earthquake Hazard Reductions Program (NEHRP) has developed soil classifications defined by their ability to amplify ground shaking. The soil classification system ranges from Type A to Type E, where Type A represents hard rock that reduces ground motions from an earthquake and Type E represents soft soils that amplify ground shaking and increase building damage (an additional classification, Type F, represents soils with special circumstances that require additional analysis for seismic evaluations). Types D and E are the NEHRP soil types most susceptible to amplified ground motion during an earthquake.

A vulnerability analysis was conducted for the county’s assets using NEHRP soil data sourced from NJDOT and Sussex County (2012, 2021). The vulnerability analysis defined the hazard area as all areas with Type C and D soil types (the two most vulnerable soil types present in Sussex County). Assets with their centroid in the hazard areas were totaled to estimate the numbers and values vulnerable to these soil types.

Loss Estimation

A probabilistic assessment was conducted for the 500-year and 1,000-year mean return period earthquake events through a Level 2 analysis in Hazus. The probabilistic method uses information from historical earthquakes and inferred faults, locations, and magnitudes to compute probable ground shaking levels, by Census tract, for a seismic event of a selected a recurrence period. Hazus' potential loss estimates are acceptable for the planning-level purposes of this HMP.

Damage estimates were calculated for losses to buildings (structural and non-structural) and contents. Structural losses include load carrying components of the structure. Non-structural losses include those to architectural, mechanical, and electrical components of the structure, such as nonbearing walls, veneer and finishes, HVAC systems, boilers, etc.

Flood

The 1- and 0.2-percent annual chance flood events were examined to evaluate the county's risk from the flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as NFIP. The following data were used to evaluate vulnerability and determine potential future losses for this plan update:

- FEMA's effective Sussex County Digital Flood Insurance Rate Map (DFIRM) dated September 29, 2011, with a latest letter of map revision of October 2, 2014.
- A depth grid created from the 2011 effective FEMA Digital Flood Insurance Rate Map (DFIRM) and a 2-foot cell size digital elevation map provided by NJDEP.

The effective Sussex County FEMA DFIRM published in 2011 was used to evaluate vulnerability and determine potential future losses. The depth grid generated using the DFIRM and 2-foot cell size digital elevation map was integrated into the Hazus riverine flood model and used to estimate potential losses for the 1-percent annual chance flood event.

Vulnerability Analysis

To estimate vulnerability to the 1-percent- and 0.2-percent annual chance flood events, the DFIRM flood boundaries were overlaid on the centroids of updated assets. Centroids that intersected the flood boundaries were totaled to estimate the building RCV and population vulnerable to the flood inundation areas. A Level 2 analysis was performed. Critical facility and building inventories were formatted to be compatible with the Hazus Comprehensive Data Management System.

Loss Estimation

The Hazus riverine flood model was run to estimate potential losses in Sussex County for the 1-percent annual chance flood event. A Level 2 analysis was performed for the building stock. Buildings located within the floodplain were imported as user-defined facilities to estimate potential losses at the structural level. Hazus calculated the estimated potential losses to the population (default 2020 U.S. Census data), potential damage to the general building stock, and potential damage to critical facilities based on the depth grids generated and the default Hazus damage functions in the flood model.

Geological Hazards

To estimate vulnerability to geological hazards, the following hazard layers were overlaid on the centroids of updated assets: carbonate karst, abandoned mines (with a 0.25-mile buffer), high landslide risk (>20 percent slopes), and moderate landslide risk (15 to 20 percent slopes). Centroids that intersected the hazard boundaries were totaled to estimate the building RCV and population vulnerable to the geologic hazard areas.

Hazardous Materials

To estimate vulnerability to hazardous materials, the following hazard layers were overlaid on the centroids of updated assets: 1-mile buffer around hazardous materials sites, 1-mile buffer around hazardous materials rail routes, 1-mile buffer around hazardous materials roadway routes, and a 50-mile buffer around Indian Point. Centroids that intersected the hazard boundaries were totaled to estimate the building RCV and population vulnerable to the hazardous materials hazard areas.

Hurricane

A level 2 Hazus Hurricane analysis was performed for the 100- and 500- year mean return periods. The probabilistic Hazus hurricane model activates a database of thousands of potential storms that have tracks and intensities reflecting the full spectrum of Atlantic hurricanes observed since 1886 and identifies those with tracks associated with Sussex County. Hazus contains data on historical hurricane events and wind speeds. It also includes surface roughness and vegetation (tree coverage) maps for the area, which support the modeling of wind force. Default demographic and updated building and critical facility inventories in Hazus were used for the analysis. Although damage is estimated at the census tract level, results were presented at the municipal level. Because there are multiple census tracts that contain more than one jurisdiction, a density analysis was used to extract the percent of building structures that fall within each tract and jurisdiction. The percentage was multiplied against the results calculated for each tract and summed for each jurisdiction.

Infestation

All of Sussex County is at risk from the impacts of infestation events. A qualitative review was conducted to assess the county’s vulnerability to this hazard of concern.

Nor’easter

All of Sussex County is exposed and vulnerable to the nor’easter hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Current modeling tools are not available to estimate specific losses for this hazard. A qualitative review was conducted to assess the county’s vulnerability to this hazard of concern.

Severe Weather

All of Sussex County is exposed and vulnerable to the severe weather hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Current modeling tools are not available to estimate specific losses for this hazard. A qualitative review was conducted to assess the county’s vulnerability to this hazard of concern.

Severe Winter Weather

All of Sussex County is exposed and vulnerable to the severe winter weather hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Current modeling tools are not available to estimate specific losses for this hazard. A qualitative review was conducted to assess the county's vulnerability to this hazard of concern.

Wildfire

Wildfire fuel hazard mapping from the New Jersey Forest Fire Service (2009) was referenced to delineate wildfire hazard areas. The high, very high, and extreme risk areas were analyzed. Hazard area boundaries were overlaid on the centroids of updated assets. Centroids that intersected the wildfire hazard areas were totaled to estimate the building RCV and population vulnerable to the wildfire hazard.

4.4 DATA SOURCE SUMMARY

Table 4-3 summarizes the data sources used for the risk assessment for this plan.

4.5 LIMITATIONS

Loss estimates, vulnerability analyses, and hazard-specific impact evaluations rely on the best-available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct such a study
- Incomplete or dated inventory, demographic, or economic parameter data
- The unique nature, geographic extent, and severity of each hazard
- Mitigation measures already employed by the participating jurisdictions
- The amount of advance notice residents have to prepare for a specific hazard event
- Uncertainty of climate change projections

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of two or more. Therefore, potential vulnerability and loss estimates are approximate. These results do not predict precise results and should be used only to understand relative risk. Over the long term, Sussex County will collect additional data and update and refine existing inventories to assist in estimating potential losses.

Potential economic loss is based on the present value of the general building stock using best-available data. The county acknowledges significant impacts may occur to critical facilities and infrastructure as a result of these hazard events, causing great economic loss. However, monetized damage estimates to critical facilities and infrastructure, and economic impacts were not quantified and require more detailed loss analyses. In addition, economic impacts to industry such as tourism and the real-estate market were not analyzed.

Table 4-3. Risk Assessment Data Documentation

Data	Source	Date	Format
Population	U.S. Census Bureau; American Community Survey 5-Year Estimates	2020; 2021	Digital (GIS)
Building Inventory	Sussex County; NJOGIS, Civil Solutions, Spatial Data Logic; RS Means	2023; 2022	Digital (GIS)
Critical Facilities and Lifelines	Sussex County Planning Partnership and County Jurisdictions; NJGIN	2021; 2023	Digital (GIS)
Digitized Effective FIRM maps	FEMA	2011; 2014	Digital (GIS)
2-Foot Cell Size Digital Elevation Model	NJDEP Bureau of GIS	2023	.csv; .laz
Landslide Hazard Data	NJDEP Bureau of GIS; NJ Office of GIS NJOIT, USGS	2023	Digital (GIS)
NEHRP Soils	NJDOT; Sussex County	2012; 2021	Digital (GIS)
Carbonate/Karst Hazard Data	NJDEP	2023	Digital (GIS)
Abandoned Mines	NJDEP	2021	Digital (GIS)
Wildfire Hazard Data	NJFFS	2009	Digital (GIS)
Rail Network	NJ Transit	2018	Digital (GIS)
Road Network	Sussex County	2021	Digital (GIS)
Hazardous Sites	EPA	2018	Digital (GIS)
Land Cover	NJDEP	2015	Digital (GIS)
New Development Data	Sussex County Planning Partnership and County Jurisdictions	2023	Digital (GIS)

Notes:
EPA = Environmental Protection Agency
FEMA = Federal Emergency Management Agency
NJDEP = New Jersey Department of Environmental Protection
NJDOT = New Jersey Department of Transportation
NJFFS = New Jersey Forest Fire Service
NJGIN = New Jersey Geographic Information Network
NJOGIS = New Jersey Office of Geographic Information Systems
NJOIT = New Jersey Office of Information Technology
USGS = U.S. Geological Survey

4.6 CONSIDERATIONS FOR MITIGATION AND NEXT STEPS

The following are considerations for the next plan update to enhance the risk assessment:

- All hazards
  - Create an updated user-defined general building stock dataset using up-to-date parcels, footprints, and RSMeans values.
  - Utilize updated and current demographic data.
- Dam failure
  - Identify available dam inundation hazard boundary data for high and very high hazard dams to incorporate a quantitative analysis.

- Earthquake
  - Identify unreinforced masonry in critical facilities and privately owned buildings (i.e., residences) by accessing local knowledge, tax assessor information, and/or pictometry/orthophotos. These buildings may not withstand earthquakes of certain magnitudes and plans to provide emergency response or recovery efforts at these properties can be developed.
- Flood
  - Update the general building stock inventory to include attributes regarding first floor elevation and foundation type (basement, slab on grade, etc.) to enhance loss estimates.
  - Conduct a Hazus loss analysis for more frequent flood events (e.g., 10- and 50-year flood events).
  - Conduct a repetitive loss area analysis.
  - Continue to expand and update urban flood areas to further inform mitigation.
  - As more current FEMA floodplain data become available (i.e., DFIRMs), update the vulnerability analysis and generate a more detailed flood depth grid that can be integrated into the current Hazus version.
- Geological hazards
  - Continue using the most up to date geologic hazard data available.
- Hazardous materials
  - Utilize the most recent location data for roadways, railways, and hazardous materials sites.
- Hurricane
  - The general building stock inventory can be updated to include attributes regarding protection against strong winds, such as hurricane straps, to enhance loss estimates.
  - Integrate evacuation route data that are currently being developed.
- Wildfire
  - General building stock inventory can be updated to include attributes such as roofing material, fire detection equipment, or distance to fuels as another measure of vulnerability.

5. IDENTIFICATION OF HAZARDS OF CONCERN

5.1 REVIEW OF POTENTIAL HAZARDS

To provide a strong foundation for mitigation actions in this plan, Sussex County considered a full range of hazards that could impact the area and then identified and ranked those that present the greatest concern. These hazards of concern were identified based on the following:

Hazards of Concern are hazards that are considered most likely to impact a community. These are identified using available data and local knowledge.

Natural Hazards are hazards that are a source of harm or difficultly created by a meteorological, environmental, or geological event.

- Input from all Planning Partners
- Review of the New Jersey State Hazard Mitigation Plan
- Review of the 2021 Sussex County HMP
- Research on the frequency, magnitude, and costs associated with hazards that have previously or could feasibly impact the region
- Qualitative information regarding natural (not human-caused) hazards and the perceived vulnerability of the study area's assets to them.

Table 5-1 documents the process of identifying the hazards of concern for further profiling and evaluation. Based on the review of potential hazards of concern, 13 hazards of concern were identified as significant hazards affecting the entire County, to be addressed at the County level in this plan (shown here in alphabetical order):

- Dam failure
- Disease outbreak
- Drought
- Earthquake
- Flood
- Geological hazards
- Hazardous materials
- Hurricane
- Infestation
- Nor'easter
- Severe weather
- Severe winter weather
- Wildfire

Other natural and human-caused hazards of concern have occurred within Sussex County, but have a low potential to occur, are addressed by other planning mechanisms, and/or do not result in significant impacts within the County. Therefore, these hazards are not addressed in this update. If deemed necessary by the County, these hazards may be considered in future plan updates.

Table 5-1. Review of Hazards of Concern for Sussex County

Hazard	May Occur in the County?	Poses Significant Threat to the County?	Why was this determination made?	Sources
Animal Disease	Yes	No	• The 2019 New Jersey State HMP identifies animal disease as a hazard of concern for New Jersey. • The Steering Committee and Planning Partnership do not consider animal disease to be a hazard of concern for Sussex County.	• New Jersey State HMP • Planning Partnership Input
Civil Unrest	Yes	No	• The 2019 New Jersey State HMP identifies civil unrest as a hazard of concern for New Jersey. • The Steering Committee and Planning Partnership do not consider civil unrest to be a hazard of concern for this HMP as it is addressed in other preparedness plans.	• New Jersey State HMP • Planning Partnership Input
Coastal Erosion	Yes	Yes	Please see Flood	
Crop Failure	Yes	No	• The 2019 New Jersey State HMP identifies crop failure as a hazard of concern for New Jersey. • The Steering Committee and Planning Partnership do not consider crop failure to be a hazard of concern for Sussex County.	• New Jersey State HMP • Planning Partnership Input
Cyber Attack	Yes	No	• The 2019 New Jersey State HMP identifies cyber-attack as a hazard of concern for New Jersey. • The Steering Committee and Planning Partnership do not consider cyber-attack to be a hazard of concern for this HMP as it is addressed in other preparedness plans.	• New Jersey State HMP • Planning Partnership Input
Dam and Levee Failure	Yes	Yes	• The 2019 New Jersey State HMP identifies dam failure as a hazard of concern for New Jersey. • Sussex County has 40 dams classified high hazard and 39 dams classified significant hazard. • The Planning Partnership identified dam failure as a hazard of concern for Sussex County.	• New Jersey State HMP • Planning Partnership Input • USACE National Inventory of Dams
Disease Outbreak	Yes	Yes	• The 2019 New Jersey State HMP identifies pandemic as a hazard of concern for New Jersey. • Sussex County has been identified in two FEMA declarations for COVID-19. • Sussex County has been impacted by mosquito and tick-borne diseases, and recently, the COVID-19 pandemic. • The Planning Partnership identified disease outbreak as a hazard of concern for Sussex County.	• New Jersey State HMP • FEMA • Sussex County Department of Health • Planning Partnership Input

Hazard	May Occur in the County?	Poses Significant Threat to the County?	Why was this determination made?	Sources
Drought	Yes	Yes	• The 2019 New Jersey State HMP identifies drought as a hazard of concern for New Jersey. • New Jersey has entered periods of drought and Sussex County has experienced droughts classified in the abnormally dry and moderate categories. • The Planning Partnership identified drought as a hazard of concern for Sussex County.	• New Jersey State HMP • FEMA • NOAA NCEI • USDA • U.S. Drought Monitor • NDMC • Planning Partnership Input
Earthquake	Yes	Yes	• The 2019 New Jersey State HMP identifies earthquakes as a hazard of concern for New Jersey. • Although the County has not experienced a major earthquake, there have been 17 instances where the epicenter of an earthquake was located in Sussex County, the most recent occurring in 2020. • The Planning Partnership identified earthquake as a hazard of concern for Sussex County.	• New Jersey State HMP • FEMA • NJGWS • USGS • Planning Partnership Input
Economic Collapse	Yes	No	• The 2019 New Jersey State HMP identifies economic collapse as a hazard of concern for New Jersey. • The Steering Committee and Planning Partnership do not consider economic collapse to be a hazard of concern for Sussex County.	• New Jersey State HMP • Planning Partnership Input
Extreme Temperature	Yes	Yes	Please see Severe Weather and Winter Weather	
Fishing Failure	No	No	• The 2019 New Jersey State HMP identifies fishing failure as a hazard of concern for New Jersey. • The Steering Committee and Planning Partnership do not consider fishing failure to be a hazard of concern for Sussex County.	• New Jersey State HMP • Planning Partnership Input
Flood (riverine, lakeshore, ice jam, dam failure, urban flooding, and flash flooding)	Yes	Yes	• The 2019 New Jersey State HMP identifies flood as a hazard of concern for New Jersey. • Sussex County was included in 9 FEMA declarations where flooding may have occurred. • Sussex County has been included in numerous flood and flash flood events from the NOAA database since 2018. • The Planning Partnership identified flood as a hazard of concern for Sussex County.	• New Jersey State HMP • FEMA • NOAA NCEI • Planning Partnership Input

Hazard	May Occur in the County?	Poses Significant Threat to the County?	Why was this determination made?	Sources
Geological Hazards	Yes	Yes	• The 2019 New Jersey State HMP identifies landslides and land subsidence as hazards of concern for New Jersey. • Carbonate rock formations are found in the northern portion of the County, which are susceptible to natural subsidence. • Between January 2015 and May 2021, there have been no identified geological hazard events in Sussex County.	• New Jersey State HMP • FEMA • 2021 Sussex County HMP • USGS • NJGWS • Planning Partnership Input
Hurricane (tropical cyclones, including tropical storms and tropical depressions)	Yes	Yes	• The New Jersey State HMP identifies hurricanes/tropical storms as hazards of concern for New Jersey. • Due to its proximity to the Atlantic Ocean, Sussex County is susceptible to hurricanes and tropical storms. • From 2018 to present, two tropical storms came within 50 nautical miles of Sussex County and three hurricanes came within 50 nautical miles.	• New Jersey State HMP • FEMA • NOAA NHC • NOAA NCEI • Planning Partnership Input
Ice Jams	Yes	Yes	Please see Flood	
Ice Storm	Yes	Yes	Please see Severe Winter Weather	
Invasive Species/ Infestation	Yes	Yes	• The 2019 New Jersey State HMP does not identify invasive species as a hazard of concern for New Jersey. • Sussex County has a diverse landscape with development woven through natural areas. • Pests in Sussex County that compete for natural resources or transmit diseases to humans, livestock, and the environment include insects and invasive plants. • Due to the large, forested area in the southern portion of the County and the abundance of parkland throughout, emerald ash borer and other pests that damage trees have become an increased focus.	• New Jersey State HMP • Planning Partnership Input
Land Subsidence	Yes	Yes	Please see Geological Hazards	
Landslide	Yes	Yes	Please see Geological Hazards	
Nor'easters (extra-tropical cyclones, including severe winter low-pressure systems)	Yes	Yes	• The New Jersey State HMP identifies nor'easters as a hazard of concern for New Jersey. • Due to its proximity to the Atlantic Ocean and location geographically, Sussex County is susceptible to nor'easters. • Between 2018 and 2023, Sussex County experienced several impactful nor'easter events.	• New Jersey State HMP • FEMA • NOAA • NOAA NCEI Storm Database • Planning Partnership Input

Hazard	May Occur in the County?	Poses Significant Threat to the County?	Why was this determination made?	Sources
Pandemic	Yes	Yes	Please see Disease Outbreak	
Power Failure	Yes	Yes	• The 2019 New Jersey State HMP identifies power failure as a hazard of concern for New Jersey. • Sussex County experiences utility failures (generally power outages) several times each year. These failures are usually due to severe storms or severe winter storms that affect the county. • The Steering Committee and Planning Partnership consider utility failure a cascading impact of severe storm, severe winter storm, and flooding events and included discussion of utility failure in those hazard profiles.	• New Jersey State HMP • Planning Partnership Input
Sea Level Rise	Yes	Yes	Please see Flood	
Seiche / Coastal Flood	Yes	Yes	Please see Flood	
Severe Weather (windstorms, thunderstorms, hail, and tornadoes)	Yes	Yes	• The 2019 New Jersey State HMP identifies severe weather as a hazard of concern for New Jersey. • Sussex County was included in 7 FEMA declarations between 2000-2023 in relation to severe storms. • The Planning Partnership identified severe weather as a hazard of concern for Sussex County.	• New Jersey State HMP • FEMA • NOAA NCEI • Planning Partnership Input
Severe Winter Weather (heavy snow, blizzards, ice storms)	Yes	Yes	• The 2019 New Jersey State HMP identifies severe winter weather as a hazard of concern for New Jersey. • Sussex County was included in 4 FEMA disaster declarations for winter weather between 1993-2023. • The Planning Partnership identified severe winter weather as a hazard of concern for Sussex County.	• New Jersey State HMP • FEMA • NOAA NCEI • Planning Partnership Input
Terrorism	No	No	• The 2019 New Jersey State HMP identifies terrorism as a hazard of concern for New Jersey. • The Steering Committee and Planning Partnership do not consider terrorism to be a hazard of concern for this HMP as it is addressed in other preparedness plans.	• New Jersey State HMP • Planning Partnership Input
Tornado	Yes	Yes	Please see Severe Weather hazard	
Utility Failure	Yes	Yes	Please see Power Failure	

Hazard	May Occur in the County?	Poses Significant Threat to the County?	Why was this determination made?	Sources
Wildfire	Yes	Yes	• The 2019 New Jersey State HMP identifies wildfire as a hazard of concern for New Jersey. • There have been many occurrences of wildfires of varying severity in Sussex County. • The Planning Partnership identified wildfire as a hazard of concern for Sussex County.	• New Jersey State HMP • FEMA • New Jersey Forest Fire Service • Planning Partnership Input

FEMA	*Federal Emergency Management Agency*
HMP	*Hazard Mitigation Plan*
NDMC	*National Drought Mitigation Center*
NCEI	*National Centers for Environmental Information*
NHC	*National Hurricane Center*
NJGWS	*New Jersey Geological and Water Survey*
NOAA	*National Oceanic and Atmospheric Administration*
USDA	*U.S. Department of Agriculture*
USGS	*United States Geologic Survey*

5.2 HAZARD DEFINITIONS AND GROUPINGS

The Steering Committee approved use of the following hazard definitions and groupings:

- Dam failures are any instances when a dam is damaged, destroyed or otherwise overtopped, releasing water or other liquid stored behind the dam.
- Disease outbreak occurs when a new virus emerges in the human population, spreading easily in a sustained manner and causing serious illness. Of particular concern in Sussex County are viruses with biological transmission to susceptible hosts (mammals, such as humans) from blood-feeding arthropods (mosquitos and ticks).
- A drought is a period characterized by long durations of below normal precipitation.
- An earthquake is the sudden movement of the earth's surface caused by the release of stress accumulated within or along the edge of the earth's tectonic plates, a volcanic eruption, or a man-made activities that cause geologic stresses.
- The flood hazard includes riverine flooding, flash flooding, urban and stormwater flooding, coastal flooding, and ice jam flooding. Inclusion of these forms of flooding under a general flood hazard is consistent with that used in FEMA's Multi-Hazard Identification and Risk Assessment guidance and the New Jersey HMP.
- Geological hazards include landslides, subsidence, and sinkholes. A landslide refers to the downslope movement of earthen materials as falls, topples, slides, spreads, or flows. Subsidence occurs when groundwater is withdrawn from an area characterized predominantly of fine-grained sediment rocks.
- The hazardous materials profile includes materials and wastes that are considered severely harmful to human health and the environment, as defined by the U.S. Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (also known as Superfund). Many hazardous materials are commonly used substances, which are harmless in their normal uses but are quite dangerous if released.
- A hurricane is a tropical cyclone with maximum sustained winds of at least 74 miles per hour. In this hazard profile, all tropical cyclones are discussed – tropical depressions, tropical storms, hurricanes, and major hurricanes.
- An infestation is the presence of native or invasive pest organisms within an area or field, on the surface of a host, or in soil at numbers or quantities large enough to harm, threaten, or otherwise negatively affect native plants, animals, and humans.
- A nor'easter is a cyclonic storm that moves along the east coast of North America. It is called a nor'easter because the damaging winds over coastal areas blow from a northeasterly direction. Nor'easters are most frequent and strongest between September and April.
- The severe weather hazard includes windstorms that often entail a variety of other influencing weather conditions. For this HMP update, severe weather includes thunderstorms, lightning, hail, high winds, tornadoes, and extreme temperature.
- The severe winter weather hazard includes heavy snow, blizzards, ice storms, sleet, and freezing rain.
- Wildfire is any non-structural fire that occurs in the wildland. Wildfires result in the disturbance of forest and brush and destruction of real estate and personal property and have secondary impacts on other hazards, such as flooding, by removing vegetation and disturbing watersheds.

These definitions and groupings are the same as those provided by FEMA (FEMA 386-2 Understanding Your Risks, Identifying Hazards and Estimating Losses; Multi-Hazard Identification and Risk Assessment – The Cornerstone of the National Mitigation Strategy; Local Mitigation Planning Handbook) and take into consideration the hazard grouping in the New Jersey HMP.

6. DAM FAILURE

6.1 HAZARD PROFILE

6.1.1 Hazard Description

A dam is a structure built across a river or stream to store water, wastewater, or liquid borne materials for purposes such as flood control, human water supply, energy generation, recreation, or pollution control. Many dams fulfill a combination of these functions (ASDSO 2023).

Concern about their safety and integrity grows as dams age, rendering oversight and regular inspection especially important. Despite efforts to provide sufficient structural integrity and to perform inspection and maintenance, problems can develop that cause dams to fail. Dam failures occur when a dam is damaged, destroyed, or otherwise overtopped, releasing the stored water or other liquid. According to the Association of State Dam Safety Officials (ASDO), the following are common causes of dam failures (ASDSO 2021):

- Overtopping caused by floods that exceed the capacity of the dam or levee (inadequate spillway capacity)
- Prolonged periods of rainfall and flooding
- Deliberate acts of sabotage (terrorism)
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate or negligent operation, maintenance, and upkeep
- Failure of upstream dams on the same waterway
- Earthquake (liquefaction/landslides)

When dams fail or overtop, they can cause catastrophic impacts and lead to major flooding and impacts. Hundreds of dams have failed in the United States, causing property and environmental damage, injuries, and fatalities. While most dams have storage volumes small enough that failures would have little or no consequences, dams with large storage amounts can cause significant flooding downstream (FEMA 2013).

Dam incidents can occur suddenly, without warning, and may occur during normal operating conditions. This is referred to as a “sunny day” failure. Dam failures may also occur during a large storm event. Significant rainfall can quickly inundate an area and cause floodwaters to overwhelm a reservoir. If the spillway of the dam cannot safely pass the resulting flows, water will begin flowing in areas not designed for such flows, and a failure may occur. New Jersey has seen significant property damage including damage or loss of dams, bridges, roads, and buildings as a result of storm events and dam failures (NJOEM 2019).

A dam failure may or may not leave enough time for evacuation of people and property, depending on its abruptness. Seepages in earth dams usually develop gradually, and if the embankment damage is detected early, downhill residents have at least a few hours or days to evacuate. Failures of concrete or masonry dams tend to occur suddenly, sending a wall of water and debris down the valley at up to 100 mph. Dam failures due to the overtopping of a dam normally give sufficient lead time for evacuation (FEMA 2019).

6.1.2 Regulatory Oversight of Dams

National Dam Safety Program

The National Dam Safety Program (NDSP) is a partnership among states, federal agencies, and other stakeholders that encourages individual and community responsibility for dam safety. Grant assistance from FEMA provides support for improvement of dam safety programs that regulate most dams in the United States. These funds have allowed participating states to improve their dam safety programs through increased inspections, emergency action planning, and purchases of needed equipment. The NDSP also supports training programs (FEMA 2022).

U.S. Army Corps of Engineers Dam Safety Program

The U.S. Army Corps of Engineers (USACE) is responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act (Public Law 92-367). USACE has inventoried dams and has surveyed each state and federal agency's capabilities, practices, and regulations regarding design, construction, operation, and maintenance of the dams. USACE has also developed guidelines for inspection and evaluation of dam safety (USACE 2014).

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) cooperates with a large number of federal and state agencies to ensure and promote dam safety and, more recently, homeland security. Nationally, over 3,000 dams are part of regulated hydroelectric projects and are included in the FERC Dam Safety Program. Two-thirds of these dams are more than 50 years old. FERC staff inspect hydroelectric projects on an unscheduled basis to investigate the following (FERC 2020):

- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters
- Issues concerning compliance with terms and conditions of a license

Every five years, an independent consulting engineer, approved by FERC, must inspect and evaluate projects with dams higher than 32.8 feet (10 meters) or with total storage capacity of more than 2,000 acre-feet (FERC 2020).

New Jersey Department of Environmental Protection Dam Safety Program

New Jersey's Dam Safety program is administered by NJDEP's Bureau of Dam Safety, under the state's 1985 Dam Safety Standards (NJDEP 2023). Dams under state jurisdiction are any artificial barriers that raise the waters of a stream more than 5 feet above the usual mean low water height. Every regulated dam in the state is required to meet state dam safety standards. Dam safety laws provide the NJDEP with enforcement capabilities to achieve compliance with the standards. This includes issuing orders for compliance to dam owners and pursuing legal action if an owner does not comply (with possible fines levied on a per-day basis for violations) (NJDEP 2023).

The Bureau of Dam Safety reviews plans and specifications for the construction of new dams or for the alternation, repair, or removal of existing dams and must grant approval prior to construction (NJDEP 2023). Existing dams are periodically inspected to ensure that they are adequately maintained, and owners are directed to correct any deficiencies found. The regulations require owners to hire professional engineers to inspect their dams on a regular basis (NJDEP 2023).

Dam safety inspections are intended to identify conditions that may adversely affect the safety and functionality of a dam and its appurtenant structures; to note the extent of deterioration as a basis for long-term planning, periodic maintenance, or immediate repair; to evaluate conformity with current design and construction practices; and to determine the appropriateness of the existing hazard classification. Inspection guidelines are summarized in Table 6-1. NJDEP has set guidelines to meet the requirements of the National Inventory of Dams condition assessment of existing dams. Table 6-2 shows the definitions for each potential deficiency rating.

Table 6-1. New Jersey Dam Inspection Requirements

Dam Size/Type	Regular Inspection	Formal Inspection
Class I (High Hazard) Large Dam	Annually	Once every 3 years
Class I (High Hazard) Dam	Once every 2 years	Once every 6 years
Class II (Significant Hazard) Dam	Once every 2 years	Once every 10 years
Class III (Low Hazard) Dam	Once every 4 years	Only as required
Class IV (Zero Hazard) Dam	Once every 4 years	Only as required

Source: NJDEP 2008

Table 6-2. New Jersey Dam Inspection Deficiency Ratings

Rating	Definition
Satisfactory	No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria. Minor maintenance items may be required.
Fair	Acceptable performance is expected under all required loading conditions (static, hydrologic, seismic) in accordance with the applicable dam safety regulatory criteria. Minor deficiencies may exist that require remedial action and/or secondary studies or investigations.
Poor	A dam safety deficiency is recognized for any required loading condition (static, hydrologic, seismic) in accordance with the applicable dam safety regulatory criteria. Remedial action is necessary. This rating also applies when further critical studies or investigations are needed to identify any potential dam safety deficiencies.
Unsatisfactory	Considered unsafe. A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution. Reservoir restrictions may be necessary.

Source: NJDEP 2017

The Bureau also coordinates with the Division of State Police and local and county emergency management officials in the preparation and approval of emergency action plans (EAPs). Since failure of a dam can take only hours or minutes, it is imperative to have a detailed emergency action plan ready for use (NJDEP 2023). All dams rated as high hazard or significant hazard must have NJDEP-approved EAPs in place. It is the responsibility of the dam owner to review and update the EAP on an annual basis.

6.1.3 Location

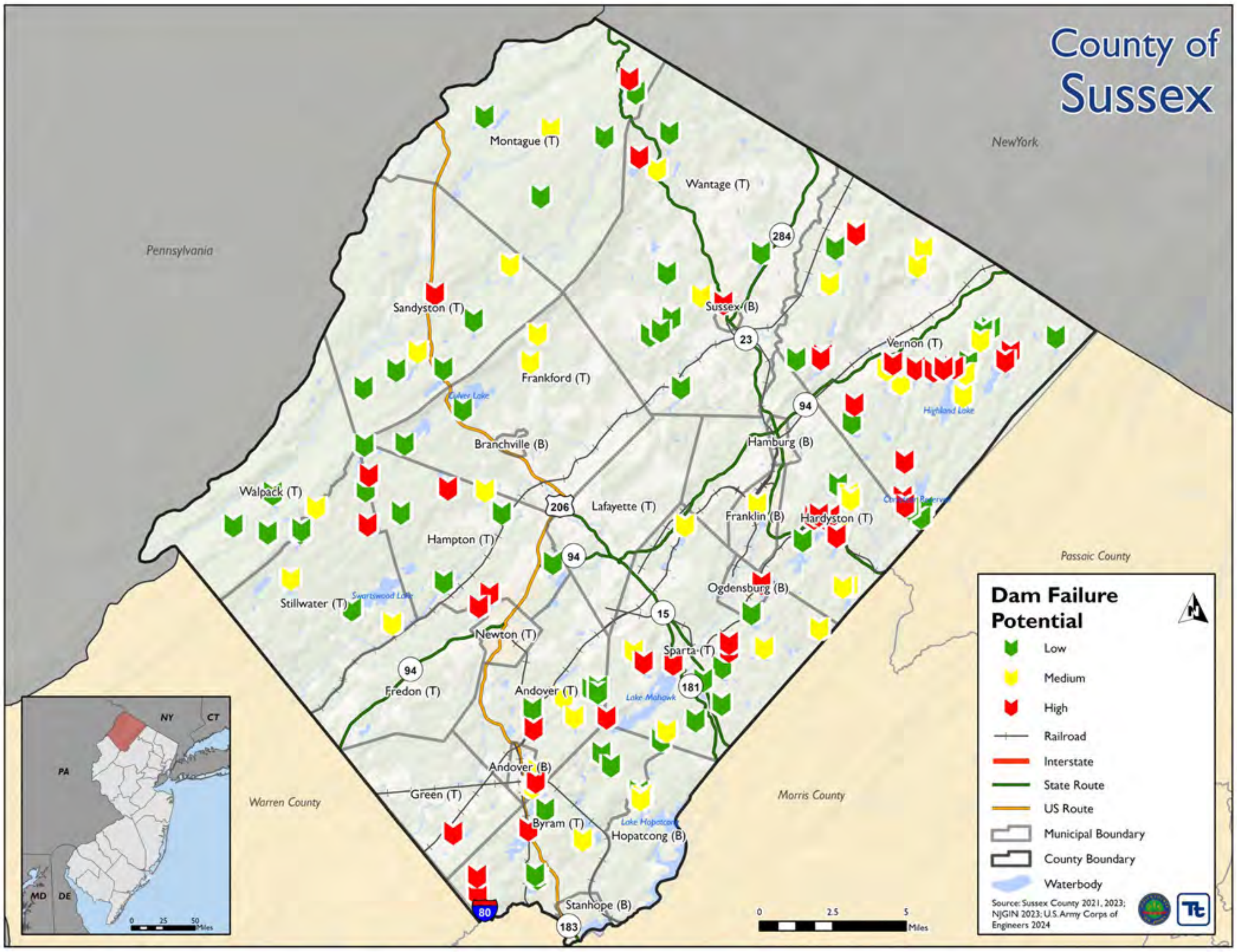
According to the USACE National Inventory of Dams, Sussex County has 139 dams. Of these dams, 40 are considered high hazard, 39 are considered significant hazard, and 60 are considered low hazard. There are 26 dams classified as in a poor state of repair; five of these are high hazard dams. Figure 6-1 shows the dams by class throughout the County. Table 6-3 lists the high hazard dams.

Table 6-3. High Hazard Dams in Sussex County

Municipality	Dam Name	Water Body
Andover Township	Forest Lake Dam	Pequest River-TR
Andover Township	Lake Lenape Dam	Tar Hill Brook
Byram Township	Reservoir Lake Dam	Watchu Pond
Byram Township	Cranberry Lake Dam	Lubbers Run
Byram Township	Frenches Pond Dam	Musconetcong River-TR
Franklin Borough	Lake Gerard Dam	Franklin Pond Creek
Franklin Borough	Lake Gerard Dam A	Franklin Pond Creek
Franklin Borough	Lake Gerard Dike C	Franklin Pond Creek
Franklin Borough	Lake Gerard Dike B	Franklin Pond Creek
Green Township	Lake Tranquility Dam	Trout Brook
Hampton Township	Crandon Lake Dam	Black Brook
Hampton Township	Kemah Lake Dam	Paulkinskill River-TR
Hardyston Township	Diversion Dam	Pequannock River
Hardyston Township	Lake Tamarack Dam	Franklin Pond Creek-TR
Hardyston Township	Canistear Reservoir #1 Dam	Pacock Brook
Montague Township	Steenykill Lake Dam	Steent Brook
Ogdensburg Borough	Heaters Pond Dam	Sawmill Brook
Sandyston Township	Robert Rooke Dam	Branch of Big Flat Brook
Sparta Township	West Shore Trail Dam	Wallkill River
Sparta Township	Morris Lake Dam	Wallkill River-TR
Sparta Township	Lake Mohawk Dam	Wallkill River
Sparta Township	Glen Lake Dam	Wallkill River
Sparta Township	Upper Mohawk Lake Dam	Paulinskill River-TR
Stillwater Township	Willow Crest Dam	Black Brook
Sussex Borough	Clove River Dam	Clove Brook
Sussex Borough	Paulinskill Water Shed #2 Dam	Moores Brook
Town of Newton	Paulins Kill Site 4 Dam	Moore's Brook-TR
Vernon Township	Lake Panorama Dike	Wallkill River-TR
Vernon Township	Great Gorge Dam	Black River-TR
Vernon Township	East Cove Dam	Wallkill River-TR
Vernon Township	Wawayanda Lake Dam	Wawayanda Creek-TR
Vernon Township	Mountain Creek Lake Dam	Black Creek-TR
Vernon Township	Upper West Highland Lake Dam	Highland Lake
Vernon Township	Highland Lakes Dam	Double Kill River
Vernon Township	Upper Highland Lake Dam	Highland Lakes-TR
Vernon Township	Hidden Valley Lake Dam	Pachuck Creek-TR
Vernon Township	Canistear Reservoir #2 Dam	Pacock Brook
Vernon Township	Stump Pond Dam	Black Creek-TR
Vernon Township	Pleasant Valley Lake Dam	Black Creek-TR
Wantage Township	Lake Rutherford Dam	Clove Brook-TR

Source: USACE 2023

Figure 6-1. Dams by Class in Sussex County



The County may also be impacted by inundation from failure of high-hazard dams in surrounding counties. The inundation zone is the area downstream of a dam that would be flooded in the event of a failure or uncontrolled release of water. This zone is generally much larger than the area of a normal river or stream flood event. Downstream development increases the potential consequences of a dam's failure. Any dam has the potential to adversely affect downstream areas and lives. Many dams, should they fail, can also affect the delivery of essential utilities or flood control (FEMA 2013). Passaic County in New Jersey has 49 high-hazard dams, Morris County in New Jersey has 42 high-hazard dams, Warren County in New Jersey has 15 high-hazard dams, Orange County in New York has 33 high-hazard dams, and Pike County in Pennsylvania has 46 high-hazard dams (USACE 2023).

6.1.4 Extent

Several state and federal agencies assign ratings to dams based on the potential consequences of the dam's failure. These ratings represent the hazard extent for dam failure. Two such rating systems are described in the sections below. Both of these classification systems are based on the consequences of dam failure, not the likelihood of failure occurring.

New Jersey Department of Environmental Protection

The NJDEP assigns the following hazard classifications to state-regulated dams in New Jersey (NJAC 7:20-1.8):

- Class I (High-Hazard Potential)—Failure of the dam may result in probable loss of life or extensive property damage
- Class II (Significant-Hazard Potential)—Failure of the dam may result in significant property damage; however, loss of life is not envisioned.
- Class III (Low-Hazard Potential)—Failure of the dam is not expected to result in loss of life or significant property damage.
- Class IV (Zero-Hazard Potential)—This classification includes any dam that impounds less than 15 acre-feet of water to the top of the dam, has less than 15 feet height-of-dam and has a drainage area above the dam of 150 acres or less. No dam may be included in Class IV if it meets the criteria for Class I or II.

The 40 high-hazard (Class I) dams in Sussex County establish the extent of the dam failure hazard as including possible loss of life and extensive property damage.

U.S. Army Corps of Engineers

Table 6-4 lists USACE-developed classifications of hazard potentials of dam failures, based on potential consequences of a dam failure.

Table 6-4. USACE Dam Hazard Classifications

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

Source: USACE 2014

a. Categories are assigned to overall projects, not individual structures at a project.

b. Loss-of-life potential is based on inundation mapping of area downstream of the project. Analyses of loss-of-life potential should take into account the population at risk, time of flood wave travel, and warning time.

c. Lifeline losses include indirect threats to life caused by the interruption of lifeline services from project failure or operational disruption; for example, loss of critical medical facilities or access to them.

d. Property losses include damage to project facilities and downstream property and indirect impact from loss of project services, such as impact from loss of a dam and navigation pool, or impact from loss of water or power supply.

e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

6.1.5 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

There are two types of federal disaster declarations that can be issued by the U.S. president: emergency (EM) declarations and major disaster (DR) declarations. Both declaration types authorize the president to provide supplemental federal disaster assistance. Sussex County has not been included in any federal declarations for dam failure-related events (FEMA 2024).

U.S. Department of Agriculture 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 declarations issued for dam failure-related events (USDA 2024).

Previous Events

There have been no known dam failure-related events that impacted Sussex County between January 2020 and June 2024.

6.1.6 Probability of Future Occurrences

Probability Based on Previous Occurrences

Information on previous dam failure occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 6-5. Based on historical records and input from the Steering Committee, the probability of occurrence for dam failure in the County is considered “occasional.”

There is a “residual risk” associated with dams. Residual risk is the risk that remains after safeguards have been implemented. For dams, the residual risk is associated with events beyond those that the facility was designed to withstand. However, the probability of any type of dam failure is low in today’s dam safety regulatory and oversight environment (NJOEM 2019).

Effect of Climate Change on Future Probability

Projections of climate change for New Jersey predict more intense rainfall events and increases in total annual precipitation (see Section 3.3.4). Increased rainfall accumulations can cause reservoirs to overtop. Dams are designed using a hydrograph to evaluate dam safety issues for situations where the reservoir inflow peak discharge is greater than the maximum spillway capacity, the reservoir has large surcharge storage, and/or the reservoir has dedicated flood control space. Increased precipitation may result in overtopping, as the hydrographs are based on historical events (USBR 2003).

Table 6-5. Probability of Future Dam Failure Events in Sussex County

Hazard Type	Number of Occurrences Between 1996 and 2024	Percent Chance of Occurring in Any Given Year
Dam Incident	20	71%

Source: Association of State Dam Safety Officials 2021; FEMA 2023; NJOEM 2019; Stanford University 2018; FEMA 2011; County of Sussex 2021

6.1.7 Cascading Impacts on Other Hazards

Dam failure can cause severe downstream flooding. Other potential secondary hazards of dam failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat (FEMA 2013).

6.2 VULNERABILITY AND IMPACT ASSESSMENT

The dam failure hazard is of significance to Sussex County because 139 dams are present across the County, 40 of which are identified as high hazard (refer to Figure 6-1) (USACE 2023). Dam failure events are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Dam failure inundation maps and downstream hazard areas are considered sensitive information and were not available for use in this risk assessment. Therefore, to assess Sussex County's risk from dam failure, a qualitative review was conducted.

6.2.1 Life, Health, and Safety

The impact of dam and levee failure on life, health, and safety is dependent on several factors such as the class of dam/levee, the area that the dam/levee is protecting, the location of the dam/levee, and the proximity of structures, infrastructure, and critical facilities to the dam or levee structure.

Overall Population

The entire population residing within a dam failure inundation zone is considered exposed and potentially vulnerable to a dam failure event. The potential for loss of life is affected by the warming time provided and the capacity and number of evacuation routes available to populations living within these areas. Dam failure can cause persons to become displaced if flooding of structures occurs. Understanding potential outcomes of flooding for each dam in Sussex County would require hydraulic modeling of the likely areas of inundation.

Socially Vulnerable Population

People living below the poverty level in Sussex County are more at risk during a dam failure event because they may be unable to evacuate based upon the net economic impact to their family. Elderly populations are more likely than the general population to need medical attention, and the availability of medical services may be limited due to isolation during a dam failure event. This population also faces difficulties in evacuating. There is often limited warning time for a dam failure event. Populations without adequate warning of the event are highly vulnerable.

Without a quantitative assessment of potential impacts of a dam failure 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 6-6 summarizes highlights of this information. For planning purposes, it is reasonable to assume that percentages and distribution of socially vulnerable populations affected by a dam failure will be similar to the countywide numbers.

6.2.2 General Building Stock

All buildings located in the dam failure inundation zone are considered vulnerable to the hazard. Property closest to the dam inundation area has the greatest potential to experience the most destructive surge of water. Dam failure can transport large volumes of sediment and debris, depending on the magnitude of the event, which can cause widespread damage to buildings, resulting in large repair costs. In addition to physical damage costs, businesses can be closed while flood waters retreat, and utilities are returned to a functioning state. Debris from damaged buildings can accumulate.

Table 6-6. Distribution of Socially Vulnerable Populations by Municipality

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

Note: B = Borough; Twp = Township

6.2.3 Community Lifelines and Other Critical Facilities

Dam failures may impact critical facilities and infrastructure located in the downstream inundation zone. All transportation infrastructure in the dam failure inundation zone is vulnerable to damage and cut-off of evacuation routes, limiting emergency access and creating isolation issues. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas. Loss of power and communications may cause drinking water and wastewater treatment facilities to become temporarily out of operation. Widespread damage to facilities and infrastructure would result in large repair costs.

6.2.4 Economy

Inundation from a dam failure can cause extensive structural damage and interfere with essential services. The 2019 State HMP discusses damage from previous dam failures in the state ranging from $7 million to $25 million. Costs vary with the density of structures and businesses in the area downstream of the dam..

6.2.5 Natural, Historic, and Cultural Resources

Natural

The environmental impacts of a dam failure can include significant water-quality and debris-disposal issues or severe erosion that can impact local ecosystems. Flood waters can back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate the flooded waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals may get added to flood waters and distributed widely across the area of inundation. After the flood waters subside, contaminated and flood-damaged building materials and contents must be properly disposed of (EPA 2024).

Historic

Historic buildings, structures, sites, monuments, districts, and documents may be damaged or destroyed by flood waters following a dam failure.

Cultural

Cultural resources include artifacts, statuary, artwork, and important documents housed in libraries, museums, archives, historical repositories, or historic properties. All of these can be damaged or destroyed by flood waters following a dam failure.

6.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

Overall, the County's vulnerability to the dam failure hazard has not changed, and the entire County will continue to be vulnerable to this hazard. Any change in vulnerability since the previous HMP would be attributed to changes in population density and new development. This updated HMP used updated building stock and critical asset inventories to assess the County's risk to these assets. The building inventory was updated using RSMeans 2022 values, which are more current and reflect replacement cost rather than the building stock improvement values reported in the 2021 HMP. Further, the 2021 5-year population estimates from the American Community Survey were used to evaluate the population exposed to the hazard areas.

6.4 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. To estimate losses in the future, dam inundation areas and depths of flooding may be used to analyze exposure and generate depth grids. Hazus could be implemented to estimate potential losses. In addition, inspections may inform the status of each dam, as well as maintenance and mitigation measures that may be needed. The following sections examine potential conditions that may affect hazard vulnerability.

6.4.1 Potential or Planned Development

Any areas of growth could be impacted by a dam failure if the structures are within the downstream inundation area and mitigation measures are not implemented. Therefore, it is the intention of the County and all participating municipalities to discourage development in vulnerable areas or to encourage higher regulatory standards at the local level. Due to the sensitive nature of dam locations and downstream inundation zones, an assessment to determine the proximity of these new development sites to potential dam inundation cannot be performed at this time.

6.4.2 Projected Changes in Population

Changes in the density of population can impact the number of persons exposed to dam failure inundation hazard areas. Higher density could create issues for local residents during evacuation of a dam failure event and for commuters who travel into and out of the County for work.

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

6.4.3 Climate Change

Most studies project that the State of New Jersey will see an increase in average annual precipitation, primarily in the form of heavy rainfalls, which have the potential to increase the risk of dam failures by increasing loading on dam structures. Existing flood control structures may not be able to retain and manage increases in water flow from more frequent, heavy rainfall events. Heavy rainfalls may result in more frequent overtopping of these dams and flooding of the County's assets in adjacent inundation areas. However, the probable maximum flood used to design each dam may be able to accommodate changes in climate.

7. DISEASE OUTBREAK

7.1 HAZARD PROFILE

7.1.1 Hazard Description

A pandemic is a global outbreak of disease that occurs when a new virus emerges in the human population, spreading easily in a sustained manner and causing serious illness. An epidemic describes a smaller scale infectious outbreak within a region or population that emerges at a disproportional rate. Infectious disease outbreaks may be widely dispersed geographically, impact large numbers of the population, and could arrive in waves lasting several months at a time (Columbia University 2021). Of particular concern in Sussex County are vector-borne diseases, which are transmitted to susceptible hosts such as humans by an infected transmitting animal called a "vector." Common disease vectors are blood-feeding mosquitos or ticks:

- **Mosquito-Borne Disease—**Mosquito-borne diseases are spread through the bite of an infected female mosquito. The most common mosquito-borne diseases in New Jersey are West Nile virus (WNV), eastern equine encephalitis (EEE), and St. Louis encephalitis (SLE) (NJDOH 2023).
- **Tick-Borne Disease—**Tick-borne diseases are spread to humans through ticks that become infected by micro-organisms when feeding on small, infected mammals (e.g., mice and voles). The most common tick-borne diseases in New Jersey are *Lyme disease*, *ehrlichiosis*, *anaplasmosis*, *Rocky Mountain spotted fever*, and *babesiosis*. It is possible to be infected with more than one tick-borne disease at a time. The three types of ticks in New Jersey that may carry disease-causing micro-organisms are the deer tick, lone star tick, and American dog tick (NJDOH 2013).

For this HMP update, the following vector-borne and other transmissible diseases are discussed:

- **West Nile Virus—**WNV is the leading cause of mosquito-borne disease in the United States. WNV is usually diagnosed starting in the summer months and continuing through the fall (NJDOH 2023). WNV was first identified in the United States in 1999. In New Jersey, 380 human cases of WNV have been reported (CDC 2023). WNV can cause serious illness, and in some cases, death. The symptoms of severe infection can include headache, high fever, neck stiffness, muscle weakness, stupor, disorientation, tremors, seizures, paralysis, and coma. Usually, symptoms occur from three to 14 days after being bitten by an infected mosquito (NJDOH 2023).
- **Eastern Equine Encephalitis—**EEE is a virus disease of wild birds that is transmitted to horses and humans by mosquitoes. It is a rare but serious viral infection. EEE is most common in the eastern half of the United States (NJDOH 2023).
- **St. Louis Encephalitis—**SLE is a rare but potentially serious viral infection, although most persons infected with it have no apparent illness. It is transmitted to humans by the bite of an infected mosquito. Most cases have occurred in eastern and central states. Initial symptoms of those who become ill include fever, headache, nausea, vomiting, and tiredness. Severe neuroinvasive disease (often involving encephalitis, an inflammation of the brain) occurs more commonly in older adults (CDC 2023).
- **Lyme Disease—**Lyme disease is the most common vector-borne disease in the United States. It is caused by bacteria transmitted by infected ticks. Typical symptoms include fever, headache, fatigue, and skin rash. Most cases can be treated successfully with antibiotics. If left untreated, symptoms can be severe. Steps to prevent Lyme disease include using insect repellent, removing ticks promptly, and reducing tick habitat

(CDC 2022). In New Jersey, the most common infected tick is the deer tick. Ticks become infected by feeding on infected mice and other small mammals (NJDOH 2012).

- **Ebola—**Ebola is a rare and deadly disease caused by infection with the Ebola virus (CDC 2023). According to the Centers for Disease Control and Prevention (CDC), the 2014 Ebola epidemic is the largest in history affecting multiple countries in West Africa. Two imported cases, including one death, and two locally acquired cases in healthcare workers were reported in the United States (CDC 2023).
- **Influenza—**Influenza is a contagious virus that affects the nose, throat, lungs, and other parts of the body. It can quickly spread from one person to another, causing mild to severe illness and can lead to death. Symptoms include fever, cough, sore throat, runny or stuffy nose, muscle or body aches, headache, and tiredness (NJDOH 2023). Pandemic influenza differs from seasonal influenza, which is caused by viruses already living among people. Pandemic influenza is a global outbreak of a new influenza virus that can infect people easily and spread from person to person in an efficient and sustained manner. The seasonal flu happens annually and usually peaks between December and February. An influenza pandemic can reduce the health, safety, and welfare of the essential services workforce (CDC 2020).
- **Coronavirus—**Coronaviruses are a type of virus spread through droplets and virus particles released into the air when an infected person breathes, talks, laughs, sings, coughs, or sneezes. Larger droplets may fall to the ground in a few seconds, but tiny infectious particles can linger in the air and accumulate in indoor places, especially where many people are gathered and there is poor ventilation (John Hopkins University 2022). COVID-19 is an infectious coronavirus disease first identified in 2019. The virus rapidly spread into a global pandemic by spring of 2020. Older people, and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illnesses from this disease (World Health Organization 2022).

New Jersey's geographic and demographic characteristics make it particularly vulnerable to importation and spread of infectious diseases. All 21 counties in the state have experienced the effects of a pandemic or disease outbreak. All counties may experience pandemic influenza outbreak caused by factors such as population density and the nature of public meeting areas. Diseases will spread more quickly in densely populated areas than in less densely populated areas.

7.1.2 Location

Diseases that can infect humans are variable in their nature and methods of transmission. The transmission rates of respiratory disease are often higher in more densely populated areas while the transmission rates of insect-borne disease are often higher in less densely populated areas that provide more habitat for insects. Ultimately, residents need to be vigilant about diseases altogether to better understand and respond to disease outbreaks.

Factors such as population density, visitation, and the length of time the public spends in a location all contribute to the spread of infectious diseases. Indoor areas where people are in close contact with each other appear to be significant locations for diseases that are spread through respiratory droplets, such as coronavirus and influenza.

Infectious diseases spread by insects may be subject to other types of location hazards. For example, the prevalence of standing water can provide breeding grounds for mosquitoes, and wooded areas are favored by the ticks that spread Lyme disease. Sussex County has large areas that have potential to breed mosquitoes. The presence of disease-carrying mosquitoes and ticks has been reported throughout most of the State of New Jersey and Sussex County. These areas include farmland, private yards, stormwater facilities, and sewer plants. These areas need to be addressed as best as possible to control mosquitoes and the viruses they can spread.

7.1.3 Extent

The severity of the next disease outbreak cannot be predicted; however, experts anticipate that its effect on the United States could be severe as demonstrated by the COVID-19 pandemic. The extent of a disease outbreak depends on how easily the illness is spread, the mode of transmission, and the amount of contact between infected and uninfected individuals.

The CDC and public health officials use the Pandemic Severity Assessment Framework (PSAF) to determine the impact of a pandemic. The PSAF uses two main factors to determine the impact of a pandemic. The first is clinical severity, or how serious is the illness associated with infection. The second is transmissibility, or how easily the pandemic virus spreads from person to person. These two factors are used to guide decisions about which actions CDC recommends at a given time during a pandemic. The results help public health officials and health care professionals make timely and informed decisions, and to take appropriate actions (CDC 2016).

The World Health Organization (WHO) defines six phases of a pandemic influenza, as outlined in Table 7-1. The State of New Jersey uses the WHO classification system to determine activities to be undertaken during a pandemic period. The WHO's *Pandemic Influenza Preparedness and Response* document provides guidance to government agencies, individuals, families and communities, and the health sectors at the local and global levels.

Table 7-1. WHO Global Pandemic Phases

Phase	Description
Preparedness and Response—Global, Regional, National, Sub-National Level	
Phase 1	No animal influenza virus circulating among animals has been reported to cause infection in humans.
Phase 2	An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a potential pandemic threat.
Phase 3	An animal or human-animal influenza virus has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks.
Containment	
Phase 4	Human-to-human transmission of an animal or human-animal influenza virus able to sustain community-level outbreaks has been verified.
Response—Global Level	
Phase 5	The same identified virus has caused sustained community-level outbreaks in two or more countries in one WHO region.
Phase 6	In addition to the criteria defined in Phase 5, the same virus has caused sustained community-level outbreaks in at least one other country in another WHO region.
Post-Pandemic	
Post-Peak Period	Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels.
Possible New Wave	Level of pandemic influenza activity in most countries with adequate surveillance rising again.
Post-Pandemic Period	Levels of influenza activity have returned to the levels seen for seasonal influenza in most countries with adequate surveillance

Source: WHO 2009

The United States and other countries are constantly preparing to respond to disease outbreaks. The U.S. Department of Health and Human Services and others are developing supplies of vaccines and medicines. In addition, the United States has been working with the WHO and other countries to strengthen the detection of disease and response to outbreaks and pandemics. Community preparedness efforts are ongoing via NJDOH and local health departments. These programs empower local health departments and their community partners to promote local readiness, foster community resilience, and to ensure comprehensive, coordinated, and effective responses.

West Nile Virus

WNV cases increase in parts of New Jersey during the late summer and early fall as mosquito populations increase. Mosquitos become infected when they feed on infected birds. There are no vaccines to prevent or medications to treat WNV in people; however, those infected rarely experience symptoms (John Hopkins University n.d.).

Eastern Equine Encephalitis

The risk of contracting EEE is highest from late July through early October (NJDOH 2023). The State of New Jersey documents this viral activity nearly every year. Horse cases are most common in the southern half of the state because the acid water swamps that produce the major mosquito vectors are especially prevalent on the southern coastal plain (Crans 1993).

St. Louis Encephalitis

Cases of SLE have been reported throughout the country, but periodic outbreaks and epidemics have primarily occurred in the Mississippi Valley and along the Gulf Coast and more recently in the Southwest. In temperate areas of the United States, SLE cases occur primarily in the late summer or early fall (CDC 2021).

Lyme Disease

Ticks can be active any time the temperature is above freezing (Occi, et al. 2019). Adult ticks, which are approximately the size of sesame seeds, are most active from March to mid-May and from mid-August to November. Most cases of Lyme disease in New Jersey are reported from May through September, which corresponds to the peak activity period for young deer ticks, called nymphs (NJDOH 2022). Both nymphs and adults can transmit Lyme disease, but this annual trend suggests that many Lyme disease cases are transmitted by nymphal deer ticks. Nymphs are active from mid-May to mid-August and are about the size of poppy seeds.

Ebola

The risk of getting Ebola is highest from late July through early October when mosquito activity is most active. However, those who travel abroad, particularly to countries where the virus is prevalent, are more likely to contract the virus (NJDOH 2022).

Influenza

Fine droplets and particles spread and accumulate more rapidly in an indoor setting. Therefore, the transmission of respiratory illness from contact with infected individuals is more likely to occur in indoor spaces. The seasonal flu happens annually and usually peaks between December and February (CDC 2020).

Coronavirus

Coronaviruses are spread through droplets and virus particles released into the air when an infected person breathes, talks, laughs, sings, coughs, or sneezes, which is more likely to occur in indoor spaces. While the statistics of COVID-19 are subject to change during the publication of this HMP, the New Jersey COVID-19 dashboard shows that Sussex County is within the lower quarter of the impacted counties in the state.

7.1.4 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Sussex County has been included in three major disaster (DR) or emergency (EM) declarations for disease outbreak-related events (FEMA 2024). Table 7-2 lists these declarations.

Table 7-2. FEMA Declarations for Disease Outbreak Events in Sussex County

Event Date	Declaration Date	Declaration Number	Description
May 30 to November 1, 2000	November 1, 2000	EM-3156	West Nile Virus
January 20, 2020, to May 11, 2023	March 13, 2020	EM-3451	New Jersey COVID-19
January 20, 2020, to May 11, 2023	March 25, 2020	DR-4488	New Jersey COVID-19 Pandemic

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 disease outbreak-related agricultural disaster declarations (USDA 2024).

Previous Events

Known disease-outbreak events that impacted Sussex County between January 2020 and June 2024 are listed in Table 7-3. For events prior to 2020, refer to the 2021 Sussex County HMP.

7.1.5 Probability of Future Occurrences

Probability Based on Previous Occurrences

As long as mosquitoes and ticks are found in Sussex County, the risk of contracting diseases carried by these insects exists. Based on available information regarding mosquito and tick populations, it is anticipated that mosquito- and tick-borne diseases will continue to be a threat to Sussex County. However, vaccines are currently being developed for Lyme Disease, which may slow the contraction rates (CDC 2022). For communicable diseases spread from person to person, the likelihood of a disease outbreak is influenced by population density and can change with changes in population. Based on historical records and input from the Steering Committee, the probability of occurrence for disease outbreak in the County is considered "occasional."

Table 7-3. Disease Outbreak Events in Sussex County (2020 to 2024)

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
2020	N/A	N/A	Sussex County	278 confirmed cases of Influenza in Sussex County
2020	N/A	N/A	Sussex County	142 confirmed cases of Lyme Disease in Sussex County
2020	DR-4488-NJ, EM-3451-NJ	Yes	Sussex County	4,896 positive cases of COVID-19 and 175 deaths in Sussex County.
2021	N/A	N/A	Sussex County	90 confirmed cases of Influenza in Sussex County
2021	N/A	N/A	Sussex County	362 confirmed cases of Lyme Disease in Sussex County
2021	DR-4488-NJ, EM-3451-NJ	Yes	Sussex County	17,627 positive cases of COVID-19 and 109 deaths in Sussex County.
2022	N/A	N/A	Sussex County	1,425 confirmed cases of Influenza in Sussex County
2022	N/A	N/A	Sussex County	438 confirmed cases of Lyme Disease in Sussex County
2022	DR-4488-NJ, EM-3451-NJ	Yes	Sussex County	13,786 positive cases of COVID-19 and 83 deaths in Sussex County.
2023	N/A	N/A	Sussex County	537 confirmed cases of Lyme Disease in Sussex County
2023	DR-4488-NJ, EM-3451-NJ	Yes [a]	Sussex County	2,193 positive cases of COVID-19 and 9 deaths in Sussex County.
2024 [b]	N/A	N/A	Sussex County	303 confirmed cases of Lyme Disease in Sussex County
2024 [c]	N/A	N/A	Sussex County	773 positive cases of COVID-19 and 9 deaths in Sussex County.

Sources:NJDOH 2022; NJDOH 2023; NJDOH 2023; NJDOH 2023; NJDOH 2022

Notes: 2023 and 2024 occurrences of Influenza in Sussex County were not available at the time of writing this HMP update.

a. *The declarations for the COVID-19 Pandemic expired on May 11, 2023*

b. *Last updated August 12, 2024*

c. *Last updated August 12, 2024*

Effect of Climate Change on Future Probability

The relationship between climate change and increase in infectious diseases is difficult to predict with certainty, but there are scientific linkages between the two. Some scientists anticipate an increase in mosquito-borne diseases due to changing climate conditions creating suitable habitats for mosquitoes (CDC 2013). Projections of climate change for New Jersey predict more intense rainfall events and increases in total annual precipitation (see Section 3.3.4). Increased rainfall and heavy rainfalls increase the chances of standing water where mosquitos breed (National Geographic 2022). Projected warming temperatures across New Jersey (see Section 3.3.4) are likely to increase the length of the insect season, increasing the potential rates of transmission of insect borne disease. Localized changes in climate and human interaction may also be a factor in the spread of disease.

7.1.6 Cascading Impacts on Other Hazards

There are no known cascading impacts that disease outbreaks can have on other hazards of concern for Sussex County. However, disease outbreak events can require changes to emergency response and sheltering procedures to prevent the spread of disease.

7.2 VULNERABILITY AND IMPACT ASSESSMENT

All of Sussex County is at risk from the impacts of disease outbreak events. 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.

7.2.1 Life, Health, and Safety

Overall Population

The entire population of Sussex County (144,221) is vulnerable to the disease outbreak hazard. Healthcare providers and first responders have an increased risk of exposure due to their frequent contact with infected populations. Areas with a higher population density also have an increased risk of exposure or transmission of disease due to their proximity to potentially infected people.

Maintaining certain key functions is important to preserve life and decrease societal disruption during disease outbreaks. Heat, clean water, waste disposal, and corpse management all contribute to public health. Ensuring functional transportation systems also protects health by making it possible for people to access medical care and by transporting food and other essential goods. Critical infrastructure groups have a responsibility to maintain public health, provide public safety, transport medical supplies and food, implement a pandemic response, and maintaining societal functions. If these workers were absent due to pandemic outbreak, these systems will fail (Cybersecurity and Infrastructure Security Agency n.d.).

Socially Vulnerable Population

Persons 65 years and older, persons living in a nursing home or long-term care facility, and persons with underlying medical conditions such as diabetes, severe obesity, serious heart conditions, etc. are at a higher risk of getting severely ill (CDC 2020).

Without a quantitative assessment of potential impacts of a disease outbreak 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 7-4 summarizes highlights of this information. For planning purposes, it is reasonable to assume that percentages and distribution of socially vulnerable populations affected by a disease outbreak will be similar to the countywide numbers.

Table 7-4. 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
			Vernon (Twp)	Walpack (Twp)	Walpack (Twp)	Sparta (Twp)
Population Over 65	**25,451**	**17.65%**	**3,687**	**100.00%**	**7**	**13.38%**
			Sparta (Twp)	Lafayette (Twp)	Walpack (Twp)	Walpack (Twp)
Population Under 5	**6,500**	**4.51%**	**1,160**	**7.21%**	**0**	**0.00%**
Non-English-			Hopatcong (B)	Hamburg (B)	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack
Speaking Population	**1,922**	**1.33%**	**339**	**10.17%**	**0**	**0.00%**
Population With			Vernon (Twp)	Franklin (B)	Walpack (Twp)	Walpack (Twp)
Disability	**15,697**	**10.88%**	**2,318**	**17.32%**	**0**	**0.00%**
Population Below			Vernon (Twp)	Sussex (B)	Walpack (Twp)	Walpack (Twp)
Poverty Level	**7,320**	**5.08%**	**877**	**18.03%**	**0**	**0.00%**
Households Below			Vernon (Twp)	Sussex (B0	Branchville (B)	Green (Twp)
ALICE Threshold	**14,428**	**21%**	1,833	**48%**	90	**14%**

Note: B = Borough; Twp = Township

7.2.2 General Building Stock

No structures are anticipated to be directly affected by disease outbreaks.

7.2.3 Community Lifelines and Other Critical Facilities

While the structures of critical facilities and infrastructure will not be impacted by a disease outbreak, the demand for community lifeline services may increase, and the effect of absenteeism on workers will impact the ability to meet that rising demand.

The most significant impact on critical facilities would be the increase in hospitalization and emergency room visits that would take place as a result of the outbreak. This would create a greater demand on these critical facilities, their staff, and resources. The healthcare system may be severely taxed, if not overwhelmed, from the large number of illnesses requiring hospitalization and critical care. Ventilators can be face critical shortage if an outbreak of a respiratory disease were to occur (Homeland Security Council 2006).

Mortuary services could be impacted due to the increased numbers of deaths. The timely, safe, and respectful disposition of the deceased is an essential component of an effective response. Pandemic influenza may quickly rise to the level of a catastrophic incident that results in mass fatalities, which will place extraordinary demands on local jurisdictions (Homeland Security Council 2006).

7.2.4 Economy

Costs associated with the activities undertaken to address disease outbreaks have not been quantified in available documentation. The COVID-19 pandemic had significant economic impacts across the State of New Jersey. Over the course of two months, New Jersey lost nearly 720,000 jobs as businesses were forced to close their doors and residents entered a period of quarantine. This sudden halt of business activity forced the closure of schools, emptied the state's typically busy roads, and disrupted a previously healthy economy. Every industry sector in New Jersey declined by at least some margin. The leisure and hospitality sector, which includes restaurants and casinos, lost nearly twice as many as any other sector, and accounted for 28 percent of all jobs lost during that time. Employment levels in the retail trade and health care sectors each declined by more than 100,000 jobs. Most of the decline in health care was due to temporary closures and limited capacity of ambulatory care services such as dentist's offices and other outpatient care centers. Many small businesses did not make it through the COVID-19 pandemic, and those that did had to significantly reduce payrolls to make ends meet (New Jersey Department of Labor and Workforce Development 2021).

7.2.5 Natural, Historic and Cultural Resources

Natural

While disease outbreaks do not have an impact on the environment, mitigation efforts against disease outbreak may have such an impact. Pesticides used to control disease-carrying insects such as mosquitos and ticks could leach into waterways and harm nearby terrestrial species. These pesticides have been reviewed by the EPA and U.S. Department of Health, and New Jersey's Pesticide Regulations state that, "no person shall distribute, sell, offer for sale, purchase, or use any pesticide which has been suspended or canceled by the EPA, except as provided for in the suspension of cancellation order" (New Jersey Department of Environmental Protection 2020).

Historic

Disease outbreak may limit access to historic resources. During the COVID-19 pandemic, historic monuments, facilities, and sites imposed restricted access to minimize the spread of the disease. The limitation of access during a disease outbreak can assist in lowering the rate of contraction.

Cultural

Similar to historic resources, cultural resources may have limited access during a disease outbreak to minimize the spread of disease.

7.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

Overall, the County's vulnerability to the disease outbreak hazard has not changed, and the entire County will continue to be vulnerable to this hazard. Any change in vulnerability since the previous HMP would be attributed to changes in population density and new development. This updated HMP used updated building stock and critical asset inventories to assess the County's risk to these assets. The building inventory was updated using RSMeans 2022 values, which are more current and reflect replacement cost rather than the building stock improvement values reported in the 2021 HMP. Further, the 2021 5-year population estimates from the American Community Survey were used to evaluate the population exposed to the hazard areas.

7.4 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.

7.4.1 Potential or Planned Development

Any areas of growth could be impacted by the disease outbreak hazard because the entire planning area is exposed. As population counts change in the County, there may be increased risk from certain diseases. Higher concentrations of persons traveling via public transportation may become more vulnerable to the exchange of disease through airborne transmission. Increase development in rural areas may expose a higher percentage of the population to insect-borne diseases.

7.4.2 Projected Changes in Population

Changes in population density could influence the number of persons exposed to disease outbreaks. Higher density jurisdictions are at risk of greater exposure to disease outbreak. Density may also reduce available basic services provided by critical facilities such as hospitals and emergency facilities. Further, as the population ages there may be increased risk to this demographic. Older adults and people who have severe underlying medical conditions like heart or lung disease or diabetes seem to be at higher risk for developing more serious complications from certain diseases, such as COVID-19.

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

7.4.3 Climate Change

Changes in the environment may create a more livable habitat for vectors carrying disease (CDC 2021). Localized changes in climate and human interaction may also be a factor in the spread of disease. The question of whether rising temperatures will increase the number of mosquitoes that can transmit malaria among humans (rather than just shift their range) has been the subject of debate. Some researchers point out that climate is not the only force at work in increasing the spread of infectious diseases. Other factors, such as expanded rapid travel and evolution of resistance to medical treatments, are already changing the ways pathogens infect people, plants, and animals. As climate change accelerates it is likely to work synergistically with many of these factors, especially in populations increasingly subject to massive migration and malnutrition (Baker, et al. 2021).

8. DROUGHT

8.1 HAZARD PROFILE

8.1.1 Hazard Description

Drought is a deficiency in precipitation over an extended period, usually a season or more, resulting in a water shortage causing adverse impacts on vegetation, animals, or people. It is a normal, recurrent feature of climate that occurs in virtually all climate zones, from very wet to very dry. Drought is a temporary aberration from normal climatic conditions and can vary significantly from one region to another. Human factors, such as water demand and water management, can exacerbate the impact that a drought has on a region (NIDIS 2020).

Anomalies of precipitation and temperature may last from several months to several decades. How long they last depends on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale (NIDIS n.d.).

Drought can be characterized in one or more of the following ways:

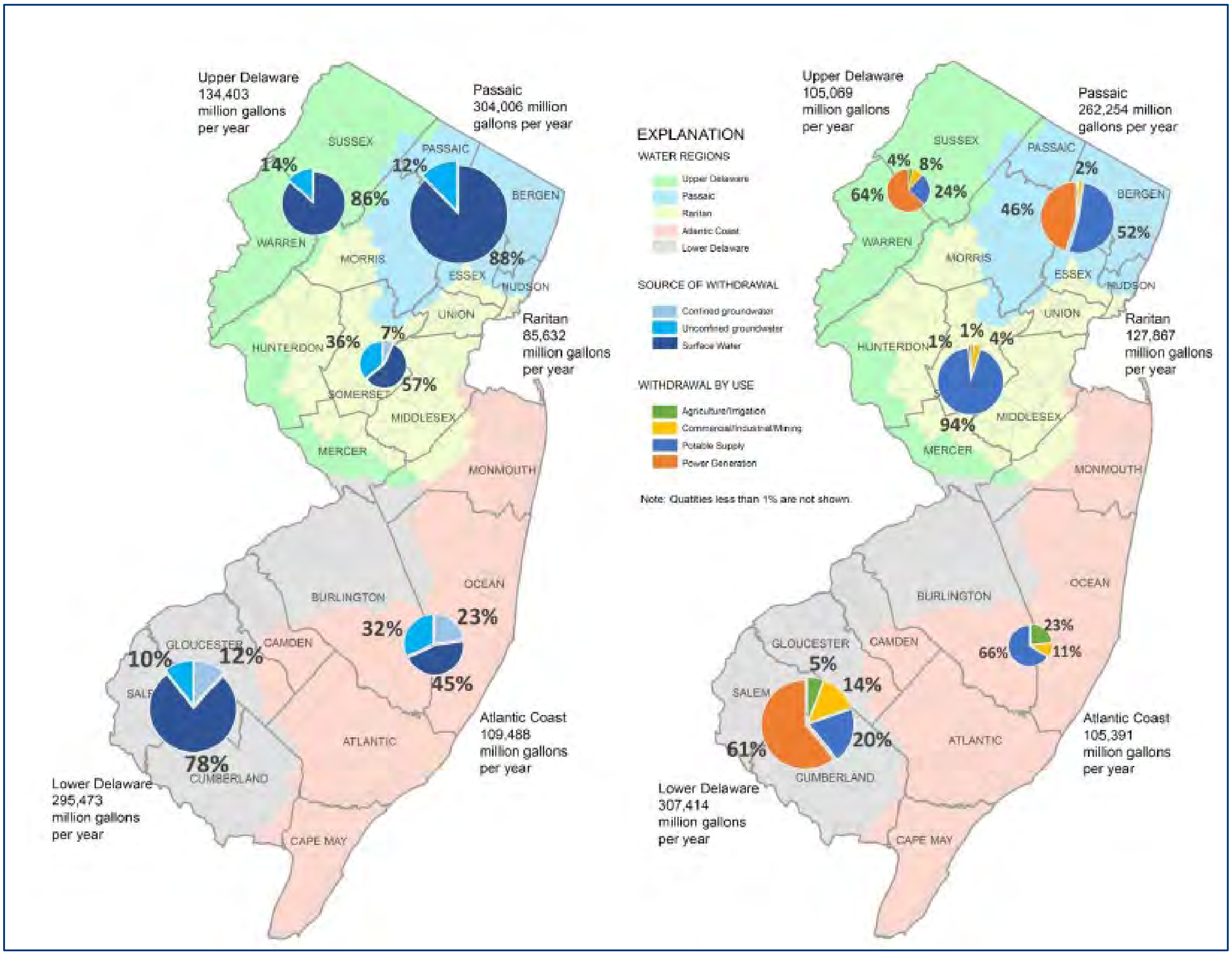
- ***Meteorological drought*** is a measure of the departure of precipitation from normal. It is defined solely by the relative degree of dryness. Due to climatic differences, what might be considered a drought in one location may not be a drought in another location (NDMC n.d.).
- ***Agricultural drought*** links drought to agricultural impacts, focusing on precipitation shortages, evapotranspiration, soil water deficits, reduced ground water or reservoir levels, and other parameters. It occurs when there is not enough water available for a particular crop to grow at a particular time (NDMC n.d.).
- ***Hydrological drought*** is defined by stream flows and reservoir, lake, and groundwater levels being below normal levels due to precipitation shortfalls (NDMC n.d.).
- ***Socioeconomic drought*** occurs when the demand for an economic good exceeds supply because of a weather-related shortfall in water supply. The supply of many economic goods depends on the weather (for example water, forage, food grains, fish, and hydroelectric power) (NDMC n.d.).
- ***Ecological drought*** is a prolonged and widespread deficit in naturally available water supplies that create multiple stresses across ecosystems (NDMC n.d.).

Meteorological and hydrological droughts pose the greatest threat to Sussex County and regional water supplies. Droughts such as these may lead to other impacts such as socioeconomic droughts, by impacting access to water for residents and businesses.

8.1.2 Water Supply and Water Use

Water resources are important to both society and ecosystems. Humans depend on reliable, clean supply of drinking water to sustain their health. Water is also needed for agriculture, energy production, navigation, recreation, and manufacturing. Understanding water supplies and withdrawal trends can assist in identifying the lifelines most at risk from drought. There are five water regions in New Jersey. Sussex County is primarily in the Upper Delaware water region, with a small area along the southeast border with Passaic County located in the Passaic water region (see Figure 8-1).

Figure 8-1. Water Regions, Sources, and Withdrawal by Sector in New Jersey



Source: New Jersey Department of Environmental Protection 2017

The water supply sources in the Upper Delaware water region are surface water and unconfined groundwater (NJDEP 2022). The majority of water withdrawal is for power generation, followed by potable water supply, commercial/industrial/mining, and agriculture. Water use trends vary from month to month, typically peaking in summer when outdoor and irrigation demands are high (EPA 2010).

Drought affects groundwater sources, but generally not as quickly as surface water supplies. Groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. Reduced replenishment of groundwater affects streams also. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest (NJDEP 2021).

Water Suppliers

According to the NJ Drinking Water Watch List, there are 483 suppliers of water to Sussex County (New Jersey Drinking Water Watch 2023). Only two of these provide water from surface water sources. The remaining 481 are sourced from groundwater.

The U.S. Environmental Protection Agency classifies water suppliers into three categories (EPA 2022):

- **Community Water System**—A public water system that supplies water to the same population year-round
- **Non-Transient Non-Community Water System**—A public water system that regularly supplies water to at least 25 of the same people at least six months per year. Examples are schools, factories, office buildings, and hospitals that have their own water systems
- **Transient Non-Community Water System**—A public water system that provides water in a place such as a gas station or campground where people do not remain for long periods of time

Overall, in Sussex County, 340 sources are transient non-community water suppliers, 77 are non-transient non-community suppliers, 62 are community suppliers, and 4 are non-public water supplies. Some County residents and organizations also rely on private wells for their water supply needs (New Jersey Drinking Water Watch 2023).

Agricultural Uses

Farms are at a higher risk for drought impacts than other types of land use, as crop growth relies on water. According to the 2017 Census of Agriculture, Sussex County is home to 1,008 farms covering 59,755 acres. About 407 acres are irrigated (USDA 2017). Table 8-1 summarizes agricultural areas in Sussex County jurisdictions.

8.1.3 Location

New Jersey is divided into six drought regions based on hydrogeologic conditions, watershed boundaries, municipal boundaries, water supply characteristics, and rainfall patterns. Sussex County is located in the Northwest Drought Region, which also includes Warren County and a portion of Hunterdon County (see Figure 8-2). Drought region boundaries are contiguous with municipal boundaries because municipal police forces serve as the primary enforcement mechanism for restrictions during a water emergency (Hoffman 2001). For planning purposes, the drought hazard is assumed to be constant across each state drought region.

8.1.4 Extent

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts (NOAA 2022). The State of New Jersey uses a multi-index system to determine the severity of a drought (NJDEP 2021).

U.S. Drought Monitor

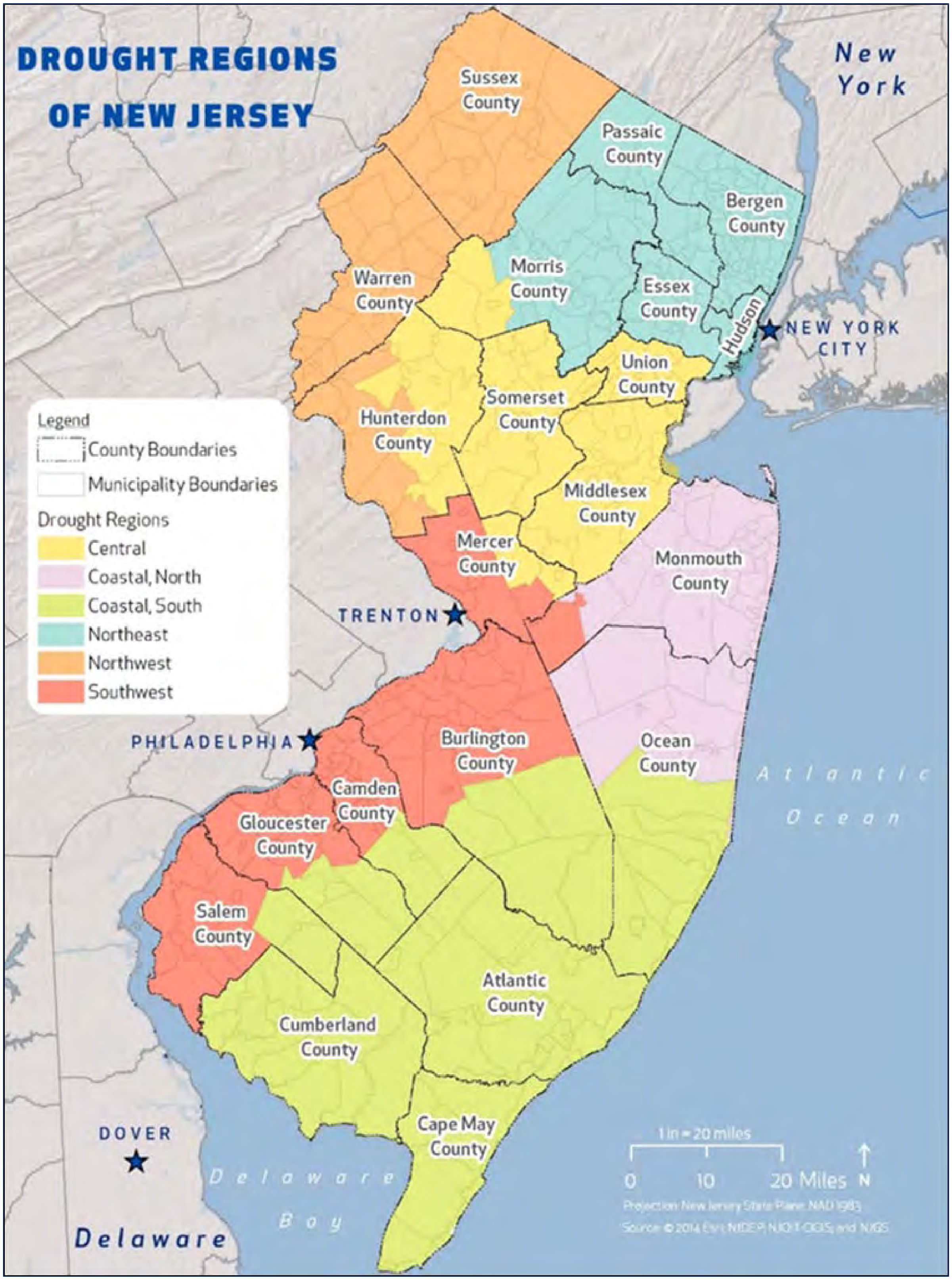
The U.S. Drought Monitor uses six classifications for drought: normal conditions, abnormally dry (D0), moderate drought (D1), severe drought (D2), extreme drought (D3), and exceptional drought (D4). Table 8-2 describes these drought categories. Moderate and severe droughts have short-term impacts, typically last less than six months, and primarily affect agriculture and grasslands. Extreme and exceptional droughts have longer-term impacts, typically last longer than six months, and affect hydrology and ecology (NIDIS 2023).

Table 8-1. Agricultural Land Use Area by Jurisdiction

Jurisdiction	Total Area (Acres)	Agriculture	
		Area (Acres)	Percent of Total Area
Andover (B)	872	211	24.2%
Andover (Twp)	13,304	1,407	10.6%
Branchville (B)	383	7	1.9%
Byram (Twp)	14,536	74	0.5%
Frankford (Twp)	22,585	4,360	19.3%
Franklin (B)	2,833	188	6.6%
Fredon (Twp)	11,464	2,619	22.8%
Green (Twp)	10,429	2,575	24.7%
Hamburg (B)	747	10	1.3%
Hampton (Twp)	16,305	1,959	12.0%
Hardyston (Twp)	20,892	985	4.7%
Hopatcong (B)	7,949	25	0.3%
Lafayette (Twp)	11,499	2,930	25.5%
Montague (Twp)	29,840	1,088	3.6%
Newton (T)	2,164	42	1.9%
Ogdensburg (B)	1,438	13	0.9%
Sandyston (Twp)	26,926	1,841	6.8%
Sparta (Twp)	24,828	1,007	4.1%
Stanhope (B)	1,341	0	0.0%
Stillwater (Twp)	18,076	1,509	8.3%
Sussex (B)	399	8	1.9%
Vernon (Twp)	44,769	1,756	3.9%
Walpack (Twp)	15,945	369	2.3%
Wantage (Twp)	43,175	9,761	22.6%
Sussex County (Total)	342,701	34,745	10.1%

Source: NJDEP 2015
Note: B = Borough; T = Town; Twp = Township

Figure 8-2. Drought Regions of New Jersey



Source: State of New Jersey 2019

Table 8-2. Palmer Drought Category Descriptions

Category	Description	Possible Impacts	Palmer Drought Index
D0	Abnormally Dry	Going into drought—short-term dryness slowing planting and growth of crops or pastures; fire risk above average. Coming out of drought—some lingering water deficits; pastures or crops not fully recovered.	–1.0 to –1.99
D1	Moderate drought	Some damage to crops and pastures; fire risk high; streams, reservoirs, or wells low; some water shortages developing or imminent; voluntary water-use restrictions requested.	–2.0 to –2.99
D2	Severe drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.	–3.0 to –3.99
D3	Extreme drought	Major crop or pasture losses; extreme fire danger; widespread water shortages or restrictions.	–4.0 to –4.99
D4	Exceptional drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies.	–5.0 or less

Source: NDMC 2023

Palmer Drought Severity Index

The Palmer Drought Severity Index (PDSI) is primarily based on soil conditions. Soil with decreased moisture content is the first indicator of an overall moisture deficit. Table 8-2 lists the PDSI classifications. A value of zero represents normal conditions, and drought is indicated by negative numbers. For example, –2 is moderate drought, –3 is severe drought, and –4 is extreme drought. The PDSI reflects above-normal precipitation using positive numbers; this is not shown in Table 8-2 (NDMC 2023).

New Jersey State Watches, Warnings, and Emergencies

The New Jersey Department of Environmental Protection (NJDEP) Division of Water Supply and Geoscience regularly monitors water supply conditions in the state. The NJDEP can declare individual regions as being within one of the following four stages of water supply drought (NJDEP 2023, NJDEP 2021):

- ***Normal Conditions*** indicate no drought conditions are present. There is routine monitoring of water supply and meteorological indicators.
- A ***Drought Watch*** is issued when drought or other factors begin to adversely affect water supply conditions. A watch indicates that conditions are dry but not significantly so. During a drought watch, NJDEP closely monitors drought indicators (including precipitation, stream flows, reservoir and ground water levels, and water demand) and consults with affected water suppliers. The aim of a drought watch is to avert a more serious water shortage that would necessitate declaration of a water emergency and the imposition of mandatory water use restrictions, bans on water use, or other potentially drastic measures.
- A ***Drought Warning*** represents a non-emergency phase of managing water supplies during the developing stages of drought. Under a drought warning, the commissioner of the NJDEP may order water purveyors to develop alternative sources of water or transfer water from areas of the state with more water to those with less. While mandatory water use restrictions are not imposed, the general public is strongly urged to use water sparingly in affected areas.
- A ***Drought Emergency*** can only be declared by the governor. Efforts initiated under a water emergency focus on reducing water demand. A phased approach to restricting water consumption is typically initiated. Phase I water use restrictions typically target non-essential, outdoor water use.

8.1.5 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Sussex County has been included in two major disaster (DR) or emergency (EM) declarations for drought-related events (FEMA 2024). Table 8-3 lists these declarations.

Table 8-3. FEMA Declarations for Drought Events in Sussex County

Event Date	Declaration Date	Declaration Number	Description
August 18, 1965	August 18, 1965	DR-205	Drought: Water Shortage
October 19, 1980	October 19, 1980	EM-3083	Drought: Water Shortage

Source: 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 declarations issued for drought (USDA 2024).

Previous Events

Known drought events that impacted Sussex County between January 2020 and June 2024 are listed in Table 8-4. For events prior to 2020, refer to the 2021 Sussex County HMP.

8.1.6 Probability of Future Occurrences

Probability Based on Previous Occurrences

Based on risk factors and past occurrences, it is likely that Sussex County will continue to experience direct and indirect impacts of drought on occasion, with secondary effects causing potential disruption or damage to agricultural activities and creating shortages in community water supplies. Based on historical records and input from the Steering Committee, the probability of occurrence for drought in the County is considered "occasional."

Effect of Climate Change on Future Probability

The pressure on water resources due to diverse water demands are likely to be worsened by future climate change. Warming is projected by the end of the 21st century. Increases in the number of extremely hot days and decreases in the number of extremely cold days are projected to accompany the overall warming. These trends will affect the probability and frequency of dry conditions that could lead to drought events in Sussex County.

Projections of climate change for New Jersey predict more intense rainfall events and increases in total annual precipitation (see Section 3.3.4). However, decreases in the amount of precipitation may occur in the summer months, resulting in greater potential for more frequent and prolonged droughts (NJDEP 2020). This follows the trend of increased extreme weather. With isolated precipitation in between long stretches of dry weather, wildfires, riverine flooding, and degraded water supply can all happen over the course of a year. The County is vulnerable to droughts, especially along the Delaware River, where the temperatures increase dramatically and severe runoff from dry soils can cause degraded water supply (Cornell University 2021).

Table 8-4. Drought Events in Sussex County (2020 to 2024)

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration ?	Location Impacted	Description
March 17 – -30, 2020	N/A	N/A	Sussex County	Rating of D0 or "abnormally dry" across Sussex County
July 7 – August 11, 2020	N/A	N/A	Sussex County	Rating of D0 or "abnormally dry" across Sussex County
May 4 – June 8, 2021	N/A	N/A	Sussex County	Rating of D0 or "abnormally dry" across Sussex County
February 1 – April 12, 2022	N/A	N/A	Sussex County	Rating of D0 or "abnormally dry" across Sussex County
July 12, 2022 – January 31, 2023	N/A	N/A	Sussex County	Rating of D0 or "abnormally dry" across Sussex County
August 9 – November 17, 2022	N/A	N/A	Sussex County	New Jersey was under a statewide drought watch as drought and heat strained water supplies. Water conservation was urged. Stream flow and ground water levels were below normal for most of the state, and some reservoirs were dropping quickly.
August 23 – December 27, 2022	N/A	N/A	Sussex County	Rating of D1 or "moderate drought" across Sussex County
August 30 – September 13, 2022	N/A	N/A	Sussex County	Rating of D2 or "moderate drought" across Sussex County
April 4 – May 2, 2023	N/A	N/A	Sussex County	Rating of D0 or "abnormally dry" across Sussex County
May 30 – July 11, 2023	N/A	N/A	Sussex County	Rating of D0 or "abnormally dry" across Sussex County
April 18 – May 2, 2023	N/A	N/A	Sussex County	Rating of D1 or "moderate drought" across Sussex County
June 20 – July 4, 2023	N/A	N/A	Sussex County	Rating of D1 or "moderate drought" across Sussex County
June 20 – July 20, 2023	N/A	N/A	Sussex County	The state urged residents and businesses to use water wisely due to dry conditions and the start of summer. Statewide, rainfall in New Jersey was less than half of normal over the preceding 30 days.

Source: Natonal Integrated Drought Information System 2023; FEMA 2023; National Drought Monitoring Center 2023

8.1.7 Cascading Impacts on Other Hazards

Drought can lead to increasing temperatures and evaporation of moisture, which are ideal dry conditions for wildfires. Dry, hot, and windy weather combined with dry vegetation makes areas more susceptible to wildfires. Additionally, droughts can lead to the following (NIDIS 2019):

- Long-term damage to crop quality and crop losses
- Insect infestation leading to crop losses and reduced tree canopy
- Reduction in the ability to perform outdoor activities, resulting in loss of tourism and recreation opportunities

8.2 VULNERABILITY AND IMPACT ASSESSMENT

All of Sussex County is at risk from the impacts of drought. 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.

8.2.1 Life, Health, and Safety

Overall Population

The entire population of Sussex County (144,221) is exposed to drought events. Drought conditions can cause a shortage of potable water for human consumption, both in quantity and quality. A decrease in available water may also impact power generation and availability to residents.

Public health impacts may include an increase in heat-related illnesses, waterborne illnesses, recreational risks, and limited food availability. Other possible impacts include increased recreational risks; effects on air quality; diminished living conditions related to energy, air quality, and sanitation; compromised food and nutrition; and increased incidence of illness and disease. Some drought-related health effects are short-term while others can be long-term (CDC 2021).

Socially Vulnerable Population

Some populations are particularly susceptible to the drought hazard due to age, health conditions, or limited ability to mobilize to medical resources. Without a quantitative assessment of potential impacts of a drought 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 8-5 summarizes highlights of this information. For planning purposes, it is reasonable to assume that percentages and distribution of socially vulnerable populations affected by a drought will be similar to the countywide numbers.

8.2.2 General Building Stock

No structures are anticipated to be directly affected by a drought event. However, droughts contribute to conditions conducive to wildfires and reduce fire-fighting capabilities. Wildfire fuel tends to be most plentiful in areas where development densities are lowest, which works to reduce losses to the general building stock. The wildfire risk to buildings is greatest in two areas:

- **The wildland-urban interface**—Where forested areas adjoin urbanized areas
- **Wildfire fuel hazard areas**—Where predominant plant species are highly susceptible to wildfire

8.2.3 Community Lifelines and Other Critical Facilities

Droughts have the potential to impact agriculture-related facilities, critical facilities, and lifelines that are associated with water supplies, such as water used for fire-fighting. Water systems and thus distribution to the population may also be impacted by drought conditions. The impacts droughts cause to agricultural-related facilities are particularly important to Sussex County due to its large area devoted to farmland. Critical facilities and lifelines in and adjacent to the wildfire hazard areas are also considered vulnerable to drought.

Table 8-5. 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			Vernon (Twp)	Walpack (Twp)	Walpack (Twp)	Sparta (Twp)
	25,451	**17.65%**	**3,687**	**100.00%**	**7**	**13.38%**
Population Under 5			Sparta (Twp)	Lafayette (Twp)	Walpack (Twp)	Walpack (Twp)
	6,500	**4.51%**	**1,160**	**7.21%**	**0**	**0.00%**
Non-English-Speaking Population			Hopatcong (B)	Hamburg (B)	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack
	1,922	**1.33%**	**339**	**10.17%**	**0**	**0.00%**
Population With Disability			Vernon (Twp)	Franklin (B)	Walpack (Twp)	Walpack (Twp)
	15,697	**10.88%**	**2,318**	**17.32%**	**0**	**0.00%**
Population Below Poverty Level			Vernon (Twp)	Sussex (B)	Walpack (Twp)	Walpack (Twp)
	7,320	**5.08%**	**877**	**18.03%**	**0**	**0.00%**
Households Below ALICE Threshold			Vernon (Twp)	Sussex (B0	Branchville (B)	Green (Twp)
	14,428	**21%**	1,833	**48%**	90	**14%**

Note: B = Borough; Twp = Township

8.2.4 Economy

The impacts of drought can be economic, environmental, or social, including reduced crop yield, increased fire hazard, reduced water levels, reduced outdoor activities, and damage to wildlife and fish habitat. When drought conditions persist, water restrictions may be put into place by local or state governments. This may include limitations on lawn watering, car washing services, or any recreational/commercial outdoor uses of water. Water withdrawals for the commercial, industrial, and mining sectors may be affected, as well as for power generation.

Increased demand for water and electricity can also result in shortages and higher costs for these resources. Industries that rely on water for business could be impacted the most (e.g., landscaping businesses). Although most businesses will still be operational, they may be impacted aesthetically. These aesthetic impacts are most significant within the recreation and tourism industry. Moreover, droughts in another area could impact the food supply and price of food for residents within the County (North Carolina State University 2013).

When a state of water emergency is declared in New Jersey, the NJDEP may impose mandatory water restrictions and require specific actions to be taken by water suppliers, though the New Jersey Water Supply Plan calls for water emergencies to cause as little disruption as possible to commercial activity and employment (NJDEP 2017).

The agricultural industry is most at risk in terms of economic impact and damage from drought. For example, crops may not mature, leading to a lessened crop yield, wildlife and livestock may become undernourished, land values could decrease, and ultimately there could be a financial loss for the farmer. Crop shortages can in turn lead to increases in the price of food (North Carolina State University 2013). Based on the 2017 Census of Agriculture, Sussex County farms had a total market value of $10.8 million for crops and $7.4 million for livestock (USDA 2017).

8.2.5 Natural, Historic and Cultural Resources

Natural

Droughts can impact the environment if they trigger wildfires, increase insect infestations, or exacerbate the spread of disease (Intergovernmental Panel on Climate Change 2016). Droughts impact water resources that are relied upon by aquatic and terrestrial species. Ecologically sensitive areas, such as wetlands, can be particularly vulnerable to drought periods because they are dependent on steady water levels and soil moisture to sustain growth. These types of habitats can be negatively impacted after long periods of dryness (NJDEP 2017).

Droughts also have the potential to lead to water pollution due to the lack of rainwater to dilute any chemicals in water sources. Contaminated water supplies may be harmful to plants and animals. If water is not getting into the soil, the ground will dry up and become unstable. Unstable soils increase the risk of erosion and loss of topsoil (North Carolina State University 2013).

Historic

The primary impacts on historic resources from drought would be an increased risk of wildfires, which could threaten these assets, and impacts on structure foundations from the shrink-swell cycle of expansive soils.

Cultural

The primary impacts on cultural resources from drought would be an increased risk of wildfires, which could threaten these assets, and impacts on structure foundations from the shrink-swell cycle of expansive soils.

Droughts may impact the traditional and customary practices of indigenous persons, who rely on healthy terrestrial ecosystems. These practices may include the collection of plants, animals, and minerals and other practices.

Drought impacts on agriculture in the County could negatively impact events associated with agriculture including farmers markets and harvest festivals.

8.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

Since the 2021 HMP update, the total population across the County has experienced a slight decrease, which can place less stress on the water supply during a drought event. However, the number of farm operations has increased since the 2012 USDA report by over 10 percent, which may increase the overall stress on the water supply during a drought event.

8.4 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.

8.4.1 Potential or Planned Development

The New Jersey Water Supply Plan indicates that seasonal outdoor water use is rising statewide and is attributable to continued suburbanization and increases in residential and commercial lawn and landscape maintenance. Changes in water demand by commercial/industrial users will depend on future development of this water use and whether efficiency techniques are effectively implemented (NJDEP 2017).

8.4.2 Projected Changes in Population

Potable water use is the second largest water use sector and largest consumptive use in New Jersey. As such, population projections, per capita water use, and non-residential water use are important factors to consider when assessing future water needs.

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

Even though the population is projected to decrease, any changes in the distribution of the population can impact the source of water resources required to sustain the user demand of each household, agricultural operation, and business operation.

8.4.3 Climate Change

The State of New Jersey is expected to see an increase in average annual temperatures. Additionally, the state is projected to experience more frequent droughts, which will affect the availability of water supplies, placing an increased stress on the population and their available potable water. Agricultural needs may increase if the climate grows warmer but may decrease if more efficient irrigation techniques are adopted broadly or if precipitation increases. A decrease in water supply, or increase in water supply demand, may increase the County’s vulnerability to structural fire and wildfire events. Critical water-related service sectors may need to adjust management practices and actively manage resources to accommodate future changes.

9. EARTHQUAKE

9.1 HAZARD PROFILE

9.1.1 Hazard Description

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. The process of breaking generates vibrations called seismic waves. These waves travel outward from the source of the earthquake at varying speeds and ultimately result in potentially damaging movement of the earth's surface.

Earthquake Geology

Tectonic Plates

The earth's crust, which is the rigid outermost shell of the planet, is broken into seven or eight major tectonic plates (depending on how they are defined) and many minor plates. Where the plates meet, they move in one of three ways along their mutual boundary: convergent (two plates moving toward one another), divergent (two plates moving apart), or transform (two plates moving parallel to one another). Earthquakes, volcanic activity, mountain-building, and oceanic trench formation occur along these plate boundaries. Subduction is a geological process that takes place at convergent boundaries of tectonic plate, in which one plate moves under another. Regions where this process occurs are known as subduction zones, and they have the potential to generate highly damaging earthquakes.

Faults

Geologists have found that earthquakes reoccur along faults, which are zones of weakness in the earth's crust. When a fault experiences an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake can still occur. In fact, relieving stress along one part of a fault may increase it in another part.

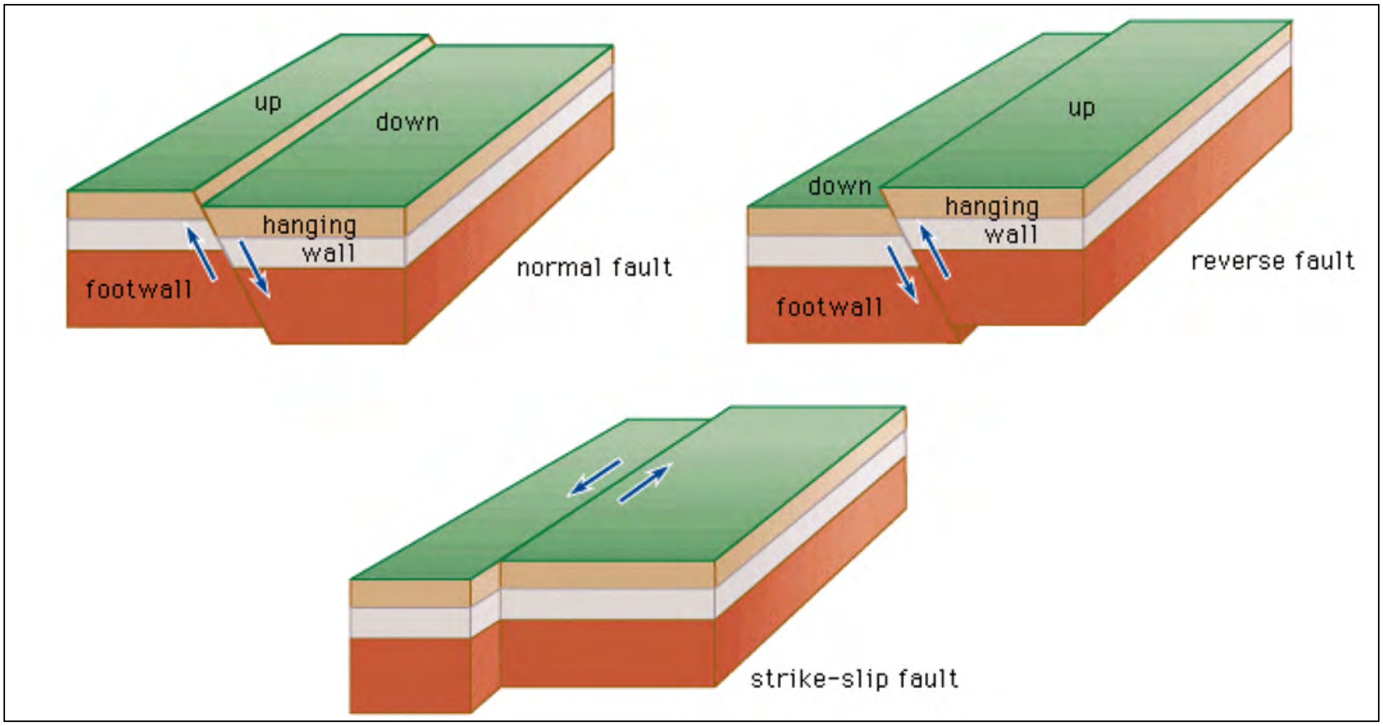
Faults are more likely to have future earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve the accumulating tectonic stresses. Geologists classify faults by their relative hazards. "Active" faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). "Potentially active" faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years) (Machette 2000).

Earthquake-Related Hazards

An earthquake hazard is anything associated with an earthquake that may affect people's normal activities. This includes the following (Earthquake Hazard Program n.d.):

- **Surface Faulting**—Displacement that reaches the earth's surface during slip along a fault. Commonly occurs with shallow earthquakes, those with an epicenter less than 12 miles. Figure 9-1 illustrates three types of surface faults.

Figure 9-1. Surface Fault Types



Source: Encyclopedia Britannica, Inc., 1994

- **Ground Motion (shaking)**—The movement of the earth's surface produced by waves that are generated by sudden slip on a fault and travel through the earth from the fault to the surface.
- **Liquefaction**—A process by which water-saturated soils temporarily lose strength and act as a fluid. Earthquake shaking can cause this effect. When liquefaction occurs, the strength of the soil decreases and the soil's ability to support foundations for buildings and bridges is reduced. Liquefaction has been responsible for tremendous amounts of damage in historical earthquakes around the world.

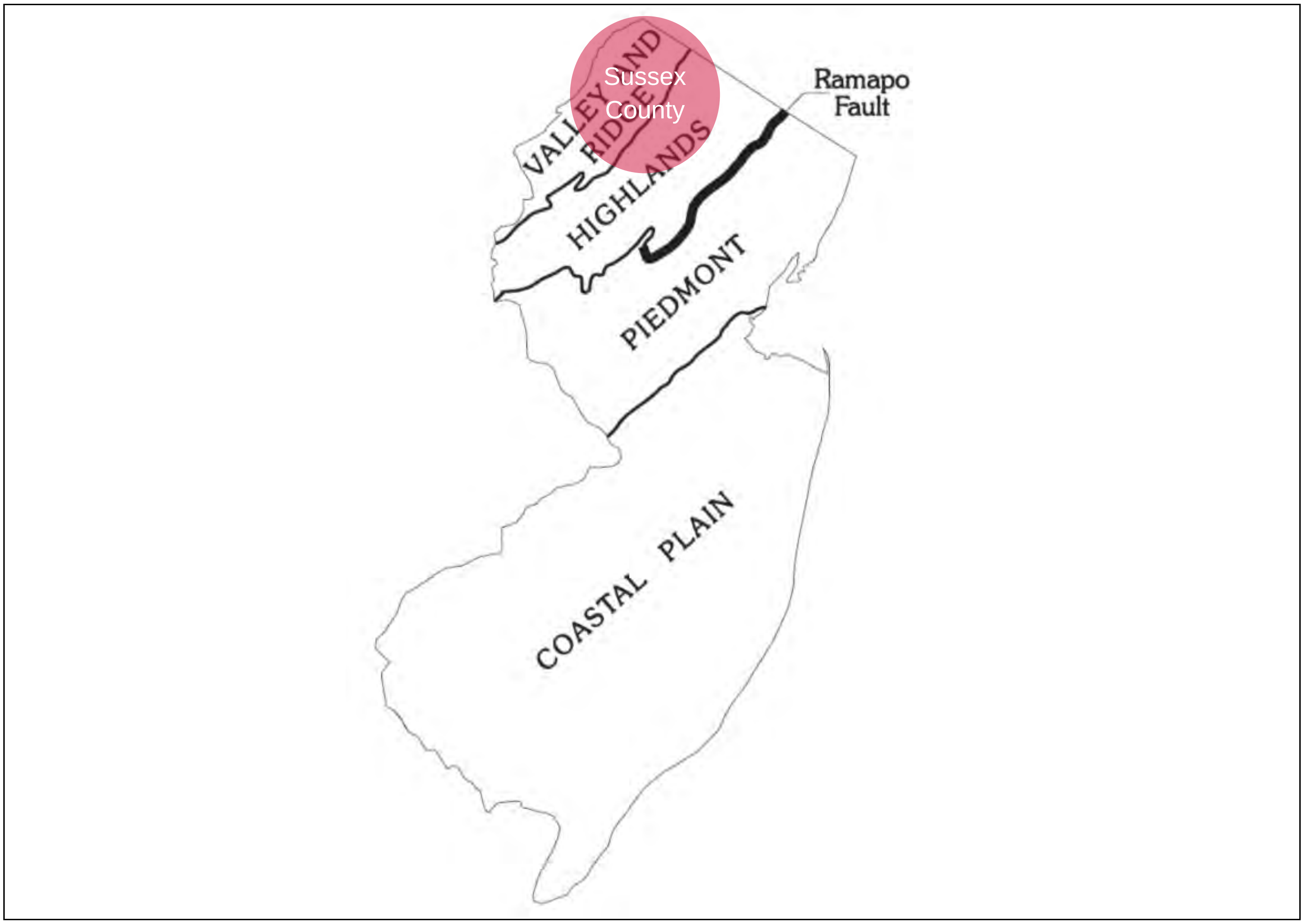
Shaking behavior and liquefaction susceptibility of soils are determined by their grain size, thickness, compaction, and degree of saturation. These properties, in turn, are determined by the geologic origin of the soils and their topographic position. Earthquake damage is least likely on rock or dense soils that resist motion and most likely on softer soils that can amplify ground shaking because they are susceptible to movement and liquefaction. One contributor to this amplification is the velocity at which the rock or soil transmits shear waves. The National Earthquake Hazard Reductions Program (NEHRP) has classified soils as follows, based on their shear-wave velocity:

- A—Hard Rock (greatest shear-wave velocity and least amplification of earthquake impacts)
- B—Rock
- C—Very dense soil and soft rock
- D—Stiff soils
- E—Soft soils (lowest shear-wave velocity and greatest amplification of earthquake impacts)
- F—Special soil requiring site-specific analysis

9.1.2 Location

Earthquakes in New Jersey are most likely in the northern part of the state, including Sussex County, where significant fault lines are concentrated. Most earthquakes in the state have occurred along faults in the central and eastern Highlands, with the Ramapo fault being the most seismically active fault in the region. The Ramapo Fault separates the Piedmont and Highlands Physiographic Provinces, as shown in Figure 9-2. Although the fault line is not within Sussex County, the County may still feel the effects of an earthquake along the Ramapo Fault due to its proximity. The Reservoir Fault, which borders the Green Pond Mountain region, is another major fault line in the state and is even closer to Sussex County than the Ramapo Fault (Volkert and Witte 2015).

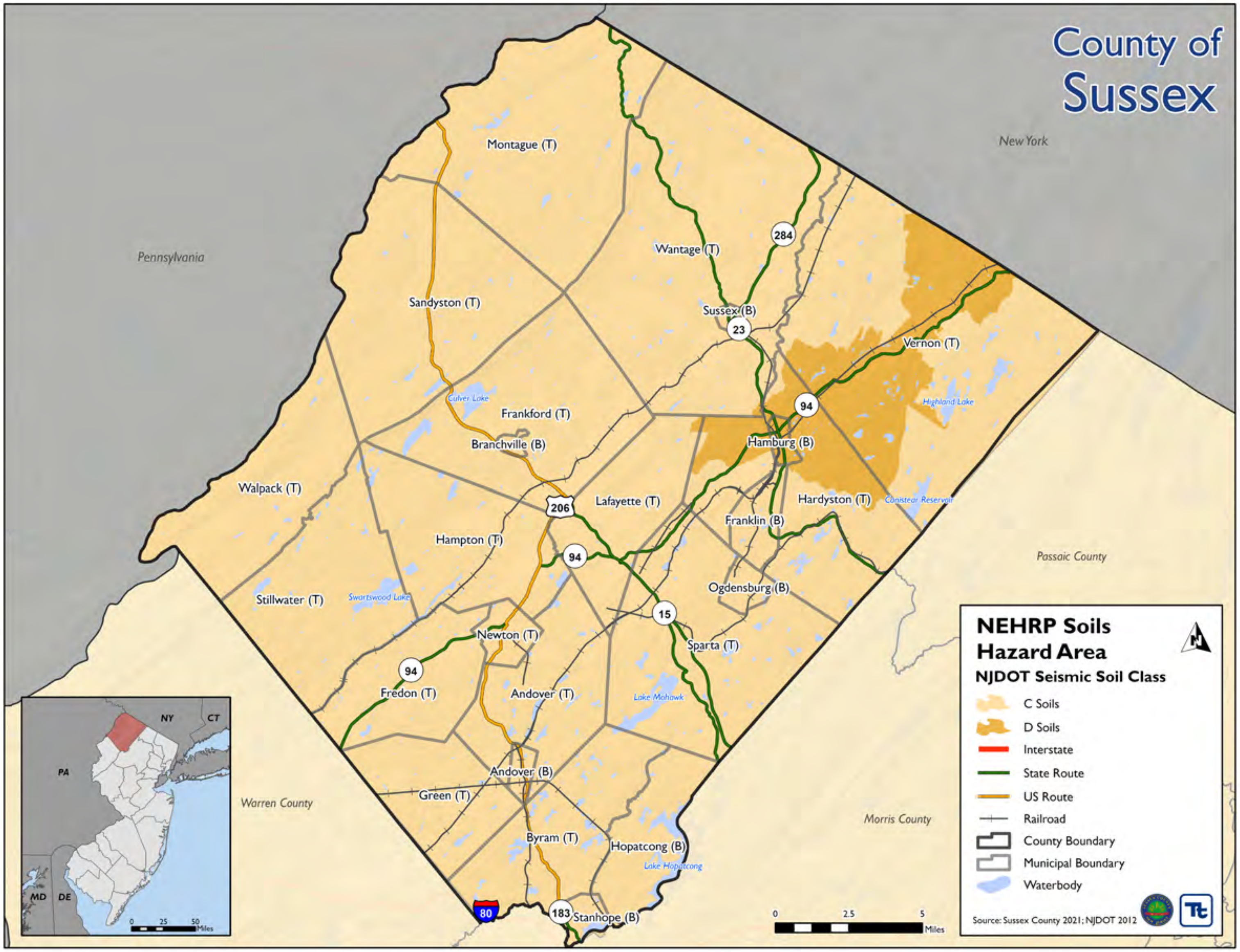
Figure 9-2. Physiographic Provinces of New Jersey and the Ramapo Fault Line



Source: Dombroski 1973 (revised 2005)

The New Jersey Department of Transportation (NJDOT) developed a Geotechnical Database Management System, which contains soil boring data across New Jersey. The soil boring logs were used to classify soil sites. Through this analysis, NJDOT developed a map of soil site classes according to ZIP codes in the state where each ZIP code was assigned a class based on its predominant soil condition. In Sussex County, most ZIP codes were classified as "C," and a few were rated as "D", as shown in Figure 9-3 (NJOEM 2019)

Figure 9-3. NEHRP Soils in Sussex County as Mapped by NJDOT



9.1.3 Extent

The severity of an earthquake can be determined by factors such as amount of seismic energy released; duration of shaking; depth of focus (hypocenter); distance from epicenter; geological, geographic, and topographic setting; population and building density; and even time of day (Reger 2023). These factors define earthquake magnitude and intensity. The magnitude is the energy released at the location of the earthquake-generating event. Intensity is the earthquake energy felt at any given location within the range of the earthquake's impacts. An earthquake has only one magnitude and one epicenter, but its intensity varies throughout the region, depending on the distance from the earthquake, local rock and soil conditions, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust.

Magnitude

Earthquake magnitude is commonly expressed by ratings on the moment magnitude scale (M_W). This scale is based on the total moment release of the earthquake (the product of the distance a fault moved, and the force required to move it). The scale is as follows (U.S. Geological Survey 2021):

- Great—Mw > 8
- Major—Mw = 7.0 – 7.9
- Strong—Mw = 6.0 – 6.9
- Moderate—Mw = 5.0 – 5.9
- Light—Mw = 4.0 – 4.9
- Minor—Mw = 3.0 – 3.9
- Micro—Mw < 3

Historically, Sussex County has not experienced a major-magnitude earthquake. However, small earthquakes may occur several times a year and generally do not cause significant damage. The largest earthquake to impact Sussex County was a magnitude 5.3 with an epicenter located in New York City (NJOEM 2019).

Intensity

The Modified Mercalli Scale is the most commonly used scale of earthquake intensity. Ratings of the scale, as well as the perceived shaking and damage potential for structures, are shown in Table 9-1. Damage levels experienced in an earthquake vary with the intensity of ground shaking and with the seismic capacity of structures, as noted in Table 9-2.

Ground Motion

During an earthquake when the ground is shaking, it also experiences acceleration. Instruments called seismometers record levels of ground acceleration due to earthquakes at stations throughout a region. From this data, estimates are developed of the annual probability that certain ground motion accelerations will be exceeded (USGS 2019). The most commonly mapped ground motion parameters are horizontal and vertical peak ground accelerations (PGA) for a given soil type. PGA is a measure of how hard the earth shakes, or accelerates, in a given geographic area. PGA is measured as a percentage of the acceleration due to gravity (%g). These readings are recorded by state and federal agencies that monitor and predict seismic activity (USGS 2019).

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. Short-period seismic motions are of concern for smaller structures such as single-family dwellings. Longer period response components determine the lateral forces that damage larger structures (apartment buildings, factories, high-rises, bridges) (USGS 2019). Table 9-3 lists damage potential and perceived shaking by PGA factors, compared to the Mercalli scale.

Table 9-1. Modified Mercalli Scale

Mercalli Intensity	Description
I	Felt by very few people; barely noticeable.
II	Felt by few people, especially on upper floors.
III	Noticeable indoors, especially on upper floors, but may not be recognized as an earthquake.
IV	Felt by many indoors, few outdoors. May feel like passing truck.
V	Felt by almost everyone, some people awakened. Small objects move; trees and poles may shake.
VI	Felt by everyone; people have trouble standing. Heavy furniture can move; plaster can fall off walls. Chimneys may be slightly damaged.
VII	People have difficulty standing. Drivers feel their cars shaking. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings; considerable in poorly built buildings.
VIII	Well-built buildings suffer slight damage. Poorly built structures suffer severe damage. Some walls collapse.
IX	Considerable damage to specially built structures; buildings shift off their foundations. The ground cracks. Landslides may occur.
X	Most buildings and their foundations are destroyed. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, and lakes. The ground cracks in large areas.
XI	Most buildings collapse. Some bridges are destroyed. Large cracks appear in the ground. Underground pipelines are destroyed.
XII	Almost everything is destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move.

Source: USGS 1989

Table 9-2. Damage Levels Experienced in Earthquakes

Ground Motion	Explanation of Damages
1-2%g	Motions are widely felt by people; hanging plants and lamps swing strongly, but damage levels, if any, are usually very low.
Below 10%g	Usually causes only slight damage, except in unusually vulnerable facilities.
10 - 20%g	May cause minor-to-moderate damage in well-designed buildings, with higher levels of damage in poorly designed buildings. At this level of ground shaking, only unusually poor buildings would be subject to potential collapse.
20 - 50%g	May cause significant damage in some modern buildings and very high levels of damage (including collapse) in poorly designed buildings.
≥50%g	May causes higher levels of damage in many buildings, even those designed to resist seismic forces.

Source: NJOEM 2019
Note: %g = Peak Ground Acceleration as a percentage of the acceleration due to gravity

Table 9-3. Modified Mercalli Scale and PGA Equivalents

Mercalli Intensity	PGA (%g)	Perceived Shaking	Potential Damage
I	<0.17%	Not Felt	None
II-III	0.17% - 1.4%	Weak	None
IV	1.4% - 3.9%	Light	None
V	3.9% - 9.2%	Moderate	Very Light
VI	9.2% - 18%	Strong	Light
VII	18% - 34%	Very Strong	Moderate
VIII	34% - 65%	Severe	Moderate to Heavy
IX	65% - 124%	Violent	Heavy
X - XII	>124%	Extreme	Very Heavy

Source: USGS 1989

Figure 9-4 and Figure 9-5 show geographic distributions of the Modified Mercalli Scale based on PGA across Sussex County for 500-year and 1,000-year mean return period (MRP) events at the census-tract level. A 500-year MRP event is an earthquake with 0.2-percent chance that mapped ground motion levels will be exceeded in any given year. A 1,000-year MRP is an earthquake with 0.1 percent chance that mapped PGAs will be exceeded in any given year.

National Seismic Hazard Map

USGS has developed National Seismic Hazard Maps. that provide information for creating and updating seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities, and land use planning. The 2023 map, shown in Figure 9-6, represents the best currently available data as determined by the USGS.

Shake Maps

The USGS Earthquake Hazards Program produces maps called ShakeMaps that map ground motion and shaking intensity following significant earthquakes. ShakeMaps focus on the ground shaking caused by the earthquake, rather than on characteristics of the earthquake source, such as magnitude and epicenter. A ShakeMap shows the extent and variation of ground shaking across the surrounding region following significant earthquakes. Such mapping is derived from peak ground acceleration amplitudes recorded on seismic sensors, with interpolation where data is lacking based on estimated amplitudes. Color-coded instrumental intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. In addition to the maps of recorded events, the USGS creates the following:

- Scenario ShakeMaps of hypothetical earthquakes of an assumed magnitude on known faults.
- Probabilistic ShakeMaps, based on predicted shaking from earthquakes over a 10,000-year period. In a probabilistic map, information is combined to make a forecast for the future. The maps indicate the ground motion at any given point that has a given probability of being exceeded in a given timeframe.

Figure 9-4. Peak Ground Acceleration 500-Year Mean Return Period for Sussex County

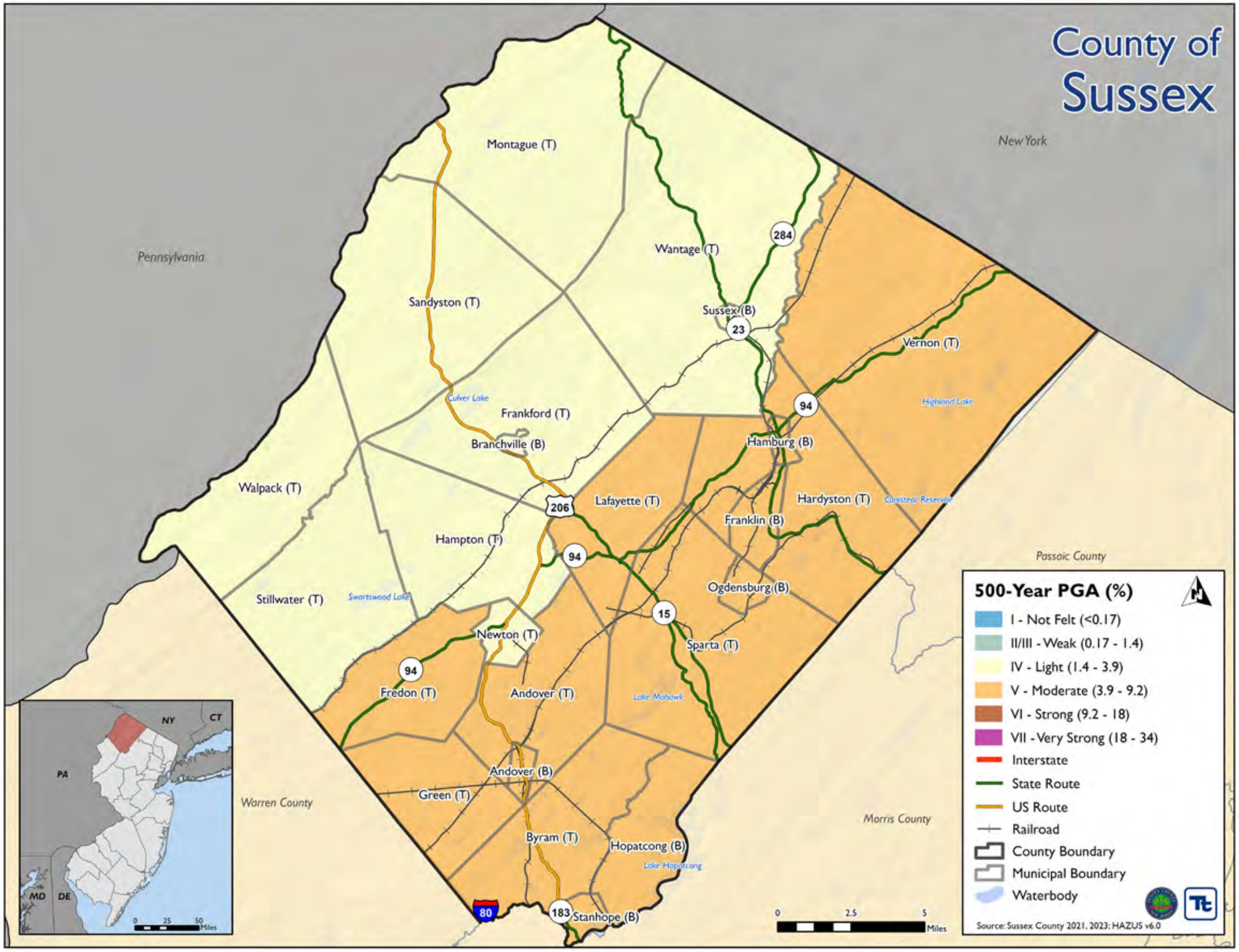


Figure 9-5. Peak Ground Acceleration 1,000-Year Mean Return Period for Sussex County

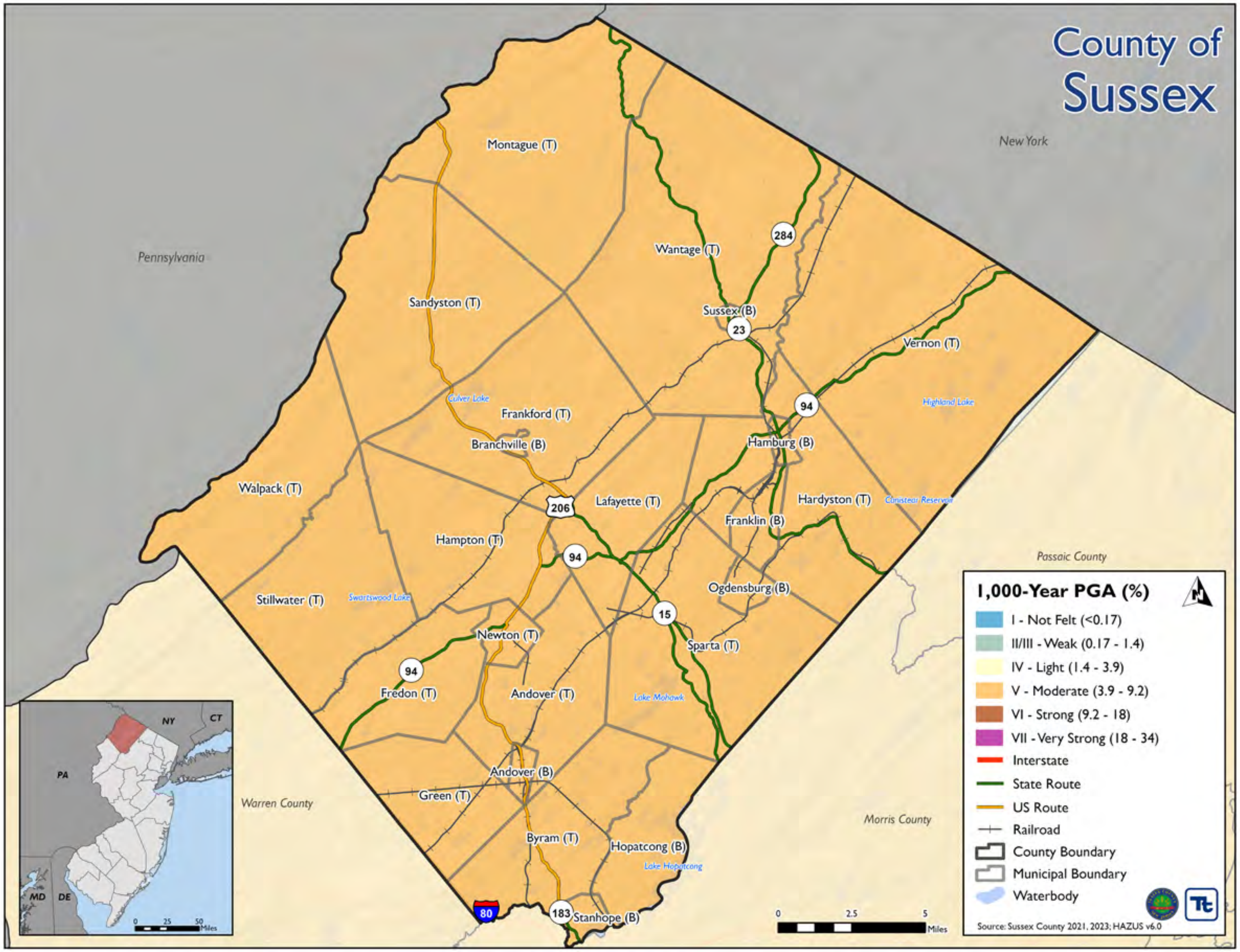
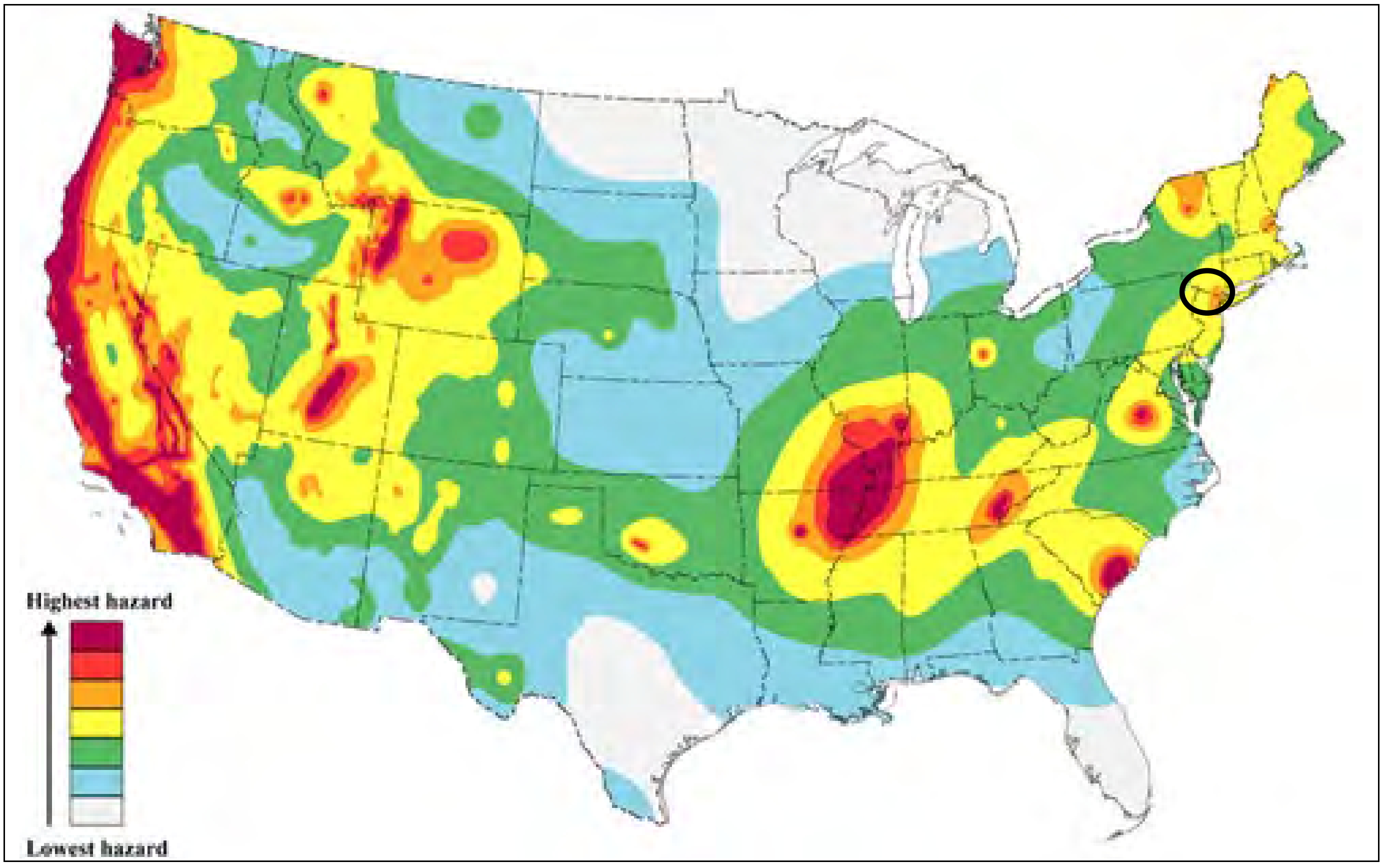


Figure 9-6. 2023 USGS National Seismic Hazard Map of the Contiguous United States



Source: USGS 2024
Note: Approximate location of Sussex County is indicated by the black circle

9.1.4 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Sussex County has not been included in any major disaster (DR) or emergency (EM) declarations for earthquake-related events (FEMA 2023).

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 earthquake-related agricultural disaster declarations (USDA 2024).

Previous Events

Figure 9-7 shows the locations of earthquake events that had epicenters in Sussex County. Known events that impacted Sussex County between January 2020 and June 2024 are discussed in Table 9-4. For events prior to 2020, refer to the 2021 Sussex County HMP.

Figure 9-7. Previous Earthquakes with Epicenters in Sussex County

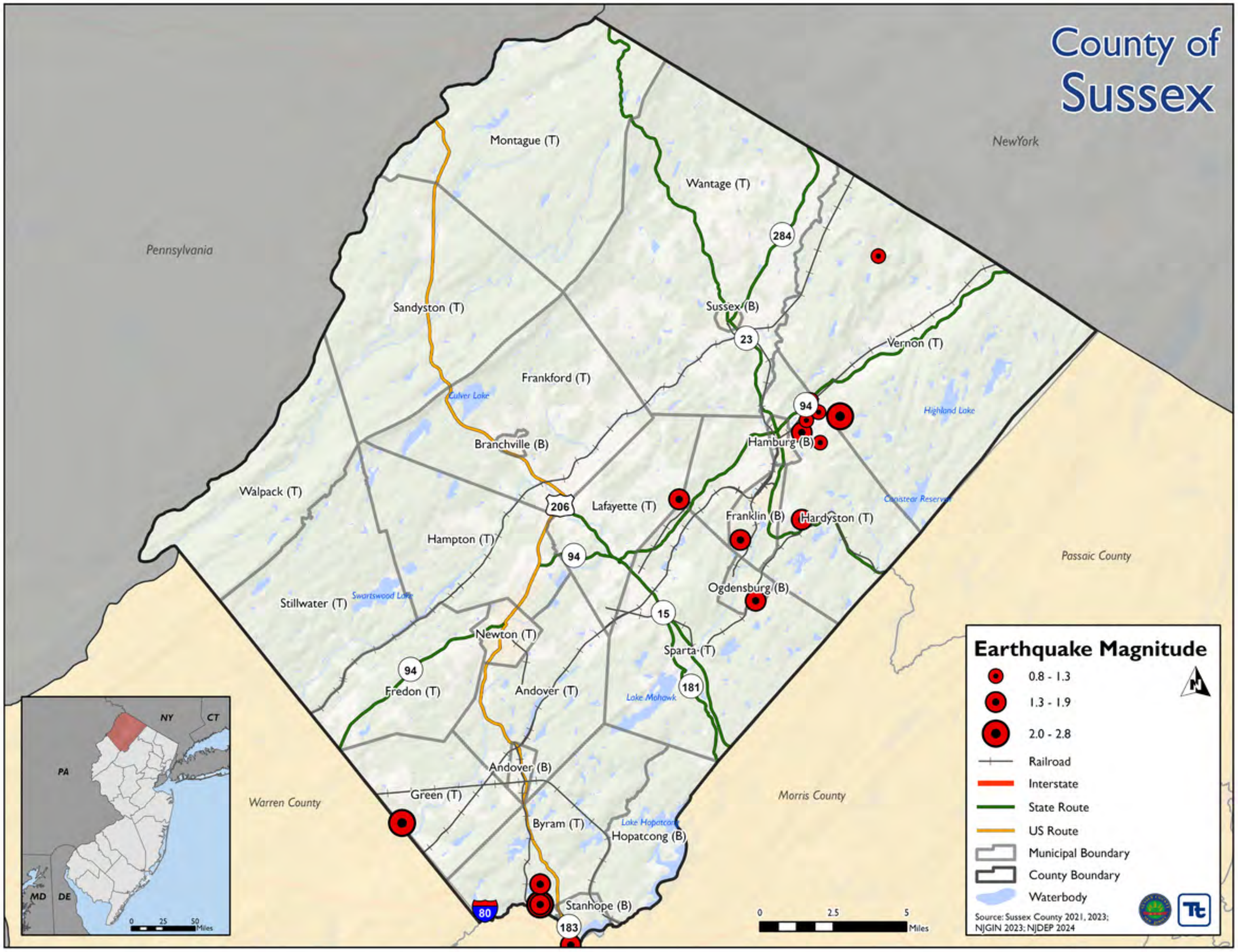


Table 9-4. Earthquake Events in Sussex County (2020 to 2024)

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
September 9, 2020	N/A	N/A	Marlboro, NJ	A magnitude 3.1 earthquake in Marlboro, NJ was faintly felt in Sussex County.
April 5, 2024	N/A	N/A	Tewksbury Township, NJ	A magnitude 4.8 earthquake in Tewksbury Township, NJ was felt in Sussex County.

Source: NOAA-NCEI 2023; NJDEP 2024

9.1.5 Probability of Future Occurrences

Probability Based on Previous Occurrences

Information on previous earthquakes with an epicenter in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 9-5. Based on historical records and input from the Steering Committee, the probability of occurrence for earthquake in the County is considered “rare.”

Table 9-5. Probability of Future Earthquake Events in Sussex County

Hazard Type	Number of Occurrences Between 1977 and 2023	Percent Chance of Occurring in Any Given Year
Earthquake	20	42.55%

Source: NJDEP 2024
Note: The number of occurrences is restricted to earthquakes with an epicenter in Sussex County. The lowest magnitude recorded was a 0.8, and the highest magnitude recorded was a 2.8.

Effect of Climate Change on Future Probability

The only current science indicating possible impacts of climate change on the occurrence of earthquakes relates to melting glaciers. Some research has suggested that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the Earth’s crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. National Aeronautics and Space Administration (NASA) and USGS scientists found that retreating glaciers in southern Alaska might be opening the way for future earthquakes (NJOEM 2019). The lack of glaciers in New Jersey and the surrounding area make it unlikely that glacier retreat will increase the occurrence of earthquake in Sussex County. Therefore, no change in future probability is expected due to climate change.

9.1.6 Cascading Impacts on Other Hazards

Earthquakes can cause large and sometimes disastrous landslides and mudslides, as they create stresses that make weak slopes fail. Any steep slope is vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils.

Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes. The most common mode of earthquake-induced dam failure is slumping or settlement of earth-fill dams where the fill has not been property compacted. If the slumping occurs when the dam is full, then overtopping of the dam, with rapid erosion leading to dam failure is possible. Dam failure is also possible if strong ground motions heavily damage concrete dams. Earthquake-induced landslides into reservoirs have also caused dam failures.

Unless properly secured, hazardous materials can be released during an earthquake, causing significant damage to the environment and people.

9.2 VULNERABILITY AND IMPACT ASSESSMENT

A vulnerability analysis was conducted for the county's assets using NEHRP soil data sourced from NJDOT and Sussex County (2012, 2021). The degree of direct earthquake impact on people and property depends on factors such as the age and construction type of residences and other buildings, the soil type that buildings are built on, and the intensity of the earthquake. Softer soils can amplify ground shaking to damaging levels even during a moderate earthquake, increasing the risk of personal harm and property damage. The vulnerability analysis defined the hazard area as all areas with Type C and D soil types (the two most vulnerable soil types present in Sussex County).

A probabilistic assessment to estimate potential losses for the 500-year and 1,000-year MRP events was conducted through a Level 2 analysis in Hazus v6.

9.2.1 Life, Health, and Safety

Overall Population

Overall, risk to public safety and loss of life in the County is minimal for the low-magnitude events common in New Jersey. People in or near the built environment, particularly those near unreinforced masonry construction, are at higher risk. According to a report by the New York City Area Consortium for Earthquake Loss Mitigation, a strong correlation exists between structural building damage and number of injuries and casualties from an earthquake event (NYCEM 2003). Those inside buildings can be harmed as a result of building structural damage. Also at risk are people walking below building ornamentations and chimneys that may be shaken loose and fall. All residents could be faced with indirect impacts: business interruption could prevent people from working, road closures could isolate populations, and loss of function of utilities could impact those who rely on those utilities.

As shown on Figure 9-3 the hazard area for this analysis, defined as areas of NEHRP Type C and D soils, covers all of Susex County. Therefore, the entire County population of 144,221 is vulnerable to the earthquake hazard (see Table 3-4).

The time of day exposes different sectors of the community to the earthquake hazard. Hazus considers residential occupancy to be at its maximum at 2:00 a.m., educational, commercial, and industrial sectors to be at their maximum at 2:00 p.m., and peak commute time to be at 5:00 p.m. Table 9-6 and Table 9-7 show the Hazus-estimated impacts on people for the 500-year and 1,000-year MRP earthquake events, respectively, based on the time of day of the event.

Table 9-6.

Earthquake Population Impacts Based on Time of Day, 500-Year Mean Return Period

	2:00 a.m. Earthquake Event	2:00 p.m. Earthquake Event	5:00 p.m. Earthquake Event
Non-Hospitalized Injuries	0	1	0
Hospitalizations	0	0	0
Fatalities	0	0	0

Source: Hazus v6.0

Table 9-7. Earthquake Population Impacts Based on Time of Day, 1,000-Year Mean Return Period

	2:00 a.m. Earthquake Event	2:00 p.m. Earthquake Event	5:00 p.m. Earthquake Event
Non-Hospitalized Injuries	1	3	1
Hospitalizations	0	0	0
Fatalities	0	0	0

Source: Hazus v6.0

As a result of an earthquake event, residents may be displaced or require temporary to long-term sheltering. The number of people requiring shelter is generally less than the number displaced as some displaced persons use hotels or stay with family or friends following a disaster event. The Hazus analysis of the 500-year and 1,000-year MRP events in Sussex County estimated no displaced households or persons requiring short-term sheltering.

Socially Vulnerable Population

Socially vulnerable populations are most susceptible to impacts from earthquakes due to decreased mobility and financial ability to react or respond during a hazard, and the location and construction quality of their housing. Because the hazard area for this analysis (NEHRP Type C and D soils) covers all of Sussex County, all socially vulnerable populations in the County are vulnerable to the hazard. Section 3.5.3 provides detailed data on socially vulnerable populations within the overall planning area. Table 9-8 summarizes highlights of this information.

9.2.2 General Building Stock

Buildings located on soft soils are at increased risk of damage from an earthquake. The entire general building stock inventory for Sussex County, as summarized in Table 9-9, is located within the defined NEHRP Type C and D soils hazard area. The distribution of these buildings by municipality is shown in Table 3-11.

The Hazus earthquake model analyzed earthquake impacts on the general building stock in Sussex County. The potential damage to buildings from an earthquake is estimated as losses to building structures and contents. There is a strong correlation between PGA and the damage a building might undergo (FEMA 2022). Figure 9-4 and Figure 9-5 show the geographic distribution of PGA across the County for 500-year and 1,000-year MRP events.

In estimating potential loss, Hazus considers building construction type and age. Additional attributes that affect a building’s ability to withstand an earthquake include its age, number of stories, and quality of construction. This information was entered into the Hazus model as available from the custom general building inventory developed for this HMP. Hazus evaluates potential building damage in the following categories: none, slight, moderate, extensive, and complete. Table 9-10 provides definitions of these categories for a light wood-framed building.

Definitions for other building types are included in the Hazus technical manual documentation. Unreinforced masonry buildings are most at risk during an earthquake because the walls are prone to collapse outward; steel and wood buildings absorb more of the earthquake's energy.

Table 9-8. 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 (Twp) **3,687**	Walpack (Twp) **100.00%**	Walpack (Twp) **7**	Sparta (Twp) **13.38%**
Population Under 5	**6,500**	**4.51%**	Sparta (Twp) **1,160**	Lafayette (Twp) **7.21%**	Walpack (Twp) **0**	Walpack (Twp) **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 (Twp) **2,318**	Franklin (B) **17.32%**	Walpack (Twp) **0**	Walpack (Twp) **0.00%**
Population Below Poverty Level	**7,320**	**5.08%**	Vernon (Twp) **877**	Sussex (B) **18.03%**	Walpack (Twp) **0**	Walpack (Twp) **0.00%**
Households Below ALICE Threshold	**14,428**	**21%**	Vernon (Twp) 1,833	Sussex (B0 **48%**	Branchville (B) 90	Green (Twp) **14%**

Note: B = Borough; Twp = Township

Table 9-9. Number and Total Replacement Cost Value of Structures on NEHRP Class C and D Soils

Occupancy Class	Number of Buildings	Replacement Cost Value
Residential	62,412	$30,074,691,358
Commercial	3,345	$24,000,040,348
Industrial	227	$1,581,124,500
Other (government, religion, agriculture, and education)	5,953	$12,855,233,999
Total	71,937	$68,511,090,204

Table 9-10. Example of Structural Damage State Definitions for a Light Wood-Framed Building

Damage	Description
Slight	Small plaster or gypsum-board cracks at corners of door and window openings and wall-ceiling intersections; small cracks in masonry chimneys and masonry veneer.
Moderate	Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.
Extensive	Large diagonal cracks across shear wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in foundations; splitting of wood sill plates and/or slippage of structure over foundations; partial collapse of room-over-garage or other soft-story configurations.

Damage	Description
Complete	Structure may have large permanent lateral displacement, may collapse, or may be in imminent danger of collapse due to cripple-wall failure or the failure of the lateral load resisting system; some structures may slip and fall off the foundations; large foundation cracks.

Source: Hazus Technical Manual

Building damage as a result of the 500-year and 1,000-year MRP earthquakes was estimated using Hazus, as summarized in Table 9-11. No buildings will be severely or completely destroyed by the 500-year MRP event; however, up to 13 will be moderately damaged and 214 will have minor damage. The majority of the losses are estimated to the residential occupancy class. No buildings will be severely or completely destroyed by the 1,000-year MRP event; however, up to 73 will be moderately damaged and 797 will have minor damage. The majority of the losses are estimated to the residential occupancy class.

Table 9-11. Estimated Building Damage (Structure and Contents) for the 500-Year MRP Earthquake Event

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	500-Year MRP Event		1,000-Year MRP Event	
			Building Count	% of All Buildings in Occupancy Class	Building Count	% of All Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	62,412	None	62,221	99.7%	61,660	98.8%
		Minor	182	0.3%	691	1.1%
		Moderate	10	0.0%	61	0.1%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%
Commercial Buildings	3,345	None	3,335	99.7%	3,310	99.0%
		Minor	9	0.3%	29	0.9%
		Moderate	1	0.0%	5	0.1%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%
Industrial Buildings	227	None	223	98.4%	217	95.7%
		Minor	3	1.2%	7	3.1%
		Moderate	1	0.3%	2	1.0%
		Severe	0	0.0%	0	0.1%
		Complete Destruction	0	0.0%	0	0.0%
Government, Religion, Agricultural, and Education Buildings	5,953	None	5,931	99.6%	5,878	98.7%
		Minor	21	0.3%	70	1.2%
		Moderate	1	0.0%	5	0.1%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%

Source: Hazus v6.0; NJGIN 2023; Sussex County 2023.

The Hazus results for potential building damage by occupancy class are summarized in Table 9-12 for the 500-year MRP event. Hazus estimates that there will be $7,186,292 in damage to structures caused by the 500-year

MRP event, with the estimated residential damage being the most expensive at $3,313,410, or 46.1 percent of the total damage. Table 9-13 summarizes the damage to structures for the 1,000-year MRP event. Hazus estimates that there will be $39,538,281 in damage to structures caused by the 1,000-year MRP event, with the estimated residential damage being the most expensive at $16,924,411, or 42.8 percent of the total damage.

Table 9-12. Estimated Building Damage by General Occupancy from the 500-Year MRP Earthquake Event

	Replacement Cost Value (RCV)	Estimated Total Damage	Percent of Total Building and Contents Replacement Cost Value	Estimated Residential Damage	Estimated Commercial Damage	Estimated Damages for All Other Occupancies
Andover (B)	$693,607,785	$100,821	<0.1%	$37,717	$48,352	$14,752
Andover (Twp)	$4,012,892,721	$932,184	<0.1%	$281,712	$475,932	$174,541
Branchville (B)	$598,388,025	$40,229	<0.1%	$15,572	$12,498	$12,159
Byram (Twp)	$3,162,144,222	$259,577	<0.1%	$130,788	$96,504	$32,286
Frankford (Twp)	$3,491,793,002	$326,176	<0.1%	$166,027	$89,944	$70,206
Franklin (B)	$2,227,977,138	$227,133	<0.1%	$102,129	$81,662	$43,342
Fredon (Twp)	$1,542,422,915	$196,205	<0.1%	$100,923	$14,408	$80,874
Green (Twp)	$1,821,582,867	$467,710	<0.1%	$254,531	$33,512	$179,667
Hamburg (B)	$1,809,235,911	$122,314	<0.1%	$37,700	$45,609	$39,005
Hampton (Twp)	$2,474,023,610	$205,171	<0.1%	$92,061	$52,956	$60,155
Hardyston (Twp)	$3,681,458,622	$294,839	<0.1%	$157,175	$75,526	$62,138
Hopatcong (B)	$3,432,619,929	$335,526	<0.1%	$238,025	$53,527	$43,974
Lafayette (Twp)	$2,142,628,709	$245,571	<0.1%	$83,855	$51,257	$110,459
Montague (Twp)	$1,659,675,648	$80,023	<0.1%	$37,835	$17,521	$24,667
Newton (T)	$5,699,120,027	$504,321	<0.1%	$164,258	$204,201	$135,862
Ogdensburg (B)	$954,409,603	$94,700	<0.1%	$39,915	$33,453	$21,332
Sandyston (Twp)	$1,350,071,503	$106,454	<0.1%	$36,788	$19,265	$50,401
Sparta (Twp)	$10,316,900,290	$983,465	<0.1%	$404,896	$399,837	$178,731
Stanhope (B)	$1,228,753,628	$112,081	<0.1%	$56,851	$17,069	$38,161
Stillwater (Twp)	$1,611,608,775	$125,162	<0.1%	$74,711	$15,821	$34,631
Sussex (B)	$2,187,092,184	$155,528	<0.1%	$50,390	$71,830	$33,309
Vernon (Twp)	$6,816,863,576	$809,756	<0.1%	$522,622	$104,331	$182,804
Walpack (Twp)	$68,015,712	$3,558	<0.1%	$1,229	$644	$1,684
Wantage (Twp)	$5,527,803,803	$457,786	<0.1%	$225,700	$59,748	$172,338
Sussex County (Total)	$68,511,090,205	$7,186,292	<0.1%	$3,313,410	$2,075,406	$1,797,476

Source: Hazus v6.0; Sussex County 2023; RS Means 2022; NJOGIS, Civil Solutions, Spatial Data Logic
Notes: B – Borough; T – Town; Twp. – Township

Table 9-13. Estimated Building Damage by General Occupancy from the 1,000-Year MRP Earthquake Event

	Replacement Cost Value (RCV)	Estimated Total Damage	Percent of Total Building and Contents Replacement Cost Value	Estimated Residential Damage	Estimated Commercial Damage	Estimated Damages for All Other Occupancies
Andover (B)	$693,607,785	$478,833	0.1%	$164,738	$250,543	$63,553
Andover (Twp)	$4,012,892,721	$4,460,683	0.1%	$1,222,152	$2,404,961	$833,570
Branchville (B)	$598,388,025	$244,227	<0.1%	$80,261	$81,285	$82,681
Byram (Twp)	$3,162,144,222	$1,580,750	<0.1%	$736,834	$654,780	$189,136
Frankford (Twp)	$3,491,793,002	$1,794,558	0.1%	$791,311	$551,371	$451,876
Franklin (B)	$2,227,977,138	$1,302,051	0.1%	$535,619	$537,610	$228,822
Fredon (Twp)	$1,542,422,915	$1,017,955	0.1%	$472,218	$76,107	$469,630
Green (Twp)	$1,821,582,867	$2,040,882	0.1%	$1,043,128	$155,009	$842,745
Hamburg (B)	$1,809,235,911	$791,552	<0.1%	$244,739	$344,427	$202,385
Hampton (Twp)	$2,474,023,610	$1,166,735	<0.1%	$481,222	$333,202	$352,310
Hardyston (Twp)	$3,681,458,622	$1,786,272	<0.1%	$874,075	$556,912	$355,285
Hopatcong (B)	$3,432,619,929	$1,920,998	0.1%	$1,314,048	$371,383	$235,568
Lafayette (Twp)	$2,142,628,709	$1,382,449	0.1%	$403,884	$330,925	$647,639
Montague (Twp)	$1,659,675,648	$507,280	<0.1%	$239,206	$124,607	$143,467
Newton (T)	$5,699,120,027	$2,884,589	0.1%	$866,201	$1,358,706	$659,682
Ogdensburg (B)	$954,409,603	$532,187	0.1%	$222,219	$210,256	$99,711
Sandyston (Twp)	$1,350,071,503	$585,352	<0.1%	$182,320	$127,102	$275,931
Sparta (Twp)	$10,316,900,290	$5,817,335	0.1%	$2,191,932	$2,723,971	$901,432
Stanhope (B)	$1,228,753,628	$655,717	0.1%	$332,042	$121,615	$202,061
Stillwater (Twp)	$1,611,608,775	$709,536	<0.1%	$382,225	$101,022	$226,288
Sussex (B)	$2,187,092,184	$955,724	<0.1%	$263,571	$543,554	$148,599
Vernon (Twp)	$6,816,863,576	$4,312,587	0.1%	$2,719,241	$666,044	$927,302
Walpack (Twp)	$68,015,712	$19,563	<0.1%	$6,093	$4,248	$9,222
Wantage (Twp)	$5,527,803,803	$2,590,469	<0.1%	$1,155,131	$406,890	$1,028,447
Sussex County (Total)	$68,511,090,205	$39,538,281	0.1%	$16,924,411	$13,036,531	$9,577,339

Source: Hazus v6.0; Sussex County 2023; RS Means 2022; NJOGIS, Civil Solutions, Spatial Data Logic
Notes: B – Borough; T – Town; Twp. – Township

Historically, Building Officials Code Administration regulations in the northeast states were developed to address local concerns such as heavy snow loads and wind. Seismic requirements for design criteria are not as stringent as those of the west coast of the United States, which rely on the more seismically focused Uniform Building Code. As such, a smaller earthquake can cause more structural damage in the northeast than an equivalent event would cause in the west.

9.2.3 Community Lifelines and Other Critical Facilities

All critical facilities in Sussex County, as described in Section 3.8 of this HMP, are located on NEHRP Type C or D soils and are therefore vulnerable to the earthquake hazard. The Hazus earthquake model was used to assign average probability of each damage category to the critical facilities in Sussex County for the 500-year and 1,000-year MRP events.

In addition, Hazus estimates the time to restore critical facilities to fully functional use. Results are presented as a probability of being functional at specified time increments (days after the event). For example, Hazus might estimate that a facility has 5 percent chance of being fully functional at Day 3, and a 95 percent chance of being fully functional at Day 90.

As shown in Table 9-14, Hazus estimates that community lifelines will be nearly 100 percent functional immediately after of a 500-year MRP event. Across the community lifeline categories, the average chance of receiving slight or no damage from the 500-year MRP event ranges from 99.3 percent to 100 percent.

As shown in Table 9-15, Hazus estimates that community lifelines will be nearly 100 percent functional by Day 7 after of a 1,000-year MRP event. Across the community lifeline categories, the average chance of receiving slight or no damage from the 1,000-year MRP event ranges from 98.1 percent to 99.9 percent.

9.2.4 Economy

Earthquakes impacts on the economy include loss of business function, damage to inventory, relocation costs, wage loss, and rental costs during to the repair or replacement of buildings. Roads and railroad tracks would undergo damage due to ground failure, resulting in interruptions of regional transportation and of distribution of materials. Losses to the community that would result from damage to lifelines could exceed costs of repair. Earthquake events can significantly affect bridges, many of which provide the only access to certain neighborhoods. Because softer soils generally follow floodplain boundaries, bridges that cross watercourses are particularly vulnerable. Potential impacts on facilities and infrastructure will depend on their age, which correlates with standards in place at times of construction.

Hazus estimates the volume of debris that may be generated as a result of an earthquake event to enable the study region to manage debris removal and disposal. Debris estimates are divided into two categories: reinforced concrete and steel that require special equipment to break up before being transported, and brick, wood, and other debris that can be loaded directly onto trucks with bulldozers (FEMA 2022).

Table 9-16 show Hazus-estimated debris quantities for the 500-year MRP event, including 1,054 tons of debris generated county-wide. The Township of Sparta will generate the most brick/wood debris (132 tons) and the most total debris (145 tons). The Town of Newton will generate the most concrete/steel debris (14 tons). For the 1,000-year MRP event, shown in Table 9-17, Hazus estimates a total of 3,583 tons of debris county-wide; with the greatest quantities in all categories generated in the Township of Sparta—452 tons of brick/wood debris, 14 tons of concrete/steel debris, and 513 tons of total debris.

Table 9-14. Estimated Damage and Loss of Functionality for Community Lifelines in Sussex County for the 500-Year MRP Earthquake Event

	Percent Probability of Sustaining Damage					Percent Functionality			
	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Communications	97.3%	2.0%	0.6%	0.1%	0.0%	97.3%	99.2%	99.9%	99.9%
Energy	98.4%	1.2%	0.3%	<0.1%	0.0%	98.4%	99.6%	99.9%	99.9%
Food, Hydration, Shelter	98.5%	1.2%	0.3%	<0.1%	0.0%	98.4%	99.6%	99.9%	99.9%
Hazardous Materials	98.5%	1.1%	0.3%	<0.1%	0.0%	98.5%	99.6%	99.9%	99.9%
Health and Medical	99.9%	<0.1%	<0.1%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%
Safety and Security	98.4%	1.2%	0.3%	<0.1%	0.0%	98.4%	99.6%	99.9%	99.9%
Transportation	97.3%	2.0%	0.6%	0.1%	0.0%	97.2%	99.2%	99.9%	99.9%

Source: Hazus v6.0; NJGIN 2023; Sussex County 2021, 2023
Notes: MRP = Mean Return Period

Table 9-15. Estimated Damage and Loss of Functionality for Community Lifelines in Sussex County for the 1,000-Year MRP Earthquake Event

	Percent Probability of Sustaining Damage					Percent Functionality			
Name	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Communications	93.4%	4.7%	1.7%	0.2%	0.0%	93.3%	98.0%	99.7%	99.9%
Energy	95.7%	3.2%	1.0%	0.1%	0.0%	95.6%	98.8%	99.8%	99.9%
Food, Hydration, Shelter	95.8%	3.1%	1.0%	0.1%	0.0%	95.7%	98.8%	99.8%	99.9%
Hazardous Materials	95.8%	3.1%	1.0%	0.1%	0.0%	95.8%	98.8%	99.8%	99.9%
Health and Medical	99.7%	0.2%	<0.1%	0.0%	0.0%	99.7%	99.9%	99.9%	99.9%
Safety and Security	95.6%	3.2%	1.0%	0.1%	0.0%	95.6%	98.7%	99.8%	99.9%
Transportation	93.4%	4.7%	1.7%	0.2%	0.0%	93.3%	98.0%	99.7%	99.9%

Source: Hazus v6.0; NJGIN 2023; Sussex County 2021, 2023
Notes: MRP = Mean Return Period

Table 9-16. Estimated Debris Generated by the 500-Year MRP Earthquake Event

	Debris Generated by the 500-Year MRP Earthquake Event		
	Brick/Wood (tons)	Concrete/Steel (tons)	Total Debris (tons)
Andover (B)	10	1	11
Andover (Twp)	80	9	90
Branchville (B)	4	0	4
Byram (Twp)	20	1	22
Frankford (Twp)	32	3	35
Franklin (B)	37	4	41
Fredon (Twp)	25	2	27
Green (Twp)	73	8	80
Hamburg (B)	24	2	26
Hampton (Twp)	31	3	33
Hardyston (Twp)	38	3	41
Hopatcong (B)	34	2	36
Lafayette (Twp)	26	2	28
Montague (Twp)	11	1	12
Newton (T)	116	14	130
Ogdensburg (B)	17	2	19
Sandyston (Twp)	19	2	21
Sparta (Twp)	132	12	145
Stanhope (B)	26	3	28
Stillwater (Twp)	10	1	11
Sussex (B)	30	3	33
Vernon (Twp)	107	9	117
Walpack (Twp)	1	0	1
Wantage (Twp)	56	5	61
Sussex County (Total)	960	93	1,054

Source: Hazus v6.0; Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic
Notes: B – Borough; T – Town; Twp. – Township

Table 9-17. Estimated Debris Generated by the 1,000-Year MRP Earthquake Event

	Debris Generated by the 1,000-Year MRP Earthquake Event		
	Brick/Wood (tons)	Concrete/Steel (tons)	Total Debris (tons)
Andover (B)	31	5	37
Andover (Twp)	245	42	287
Branchville (B)	13	2	14
Byram (Twp)	78	9	86
Frankford (Twp)	108	14	122
Franklin (B)	122	17	139
Fredon (Twp)	83	9	92
Green (Twp)	210	30	240
Hamburg (B)	88	10	99
Hampton (Twp)	107	13	120
Hardyston (Twp)	134	16	149
Hopatcong (B)	127	14	141
Lafayette (Twp)	86	11	96
Montague (Twp)	42	5	47
Newton (T)	351	55	406
Ogdensburg (B)	58	7	65
Sandyston (Twp)	63	8	71
Sparta (Twp)	452	61	513
Stanhope (B)	91	11	102
Stillwater (Twp)	36	3	40
Sussex (B)	90	13	104
Vernon (Twp)	364	42	407
Walpack (Twp)	2	0	2
Wantage (Twp)	185	21	205
Sussex County (Total)	3,165	417	3,583

Source: Hazus v6.0; Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic
Notes: B – Borough; T – Town; Twp. – Township

9.2.5 Natural, Historic and Cultural Resources

Natural

According to USGS, earthquakes can cause damage to the surface of the earth in various forms depending on the magnitude and distribution of the event. Surface faulting can create wide ruptures in the ground that can disconnect habitats for miles, isolating animal species or tearing apart plant roots (USGS n.d.).

Furthermore, ground failure as a result of soil liquefaction can have an impact on soil pores and retention of water resources. The greater the seismic activity and liquefaction properties of the soil, the more likely drainage of groundwater can occur, which depletes groundwater resources. In areas where there is higher pressure of groundwater retention, the pores can build up more pressure and make soil behave more like a fluid than a solid, increasing risk of localized flooding and accumulation of silt (USGS n.d.).

Earthquake-caused landslides or mudslides that fall into streams may significantly impact fish and wildlife habitat, as well as affecting water quality. Hillsides that provide wildlife habitat can be lost for prolonged periods due to landslides.

Historic

Earthquake events could damage property in and around historical landmarks. Many historical buildings and homes may not be built to withstand earthquakes and are more vulnerable than other structures.

Cultural

Earthquake events could bring damage to areas in and around cultural landmarks.

9.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

Overall, the County's vulnerability to the earthquake hazard has not changed, and the entire County will continue to be vulnerable to this hazard. Any change in vulnerability since the previous HMP would be attributed to changes in population density and new development. This updated HMP used updated building stock and critical asset inventories to assess the County's risk to these assets. The building inventory was updated using RSMeans 2022 values, which are more current and reflect replacement cost rather than the building stock improvement values reported in the 2021 HMP. Further, the 2021 5-year population estimates from the American Community Survey were used to evaluate the population exposed to the hazard areas.

9.4 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.

9.4.1 Potential or Planned Development

As discussed in Chapter 3, areas targeted for future growth have been identified across the County. Development in areas with softer NEHRP soil classes, liquefaction, and landslide-susceptibility may experience shifting or cracking in the foundation during earthquakes because of loose soils. However, seismic provisions in current building codes should render new construction less vulnerable to seismic impacts than older construction that may have been built to lower construction standards.

9.4.2 Projected Changes in Population

Changes in the density of population can impact the number of persons exposed to the earthquake hazard. Persons that move into older buildings may increase their overall vulnerability to earthquakes. 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. Sussex County is projected to have a decrease in population in the upcoming years. These projections estimate a population of 140,400 by 2024, 137,300 by 2029, and 136,600 by 2034 (State of New Jersey 2017).

9.4.3 Climate Change

Secondary impacts of earthquakes could be magnified by future climate change. Soils saturated by repetitive storms could experience liquefaction during seismic activity because of the increased saturation. Dams storing increased volumes of water from changes in the hydrograph could fail during seismic events. County assets in areas of saturated soils and on or at the base of steep slopes are at a higher risk of landslides/mudslides because of seismic activity. There are currently no models available to estimate these impacts (NJOEM 2019).

10. FLOOD

10.1 HAZARD PROFILE

10.1.1 Hazard Description

A flood is the inundation of normally dry land resulting from the rising and overflowing of a body of water. Flooding is a natural hazard that typically occurs during prolonged rainfalls over several days, intense rainfalls over a short period of time, or when an ice or debris jam causes a river or stream to overflow onto the surrounding area. Flooding can also result from the failure of a water control structure, such as a dam or levee (NWS 2019). Flood can be exacerbated by changes such as sea level rise or increased precipitation.

Flood events can develop slowly over a period of days or quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states) (FEMA 2021). Floods are frequent and costly natural hazards in New Jersey in terms of human hardship and economic loss. They can cause widespread damage, loss of life, injury, severe water damage to buildings, bridge and road closures, transit service disruptions, and damage to electrical and communication networks.

Flooding commonly includes one or more of the following scenarios (NWS 2019):

- Riverine overbank flooding
- Flash floods
- Alluvial fan floods
- Dam- and levee-break floods
- Local draining or high groundwater levels
- Fluctuating lake levels
- Ice-jams
- Coastal flooding

For this HMP, as deemed appropriate by the Steering Committee, the main flood types of concern are riverine, flash, urban stormwater, and ice jam.

Riverine Flooding

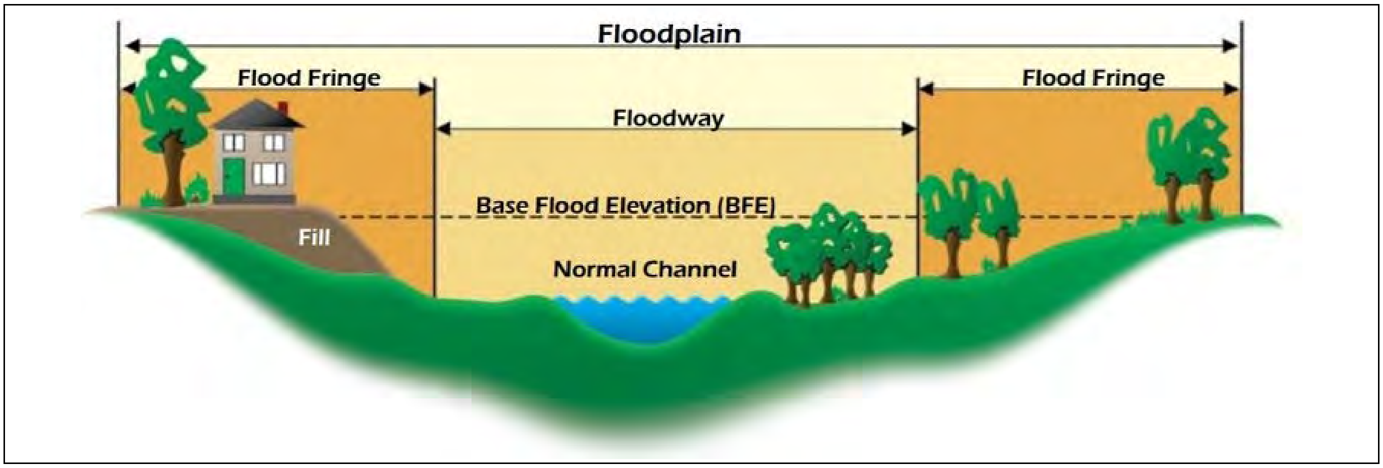
Riverine floods are the most common flood type. They occur along the channels of rivers, creeks, streams, or ditches and include overbank and flash flooding. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas (FEMA 2019).

Riverine flooding is measured by how frequently a given level of flooding occurs. The 1 percent annual chance flood, also referred to as the base flood or 100-year flood, is a flood with a level that has a 1 percent chance of being equaled or exceeded in any given year. Though commonly called the 100-year flood, this flood can occur more than once in a relatively short period of time. Similarly, the flood with a 0.2 percent chance of being equaled or exceeded each year is often called the 500-year flood but can occur more frequently than that (FEMA 2020).

The land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood is called a floodplain. These areas are typically flat land adjacent to a watercourse that is subject to periodic inundation. A floodplain is made up of the following components (refer to Figure 10-1) (FEMA 2019, US DHS 2019):

- **Floodway** is the channel of a river or other waterway and the adjacent land areas that are under water or reserved to carry and discharge the overflow of water caused by flooding.
- **Flood Fringe** is the area within the floodplain but outside the floodway. This area extends from the outer banks of a floodway to the river valley, where the elevation begins to rise.

Figure 10-1. Characteristics of a Floodplain



Sources: FEMA 2022

FEMA prepare maps of the expected floodplains along water courses, based on historical riverine and coastal flooding conditions. In FEMA flood maps, the floodplain inundated by the 1 percent annual chance flood is identified as Special Flood Hazard Area (SFHA). This is the area where flood insurance and floodplain management requirements apply (FEMA 2020). The following are additional definitions relating to flood map:

- **Special Hazard Flood Areas (SFHAs)—**Labeled as Zone A, Zone AO, Zone AH, Zones A1-A30, Zone AE, Zone A99, Zone AR, Zone AR/AE, Zone AR/AO, Zone AR/A1-A30, Zone AR/A, Zone V, Zone VE, and Zones V1-V30.
- **Zone B or Zone X (shaded)—**Moderate flood hazard areas. These are the areas between the limits of the base flood and the 0.2 percent annual chance (or 500-year) flood.
- **Zone C or Zone X (unshaded)—**Areas of minimal flood hazard, outside the SFHA and at higher elevations than the elevation of the 0.2 percent annual chance flood.

Mapped floodplain boundaries may require updating as a result of changes in land use or the amount of impervious surface, the placement of obstructing structures in floodways, changes in precipitation and runoff patterns, improvements in technology for measuring topographic features, or new hydrologic modeling techniques (USGS 2016). Flooding outside of the SFHA area may include stormwater or urban flooding and flash flooding. Urban and stormwater flooding and future conditions (e.g., sea level rise and rainfall areas) are not reflected in FEMA floodplain mapping. As such, FEMA floodplain maps may underestimate flood risk in many areas.

Flash Flooding

Flash floods are floods caused by heavy rainfall in a short period of time, generally less than 6 hours (NWS 2009). These floods are usually characterized by raging torrents after heavy rains that rip through riverbeds, urban streets, or mountain canyons. They can occur within minutes or a few hours of excessive rainfall.

Urban

Stormwater Flooding

Urban stormwater flooding is flooding caused by local drainage issues and high groundwater levels in areas other than delineated floodplains or along recognizable channels. It is generally the result of increased water runoff due to urban development and inadequate drainage systems. If local conditions cannot accommodate intense precipitation through a combination of infiltration and surface runoff, water may accumulate and cause flooding problems. During winter and spring, frozen ground and snow accumulations may contribute to inadequate drainage and localized ponding. Flooding of this nature generally occurs in areas with flat gradients and generally increases with urbanization, which speeds the accumulation of floodwaters because of impervious areas. Shallow street flooding can occur unless channels have been improved to account for increased flows. Urban flooding can inundate streets, underpasses, low lying areas, or storm drains (FEMA 2007).

Drainage systems are designed to remove surface water from developed areas as quickly as possible to prevent flooding on streets and other urban areas. Such systems often make use of a closed conveyance system that channels water away from an urban area to surrounding streams. This bypasses the natural processes of water filtration through the ground, containment, and evaporation of excess water. Because drainage systems reduce the amount of time the surface water takes to reach surrounding streams, flooding in those streams can occur more quickly and reach greater depths than prior to development in that area(Harris 2008). The growing number of extreme rainfall events that produce intense precipitation are resulting in increased urban flooding (Center for Disaster Resilience 2016).

High groundwater levels can cause problems even where there is no surface flooding. Basements are susceptible to high groundwater levels. Seasonally high groundwater is common in many areas, though it often occurs only after a long period of above-average precipitation (USGS 2016).

Ice Jam Flooding

An ice jam occurs when pieces of floating ice are carried with a stream's current and accumulate behind an obstruction to the stream flow. Obstructions may include river bends, mouths of tributaries, points where the river slope decreases, dams, or bridges. The water held back by this obstruction can cause flooding upstream, and if the obstruction suddenly breaks, flash flooding can occur (NESEC 2021). The formation of ice jams depends on the weather and physical condition of the river and stream channels. They are most likely to occur where the channel slope naturally decreases, in culverts, and along shallows where channels may freeze solid.

There are two different types of ice jams: freeze-up and breakup. Freeze-up jams occur in the early to mid-winter when floating ice may slow or stop due to a change in water slope as it reaches an obstruction to movement. Breakup jams occur during periods of thaw, generally in late winter and early spring. The ice cover breakup is usually associated with a rapid increase in runoff and corresponding river discharge due to a heavy rainfall, snowmelt, or warmer temperatures (FEMA 2023).

10.1.2 Location

Flooding potential is influenced by climatology, meteorology, and topography. Extensive development can impact flooding potential, as it leaves fewer natural surfaces available to absorb rainwater, forcing water directly into streams, rivers, and existing drainage systems and swelling them more than when natural surfaces are available to buffer the runoff. Areas that are more likely to have an increased risk of flooding include the following:

- Areas with poor drainage
- Locations on or near construction projects

- The FEMA defined SFHA
- Developed areas with excess amounts of impermeable surfaces

The most damaging floods (particularly riverine floods) in New Jersey appear to occur in the northern half of the state, including Sussex County. This is a function of several physiographic and physical features of the landscape. Sloped land in the northern half results in flowing water moving down steeper gradients and being naturally or artificially channelized through valleys and gullies. The Delaware, Raritan, and Passaic Rivers drain more than 90 percent of their waters into the northern New Jersey counties and are common locations for flooding. Floods can happen almost anywhere in Sussex County, although they tend to occur in and around areas near existing bodies of water, such as rivers and streams. Sussex County has primarily a mountainous terrain, with significant exposure to water and vulnerability to flooding.

Riverine Flooding

Flood Mapping

Locations of flood zones in Sussex County as depicted on the FEMA preliminary Digital Flood Insurance Rate Map (DFIRM) are illustrated in Figure 10-2 and the total land area in the floodplain, exclusive of water bodies, is summarized in Table 10-2. Refer to Volume II for a map of floodplains in each jurisdiction.

Primary Waterways in the County

Sussex County has several large waterways, including the Musconetcong River and Paulins Kill, as well as the Delaware River, which has a total drainage area of over 14,000 square miles. Larger lakes and reservoirs include Lake Hopatcong, Lake Musconetcong, and Lake Mohawk. Over the years, Sussex County has been impacted by flooding especially in the municipalities adjacent to these bodies of water. While flooding in Sussex County may occur during any season of the year, the most extensive flooding typically occurs in the late summer and early fall and is associated with tropical storms moving north along the Atlantic coast. Spring storms in concurrence with snowmelt can also cause extensive flooding in the County.

The New Jersey Department of Environmental Protection (NJDEP) has divided the state into 21 Watershed Management Areas (WMAs) based on large scale drainage patterns. Each WMA encompasses a particular group of major rivers. Sussex County contains parts of the following four regions:

- WMA 01: Upper Delaware - Northwest Region
- WMA 02: Wallkill - Northwest Region
- WMA 03: Pompton, Pequannock, Wanaque, Ramapo - Northeast Region
- WMA 06: Middle Passaic, Whippany – Northeast Region

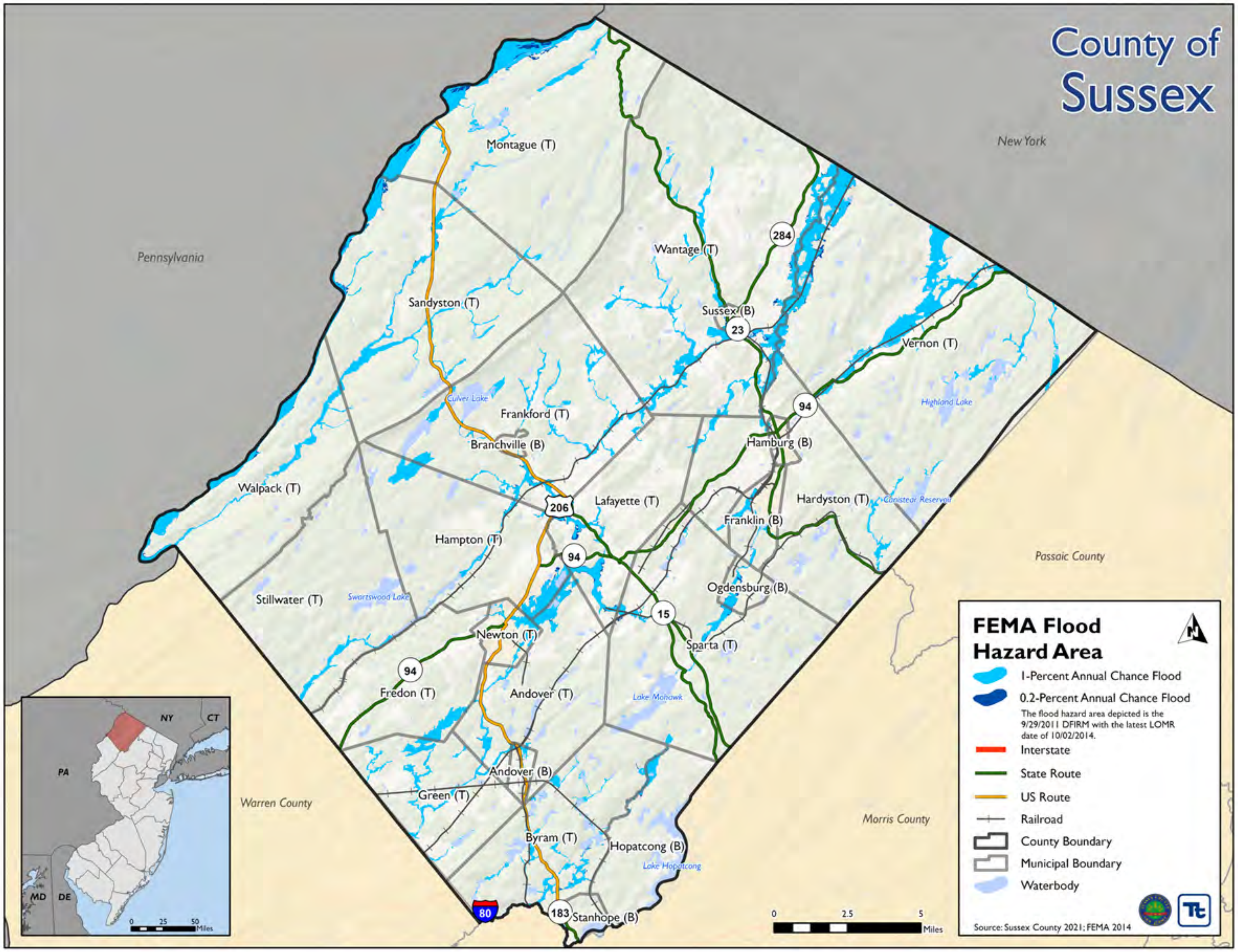
These areas delineate the principal stream systems that drain the county’s land area. Each WMA is described in the sections below (State of New Jersey 2019).

Table 10-1. Number of Acres in Sussex County Exposed to 1 percent and 0.2 Percent Annual Chance Flood

	Total Land Area (Excluding Water Bodies) (Acres)	Land Area (Excluding Water Bodies) in the 1% Annual Chance Flood Hazard Area		Land Area (Excluding Water Bodies) in the 0.2% Annual Chance Flood Hazard Area	
		Total Area (Acres)	% of Jurisdiction Total	Total Area (Acres)	% of Jurisdiction Total
Andover (B)	855	84	9.8%	84	9.8%
Andover (Twp)	12,746	735	5.8%	756	5.9%
Branchville (B)	383	23	6.1%	25	6.5%
Byram (Twp)	13,699	918	6.7%	960	7.0%
Frankford (Twp)	21,611	1,662	7.7%	1,705	7.9%
Franklin (B)	2,778	236	8.5%	255	9.2%
Fredon (Twp)	11,314	356	3.2%	356	3.2%
Green (Twp)	10,285	811	7.9%	811	7.9%
Hamburg (B)	734	31	4.2%	34	4.6%
Hampton (Twp)	15,668	1,062	6.8%	1,103	7.0%
Hardyston (Twp)	20,409	576	2.8%	585	2.9%
Hopatcong (B)	6,943	235	3.4%	246	3.5%
Lafayette (Twp)	11,429	757	6.6%	873	7.6%
Montague (Twp)	29,343	2,436	8.3%	2,639	9.0%
Newton (T)	2,144	343	16.0%	348	16.3%
Ogdensburg (B)	1,409	175	12.4%	204	14.5%
Sandyston (Twp)	26,641	1,946	7.3%	2,060	7.7%
Sparta (Twp)	23,446	450	1.9%	482	2.1%
Stanhope (B)	1,160	23	2.0%	24	2.1%
Stillwater (Twp)	17,185	336	2.0%	337	2.0%
Sussex (B)	399	61	15.4%	68	17.1%
Vernon (Twp)	42,993	4,428	10.3%	4,543	10.6%
Walpack (Twp)	15,807	1,617	10.2%	1,668	10.6%
Wantage (Twp)	42,554	3,111	7.3%	3,199	7.5%
Sussex County (Total)	331,933	22,411	6.8%	23,365	7.0%

Source: Sussex County 2021, 2023; FEMA 2014

Figure 10-2. FEMA Flood Hazard Areas in Sussex County



Upper Delaware River (WMA 01)

The Upper Delaware River Watershed (WMA 01) is the largest watershed in the county by area, with waters draining west and southwest to the Delaware River. This watershed includes portions of Sussex, Morris, and Hunterdon Counties and all of Warren County. It encompasses 746 square miles and has six major drainage basins: Delaware River, Flat Brook, Paulins Kill, Pequest River, Lopatcong and Pohatcong River Drainage, and the Musconetcong River. Located in the western and southern sections of Sussex County, the Upper Delaware River Watershed comprises more than half of the County's land area (State of New Jersey 2019).

Waterways in this area flow southwest, roughly parallel to one another, toward the Delaware River. Montague and Sandyston Townships contain a large amount of these waterways, most of which are part of the Big and Little Flat Brook systems. The upper half of the Big Flat Brook flows through High Point State Park and Stokes State Forest. Clove Brook and Mill Brook also run through Montague Township. Walpack Township contains tributaries of the Flat Brook draining the west slope of the Kittatinny Ridge.

Wallkill River Watershed (WMA 02)

The second largest watershed in the county by area is the Wallkill River Watershed (WMA 02). The Wallkill, which flows north into Orange County, New York, drains the north-central and northeastern section of Sussex County. This watershed occupies the northern and northeastern parts of Sussex County, extending south through Sparta and northern Byram Townships.

The Wallkill River flows northeast across the state border and lets out on the Hudson River near Kingston, New York. Major tributaries of the Wallkill River that cross through Sussex County include Papakating Creek, which begins in Frankford Township, and Clove Brook, the upper reaches of which flow south from northern Wantage Township. Pochuck Creek drains parts of Vernon and Hardyston Townships east of Pochuck Mountain before merging with the Wallkill several miles over the state border. Several branches of the Black Creek flow through Vernon Township (State of New Jersey 2019).

Pompton, Pequannock, Ramapo, Wanaque River Watershed (WMA 03)

The Pequannock River Watershed (WMA 03) drains to the southeast and comprises a small area of eastern Sussex County. The Pequannock River flows south out of Vernon Township, continuing into Hardyston Township where it turns southeast, forming the border between Morris and Passaic Counties, before ultimately converging with the Passaic River in Essex County. Tributaries of the Pequannock in Sussex County include a stretch of the upper Pascack Brook and an unnamed tributary in Hardyston Township (State of New Jersey 2019).

Upper and Mid Passaic, Whippany, Rockaway River Watersheds (WMA 06)

The Rockaway River Watershed (WMA 06) drains to the southeast and comprises a small part of the County. The Rockaway River itself does not pass through Sussex County, but the system's upper reaches include many tributaries in eastern Sparta Township, where several streams merge to form Russia Brook. Russia Brook flows into Jefferson Township (Morris County) where it meets the Rockaway River (State of New Jersey 2019).

Flash Flooding

Flash flooding, like riverine flooding, occurs throughout the County, primarily along the bodies of water that flow through it.

Urban Stormwater Flooding

Urban stormwater flooding is not mapped by the state or FEMA but is most likely to occur in highly developed areas with high percentages of impervious surface that contribute to high rates of runoff. Locations that have undersized stormwater components or stormwater components that are prone to becoming clogged or failing often experience stormwater flooding.

Ice Jams

The State of New Jersey documented 109 ice jam incidents between 1867 and 2023 (USACE 2023). Areas of New Jersey that include characteristics lending to ice jam flooding, including locations where the channel slope changes from relatively steep to mild and where a tributary stream enters a large river include the northern counties that border the Delaware River and its tributaries (i.e., Hunterdon, Warren, Sussex, and Mercer).

10.1.3 Extent

Generally, floods are long-term events that can last for several days. The severity of flooding depends on the amount of water that accumulates in a period and on the land's ability to manage this water. It is related to the size of rivers and streams in an area and the surrounding land's absorbency. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration into the ground slows and any more water that accumulates must flow as runoff (Harris 2008).

Riverine Flooding

The severity of riverine flooding is determined by stream and river basin topography, weather patterns, soil moisture conditions, vegetative clearing, and impervious surface. Generally, riverine floods are long-term events that can last for several days.

Riverine flooding is assessed based on the probability that a given river discharge (flow) level will be equaled or exceeded each year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. In the case of riverine flooding, once a river reaches flood stage, the flood extent or severity categories used by the NWS are as follows (NWS 2011):

- **Minor Flooding** can cause minimal or no property damage, with possibly some public threat or inconvenience.
- **Moderate Flooding** can cause some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- **Major Flooding** can cause extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

Flash Flooding

The extent of a flash flood is consistent with that of a riverine flood as described above.

Urban and Stormwater Flooding

Locations that have undersized stormwater components or stormwater components that are prone to becoming clogged or failing often experience stormwater flooding. Currently, there is no measurement used to further define the frequency and severity of urban stormwater flooding.

Ice Jam Flooding

Ice jam flooding events often occur suddenly and are difficult to predict, allowing for little time to prepare for and warn of an event. The size of the snowpack and the rate of snowmelt controls the extent of an ice jam (Rokaya 2018).

10.1.4 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Sussex County has been included in 19 major disaster (DR) or emergency (EM) declarations for flood-related events, as listed in Table 10-3.

Table 10-2. FEMA Declarations for Flood Events in Sussex County

Event Date	Declaration Date	Declaration Number	Description
September 4, 1971	September 4, 1971	DR-310	Flood: Heavy Rains & Flooding
July 23, 1975	July 23, 1975	DR-477	Flood: Heavy Rains, High Winds, Hail & Tornadoes
September 16 – 18, 1999	September 17, 1999	EM-3148	New Jersey Hurricane Floyd
August 12 – 21, 2000	August 17, 2000	DR-1337	Severe Storms, Flooding and Mudslides
September 18 – October 1, 2004	October 1, 2004	DR-1563	Severe Storms and Flooding
April 1 – 3, 2005	April 19, 2005	DR 1588	Severe Storm(s): Severe Storms and Flooding
June 23 – July 10, 2006	July 7, 2006	DR-1653	Severe Storms and Flooding
April 14 – 20, 2007	April 26, 2007	DR-1694	Severe Storm(s): Severe Storms and Inland and Coastal Flooding
August 26 – September 5, 2011	August 27, 2011	EM-3332	Hurricane Irene in New Jersey
August 26 – September 5, 2011	August 27, 2011	DR-4021	Hurricane Irene in New Jersey
September 28 – October 6, 2011	October 14, 2011	DR-4039	Remnants of Tropical Storm Lee in New Jersey
October 26 – November 8, 2012	October 28, 2012	EM-3354	New Jersey Hurricane Sandy
October 26 – November 8, 2012	October 30, 2012	DR-4086	New Jersey Hurricane Sandy
August 4, 2020	December 11, 2020	DR-4574	Tropical Storm Isaias
September 1 – 3, 2021	September 2, 2021	EM-3573	Remnants of Hurricane Ida
September 1 – 3, 2021	September 5, 2021	DR-4614	Remnants of Hurricane Ida

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 been included in two USDA flood-related agricultural disaster declarations, as listed in Table 10-4.

Table 10-3. USDA Declarations for Flood Events in Sussex County (2020 to 2024)

Event Date	USDA Declaration Number	Description
August 3 – 4, 2020	S4892	High Winds and Heavy Rain from Hurricane Isaias
August 21 – September 2, 2021	S5092	Excessive Rain

Sources: USDA 2024

Previous Events

Known flood events that impacted Sussex County between January 2020 and June 2024 are listed in Table 10-5. For events prior to 2020, refer to the 2021 Sussex County HMP.

Table 10-4. Flood Events in Sussex County (2020 to 2024)

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
September 1, 2021	EM-3573-NJ, DR-4614-NJ	Yes	Flatbrookville	Post Tropical Cyclone Ida brought heavy rain to New Jersey. Rainfall totals were as high as 10 inches. The heavy rain caused significant flash flooding, mainly in the northern half of the state. It resulted in widespread property damage. There were several fatalities. Widespread flash flooding occurred in Sussex County with numerous road closures.
June 26, 2023	N/A	N/A	Andover Junction	Thunderstorms produced locally heavy rain in northern New Jersey. Rainfall totals were as high as 5 inches. U.S. Route 206 in Andover Township was closed due to flooding near Goodale Road.
July 14, 2023	N/A	N/A	Newton	Thunderstorms brought heavy rain to northern New Jersey from the late afternoon into the evening of July 14. Rainfall totals were as high as 7 inches. High Street was closed between West End Avenue and Church Street in Newton due to flooding.

Sources: NOAA 2023

10.1.5 Probability of Future Occurrences

Probability Based on Previous Occurrences

Information on previous flood occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 10-6. Based on historical records and input from the Steering Committee, the probability of occurrence for flood in the County is considered “frequent.”

Table 10-5. Probability of Future Flood Events in Sussex County

Hazard Type	Number of Occurrences Between 1996[a] and 2023	Percent Chance of Occurring in Any Given Year
Flood	23	82.14%
Flash Flood	30	100%
Ice Jams	1	3.57%
Total	**54**	**100%**

Sources: FEMA 2023; NOAA 2023; USACE 2023

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

Projections of climate change for New Jersey predict more intense rainfall events and increases in total annual precipitation (see Section 3.3.4). This could result in an increased probability of flood events. In New Jersey, extreme storms typically include coastal nor'easters, snowstorms, spring and summer thunderstorms, tropical storms, and on rare occasions hurricanes. Most of these events occur in the warmer months between April and October, with nor'easters occurring between September and April.

10.1.6 Cascading Impacts on Other Hazards

Erosion and Landslides

Riverine flooding often results in bank erosion. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly, scouring the banks and edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail.

Public Health

Floodwaters also can be contaminated by pollutants such as sewage, human and animal feces, pesticides, fertilizers, oil, asbestos, and rusting building materials. Common public health risks associated with flood events include the following (FEMA 2022):

- Unsafe food
- Contaminated drinking and washing water and poor sanitation
- Mosquitos and animals
- Carbon monoxide poisoning
- Secondary hazards associated with re-entering and cleaning flooded structures
- Mental stress and fatigue

After flood events, excess moisture and standing water contribute to the growth of mold in buildings. Mold may present a health risk to building occupants, especially infants, children, older people, pregnant women, and those with already compromised immune systems. Mold spores can grow in as little as 24 hours in wet and damaged areas of buildings that have not been properly cleaned. Very small mold spores can be inhaled, creating the potential for allergic reactions and respiratory problems (CDC 2020).

The best mitigation for these impacts is to be aware that they can occur, educate the public on prevention, and be prepared to deal with them in flood disaster response.

Utility Disruption

Floodwater picks up debris, bacteria, sewage, and other industrial waste and chemicals and can contaminate private drinking water sources, such as wells and springs. Excess water also makes it more difficult for water treatment plants to treat water adequately. Contamination in the water supply puts consumers at risk of exposure to toxins that could result in serious harm. In extreme cases, death may occur (Andrew 2021).

Consumers without access to clean water are unable to cook or clean in their homes. Depending on the severity of the flood and the storm, this could last for days, weeks, or months. Cconsumers ultimately become reliant on bottled water, which is especially detrimental in impoverished communities where residents may not have the economic means to purchase bottled water. Moreover, in a flood, retail locations are often inaccessible or low on water supply (Andrew 2021).

Flooded buildings may have their power disrupted if the service panel, generator, meter, etc. are not elevated above the flood level. Oversaturated soils from periods of heavy rain and flooding may cause utility poles to tip over or fall completely, interrupting the power grid for a potentially large area, especially if a transformer is impacted.

Dam Failure

Flooding can result in large quantities of rain upstream of a dam that raise water levels behind the dam, potentially leading to overtopping of the dam or flooding of properties upstream of the dam. Should the flooding result in a dam failure, the water behind the dam, including flood waters, may inundate jurisdictions downstream of the dam.

10.2 VULNERABILITY AND IMPACT ASSESSMENT

The 1 percent and 0.2 percent annual chance flood events were examined to evaluate the county’s risk from the flood hazard. The following data were used:

- FEMA’s effective Sussex County DFIRM dated September 29, 2011, with a latest letter of map revision dated October 2, 2014. This was used to evaluate vulnerability and determine potential future losses.
- A depth grid created from the 2011 effective DFIRM and a 2-foot cell size digital elevation map (DEM) model provided by NJDEP Bureau of GIS. This was integrated into the Hazus riverine flood model and used to estimate potential losses for the 1 percent annual chance flood event.

To estimate vulnerability to the 1 percent and 0.2 percent annual chance flood events, the DFIRM flood boundaries were overlaid on the centroids of assets in the updated inventories. Centroids that intersected the flood boundaries were totaled to estimate the building RCV and population located in flood inundation areas.

A Level 2 Hazus riverine flood analysis was performed. The critical facility and building inventories were formatted to be compatible with Hazus, and the Hazus riverine flood model was run to estimate potential losses for the 1 percent annual chance flood. Hazus calculated estimated population losses (for the default 2020 U.S. Census data across dasymetric blocks), potential damage to the general building stock, and potential damage to critical facilities based on the depth grids and the default damage functions in the Hazus flood model. Urban stormwater flooding was not evaluated because no mapping is available for it. Therefore, this assessment can be assumed to underestimate flooding risk in Sussex County.

10.2.1 Life, Health, and Safety

Overall Population

Hazard exposure was estimated as the population living in or near floodplain areas. The exposure of other individuals who may be traveling in flooded areas or have their access to emergency services compromised by a flood is not strictly measurable. Table 10-7 summarizes the population exposed to the flood hazard by jurisdiction. There are 682 residents living in the 1 percent annual chance floodplain or 0.5 percent of the County's total population. There are 856 residents living in the 0.2 percent annual chance floodplain, or 0.6 percent of the County's total population. The Borough of Hopatcong has the greatest number of residents living in both evaluated floodplains—204 in both the 1 percent and 2 percent annual chance floodplains.

Table 10-6. Sussex County Population in the 1 Percent and 0.2 Percent Annual Chance Flood Hazard Areas

	Total Population	Population in the 1% Annual Chance Flood Hazard Area		Population in the 0.2% Annual Chance Flood Hazard Area	
		Number of People	Percent Total	Number of People	Percent Total
Andover (B)	595	10	1.7%	10	1.7%
Andover (Twp)	5,996	2	<0.1%	2	<0.1%
Branchville (B)	791	4	0.5%	4	0.5%
Byram (Twp)	8,028	28	0.3%	69	0.9%
Frankford (Twp)	5,302	51	1.0%	55	1.0%
Franklin (B)	4,912	16	0.3%	21	0.4%
Fredon (Twp)	3,235	0	0.0%	0	0.0%
Green (Twp)	3,627	15	0.4%	15	0.4%
Hamburg (B)	3,266	2	0.1%	2	0.1%
Hampton (Twp)	4,893	4	0.1%	4	0.1%
Hardyston (Twp)	8,125	2	<0.1%	2	<0.1%
Hopatcong (B)	14,362	204	1.4%	204	1.4%
Lafayette (Twp)	2,358	22	0.9%	36	1.5%
Montague (Twp)	3,792	56	1.5%	87	2.3%
Newton (T)	8,374	37	0.4%	52	0.6%
Ogdensburg (B)	2,258	2	0.1%	57	2.5%
Sandyston (Twp)	1,977	14	0.7%	23	1.2%
Sparta (Twp)	19,600	69	0.4%	69	0.4%
Stanhope (B)	3,526	0	0.0%	0	0.0%
Stillwater (Twp)	4,004	4	0.1%	4	0.1%
Sussex (B)	2,024	3	0.1%	3	0.1%
Vernon (Twp)	22,358	72	0.3%	72	0.3%
Walpack (Twp)	7	1	14.3%	1	14.3%
Wantage (Twp)	10,811	64	0.6%	64	0.6%
Sussex County (Total)	**144,221**	**682**	**0.5%**	**856**	**0.6%**

Source: U.S. Census Bureau 2020, 2021; FEMA 2014; CDC/ATSDR 2020
Note: Results for population are rounded down.

The total number of injuries and casualties resulting from flooding is generally limited based on advance weather forecasting, blockades, and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning and precautions are in place. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results from persons trying to cross flooded roadways or channels during a flood.

The Hazus riverine model estimates the potential sheltering needs as a result of a 1 percent annual chance flood event. The demographic data in Hazus has not been updated and the estimated sheltering needs are based on 2020 U.S. Census data. Hazus estimates 1,523 persons may be displaced and 359 people may seek short-term shelter. These statistics, by jurisdiction, are presented in Table 10-11. The estimated displaced population and number of persons seeking short-term shelter differs from the number of persons exposed to the 1 percent annual chance flood, because the displaced population numbers take into consideration that not all residents will be impacted enough to be displaced or to require short-term shelter during a flood event.

Table 10-7. Population Displaced or Neding Short-Term Shelter from the 1 Percent Annual Chance Flood Event

	Total Population (U.S. Census Bureau Decennial 2020)	1 Percent Annual Chance Flood Event Hazard Area	
		Displaced Population	Persons Seeking Short-Term Shelter
Andover (B)	595	17	2
Andover (Twp)	5,996	10	2
Branchville (B)	791	22	2
Byram (Twp)	8,028	145	34
Frankford (Twp)	5,302	130	17
Franklin (B)	4,912	53	19
Fredon (Twp)	3,235	3	2
Green (Twp)	3,627	50	4
Hamburg (B)	3,266	0	0
Hampton (Twp)	4,893	15	8
Hardyston (Twp)	8,125	14	3
Hopatcong (B)	14,362	60	29
Lafayette (Twp)	2,358	43	9
Montague (Twp)	3,792	87	49
Newton (T)	8,374	376	107
Ogdensburg (B)	2,258	30	4
Sandyston (Twp)	1,977	37	2
Sparta (Twp)	19,600	109	11
Stanhope (B)	3,526	19	2
Stillwater (Twp)	4,004	11	2
Sussex (B)	2,024	31	4
Vernon (Twp)	22,358	139	11
Walpack (Twp)	7	1	0
Wantage (Twp)	10,811	121	36
Sussex County (Total)	**144,221**	**1,523**	**359**

Source: Hazus v6.0, U.S. Census Bureau 2020; FEMA 2016
Note: Results for population are rounded down.

Socially Vulnerable Population

Economically disadvantaged populations are more vulnerable because they are likely to lack financial resources to evacuate. The population over the age of 65 is more vulnerable because they are more likely to need medical attention, which may not be available due to isolation during a flood event, and they may have more difficulty evacuating. Special consideration should be taken when planning for disaster preparation, response, and recovery for these vulnerable groups.

Table 10-10 presents the estimated socially vulnerable populations living in the 1 percent and 0.2 percent annual chance flood hazard areas. There are 106 persons over the age of 65 years, 25 persons under the age of 5 years, 5 non-English speakers, 66 persons with a disability, and 23 living in poverty located in the 1 percent annual chance flood hazard area. There are 139 persons over the age of 65 years, 32 persons under the age of 5 years, 7 non-English speakers, 82 persons with a disability, and 33 living in poverty located in the 0.2 percent annual chance flood hazard area.

10.2.2 General Building Stock

Buildings in the Flood Hazard Areas

Table 10-12 summarizes the number and value of buildings within the 1 percent and 0.2 percent annual chance flood hazard areas, as estimated by the analysis. There are 462 buildings in the 1 percent annual chance flood hazard area with an estimated $968 million of replacement cost value (building and content replacement costs). This represents 0.6 percent of the County's total general building stock inventory. There are 562 buildings in the 0.2 percent annual chance flood boundary with an estimated $1 billion of building stock and contents exposed. This represents 0.8 percent of the County's total general building stock inventory.

Table 10-14 summarizes buildings within the 1 percent or 0.2 percent annual chance flood hazard areas by general occupancy. The analysis estimates that, the residential occupancy is the most exposed for both flood hazard areas, accounting for 69 percent and 69.7 percent of the buildings within the 1 percent and 0.2 percent annual chance flood hazard areas, respectively

Potential Damage

The Hazus flood model estimated potential damage to buildings using the custom building inventory developed for this HMP and the depth grid generated for this analysis. Table 10-13 shows estimated losses by jurisdiction. The for the 1 percent annual chance flood. The countywide total is $149.7 million or 0.2 percent of the total building replacement cost value. The Borough of Hopatcong has the greatest estimated building loss—$38.5 million (1.1 percent of the total replacement cost value).

NFIP Statistics

Individual data on flood policies, claims, and repetitive loss (RL) properties was analyzed. FEMA Region 2 provided a list of residential properties with NFIP policies, past claims, and multiple claims (RLs). A property is considered an RL property when there are two or more reported losses that were paid more than $1,000 each, within 10 years of each other and at least 10 days apart. Table 10-15 summarizes the NFIP policies, claims, and RL statistics for Sussex County. Of the 15 RL properties identified in the County, one currently has NFIP insurance coverage. This information is current as of April 2024.

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Table 10-8. Vulnerable Persons Located in the 1 Percent and 0.2 Percent Annual Chance Flood Hazard Areas

	Vulnerable Persons Located in the 1 Percent Annual Chance Flood Hazard Area					Vulnerable Persons Located in the 0.2 Percent Annual Chance Flood Hazard Area				
	Persons Over 65	Persons Under 5	Non-English Speaking Persons	Persons with a Disability	Persons in Poverty	Persons Over 65	Persons Under 5	Non-English Speaking Persons	Persons with a Disability	Persons in Poverty
Andover (B)	1	0	0	1	0	1	0	0	1	0
Andover (Twp)	0	0	0	0	0	0	0	0	0	0
Branchville (B)	0	0	0	0	0	0	0	0	0	0
Byram (Twp)	3	1	0	2	0	9	3	0	5	1
Frankford (Twp)	9	2	0	5	1	10	2	0	5	1
Franklin (B)	3	0	0	2	0	5	1	0	3	1
Fredon (Twp)	0	0	0	0	0	0	0	0	0	0
Green (Twp)	3	0	0	2	0	3	0	0	2	0
Hamburg (B)	0	0	0	0	0	0	0	0	0	0
Hampton (Twp)	1	0	0	0	0	1	0	0	0	0
Hardyston (Twp)	0	0	0	0	0	0	0	0	0	0
Hopatcong (B)	28	8	4	21	8	28	8	4	21	8
Lafayette (Twp)	4	1	0	2	1	7	2	0	3	3
Montague (Twp)	12	3	1	5	2	19	4	1	9	4
Newton (T)	7	1	0	5	3	11	1	1	7	4
Ogdensburg (B)	0	0	0	0	0	9	1	1	4	3
Sandyston (Twp)	2	0	0	1	0	3	1	0	2	0
Sparta (Twp)	9	4	0	5	2	9	4	0	5	2
Stanhope (B)	0	0	0	0	0	0	0	0	0	0
Stillwater (Twp)	1	0	0	0	0	1	0	0	0	0
Sussex (B)	0	0	0	0	0	0	0	0	0	0
Vernon (Twp)	11	3	0	7	2	11	3	0	7	2
Walpack (Twp)	1	0	0	0	0	1	0	0	0	0
Wantage (Twp)	11	2	0	8	4	11	2	0	8	4
Sussex County (Total)	**106**	**25**	**5**	**66**	**23**	**139**	**32**	**7**	**82**	**33**

Source: U.S. Census Bureau 2021; FEMA 2014

Note: Results for population are rounded down.

Table 10-9. Estimated General Building Stock Located in the 1% and 0.2% Annual Chance Flood Hazard Areas - All Occupancies

	Jurisdiction Total Buildings		1 Percent Annual Chance Flood Hazard Area				0.2 Percent Annual Chance Flood Hazard Area			
			Number of Buildings		Replacement Cost Value		Number of Buildings		Replacement Cost Value	
	Count	Replacement Cost Value	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Andover (B)	326	$693,607,785	8	2.5%	$73,800,865	10.6%	8	2.5%	$73,800,865	10.6%
Andover (Twp)	2,577	$4,012,892,721	3	0.1%	$36,392,880	0.9%	3	0.1%	$36,392,880	0.9%
Branchville (B)	426	$598,388,025	3	0.7%	$3,847,896	0.6%	3	0.7%	$3,847,896	0.6%
Byram (Twp)	3,676	$3,162,144,221	18	0.5%	$16,816,811	0.5%	35	1.0%	$23,526,288	0.7%
Frankford (Twp)	3,529	$3,491,793,002	43	1.2%	$53,967,319	1.5%	48	1.4%	$63,089,646	1.8%
Franklin (B)	2,058	$2,227,977,138	7	0.3%	$4,785,587	0.2%	13	0.6%	$11,815,836	0.5%
Fredon (Twp)	1,615	$1,542,422,915	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Green (Twp)	1,697	$1,821,582,866	14	0.8%	$10,608,668	0.6%	14	0.8%	$10,608,668	0.6%
Hamburg (B)	1,593	$1,809,235,911	1	0.1%	$446,136	<0.1%	1	0.1%	$446,136	<0.1%
Hampton (Twp)	2,761	$2,474,023,610	3	0.1%	$2,411,091	0.1%	4	0.1%	$3,625,639	0.1%
Hardyston (Twp)	4,401	$3,681,458,622	1	0.0%	$385,015	<0.1%	1	<0.1%	$385,015	<0.1%
Hopatcong (B)	8,004	$3,432,619,930	114	1.4%	$101,360,010	3.0%	114	1.4%	$101,360,010	3.0%
Lafayette (Twp)	1,463	$2,142,628,709	15	1.0%	$26,810,208	1.3%	25	1.7%	$36,003,368	1.7%
Montague (Twp)	2,175	$1,659,675,649	29	1.3%	$10,522,033	0.6%	45	2.1%	$20,426,285	1.2%
Newton (T)	2,676	$5,699,120,026	27	1.0%	$195,829,641	3.4%	35	1.3%	$218,640,318	3.8%
Ogdensburg (B)	992	$954,409,603	2	0.2%	$71,248,947	7.5%	24	2.4%	$76,607,140	8.0%
Sandyston (Twp)	1,526	$1,350,071,503	12	0.8%	$9,616,699	0.7%	25	1.6%	$18,302,706	1.4%
Sparta (Twp)	8,127	$10,316,900,290	35	0.4%	$50,014,543	0.5%	35	0.4%	$50,014,543	0.5%
Stanhope (B)	1,552	$1,228,753,628	1	0.1%	$486,280	<0.1%	1	0.1%	$486,280	<0.1%
Stillwater (Twp)	2,487	$1,611,608,776	2	0.1%	$442,101	<0.1%	2	0.1%	$442,101	<0.1%
Sussex (B)	677	$2,187,092,184	11	1.6%	$117,354,278	5.4%	13	1.9%	$122,208,003	5.6%
Vernon (Twp)	12,039	$6,816,863,576	57	0.5%	$95,723,008	1.4%	57	0.5%	$95,723,008	1.4%
Walpack (Twp)	51	$68,015,712	9	17.6%	$26,935,298	39.6%	9	17.6%	$26,935,298	39.6%
Wantage (Twp)	5,509	$5,527,803,803	47	0.9%	$58,709,782	1.1%	47	0.9%	$58,709,782	1.1%
Sussex County (Total)	**71,937**	**$68,511,090,204**	**462**	**0.6%**	**$968,515,095**	**1.4%**	**562**	**0.8%**	**$1,053,397,709**	**1.5%**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; RS Means 2022; FEMA 2014

Table 10-10. Buildings on Lands in the 1% and 0.2% Annual Chance Flood Hazard Areas, by General Occupancy Class

	1 Percent Annual Chance Flood Event Hazard Area				0.2 Percent Annual Chance Flood Event Hazard Area			
	Residential	Commercial	Industrial	Other[a]	Residential	Commercial	Industrial	Other[a]
Andover (B)	4	4	0	0	4	4	0	0
Andover (Twp)	1	1	0	1	1	1	0	1
Branchville (B)	2	1	0	0	2	1	0	0
Byram (Twp)	12	2	0	4	29	2	0	4
Frankford (Twp)	27	5	0	11	29	7	0	12
Franklin (B)	6	1	0	0	8	2	0	3
Fredon (Twp)	0	0	0	0	0	0	0	0
Green (Twp)	6	0	0	8	6	0	0	8
Hamburg (B)	1	0	0	0	1	0	0	0
Hampton (Twp)	2	0	0	1	2	0	0	2
Hardyston (Twp)	1	0	0	0	1	0	0	0
Hopatcong (B)	109	2	0	3	109	2	0	3
Lafayette (Twp)	9	3	0	3	15	4	0	6
Montague (Twp)	28	0	0	1	43	0	0	2
Newton (T)	10	11	2	4	14	14	2	5
Ogdensburg (B)	1	1	0	0	23	1	0	0
Sandyston (Twp)	8	0	0	4	13	8	0	4
Sparta (Twp)	26	5	0	4	26	5	0	4
Stanhope (B)	0	1	0	0	0	1	0	0
Stillwater (Twp)	2	0	0	0	2	0	0	0
Sussex (B)	1	2	0	8	1	3	0	9
Vernon (Twp)	36	13	3	5	36	13	3	5
Walpack (Twp)	2	0	0	7	2	0	0	7
Wantage (Twp)	25	11	2	9	25	11	2	9
Sussex County (Total)	**319**	**63**	**7**	**73**	**392**	**79**	**7**	**84**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; FEMA 2014

a. Other = Government, Religion, Agricultural, and Education

Table 10-11. Estimated General Building Stock Potential Loss to the 1 Percent Annual Chance Flood Event

	Total Replacement Cost Value	1 Percent Annual Chance Flood Event Impact on Buildings				
		Estimated Loss for All Occupancies	Percent of Total	Estimated Loss for Residential Properties	Estimated Loss for Commercial Properties	Estimated Loss for All Other Occupancies
Andover (B)	$693,607,785	$7,483,884	1.1%	$306,631	$7,177,253	$0
Andover (Twp)	$4,012,892,721	$166,763	<0.1%	$5,178	$160,332	$1,253
Branchville (B)	$598,388,025	$214,971	<0.1%	$34,898	$180,072	$1
Byram (Twp)	$3,162,144,222	$2,293,188	0.1%	$417,161	$186,864	$1,689,163
Frankford (Twp)	$3,491,793,002	$5,205,087	0.1%	$2,391,381	$402,171	$2,411,535
Franklin (B)	$2,227,977,138	$590,132	<0.1%	$465,232	$124,900	$0
Fredon (Twp)	$1,542,422,915	$0	0.0%	$0	$0	$0
Green (Twp)	$1,821,582,867	$2,843,263	0.2%	$248,234	$0	$2,595,029
Hamburg (B)	$1,809,235,911	$0	0.0%	$0	$0	$0
Hampton (Twp)	$2,474,023,610	$255,632	<0.1%	$117,408	$0	$138,224
Hardyston (Twp)	$3,681,458,622	$116,131	<0.1%	$116,131	$0	$0
Hopatcong (B)	$3,432,619,929	$38,597,608	1.1%	$5,289,268	$32,968,054	$340,286
Lafayette (Twp)	$2,142,628,709	$9,664,809	0.5%	$428,838	$982,625	$8,253,346
Montague (Twp)	$1,659,675,648	$2,032,497	0.1%	$1,923,726	$0	$108,771
Newton (T)	$5,699,120,027	$12,875,345	0.2%	$471,331	$1,574,255	$10,829,759
Ogdensburg (B)	$954,409,603	$6,486,264	0.7%	$74,167	$6,412,097	$0
Sandyston (Twp)	$1,350,071,503	$3,606,318	0.3%	$440,653	$0	$3,165,665
Sparta (Twp)	$10,316,900,290	$10,803,857	0.1%	$1,188,939	$9,149,006	$465,912
Stanhope (B)	$1,228,753,628	$19,086	<0.1%	$0	$19,086	$0
Stillwater (Twp)	$1,611,608,775	$37,742	<0.1%	$37,742	$0	$0
Sussex (B)	$2,187,092,184	$894,900	<0.1%	$44,936	$804,296	$45,668
Vernon (Twp)	$6,816,863,576	$26,495,071	0.4%	$2,476,782	$20,601,385	$3,416,904
Walpack (Twp)	$68,015,712	$5,406,843	7.9%	$56,016	$0	$5,350,827
Wantage (Twp)	$5,527,803,803	$13,627,304	0.2%	$2,383,450	$5,302,506	$5,941,348
Sussex County (Total)	**$68,511,090,205**	**$149,716,695**	**0.2%**	**$18,918,102**	**$86,044,902**	**$44,753,691**

Source: Hazus v6.0, Sussex County 2023; RS Means 2022; NJOGIS, Civil Solutions, Spatial Data Logic; FEMA 2016

Table 10-12. Repetitive Loss Properties and NFIP Data for Sussex County

	Total Number of Policies	Total Premium + Policy Fee	Total Claims	Total Payments	Number of NFIP Repetitive Loss (RL) Properties
Andover (B)	3	$6,988	1	$4,313.60	0
Andover (Twp)	3	$2,339	2	$303.65	0
Branchville (B)	3	$2,576	9	$57,588.67	2
Byram (Twp)	13	$13,896	14	$129,877.78	3
Frankford (Twp)	12	$14,415	13	$74,895.88	0
Franklin (B)	5	$7,108	9	$42,743.97	0
Fredon (Twp)	2	$1,170	2	$6,936.73	0
Green (Twp)	5	$3,657	3	$21,582.77	0
Hamburg (B)	2	$1,590	0	$0.00	0
Hampton (Twp)	3	$4,023	1	$0.00	0
Hardyston (Twp)	4	$2,957	3	$60,786.68	0
Hopatcong (B)	8	$4,065	12	$54,192.61	1
Lafayette (Twp)	2	$1,367	7	$24,565.66	1
Montague (Twp)	13	$22,373	17	$178,247.79	3
Newton (T)	10	$15,542	8	$295,504.96	0
Ogdensburg (B)	8	$5,114	9	$49,121.63	1
Sandyston (Twp)	5	$6,596	5	$209,805.75	1
Sparta (Twp)	28	$22,928	14	$32,999.07	0
Stanhope (B)	3	$10,379	2	$16,257.13	0
Stillwater (Twp)	5	$3,680	5	$87,322.80	0
Sussex (B)	3	$2,270	4	$65,202.14	1
Vernon (Twp)	19	$18,380	21	$121,236.16	2
Walpack (Twp)	0	$0	1	$7,076.41	0
Wantage (Twp)	9	$8,854	10	$180,963.26	0
Sussex County (Total)	**168**	**$182,267**	**172**	**$1,721,525**	**15**

Source: FEMA Region 2 2024

B – Borough; T – Town; Twp – Township

Notes: NFIP statistics provided by FEMA Region 2 and are current as of April 2024. The statistics were summarized using the Community Name provided by FEMA Region 2

Data on severe repetitive loss properties was not available for this update. These are residential properties covered under an NFIP flood insurance policy that satisfy either of conditions 1 and 2, as well as condition 3:

1. At least four NFIP claim payments for the property (including building and contents) over $5,000 each have occurred, and the cumulative amount of such claims payments exceeded $20,000.
2. At least two separate claims payments for the property (building payments only) have occurred, and the cumulative amount of the building portion of such claims exceeded the market value of the building.
3. For either of the above, at least two of the referenced claims occurred within any 10 year period and more than 10 days apart.

10.2.3 Community Lifelines and Other Critical Facilities

Critical services may not be available during and after a flood event if critical facilities are directly damaged or transportation routes to access these critical facilities are impacted. Roads that are blocked or damaged can isolate residents and can prevent access throughout the planning area to many service providers needing to reach vulnerable populations or to make repairs. Utilities such as overhead power, cable, and phone lines could also be vulnerable due to utility poles damaged by standing water. Loss of these utilities could create additional isolation issues for the inundation zones. When short-term functionality at a critical facility is impacted by flooding, facilities of neighboring municipalities may need to increase support response.

In Sussex County, 1.4 percent of all roadways are in the 1 percent annual chance flood event, and 1.7 percent are in the 0.2 percent annual chance flood event. The major highways exposed to the 1 percent annual chance flood include portions of: I-80, NJ 181, NJ 23, NJ 15, NJ 94, NJ 183, and US 206. Table 10-16 summarizes the total number of miles of exposed roadways by jurisdiction.

Table 10-13. Roadway Miles Exposed to the 1% and 0.2% Annual Chance Flood Hazard Areas

		1 Percent Annual Chance Flood		0.2 Percent Annual Chance Flood	
	Total Road Miles	Total Road Miles	% of Jurisdiction Total	Total Road Miles	% of Jurisdiction Total
Andover (B)	7.0	0.2	2.3%	0.2	2.3%
Andover (Twp)	68.3	0.1	0.1%	0.1	0.2%
Branchville (B)	7.1	0.1	0.8%	0.1	1.1%
Byram (Twp)	70.1	1.2	1.7%	1.8	2.6%
Frankford (Twp)	98.5	2.7	2.7%	2.8	2.9%
Franklin (B)	27.3	0.3	1.3%	0.4	1.6%
Fredon (Twp)	50.9	0.0	0.0%	0.0	0.0%
Green (Twp)	49.6	0.8	1.7%	0.8	1.7%
Hamburg (B)	11.5	<0.1%	<0.1%	<0.1%	<0.1%
Hampton (Twp)	52.5	0.5	0.9%	0.5	1.0%
Hardyston (Twp)	64.4	0.3	0.5%	0.3	0.5%
Hopatcong (B)	80.0	0.1	0.2%	0.1	0.2%
Lafayette (Twp)	44.3	1.9	4.2%	2.5	5.6%
Montague (Twp)	57.2	1.4	2.4%	1.7	2.9%
Newton (T)	30.3	0.4	1.3%	0.5	1.6%
Ogdensburg (B)	14.8	0.2	1.1%	0.3	2.2%
Sandyston (Twp)	51.9	1.3	2.5%	1.6	3.0%
Sparta (Twp)	139.1	0.3	0.2%	0.5	0.4%
Stanhope (B)	17.6	<0.1%	<0.1%	<0.1%	<0.1%
Stillwater (Twp)	60.3	0.5	0.9%	0.5	0.9%
Sussex (B)	9.1	0.2	2.7%	0.3	3.5%
Vernon (Twp)	126.8	1.1	0.9%	1.2	1.0%
Walpack (Twp)	20.2	2.6	12.7%	4.2	20.5%
Wantage (Twp)	174.2	2.5	1.4%	2.6	1.5%
Sussex County (Total)	**1,333.2**	**18.6**	**1.4%**	**23.1**	**1.7%**

Source: Sussex County 2021, 2023; FEMA 2014

Issues associated with flooding of critical facilities include isolation, health problems caused by water and sewer systems that are flooded or backed up, and drinking water contamination caused by floodwaters carrying pollutants in water supplies. Debris from flood events may also affect culverts and sewer systems by creating bottlenecks in the wastewater system. This could cause or exacerbate localized urban flooding and cause wastewater to spill into homes and neighborhoods or contaminate local rivers and streams. As a result, contamination of drinking water supplies can be a significant secondary event created by major flood events.

10.2.4 Economy

Flood impacts on the local and regional economy include general building stock damage and associated tax loss, loss of use of utilities and infrastructure, agricultural losses, business interruption, and impacts on tourism. R enovations of commercial and industrial buildings may be necessary, disrupting associated services. Extensive flood damage to public utilities can cause disruptions to delivery of services. Loss of power and communications may occur, and drinking water and wastewater treatment facilities may be temporarily out of operation.

Hazus estimates the amount of debris generated from the 1 percent annual chance event. The model breaks down debris into three categories based on the types of equipment needed to handle the debris: finishes (dry wall, insulation, etc.); structural (wood, brick, etc.); and foundations (concrete slab and block, rebar, etc.). This does not include non-structural debris or additional potential damage and debris possibly generated by wind that may be associated with a flood event or storm that causes flooding. Table 10-17 summarizes the debris Hazus estimates for Sussex County. Hazus estimates 2,786 tons of debris will be generated in total.

10.2.5 Natural, Historic and Cultural Resources

Natural

The environmental impacts of a flood can include significant water quality and debris-disposal issues. Floodwaters can back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate the flooded waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals get added to floodwaters. Hazardous materials may be released and distributed widely across the floodplain. After floodwaters subside, contaminated and flood-damaged building materials and contents must be properly disposed of. Contaminated sediment must be removed from buildings, yards, and properties. In addition, severe erosion caused by flooding can negatively impact local ecosystems. The erosion of sediment can deteriorate riverbanks, causing additional flooding into locations that may not otherwise have experienced flooding conditions.

Historic

Historic places, community facilities, and religious institutions are all vulnerable to impacts from flooding. Museums and historic buildings face structural damage during flood events. Historic structures often are not built to modern building code requirements, including design flood elevation and construction standards. Historic resources and structures were often built close to waterways, increasing their flood risk. Depending on severity, flood events affecting the County could bring devastating loss of life and property to the area in and around historical landmarks.

Table 10-14. Estimated Debris Generated from the 1 Percent Annual Chance Flood Event

	1 Percent Annual Chance Flood Event Hazard Area			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Andover (B)	69	69	0	0
Andover (Twp)	7	6	1	0
Branchville (B)	30	28	1	1
Byram (Twp)	105	90	9	7
Frankford (Twp)	105	104	0	0
Franklin (B)	80	68	7	6
Fredon (Twp)	1	1	0	0
Green (Twp)	16	12	2	1
Hamburg (B)	54	54	0	0
Hampton (Twp)	15	13	1	1
Hardyston (Twp)	7	6	0	0
Hopatcong (B)	300	122	103	75
Lafayette (Twp)	34	32	1	1
Montague (Twp)	118	56	36	26
Newton (T)	263	262	1	0
Ogdensburg (B)	33	33	0	0
Sandyston (Twp)	49	32	10	7
Sparta (Twp)	325	259	40	26
Stanhope (B)	37	20	11	7
Stillwater (Twp)	91	28	37	26
Sussex (B)	436	198	132	106
Vernon (Twp)	326	217	62	47
Walpack (Twp)	116	24	51	41
Wantage (Twp)	168	94	42	32
Sussex County (Total)	**2,786**	**1,830**	**546**	**410**

Source: Hazus v6.0; Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic

Cultural

Cultural institutions, parks and open spaces, community facilities, and religious institutions are all vulnerable to impacts from flooding. Floods pose the risk of damage to cultural artifacts that are not easily replaceable. Parks, recreation, and community space closures due to flood events can disrupt residents' lives and hinder access to critical community services. Parks and recreational areas are often located near waterways. Depending on severity, flood events affecting the County could bring devastating loss of life and property to the area in and around cultural landmarks.

10.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

Overall, the County's vulnerability to the flood hazard has not changed, and the entire County will continue to be vulnerable to this hazard. Any change in vulnerability since the previous HMP would be attributed to changes in population density and new development. This updated HMP used updated building stock and critical asset inventories to assess the County's risk to these assets. The building inventory was updated using RSMeans 2022 values, which are more current and reflect replacement cost rather than the building stock improvement values reported in the 2021 HMP. Further, the 2021 5-year population estimates from the American Community Survey were used to evaluate the population exposed to the hazard areas.

10.4 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.

10.4.1 Potential or Planned Development

As Sussex County communities grow, flood events may increase in frequency and/or severity as land use changes, more structures are built, and impervious surfaces expand. Being aware of flood extents and requirements of protection will be critical for all future projects. The Sussex County Planning Board (SCPB) is responsible for review or approval of site plan and subdivision applications and implementing the Sussex County Land Development Standards. Further, a site plan review process is done at the municipal level to ensure compliance with local ordinances. The State of New Jersey's 2023 Inland Flood Rule which, among other protections, increases building freeboard requirements to 3 feet above the base flood elevation. This amount of freeboard better protects new development from flooding impacts.

10.4.2 Projected Changes in Population

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

Changes in the density of population can create issues for local residents during evacuation for a flood event. Historically, flooding and debris have severely impacted transportation corridors as well as infrastructure. As areas continue to be cleared for new development and run-off persists, the population in the County will remain exposed to this hazard.

10.4.3 Climate Change

Flood extents for the 1 percent and 0.2 percent annual chance flood events will continue to evolve alongside natural occurrences such as climate change and/or severity of storms. Annual precipitation amounts in the region are projected to increase, primarily in the form of heavy rainfalls, which have the potential to increase the risk to flash flooding and riverine flooding, and flood critical transportation corridors and infrastructure. Increases in precipitation may alter and expand the floodplain boundaries and runoff patterns, resulting in the exposure of populations, buildings, and critical facilities that were previously outside the floodplain. This increase in exposure would result in an increased risk to life and health, an increase in structural losses, a diversion of additional resources to response and recovery efforts, and an increase in business closures affected by future flooding events due to loss of service or access.

11. GEOLOGICAL HAZARDS

11.1 HAZARD PROFILE

11.1.1 Hazard Description

For the purpose of Sussex County's HMP update, geological hazards include landslides and land subsidence/sinkholes.

Landslides

A landslide is a downslope movement of earthen materials. Landslides destroy property and infrastructure and can take the lives of people. When landslides deform and tilt the ground surface, the result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures.

Landslide Types

Figure 11-1 shows common landslide types as classified by the USGS. All these types of landslides are considered aggregately in USGS landslide mapping.

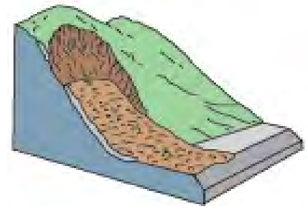
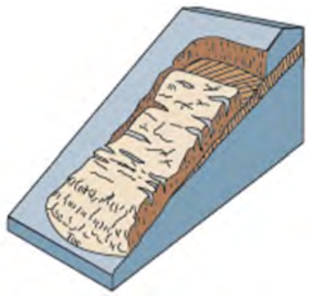
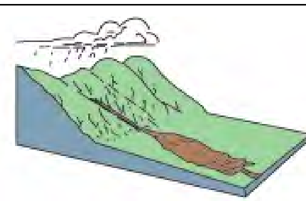
Landslide Causes

Landslides are caused by a combination of geological and climate conditions and the influence of urbanization. They can be initiated by storms, earthquakes, fires, volcanic eruptions, or human modification of the land. While small landslides are frequently a result of human activity, the largest landslides are often naturally occurring phenomena with little or no human contribution. Landslides are associated primarily with the following factors (USGS 2004):

- **Water—**Intense rainfall, changes in groundwater level, and water level changes along coastlines, earthen dams, and the banks of lakes, reservoirs, and rivers are the primary triggers of landslides.
- **Seismic Activity—**Earthquakes in landslide-prone areas greatly increase the likelihood that landslides will occur, either due to ground shaking alone or shaking-caused dilation of soil materials.
- **Mining—**Large vibrations, including blasting, reach yards under the soil surface, which poses a greater threat to areas that are already at risk for sliding.
- **Other Human Activity—**Construction activity that undercuts or overloads dangerous slopes or that redirects the flow of surface or groundwater can trigger slope failures.

Landslides are typically a function of soil type and slope steepness. Soil type is a key indicator for landslide potential and is used by geologists and geotechnical engineers to determine soil stability for construction standards.

Figure 11-1. Common Landslides Types

Rotational slides—Slides in which the surface of rupture is curved upward, and the slide movement rotates parallel to the ground surface. 	**Debris avalanches—** Debris flows that travel faster than about 10 miles per hour (mph). Speeds in excess of 20 mph are not uncommon, and speeds in excess of 100 mph, although rare, can occur. The slurry can travel miles from its source, growing as it descends, picking up trees, boulders, cars, and anything else in its path. 
Translational slides— Slides in which the mass moves along a roughly flat surface with little rotation. 	**Earthflows—**Landslides with an "hourglass" shape. The slope material liquefies and runs out, forming a bowl or depression at the head. A **mudflow** is an earthflow consisting of material that is wet enough to flow rapidly and that contains at least 50 percent sand-, silt-, and clay-sized particles. 
Falls—Abrupt movements of geologic materials, such as rocks and boulders, that become detached from steep slopes or cliffs. Falls are strongly influenced by gravity, weathering, and the presence of water in a mineral's pores. 	**Creep—**Slow, steady, downward movements of slope-forming soil or rock. Creep is indicated by curved tree trunks, bent fences, or retaining walls, tilted poles or fences, and small soil ripples or ridges. 
Topples—Slides involving the forward rotation of a unit about some point under the actions of gravity and forces exerted by surrounding objects or by fluids in cracks. 	**Lateral Spreads—**Slides on very gentle slopes or flat terrain caused by liquefaction, the process whereby saturated, loose, sediments are transformed from a solid into a liquefied state. The failure starts suddenly in a small area and spreads rapidly. 
Debris flows—Rapid landslides in which loose soil, rock, organic matter, air, and water mobilize as a slurry that flows downslope. Commonly caused by intense surface water flow due to heavy rain or rapid snowmelt that erodes loose soil or rock on steep slopes. 	

Source: (U.S. Geological Survey 2006, USGS 2004)

Subsidence/Sinkholes

Subsidence is any lowering of the earth's surface, from small or local collapses (sinkholes) to broad regional areas of lowering (USGS 2019). Subsidence and sinkholes can occur due to natural processes or because of human activities. The most common causes of subsidence include the following (USGS 2019):

- Aquifer-system compaction associated with groundwater withdrawals
- Drainage of organic soils
- Fracking and underground mining
- Earthquakes and erosion
- Natural compaction or collapse
- Expansive soils
- Hydrocompaction

In the United States, more than 17,000 square miles in 45 states, an area roughly the size of New Hampshire and Vermont combined, have been directly affected by subsidence (USGS 2018). Consequences of land subsidence include the following (USGS 2019):

- Reduced ability to store water in an aquifer
- Partially or completely submerged land
- Collapsed water well casings
- Disruption of collector drains and irrigation ditches
- Altered flow in creeks, which may increase the frequency and severity of flooding
- Damage to roadways, bridges, building foundations, and other infrastructure

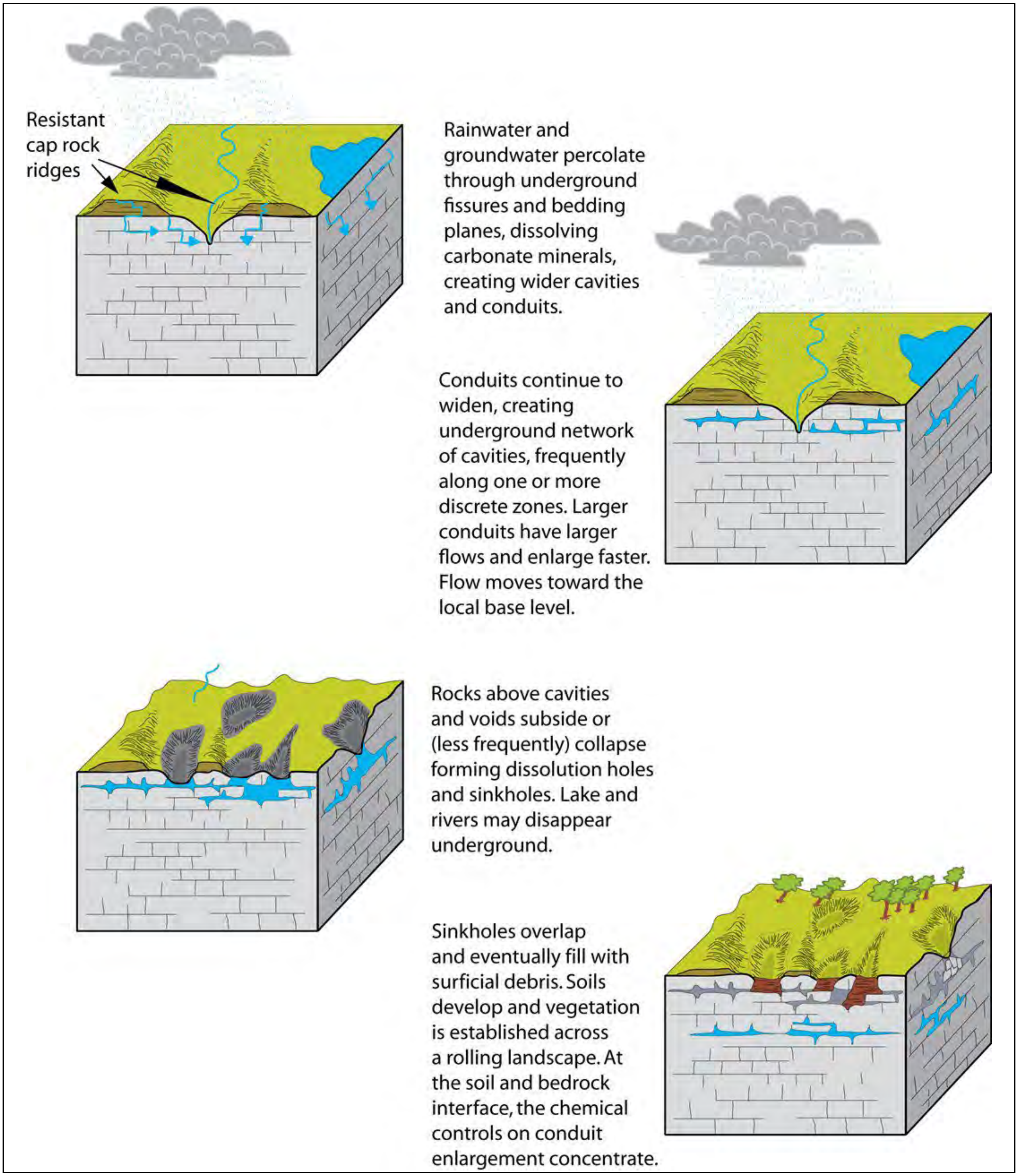
Both natural and man-made sinkholes can occur without warning. Slumping or falling fence posts, trees, or foundations, sudden formation of small ponds, wilting vegetation, discolored well water, and/or structural cracks in walls and floors are all signs that a sinkhole is forming.

Subsidence Due to Dissolving Bedrock (Karst)

Subsidence often occurs through the loss of subsurface support in areas underlain with soluble carbonate rocks (e.g., limestone and dolomite) that are gradually dissolving due to surface water or groundwater (NPS 2022). Such areas, called karst terrain, may result from several natural- and human-caused occurrences. The dissolution process causes surface depressions and the development of sinkholes, sinking streams, enlarged bedrock fractures, caves, and underground streams (NJOEM 2019). Figure 11-2 illustrates the development of karst terrain. Over 20 percent of the United States is underlain by karst terrain, but 40 percent of the nation's groundwater used for drinking is sourced from karst aquifers, increasing the potential for land subsidence and sinkholes (NPS 2022).

Sinkholes are the type of subsidence most frequently seen in New Jersey. They are a natural and common geologic feature in areas with underlying karst terrain. Over thousands of years, acidic rainwater traveling through fractures in the bedrock, slowly dissolves the bedrock, creating larger openings through which water and overlying soil materials will travel. The openings, called voids, enlarge until the ground is unable to support the land above, resulting in a collapse that forms a sinkhole (USGS 2018).

Figure 11-2. Formation of Sinkholes in Karst Terrain



Source: NPS 2022

Human Causes of Subsidence

Anthropogenic activities can accelerate the natural processes that result in soil voids and sinkholes (NJOEM 2019):

- Changes to the water balance of an area such as over-withdrawal of groundwater
- Diverting surface water from a large area and concentrating it in a single point
- Artificially creating ponds of surface water
- Drilling new water wells

Leaking water pipes or structures that convey stormwater runoff may result in areas of subsidence as the water dissolves rock over time. In some cases, construction, land grading, or earth-moving activities that cause changes in stormwater flow can trigger subsidence events. Subsidence events may occur during mining activities, especially where the cover of a mine is thin. Underground extraction of materials such as oil, gas, coal, metal ores, clay, shale, limestone, or water may result in slow-moving or abrupt shifts in the ground surface (Whittaker and Reddish 1989).

According to the USGS, sinkholes are linked to groundwater pumping, construction, and development. Sinkholes can form when natural water drainage patterns are changed, and new water diversion systems are developed. Some sinkholes form when the land surface is changed, such as when industrial and runoff-storage ponds are created. The weight of the new material can trigger a collapse of supporting material, causing a sinkhole (USGS 2018).

Groundwater Withdrawal

Land subsidence can occur when groundwater is withdrawn from an area characterized predominantly by fine-grained sediment rocks. These types of rocks contain water, which is partially responsible for holding the rock's structure and form. When the water is removed, the open spaces between the fine sediments cause a partial collapse (USGS 2018). Figure 11-3 illustrates the land subsidence process, where soil layers become more compact and unstable due to the loss of groundwater.

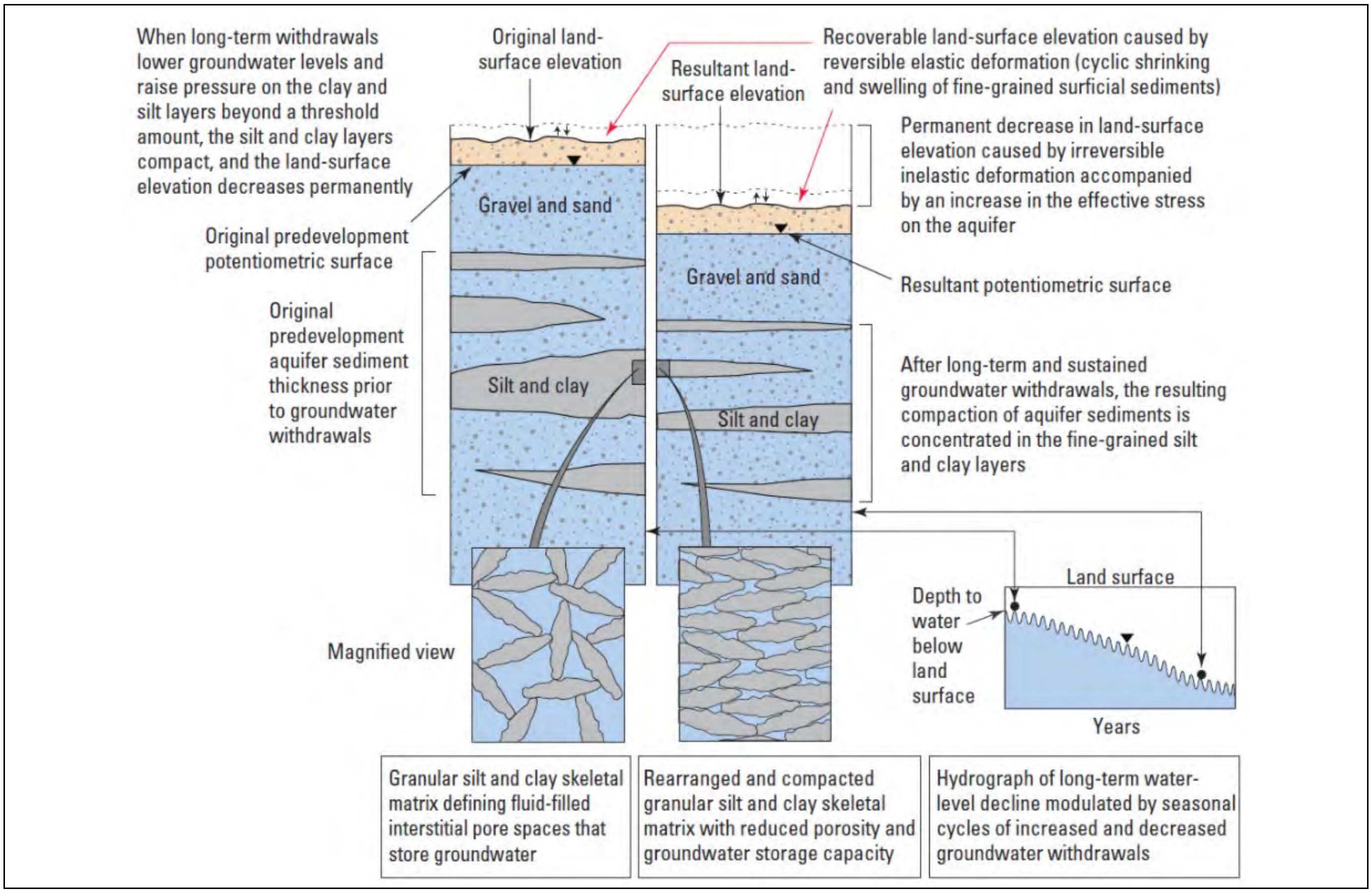
The overburdened sediments that cover underground areas in aquifer systems are balanced by groundwater pressure. The water below ground helps keep the surface soil in place. Groundwater pumping for urban water supply can produce new sinkholes. If pumping results in the lowering of groundwater levels, then underground structural failure, such as sinkholes, can occur (USGS 2018).

Abandoned Mines

New Jersey's susceptibility to subsidence is due in part to abandoned mines throughout the region. The mining industry in the state dates to the early 1600s when cooper was mined by Dutch settlers along the Delaware River in Warren County. There are almost 600 abandoned mines in New Jersey (NJDEP 2011).

The extensive mining that previously occurred in the northern part of the state has caused widespread subsidence. Many of the surface openings were improperly filled in, and roads and structures have been built adjacent to or on top of these former mine sites (NJOEM 2019). Mines create voids under the earth's surface, making areas above them more susceptible to land subsidence. Sinkholes and subsidence occur from the collapse of a mine roof into a mine opening. Areas most vulnerable to sinkholes are those where mining occurred less than 50 feet below the surface (PADEP 1999).

Figure 11-3. Subsidence Process Due to Groundwater Removal



Source: USGS n.d.

11.1.2 Location

Landslides

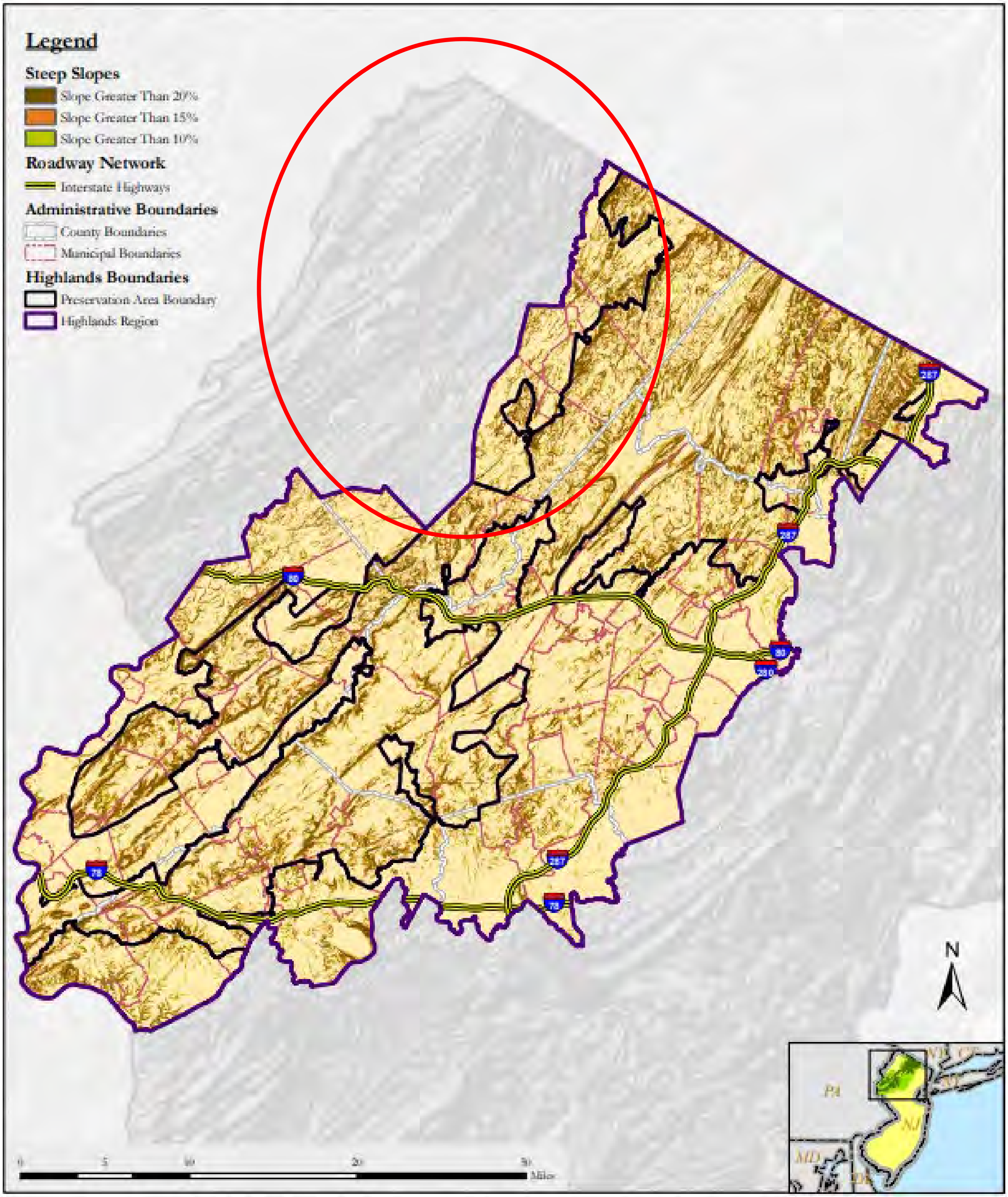
Landslides are common in New Jersey, primarily in northern regions. Expansion of urban and recreational developments into hillside areas exposes more people to the threat of landslides each year. Local landslide susceptibility mapping is available from multiple sources:

- The USGS reports a range of very high to moderate landslide potential in Sussex County (USGS 2005).
- Figure 11-4 shows a relatively moderate Landslide Risk Index for Sussex County from FEMA's National Risk Index (FEMA 2019).
- Figure 11-5 shows steep slopes in the portion of Sussex County that is within the Highlands Council Steep Stope Protection Area (New Jersey Highlands Council 2006).
- Figure 11-6 shows historical landslide locations in Sussex County. Landslides have occurred throughout Sussex County, with a large number in Vernon and Sparta. Many of the documented landslide were the result of Hurricane Irene storm damage destabilizing roads and causing debris flows. This demonstrates how landslides can become a secondary hazard during another disaster event.

Figure 11-4. National Risk Index, Landslide Index Score

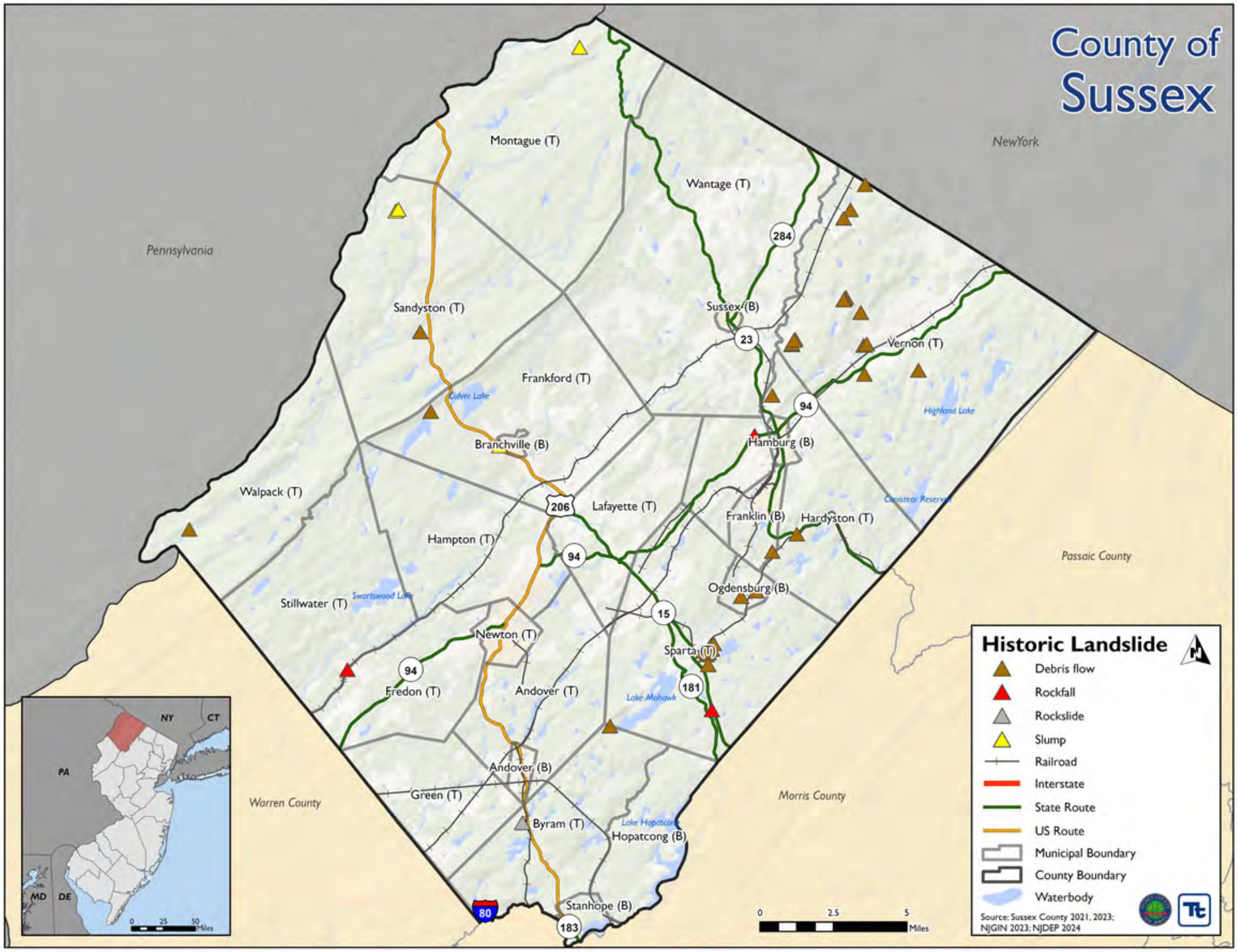
Source: FEMA 2019

Figure 11-5. Highlands Council Steep Stope Protection Area



Source: Highlands Council 2007
Note: The red circle indicates the approximate location of Sussex County.

Figure 11-6. Historical Landslides in Sussex County



Subsidence/Sinkholes

Naturally occurring subsidence and sinkholes in New Jersey occur within bands of carbonate bedrock. In northern New Jersey, there are more than 225 square miles that are underlain by limestone, dolomite, and marble. In some areas, no sinkholes have appeared, while in others, sinkholes are common (NJOEM 2019). The State has recorded 382 carbonate bedrock formations, most of which (39 percent) are characterized as dolomite and minor limestone formations (NJGIN 2008). Sussex County has bands of carbonate rock running throughout the County; the only areas not containing notable bands of carbonate rock are along the southwestern border and part of the northern section. Figure 11-7 illustrates areas of carbonate bedrock located in Sussex County.

According to NJDEP, 59 of the 88 municipalities in the Highlands region contain carbonate rocks; eight of those municipalities are in Sussex County. As seen in Figure 11-8, large areas of carbonate rock formations and karst features exist in some, but not all, of these areas (Highlands Regional Master Plan 2008).

Figure 11-9 shows the location of mapped abandoned mines in Sussex County. Sussex County has 75 abandoned mines, principally in the eastern and southern portions of the County (NJDEP 2011).

11.1.3 Extent

Landslide

The extent of a landslide can be measured by the characteristics of the affected area (susceptibility) and the history of landslides (incidence). Landslide susceptibility is defined as the likely response of a geologic formation to natural or artificial cutting, to loading of slopes, or to unusually high precipitation. Unusually high precipitation or changes in existing conditions can initiate landslide movement in areas where rocks and soils have experienced numerous landslides in the past. Landslide susceptibility depends on slope angle and the geologic material underlying the slope.

The "Landslide Overview Map of the Conterminous United States" classifies areas as having high, medium, or low landslide incidence and high, medium, or low susceptibility to landsliding (Radbruch-Hall, et al. 1982):

- Incidence:
  - High—More than 15 percent of a location's area has been involved in landsliding
  - Medium—1.5 to 15 percent of a location's area has been involved in landsliding
  - Low—Less than 1.5 percent of a location's area has been involved in landsliding
- Susceptibility:
  - High—More than 15 percent of a location's area would move in response to cutting or heavy rainfall
  - Medium—1.5 to 15 percent of a location's area would move in response to cutting or heavy rainfall
  - Low—Less than 1.5 percent of a location's area would move in response to cutting or heavy rainfall

Figure 11-10 shows USGS mapping of landslide incidence and susceptibility in the northern New Jersey region. Most of Sussex County is mapped as low incidence and susceptibility. The only exception is the northwest corner, which is mapped as moderate susceptibility and low incidence.

Figure 11-7. Carbonate Rock in Sussex County

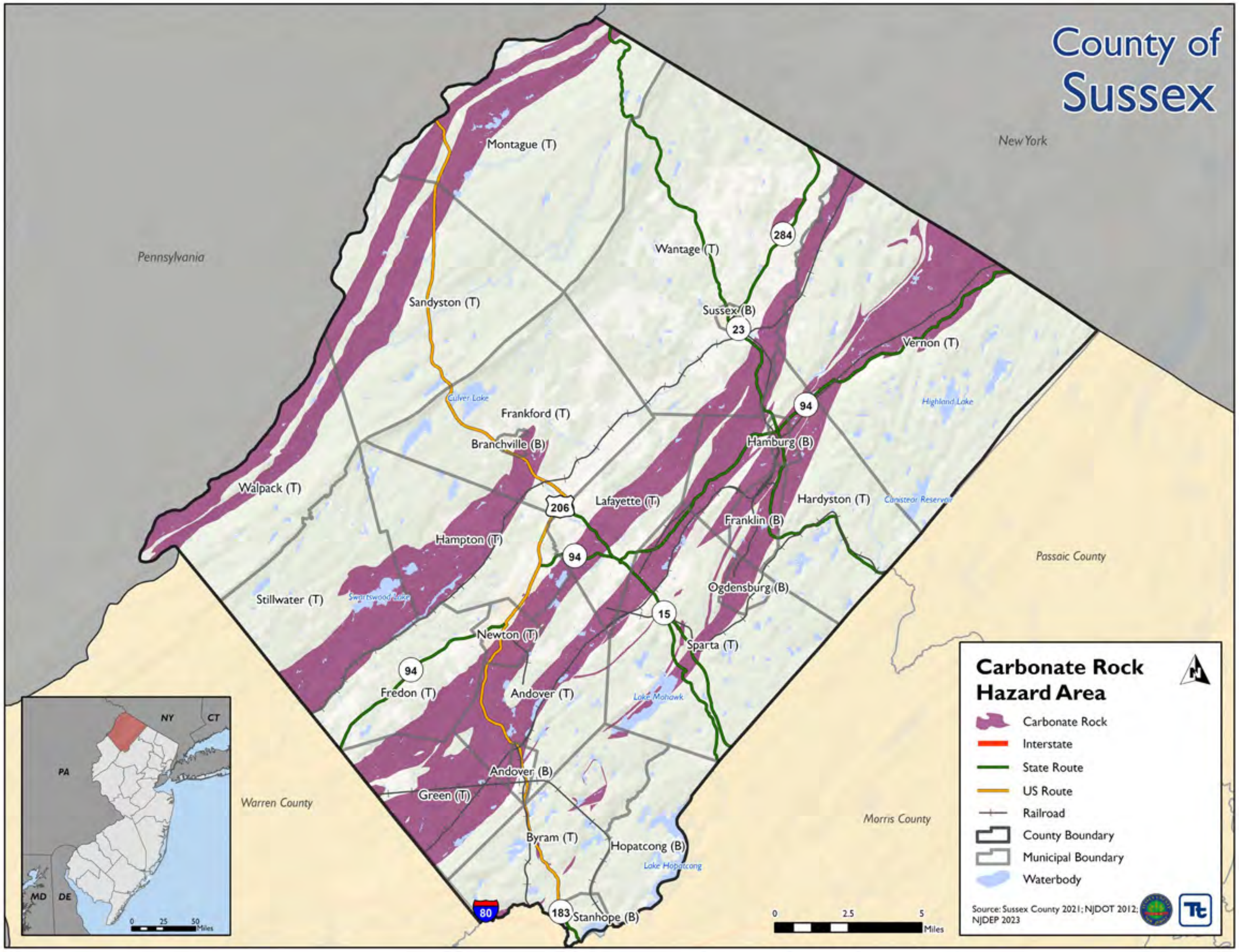
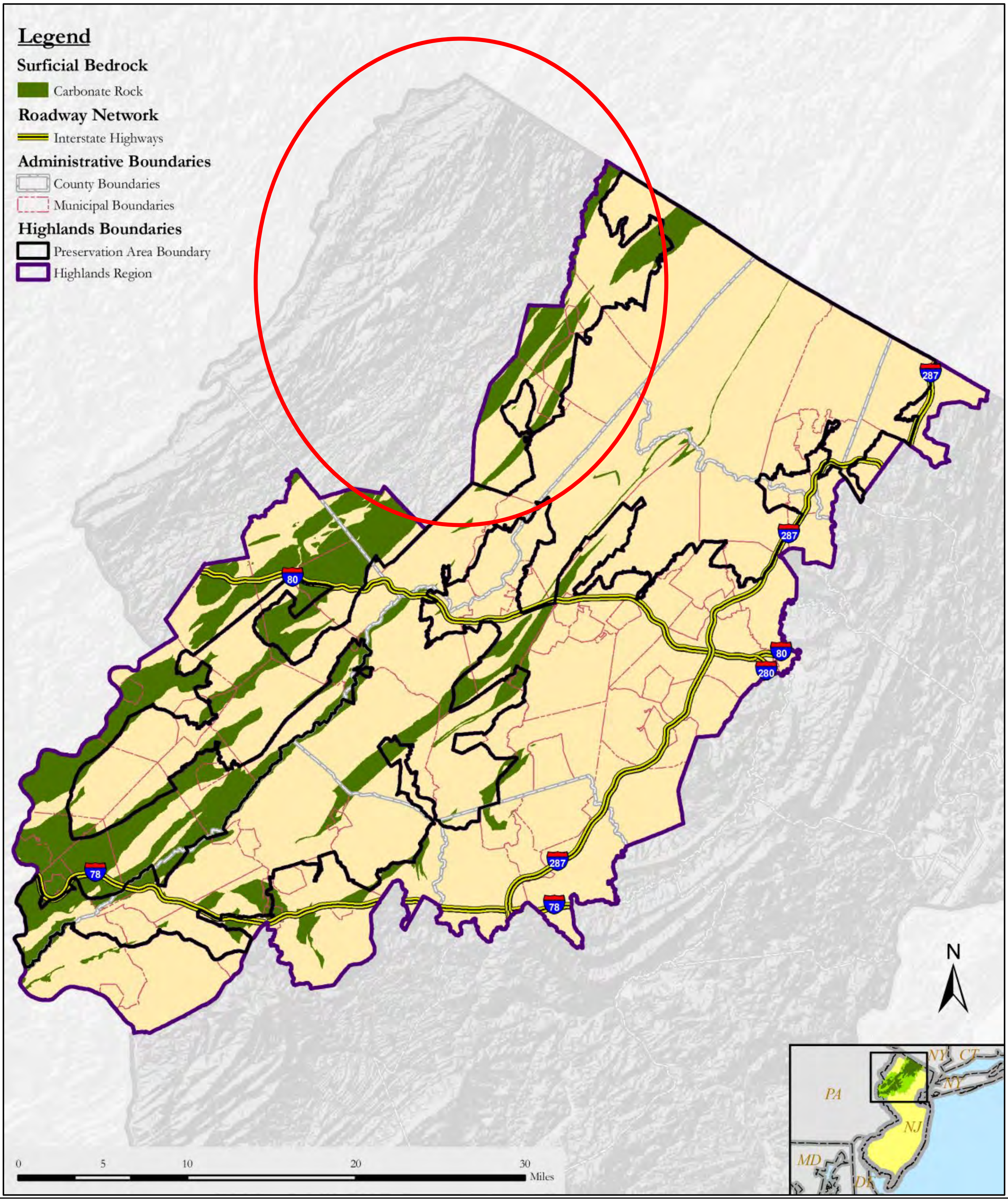


Figure 11-8. Carbonate Rock in the New Jersey Highlands



Source: New Jersey Highlands Council 2008
Note: The red circle indicates the approximate location of Sussex County.

Figure 11-9. Abandoned Mines in Sussex County

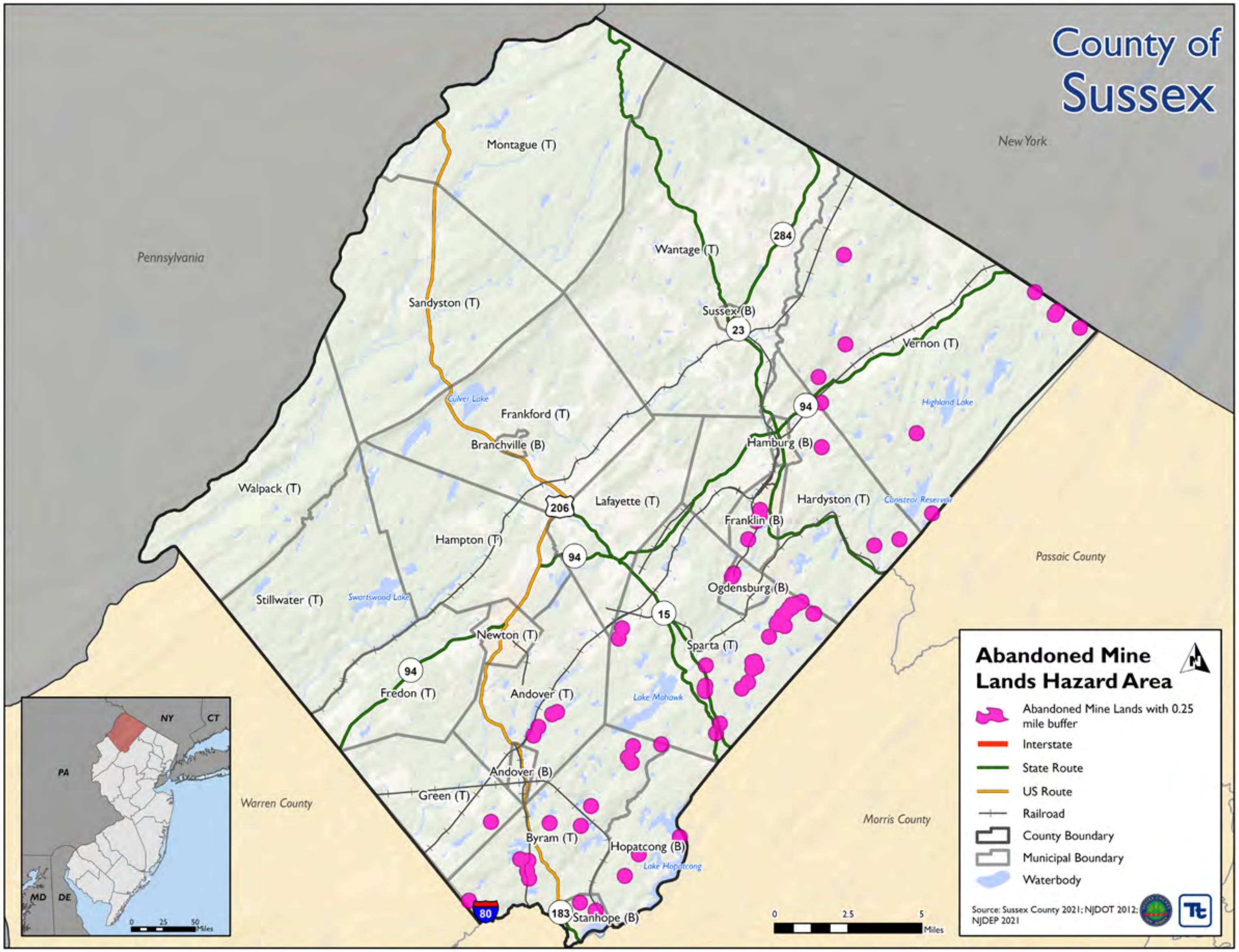
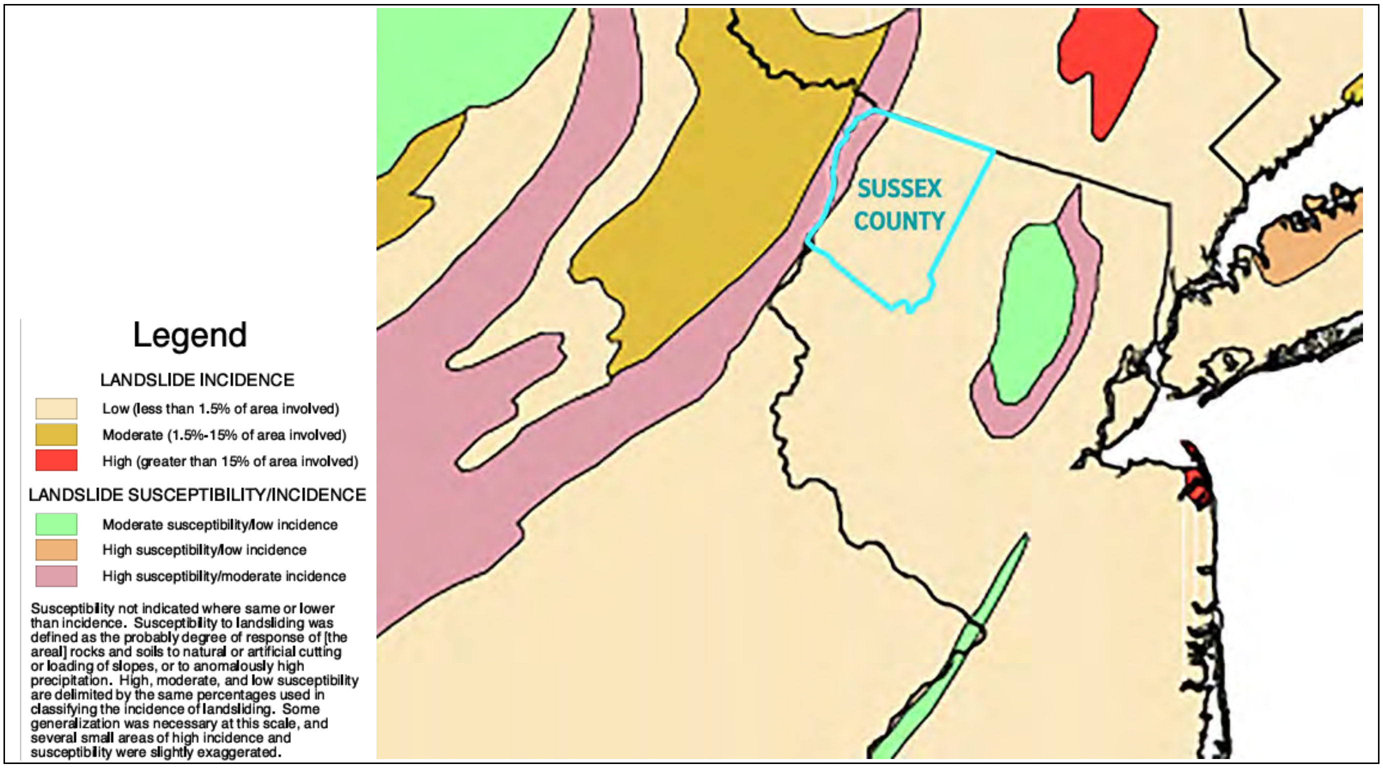


Figure 11-10. Sussex County Landslide Incidence and Susceptibility



Source: USGS 1982

A landslide also can be measured using the volume of material moved during the event. This is affected by the velocity of the landslide. The rate at which materials move ranges from inches per year to tens of miles per hour (mph) (USGS n.d.-c). A debris flow—a fast-moving slurry of water, rock, soil, vegetation, boulders, and trees—is triggered by short, intense periods of rainfall or rapid snowmelt, and can cause serious property damage and loss of life. A debris flow typically travels at about 10 mph but can exceed 35 mph in extreme cases (USGS 2022).

Subsidence/Sinkhole

Subsidence can occur abruptly or slowly and continuously over time. Sinkholes can range from steep-walled holes, to bowl, or cone-shaped depressions. When sinkholes occur in developed areas they can cause severe property damage, disruption of utilities, damage to roadways, injury, and loss of life (NJOEM 2019). There are several methods used to measure land subsidence:

- Global Positioning System (GPS) is used to monitor subsidence on a regional scale.
- USGS uses radar images from Earth-orbiting satellites to monitor subsidence by mapping land-surface deformation.
- Interferometric Synthetic Aperture Radar (InSAR) is a tool used to measure land subsidence by utilizing radar signals to track deformation in the earth's crust. USGS is using InSAR to map and monitor subsidence caused by compaction of aquifer systems (USDI, USGS 2000). Assessments of the InSAR data can be done to improve understanding of subsidence processes (USGS 2019).

11.1.4 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Sussex County has been included in one major disaster (DR) or emergency (EM) declaration specifically related to a geological hazard event (FEMA 2024). In addition, Sussex County was included in the FEMA disaster declaration for the remnants of Tropical Storm Lee in 2011 and Hurricane Ida in 2021. These disasters resulted in flood-induced landslides and mudslides. Sussex County experienced a debris flow along the lower end of Holland Circle a result of Tropical Storm Lee, as well as mudslides causing lane closures from Hurricane Ida; other minor events may have also occurred. Table 11-1 lists these declarations.

Table 11-1. FEMA Declarations for Geological Hazard Events in Sussex County

Event Date	Declaration Date	Declaration Number	Description
August 12 - 21, 2000	August 17, 2000	DR-1337	Severe Storms, Flooding, and Mudslides
September 8, 2011 - October 6, 2011	October 14, 2011	DR-4039	Remnants of Tropical Storm Lee
September 1 –3, 2021	September 5, 2021	DR-4614; EM-3573	Remnants of Hurricane Ida

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 agricultural disaster declarations related to geological hazards (USDA 2024).

Previous Events

Known geological hazard events that impacted Sussex County between January 2020 and June 2024 are listed in Table 11-2. For events prior to 2020, refer to the 2021 Sussex County HMP.

11.1.5 Probability of Future Occurrences

Probability Based on Previous Occurrences

Information on previous geological hazard occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 11-3. Based on historical records and input from the Steering Committee, the probability of occurrence for geological hazards in the County is considered “rare.”

Table 11-2. Geological Hazard Events in Sussex County (2020 to 2024)

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
March 2021	N/A	N/A	Township of Vernon	The Township of Vernon had a relatively small sinkhole form as a result of heavy rain, snow melt and lake run off at the National Winter Activity Center. It was approximately 30” x 24” and 6’ deep, connected to a spillway basin that ties into a stream. It was kept under watch and was remediated with a dam replacement project.
September 27, 2023	N/A	N/A	Township of Union	Ramsey Avenue in Township of Union was blocked off due to a sinkhole that affected a significant portion of the main road. The sinkhole occurred below the I-78 overpass. A project to mitigate the impacts from this event occurred in March 2023.

Source: NOAA-NCEI 2023; FEMA 2024

Table 11-3. Probability of Future Geological Hazard Events in Sussex County

Hazard Type	Number of Occurrences Between 1996[a] and 2023	Percent Chance of Occurring in Any Given Year
Debris Flows	27	100%
Mudslide	1	3.57%
Rockfalls	3	10.71%
Slump	3	10.71%
Sinkhole	2	7.14%
Total	**36**	**100%**

Source: NJOEM 2019; NOAA NCEI 2024; NJGWS 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

Landslides

Projections of climate change for New Jersey predict increases in total annual precipitation, more intense rainfall events in fall, winter, and spring, and increased summer dry weather that can lead to wildfires that destroy vegetation growth that helps to support steep slopes (see Section 3.3.4). All these factors would increase the probability for landslide occurrences.

Northern New Jersey’s 1971-2000 precipitation average was over 5 inches (12 percent) greater than the average from 1895-1970 (Office of New Jersey State Climatologist). Annual precipitation in New Jersey increased by 4.1 inches over the previous 100 years and was 8 percent above average from 2010 through 2020 (NJDEP 2019).

Subsidence/Sinkholes

One of the triggers for subsidence and sinkholes is an abundance of moisture permeating and dissolving the bedrock. Climatologists expect an increase in annual precipitation amounts, which will coincide with an increased risk in subsidence and sinkholes in vulnerable areas.

11.1.6 Cascading Impacts on Other Hazards

Landslides can cause secondary effects such as blocking roads, which can isolate residents and businesses and delay commercial, public, and private transportation. Other potential problems can result from landslides if vegetation or poles on slopes are knocked over, causing losses to power and communication lines. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents. They can damage rivers or streams, potentially harming water quality, fisheries, and spawning habitat. Landslides can contribute to instances of flooding if the collapsed soil and sediment block streams, causing waters to flow outside of their banks. Sinkholes can pull down utility poles, structures, and vehicles. They can also impact underground pipes.

11.2 VULNERABILITY AND IMPACT ASSESSMENT

To evaluate the geological hazard, the following areas were defined as hazard areas:

- Landslide hazard areas:
  - Moderate slopes—15 to 20 percent
  - High slopes—greater than 20 percent
- Subsidence/sinkhole hazard areas:
  - 2023 NJDEP carbonate rock layer
  - Abandoned mine locations buffered by 0.25 miles

11.2.1 Life, Health, and Safety

Generally, a landslide or subsidence event is an isolated incident, impacting the populations within the immediate area. In addition to causing damage to homes and displacing residents, these events can block or damage major roadways and inhibit travel for emergency responders or populations trying to evacuate the area.

Overall Population

Table 11-4 summarizes the population living in the high and moderate slope landslide hazard areas. Overall, 20,921 persons are living in the high landslide area and 16,335 persons live in the moderate landslide area. The Township of Vernon (4,883) and Township of Sparta (3,456) have the greatest number of residents living in the high landslide area. The Township of Sparta (2,801) and Township of Vernon (1,025) have the greatest number of residents living in the moderate landslide area.

Table 11-5 summarizes the population living on landscapes with carbonate karst bedrock or within 0.25 miles of an abandoned mine. Overall, 41,329 persons are living on carbonate karst bedrock and 6,369 persons live within 0.25 miles of an abandoned mine. The Town of Newton (5,550) and the Township of Vernon (4,899) have the greatest number of residents living on carbonate karst bedrock. The Borough of Hopatcong (1,916) and the Borough of Stanhope (1,025) have the greatest number of residents living within 0.25 miles of an abandoned mine.

Table 11-4. Estimated Population in the Landslide Hazard Areas

	Total Population (US Census Bureau Decennial 2020)	Population in the High Slope Landslide Hazard Area		Population in the Moderate Slope Landslide Hazard Area	
		Number of Persons	% of Jurisdiction Total	Number of Persons	% of Jurisdiction Total
Andover (B)	595	63	10.6%	45	7.6%
Andover (Twp)	5,996	704	11.7%	536	8.9%
Branchville (B)	791	67	8.5%	65	8.2%
Byram (Twp)	8,028	1,396	17.4%	847	10.6%
Frankford (Twp)	5,302	490	9.2%	494	9.3%
Franklin (B)	4,912	375	7.6%	339	6.9%
Fredon (Twp)	3,235	362	11.2%	332	10.3%
Green (Twp)	3,627	274	7.6%	271	7.5%
Hamburg (B)	3,266	254	7.8%	252	7.7%
Hampton (Twp)	4,893	381	7.8%	405	8.3%
Hardyston (Twp)	8,125	1,189	14.6%	1,269	15.6%
Hopatcong (B)	14,362	2,662	18.5%	1,909	13.3%
Lafayette (Twp)	2,358	191	8.1%	169	7.2%
Montague (Twp)	3,792	356	9.4%	462	12.2%
Newton (T)	8,374	794	9.5%	816	9.7%
Ogdensburg (B)	2,258	196	8.7%	156	6.9%
Sandyston (Twp)	1,977	359	18.2%	197	10.0%
Sparta (Twp)	19,600	3,456	17.6%	2,801	14.3%
Stanhope (B)	3,526	433	12.3%	411	11.7%
Stillwater (Twp)	4,004	475	11.9%	410	10.2%
Sussex (B)	2,024	303	15.0%	252	12.5%
Vernon (Twp)	22,358	4,883	21.8%	2,646	11.8%
Walpack (Twp)	7	0	0.0%	0	0.0%
Wantage (Twp)	10,811	1,258	11.6%	1,251	11.6%
Sussex County (Total)	**144,221**	**20,921**	**14.5%**	**16,335**	**11.3%**

Source: U.S. Census Bureau 2020, 2021; NJDEP Bureau of GIS; NJ Office of GIS NJOIT, USGS 2023; CDC/ATSDR 2020
Note: Results for population are rounded down.

Table 11-5. Estimated Population in the Subsidence/Sinkhole Hazard Areas

\	Total Population (US Census Bureau Decennial 2020)	Population in the Carbonate Karst Subsidence/Sinkhole Hazard Area		Population in the Abandoned Mine Subsidence/Sinkhole Hazard Area	
		Number of Persons	% of Jurisdiction Total	Number of Persons	% of Jurisdiction Total
Andover (B)	595	205	34.5%	595	0
Andover (Twp)	5,996	2,257	37.6%	5,996	164
Branchville (B)	791	296	37.4%	791	0
Byram (Twp)	8,028	475	5.9%	8,028	878
Frankford (Twp)	5,302	217	4.1%	5,302	0
Franklin (B)	4,912	3,677	74.9%	4,912	562
Fredon (Twp)	3,235	258	8.0%	3,235	0
Green (Twp)	3,627	2,672	73.7%	3,627	26
Hamburg (B)	3,266	2,736	83.8%	3,266	0
Hampton (Twp)	4,893	1,828	37.4%	4,893	0
Hardyston (Twp)	8,125	4,770	58.7%	8,125	100
Hopatcong (B)	14,362	0	0.0%	14,362	1,916
Lafayette (Twp)	2,358	1,375	58.3%	2,358	0
Montague (Twp)	3,792	2,169	57.2%	3,792	0
Newton (T)	8,374	5,550	66.3%	8,374	0
Ogdensburg (B)	2,258	1,741	77.1%	2,258	248
Sandyston (Twp)	1,977	577	29.2%	1,977	0
Sparta (Twp)	19,600	3,169	16.2%	19,600	558
Stanhope (B)	3,526	0	0.0%	3,526	1,025
Stillwater (Twp)	4,004	2,125	53.1%	4,004	0
Sussex (B)	2,024	0	0.0%	2,024	0
Vernon (Twp)	22,358	4,899	21.9%	22,358	892
Walpack (Twp)	7	5	71.4%	7	0
Wantage (Twp)	10,811	328	3.0%	10,811	0
Sussex County (Total)	**144,221**	**41,329**	**28.7%**	**144,221**	**6,369**

Source: U.S. Census Bureau 2020, 2021; NJGIN 2023; Sussex County 2021, 2023; NJDEP 2023; CDC/ATSDR 2020
Note: Results for population are rounded down.

Socially Vulnerable Population

Persons over the age of 65 and people below the poverty level are most vulnerable to geological hazards because of the potential limited access to mobilization or medical resources if a landslide or subsidence event occurs.

Table 11-6 presents the estimated socially vulnerable populations living in the high slope and moderate slope landslide hazard areas. There are 3,516 persons over the age of 65 years, 951 persons under the age of 5 years, 231 non-English speakers, 2,185 persons with a disability, and 985 living in poverty located in the high slope landslide hazard area. There are 2,806 persons over the age of 65 years, 732 persons under the age of 5 years, 194 non-English speakers, 1,736 persons with a disability, and 804 living in poverty located in the moderate slope landslide hazard area.

Table 11-7 presents the estimated socially vulnerable populations located in landscapes with carbonate karst bedrock or within 0.25 miles of an abandoned mine. There are 8,144 persons over the age of 65 years, 1,748 persons under the age of 5 years, 802 non-English speakers, 4,808 persons with a disability, and 2,326 living in poverty located in landscapes with carbonate karst bedrock. There are 986 persons over the age of 65 years, 307 persons under the age of 5 years, 82 non-English speakers, 638 persons with a disability, and 224 living in poverty located within 0.25-miles of an abandoned mine.

11.2.2 General Building Stock

Table 11-8 summarizes the number of buildings in the landslide hazard areas and the total replacement cost of these buildings by municipality. There are 10,107 buildings with a replacement cost value of approximately $6.8 trillion built on lands in the high landslide area. Furthermore, there are 7,714 buildings with a replacement cost value of approximately $6.1 trillion built in the moderate landslide area. The Township of Vernon has the greatest number of buildings built in the high landslide area; 2,530 buildings (21-percent of its total building stock) with an estimated replacement cost of $1 trillion. The Township of Vernon also has the greatest number of buildings built in the moderate landslide area; 1,388 buildings (11.5-percent of its total building stock) with an estimated replacement cost of $686 million.

Table 11-9 summarizes the number of buildings built in the subsidence/sinkhole hazard areas and the total replacement cost of these buildings by municipality. There are 20,634 buildings on lands with carbonate karst bedrock, with a replacement cost value of $23.9 billion. There are 3,035 buildings within 0.25 miles of an abandoned mine, with a replacement cost value of $1.6 billion. The Township of Vernon has the greatest number of buildings built on carbonate karst bedrock; 2,857 buildings (23.7-percent of its total building stock) with an estimated replacement cost of $2.4 billion. The Borough of Hopatcong has the greatest number of buildings built within 0.25-miles of an abandoned mine; 1,031 buildings (12.9-percent of its total building stock) with an estimated replacement cost of $339 million.

Table 11-10 summarizes buildings in the landslide hazard areas by general occupancy located. The exposure analysis estimates that across all subsidence hazard areas, the residential occupancy is the most exposed to landslide hazards, accounting for 91.8 percent and 92.4 percent of the buildings in the high slope landslide area and moderate slope landslide area, respectively.

Table 11-11 summarizes buildings in the subsidence/sinkhole hazard areas by general occupancy. The exposure analysis estimates that across all subsidence hazard areas, the residential occupancy is the most exposed to geological hazards, accounting for 83.2 percent and 95.1 percent of buildings on carbonate karst bedrock or within 0.25 miles of an abandoned mine, respectively.

Table 11-6. Estimated Vulnerable Persons Located in the Landslide Hazard Areas

	Vulnerable Population in the High Slope Landslide Hazard Area					Vulnerable Population in the Moderate Slope Landslide Hazard Area				
	Persons Over 65	Persons Under 5	Non-English Speaking Persons	Persons with a Disability	Persons in Poverty	Persons Over 65	Persons Under 5	Non-English Speaking Persons	Persons with a Disability	Persons in Poverty
Andover (B)	8	2	1	6	3	6	2	1	4	2
Andover (Twp)	160	28	0	61	31	122	21	0	46	23
Branchville (B)	13	3	2	7	2	13	3	2	6	2
Byram (Twp)	193	77	17	106	30	117	46	10	64	18
Frankford (Twp)	92	21	0	51	13	93	21	0	51	13
Franklin (B)	89	17	10	64	21	81	15	9	58	19
Fredon (Twp)	71	14	3	32	19	65	13	2	30	18
Green (Twp)	55	9	3	35	11	55	9	3	35	11
Hamburg (B)	35	11	25	18	13	34	11	25	18	13
Hampton (Twp)	90	15	7	57	27	95	16	8	61	28
Hardyston (Twp)	240	47	14	135	67	256	50	15	144	72
Hopatcong (B)	371	111	62	281	116	266	79	45	201	83
Lafayette (Twp)	41	13	2	20	16	36	12	2	18	14
Montague (Twp)	79	19	7	37	16	102	25	9	48	21
Newton (T)	169	24	19	113	69	174	25	19	116	71
Ogdensburg (B)	32	6	3	16	11	25	4	2	13	8
Sandyston (Twp)	58	20	0	40	13	31	10	0	22	7
Sparta (Twp)	462	204	23	273	132	374	165	19	221	107
Stanhope (B)	59	27	0	37	3	56	26	0	35	3
Stillwater (Twp)	123	11	0	65	32	106	9	0	56	28
Sussex (B)	44	13	1	52	54	37	10	0	43	45
Vernon (Twp)	805	216	20	506	191	436	117	11	274	103
Walpack (Twp)	0	0	0	0	0	0	0	0	0	0
Wantage (Twp)	227	43	12	173	95	226	43	12	172	95
Sussex County (Total)	**3,516**	**951**	**231**	**2,185**	**985**	**2,806**	**732**	**194**	**1,736**	**804**

Source: U.S. Census Bureau 2021; NJDOT 2012; Sussex County 2021
Note: Results for population are rounded down.

Table 11-7. Estimated Vulnerable Persons Located in the Subsidence/Sinkhole Hazard Areas

	Vulnerable Population in the Carbonate Karst Subsidence/Sinkhole Hazard Area					Vulnerable Population in the Abandoned Mine Subsidence/Sinkhole Hazard Area				
	Persons Over 65	Persons Under 5	Non-English Speaking Persons	Persons with a Disability	Persons in Poverty	Persons Over 65	Persons Under 5	Non-English Speaking Persons	Persons with a Disability	Persons in Poverty
Andover (B)	28	9	4	21	11	0	0	0	0	0
Andover (Twp)	515	91	0	197	100	37	6	0	14	7
Branchville (B)	61	14	10	31	13	0	0	0	0	0
Byram (Twp)	65	26	6	36	10	121	48	11	66	19
Frankford (Twp)	41	9	0	22	6	0	0	0	0	0
Franklin (B)	879	170	98	637	213	134	26	15	97	32
Fredon (Twp)	50	10	2	23	14	0	0	0	0	0
Green (Twp)	544	92	36	347	110	5	0	0	3	1
Hamburg (B)	377	119	278	201	145	0	0	0	0	0
Hampton (Twp)	431	75	36	275	130	0	0	0	0	0
Hardyston (Twp)	964	189	58	543	271	20	3	1	11	5
Hopatcong (B)	0	0	0	0	0	267	80	45	202	84
Lafayette (Twp)	298	99	19	147	116	0	0	0	0	0
Montague (Twp)	482	120	46	226	100	0	0	0	0	0
Newton (T)	1,184	172	134	792	485	0	0	0	0	0
Ogdensburg (B)	288	55	31	149	97	41	7	4	21	13
Sandyston (Twp)	93	32	0	65	22	0	0	0	0	0
Sparta (Twp)	423	187	21	250	121	74	33	3	44	21
Stanhope (B)	0	0	0	0	0	140	65	0	88	8
Stillwater (Twp)	550	51	0	294	145	0	0	0	0	0
Sussex (B)	0	0	0	0	0	0	0	0	0	0
Vernon (Twp)	807	217	20	507	192	147	39	3	92	34
Walpack (Twp)	5	0	0	0	0	0	0	0	0	0
Wantage (Twp)	59	11	3	45	25	0	0	0	0	0
Sussex County (Total)	**8,144**	**1,748**	**802**	**4,808**	**2,326**	**986**	**307**	**82**	**638**	**224**

Source: U.S. Census Bureau 2021; NJDOT 2012; Sussex County 2021
Note: Results for population are rounded down.

Table 11-8. Number and Value of Buildings Built in the Landslide Hazard Areas, by Municipality

	Jurisdiction Total Buildings		High Slope Landslide Hazard Area				Moderate Slope Landslide Hazard Area			
			Number of Buildings		Replacement Cost Value		Number of Buildings		Replacement Cost Value	
	Count	Replacement Cost Value	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Andover (B)	326	$693,607,785	30	9.2%	$84,851,904	12.2%	22	6.7%	$14,937,299	2.2%
Andover (Twp)	2,577	$4,012,892,721	287	11.1%	$429,401,649	10.7%	218	8.5%	$489,814,622	12.2%
Branchville (B)	426	$598,388,025	30	7.0%	$22,831,953	3.8%	31	7.3%	$21,203,392	3.5%
Byram (Twp)	3,676	$3,162,144,221	603	16.4%	$394,980,945	12.5%	375	10.2%	$549,573,138	17.4%
Frankford (Twp)	3,529	$3,491,793,002	303	8.6%	$189,028,522	5.4%	308	8.7%	$336,138,928	9.6%
Franklin (B)	2,058	$2,227,977,138	158	7.7%	$270,405,197	12.1%	139	6.8%	$173,759,118	7.8%
Fredon (Twp)	1,615	$1,542,422,915	174	10.8%	$117,580,742	7.6%	150	9.3%	$106,536,412	6.9%
Green (Twp)	1,697	$1,821,582,866	130	7.7%	$104,158,588	5.7%	115	6.8%	$96,438,967	5.3%
Hamburg (B)	1,593	$1,809,235,911	131	8.2%	$200,223,008	11.1%	122	7.7%	$260,564,737	14.4%
Hampton (Twp)	2,761	$2,474,023,610	216	7.8%	$128,537,181	5.2%	220	8.0%	$164,434,727	6.6%
Hardyston (Twp)	4,401	$3,681,458,622	610	13.9%	$272,210,653	7.4%	640	14.5%	$341,801,016	9.3%
Hopatcong (B)	8,004	$3,432,619,930	1,457	18.2%	$509,910,100	14.9%	1,048	13.1%	$376,504,480	11.0%
Lafayette (Twp)	1,463	$2,142,628,709	115	7.9%	$103,828,169	4.8%	89	6.1%	$76,864,103	3.6%
Montague (Twp)	2,175	$1,659,675,649	196	9.0%	$86,148,793	5.2%	239	11.0%	$105,538,715	6.4%
Newton (T)	2,676	$5,699,120,026	240	9.0%	$363,498,898	6.4%	246	9.2%	$310,627,969	5.5%
Ogdensburg (B)	992	$954,409,603	87	8.8%	$46,086,565	4.8%	66	6.7%	$24,652,221	2.6%
Sandyston (Twp)	1,526	$1,350,071,503	234	15.3%	$274,764,211	20.4%	138	9.0%	$81,770,500	6.1%
Sparta (Twp)	8,127	$10,316,900,290	1,362	16.8%	$1,037,361,205	10.1%	1,106	13.6%	$976,202,794	9.5%
Stanhope (B)	1,552	$1,228,753,628	186	12.0%	$85,342,689	6.9%	175	11.3%	$97,522,202	7.9%
Stillwater (Twp)	2,487	$1,611,608,776	290	11.7%	$155,280,322	9.6%	230	9.2%	$121,387,915	7.5%
Sussex (B)	677	$2,187,092,184	103	15.2%	$368,327,856	16.8%	83	12.3%	$362,896,317	16.6%
Vernon (Twp)	12,039	$6,816,863,576	2,530	21.0%	$1,042,734,539	15.3%	1,388	11.5%	$686,404,866	10.1%
Walpack (Twp)	51	$68,015,712	7	13.7%	$27,328,302	40.2%	4	7.8%	$5,048,870	7.4%
Wantage (Twp)	5,509	$5,527,803,803	628	11.4%	$508,755,997	9.2%	562	10.2%	$392,530,176	7.1%
Sussex County (Total)	**71,937**	**$68,511,090,204**	**10,107**	**14.0%**	**$6,823,577,988**	**10.0%**	**7,714**	**10.7%**	**$6,173,153,486**	**9.0%**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; RS Means 2022; NJDEP 2023; NJDEP Bureau of GIS; NJ Office of GIS NJOIT, USGS 2023

Table 11-9. Number and Value of Buildings Built in the Subsidence/Sinkhole Hazard Areas, by Municipality

	Jurisdiction Total Buildings		Carbonate Karst Subsidence/Sinkhole Hazard Area				Abandoned Mine Subsidence/Sinkhole Hazard Area			
			Number of Buildings		Replacement Cost Value		Number of Buildings		Replacement Cost Value	
	Count	Replacement Cost Value	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Andover (B)	326	$693,607,785	121	37.1%	$320,267,859	46.2%	0	0.0%	$0	0.0%
Andover (Twp)	2,577	$4,012,892,721	1,013	39.3%	$1,115,273,725	27.8%	61	2.4%	$28,403,619	0.7%
Branchville (B)	426	$598,388,025	145	34.0%	$184,636,652	30.9%	0	0.0%	$0	0.0%
Byram (Twp)	3,676	$3,162,144,221	241	6.6%	$143,006,808	4.5%	388	10.6%	$247,533,203	7.8%
Frankford (Twp)	3,529	$3,491,793,002	174	4.9%	$312,081,741	8.9%	0	0.0%	$0	0.0%
Franklin (B)	2,058	$2,227,977,138	1,568	76.2%	$1,715,235,362	77.0%	242	11.8%	$314,908,179	14.1%
Fredon (Twp)	1,615	$1,542,422,915	128	7.9%	$128,671,683	8.3%	0	0.0%	$0	0.0%
Green (Twp)	1,697	$1,821,582,866	1,270	74.8%	$1,518,168,438	83.3%	15	0.9%	$9,984,538	0.5%
Hamburg (B)	1,593	$1,809,235,911	1,323	83.1%	$1,470,386,117	81.3%	0	0.0%	$0	0.0%
Hampton (Twp)	2,761	$2,474,023,610	1,018	36.9%	$752,201,778	30.4%	0	0.0%	$0	0.0%
Hardyston (Twp)	4,401	$3,681,458,622	2,591	58.9%	$2,464,946,699	67.0%	50	1.1%	$32,357,056	0.9%
Hopatcong (B)	8,004	$3,432,619,930	0	0.0%	$0	0.0%	1,031	12.9%	$339,413,809	9.9%
Lafayette (Twp)	1,463	$2,142,628,709	789	53.9%	$915,626,081	42.7%	0	0.0%	$0	0.0%
Montague (Twp)	2,175	$1,659,675,649	1,263	58.1%	$1,056,880,331	63.7%	0	0.0%	$0	0.0%
Newton (T)	2,676	$5,699,120,026	1,677	62.7%	$2,105,906,361	37.0%	0	0.0%	$0	0.0%
Ogdensburg (B)	992	$954,409,603	780	78.6%	$849,309,854	89.0%	114	11.5%	$61,470,836	6.4%
Sandyston (Twp)	1,526	$1,350,071,503	530	34.7%	$535,685,808	39.7%	0	0.0%	$0	0.0%
Sparta (Twp)	8,127	$10,316,900,290	1,572	19.3%	$4,266,097,281	41.4%	232	2.9%	$233,229,672	2.3%
Stanhope (B)	1,552	$1,228,753,628	0	0.0%	$0	0.0%	441	28.4%	$185,991,698	15.1%
Stillwater (Twp)	2,487	$1,611,608,776	1,268	51.0%	$857,062,613	53.2%	0	0.0%	$0	0.0%
Sussex (B)	677	$2,187,092,184	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Vernon (Twp)	12,039	$6,816,863,576	2,857	23.7%	$2,441,115,486	35.8%	461	3.8%	$151,997,698	2.2%
Walpack (Twp)	51	$68,015,712	45	88.2%	$55,790,111	82.0%	0	0.0%	$0	0.0%
Wantage (Twp)	5,509	$5,527,803,803	261	4.7%	$755,058,868	13.7%	0	0.0%	$0	0.0%
Sussex County (Total)	**71,937**	**$68,511,090,204**	**20,634**	**28.7%**	**$23,963,409,656**	**35.0%**	**3,035**	**4.2%**	**$1,605,290,309**	**2.3%**

Source : Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; RS Means 2022; NJDEP 2021; NJDEP 2023

Table 11-10. Buildings on Lands in the Landslide Hazard Areas, by General Occupancy Class

	High Slope Landslide Hazard Area				Moderate Slope Landslide Hazard Area			
	Residential	Commercial	Industrial	Other[a]	Residential	Commercial	Industrial	Other[a]
Andover (B)	25	4	0	1	18	2	0	2
Andover (Twp)	252	8	1	26	192	9	0	17
Branchville (B)	29	1	0	0	28	2	0	1
Byram (Twp)	582	6	0	15	353	11	0	11
Frankford (Twp)	257	8	0	38	259	9	0	40
Franklin (B)	138	12	1	7	125	9	0	5
Fredon (Twp)	136	2	0	36	125	2	0	23
Green (Twp)	104	4	0	22	103	2	0	10
Hamburg (B)	115	15	1	0	114	7	0	1
Hampton (Twp)	180	4	0	32	191	2	0	27
Hardyston (Twp)	580	14	0	16	619	5	1	15
Hopatcong (B)	1,417	25	0	15	1,016	16	0	16
Lafayette (Twp)	78	7	2	28	69	7	0	13
Montague (Twp)	176	4	0	16	228	3	0	8
Newton (T)	213	16	0	11	219	13	1	13
Ogdensburg (B)	79	5	0	3	63	1	0	2
Sandyston (Twp)	199	8	1	26	109	7	0	22
Sparta (Twp)	1,299	30	1	32	1,053	33	1	19
Stanhope (B)	178	7	0	1	169	4	0	2
Stillwater (Twp)	235	11	0	44	203	3	0	24
Sussex (B)	83	15	1	4	69	14	0	0
Vernon (Twp)	2,441	42	3	44	1,323	27	1	37
Walpack (Twp)	0	1	0	6	0	3	0	1
Wantage (Twp)	486	11	0	131	483	5	0	74
Sussex County (Total)	**9,282**	**260**	**11**	**554**	**7,131**	**196**	**4**	**383**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; NJDEP 2023; NJDEP Bureau of GIS; NJ Office of GIS NJOIT, USGS 2023

a. Other = Government, Religion, Agricultural, and Education

Table 11-11. Buildings on Lands in the Subsidence/Sinkhole Hazard Areas, by General Occupancy Class

	Carbonate Karst Subsidence/Sinkhole Hazard Area				Abandoned Mine Subsidence/Sinkhole Hazard Area			
	Residential	Commercial	Industrial	Other[a]	Residential	Commercial	Industrial	Other[a]
Andover (B)	81	29	0	11	0	0	0	0
Andover (Twp)	808	73	8	124	59	0	0	2
Branchville (B)	127	15	1	2	0	0	0	0
Byram (Twp)	198	7	0	36	366	6	0	16
Frankford (Twp)	114	13	0	47	0	0	0	0
Franklin (B)	1,353	141	10	64	207	14	3	18
Fredon (Twp)	97	0	4	27	0	0	0	0
Green (Twp)	1,014	28	4	224	10	0	0	5
Hamburg (B)	1,234	68	6	15	0	0	0	0
Hampton (Twp)	862	16	0	140	0	0	0	0
Hardyston (Twp)	2,327	123	16	125	49	0	0	1
Hopatcong (B)	0	0	0	0	1,020	9	0	2
Lafayette (Twp)	560	32	20	177	0	0	0	0
Montague (Twp)	1,070	61	2	130	0	0	0	0
Newton (T)	1,488	132	14	43	0	0	0	0
Ogdensburg (B)	702	50	0	28	100	7	0	7
Sandyston (Twp)	319	29	2	180	0	0	0	0
Sparta (Twp)	1,191	235	32	114	210	9	2	11
Stanhope (B)	0	0	0	0	421	14	0	6
Stillwater (Twp)	1,050	71	0	147	0	0	0	0
Sussex (B)	0	0	0	0	0	0	0	0
Vernon (Twp)	2,449	171	21	216	446	7	6	2
Walpack (Twp)	9	21	0	15	0	0	0	0
Wantage (Twp)	127	76	1	57	0	0	0	0
Sussex County (Total)	**17,180**	**1,391**	**141**	**1,922**	**2,888**	**66**	**11**	**70**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; NJDEP 2023

a. *Other = Government, Religion, Agricultural, and Education*

11.2.3 Community Lifelines and Other Critical Facilities

A significant amount of infrastructure can be exposed to geological hazards (USGS 2023):

- *Roads*—Access to major roads is crucial to life-safety after a disaster event and to response and recovery operations. Landslides and sinkholes can block egress and ingress on roads, causing isolation for neighborhoods, traffic problems, and delays for public and private transportation. This can result in economic losses for businesses. Portions of Interstate I-80, US Route US-206, and State Routes, including NJ-15, NJ-94, NJ-183, and NJ-23 are in the mine subsidence hazard area.
- *Bridges*—Landslides can knock out bridge abutments or significantly weaken the soil supporting them, making them hazardous for use.
- *Power Lines*—Power lines are generally elevated above steep slopes; but the towers supporting them can be subject to landslides. A landslide could trigger failure of the soil underneath a tower, causing it to collapse and ripping down the lines. Sinkholes can swallow utility lines and cause impacts on underground pipes. Resulting power and communication failures can create problems for vulnerable populations and businesses.
- *Rail Lines*—Rail lines are important for response and recovery operations after a disaster. Landslides can block travel along the rail lines A detour for a rail line is not as easy as a detour for a local road or highway. Many residents rely on public transport to get to work around the County and into New York City, and a landslide event could prevent travel to and from work.

Water and sewer infrastructure also may be exposed to geological hazards.

11.2.4 Economy

Geological hazards can impose direct and indirect impacts on society. Direct costs include the damage sustained by buildings, property, and infrastructure due to a hazard event. Such events also threaten transportation corridors, fuel and energy conduits, and communication lines (USGS 2020). Indirect costs, such as clean-up costs, business interruption, loss of tax revenues, reduced property values, and loss of productivity may also occur. Building damage impacts the local tax base and economy. Subsidence and sinkholes can block access to roads, which can isolate residents and businesses and delay commercial, public, and private transportation.

11.2.5 Natural, Historic and Cultural Resources

Natural

Steep slopes in the Highlands Region play an important ecological, recreational, scenic, and functional role. They provide specialized habitats for rare plant and animal species. Areas of steep slope provide recreational opportunities and contribute to the rural character of the Highlands Region and Sussex County. Disturbance of areas containing steep slopes can trigger erosion and sedimentation, resulting in the loss of topsoil. Silting of water bodies degrades wetland and aquatic habitats that are found throughout the region and receive the state's highest water quality protections. Steep slope disturbance can result in the loss of habitat quality, degradation of surface water quality, silting of wetlands, and alteration of drainage patterns (NJ Highlands Council 2012).

Historic

Landslide impacts on historic resources within the County are highest in areas near hillsides that are characterized by unstable soil and erosion. Historical landmarks in these areas are highly susceptible to landslides, especially following seismic activity.

Cultural

Landslide impacts on cultural resources within the County are highest in areas near hillsides that are characterized by unstable soil and erosion. Cultural landmarks in these areas are highly susceptible to landslides, especially following seismic activity.

11.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

Overall, the County's vulnerability to geological hazards has not changed, and the entire County will continue to be vulnerable to these hazards. Any change in vulnerability since the previous HMP would be attributed to changes in population density and new development. This updated HMP used updated building stock and critical asset inventories to assess the County's risk to these assets. The building inventory was updated using RSMeans 2022 values, which are more current and reflect replacement cost rather than the building stock improvement values reported in the 2021 HMP. Further, the 2021 5-year population estimates from the American Community Survey were used to evaluate the population exposed to the geological hazard areas.

11.4 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.

11.4.1 Potential or Planned Development

Any areas of growth could be impacted by the geological hazard if located within the identified hazard areas or downslope. In general, development of slopes is not recommended due to the increased risk of erosion, stormwater runoff, and flooding. The Highlands Council has template ordinances available to define Steep Slope Protection Areas and protect against their disturbance. In addition, there are recommendations for site design for permitted disturbances to minimize impacts. Geological make-up should also be considered for future development; certain soils, such as limestone, are more prone to sinkholes.

Sinkholes may form when the land surface is changed, such as when industrial and runoff-storage ponds are created. The weight of new material can trigger an underground collapse of supporting material, causing a sinkhole. Additionally, the overburden sediments that cover buried cavities in the aquifer systems are balanced by groundwater fluid pressure. Groundwater is helping keep the surface soil in place. Pumping groundwater for urban water supply and irrigation can produce new sinkholes. If pumping results in a lowering of groundwater levels, then underground structural failure may occur (USGS 2018).

11.4.2 Projected Changes in Population

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).

Changes in density can create issues for local residents during evacuation of a landslide or ground failure event and can have an effect on commuters that travel into and out of the County for work, particularly during a geologic event (such as a sinkhole) that breaches major transportation corridors, which are also major commuter roads.

11.4.3 Climate Change

The County is expected to see an increase in average annual temperatures and precipitation due to climate change. Increased severe storm and heavy rainfall events may elevate the likelihood of a landslide occurring in steep sloped areas because precipitation may fall faster or in larger quantities than the soil can absorb in a given timeframe. However, these changes depend on to what degree steep sloped areas are developed and other climate trends, such as seasonal precipitation and drought, which affect vegetation growth.

Higher temperatures and the possibility of more intense, less frequent summer rainfall may lead to changes in water resource availability. Increase in average temperatures may lead to an increase in the frequency of droughts. Sinkhole activity intensifies in some karst areas during periods of drought. With an increase in drought periods, the number of sinkholes could increase. Additionally, changes to the water balance of an area including over-withdrawal of groundwater, diverting surface water from a large area, and concentrating it in a single point, artificially creating ponds of surface water, and drilling new water wells will cause sinkholes. These actions can also serve to accelerate the natural processes of bedrock degradation, which can have a direct impact on sinkhole creation.

12. HAZARDOUS MATERIALS

12.1 HAZARD PROFILE

12.1.1 Hazard Description

Hazardous materials are substances that are severely harmful to human health and the environment, as defined by the Environmental Protection Agency's (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Superfund Law). This law created a tax on the chemical and petroleum industries and provided federal authority to respond directly to releases or threatened releases of hazardous materials that may endanger public health or the environment (U.S. EPA 2022). There are about 800 CERCLA hazardous materials. Additionally, there are approximately 1,500 known radionuclides, approximately 760 of which are listed individually (U.S. EPA 2022a). CERCLA defines the following as hazardous materials (U.S. EPA 2024):

- Any substance designated in section 311(b)(2)(A) of the Federal Water Pollution Control Act
- Any element, compound, mixture, solution, or substance designated in section 102 of CERCLA
- Any hazardous waste having the characteristics identified in section 3001 of the Solid Waste Disposal Act (unless that regulation under the Solid Waste Disposal Act has been suspended by act of Congress)
- Any toxic pollutant listed under section 307(a) of the Federal Water Pollution Control Act
- Any hazardous air pollutant listed under section 112 of the Clean Air Act
- Any imminently hazardous chemical substance or mixture with respect to which the Administrator of EPA has taken action pursuant to section 7 of the Toxic Substances Control Act, excluding petroleum, natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel

Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. These types of substances are most often released because of transportation accidents or a chemical spill at a facility. Many products containing hazardous materials are also used and stored in homes. If released or misused, hazardous materials can cause death, serious injury, long-lasting health effects, and damage to structures and other properties, as well as the environment. Releases can occur because of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, these incidents are secondary events. A hazardous materials event requires an urgent response to contain the material released and protect humans and the environment. Otherwise, the event could quickly escalate into a public health emergency.

Hazardous Materials Fixed Site

In response to concerns regarding health and environmental risks, Congress established the Superfund program in 1980 to clean up sites contaminated with hazardous materials. The Superfund program is administered by the EPA in cooperation with individual states. The New Jersey Department of Environmental Protection (NJDEP) Site Remediation Program oversees the Superfund program for New Jersey (NJDEP 2013). CERCLA and the Superfund Amendments and Reauthorization Act (SARA; signed into law on October 17, 1986) require that a National Priorities List (NPL) of contaminated sites throughout the United States be maintained and revised at least annually (NJDEP 2013).

Nuclear Facilities

Nuclear incidents can be considered a type of hazard material release. Primary concerns following a nuclear incident are impacts on public health from direct exposure to a radioactive plume; inhalation of radioactive materials; ingestion of contaminated food and liquids; and long-term exposure to radioactive materials in the environment that may lead to acute (radiation sickness or death) or chronic (cancer) health effects (CDC 2019).

The Nuclear Regulatory Commission encourages the use of probabilistic risk assessments to estimate the potential risk to public health and safety considering the design, operation, and maintenance practices at nuclear power plants. Preparedness plans typically consider the Plume Exposure Pathway Emergency Planning Zone, which has a radius of 10 miles from the facility, and the Ingestion Exposure Pathway (IEP), which has a radius of 50 miles from each facility.

Hazardous Materials in Transit

Many products containing hazardous materials are shipped daily on highways, railroads, waterways, and pipelines. As defined in regulations by the U.S. Department of Transportation (DOT), a hazardous materials transportation incident is any event resulting in an uncontrolled release of materials during transport that can pose a risk to health, safety, and property. Hazardous materials in transit are regulated by DOT.

Transportation of hazardous materials on highways involves tanker trucks or trailers, and these are responsible for the greatest number of hazardous material release incidents. The State of New Jersey has 39,000 miles of highway, many of which are used to transport hazardous materials (State of New Jersey 2019). These roads cross rivers and streams at many points; hazardous material spills on roads have the potential to pollute watersheds that serve as domestic water supplies for parts of the state.

Potential also exists for hazardous material releases to occur along rail lines, as collisions and derailments of train cars can result in large spills. The adoption of hydraulic fracturing ("fracking") to extract oil and gas has led to an increase in the production and shipment of energy products. Lack of pipelines connecting the energy-producing regions with refineries or ports, coupled with the flexibility that railroad transportation provides, have resulted in significant shipments of oil by rail. Major commodities shipped by rail include petrochemicals (including plastic pellets and crude oil), construction materials, food products, raw materials, and finished goods for manufacturers (NJDOT 2023).

Pipelines can transport hazardous liquids and flammable substances such as natural gas and petroleum. Incidents can occur when pipes corrode, when they are damaged during excavation, incorrectly operated, or damaged by other forces. In New Jersey, most large pipeline leaks have been caused by marine traffic or the anchors of ships affecting pipelines in waterways.

In addition, hazardous materials can be transported by aircraft or by watercraft. Crashes, spills of materials, and fires on these vessels can pose a hazard.

Regulatory Framework

SARA requires each state to establish a state emergency response commission (U.S. EPA 2023). New Jersey's commission was established by executive order on February 13, 1987 (NJOEM 2023). SARA requires the commission to establish emergency planning districts to facilitate preparation and implementation of emergency plans (U.S. EPA 2023). These districts can be existing political subdivisions. In New Jersey, all municipalities and counties have been designated emergency planning districts (total of 588). The Local Emergency Planning Committee (LEPC) is the policy body for the emergency planning district (State of New Jersey 2022).

Under New Jersey's Toxic Catastrophe Prevention Act (N.J.S.A. 13:1K-19 et seq), certain industrial facilities using materials considered extraordinarily hazardous must take steps to prevent releases and protect public safety (NJDEP 2018). Under the New Jersey Spill Compensation and Control Act (N.J.S.A. 58:10-23.11), New Jersey has also mandated that facilities storing large quantities of hazardous materials take preventive measures to reduce the likelihood of a leak or discharge. These requirements include testing and inspection of storage tanks, training of employees, and emergency response planning. The Discharge Prevention Containment and Countermeasure program facilitates implementation of these requirements and administers regulations related to reporting of chemical and petroleum discharges (NJDEP 1976).

Fixed-site facilities that use, manufacture, or store hazardous materials in New Jersey must comply with the federal Emergency Planning and Community Right to Know Act of 1986 (EPCRA; Title III of the federal SARA law), which is linked to the New Jersey Worker and Community Right to Know Act (N.J.S.A. 34:5A). The State's Community Right to Know (CRTK) program collects, processes, and disseminates the chemical inventory, environmental release and materials accounting data required to be reported under these state and federal laws. This information is used by the public, emergency planners, and first responders to determine the chemical hazards in the community (NJDEP 2020).

New Jersey employers listed in the New Jersey CRTK regulations whose businesses are assigned codes in the North American Industry Classification System are required to submit surveys listing the environmental hazardous materials present at their facilities in quantities that exceed 500 pounds, unless the substance is on the EPCRA list of extremely hazardous materials with a lower reporting threshold. In addition, EPCRA requires owners and operators of federal facilities and private sector facilities that are subject to the Occupational Safety and Health Administration's Hazard Communication Standard to report their inventories of any chemical that requires a materials safety data sheet and is present on site in quantities that exceed 10,000 pounds, unless the chemical is an extremely hazardous material with a lower reporting threshold (NJDEP 2018).

Approximately 500 New Jersey companies are required to file annual federal Toxic Chemical Release Inventory (TRI) forms (companies with the equivalent of 10 or more full-time employees that manufacture, import, process or otherwise use toxic chemicals listed on the EPCRA Section 313 list in quantities that exceed specified thresholds). TRI Form R requires a list of environmental releases, on-site waste management, and off-site transfers. The simplified Form A Certification Statement requires only a list of chemicals. These companies are also required to submit to NJDEP a Release and Pollution Prevention Report (RPPR) listing quantities of environmental release, on-site waste management, waste transfer, and chemical throughput information. If these facilities are subject to pollution prevention planning requirements, then they are also required to report pollution prevention progress information on the RPPR (NJDEP 2018).

Sussex County Hazardous Materials Team

The Sussex County Hazardous Materials Team was developed to support the County in the response of any hazardous materials or chemical, biological, radiological, nuclear, and explosives incident. The team consists of approximately 20 full-time County employees who have completed the Hazardous Materials Technician course and is a collaborative effort between the County's Sheriff's Office, Office of the Prosecutor, Division of Public Works, and Department of Environmental and Public Health Services. It has been recognized by the NJDEP as a model program for hazardous materials response (Sussex County n.d.).

12.1.2 Location

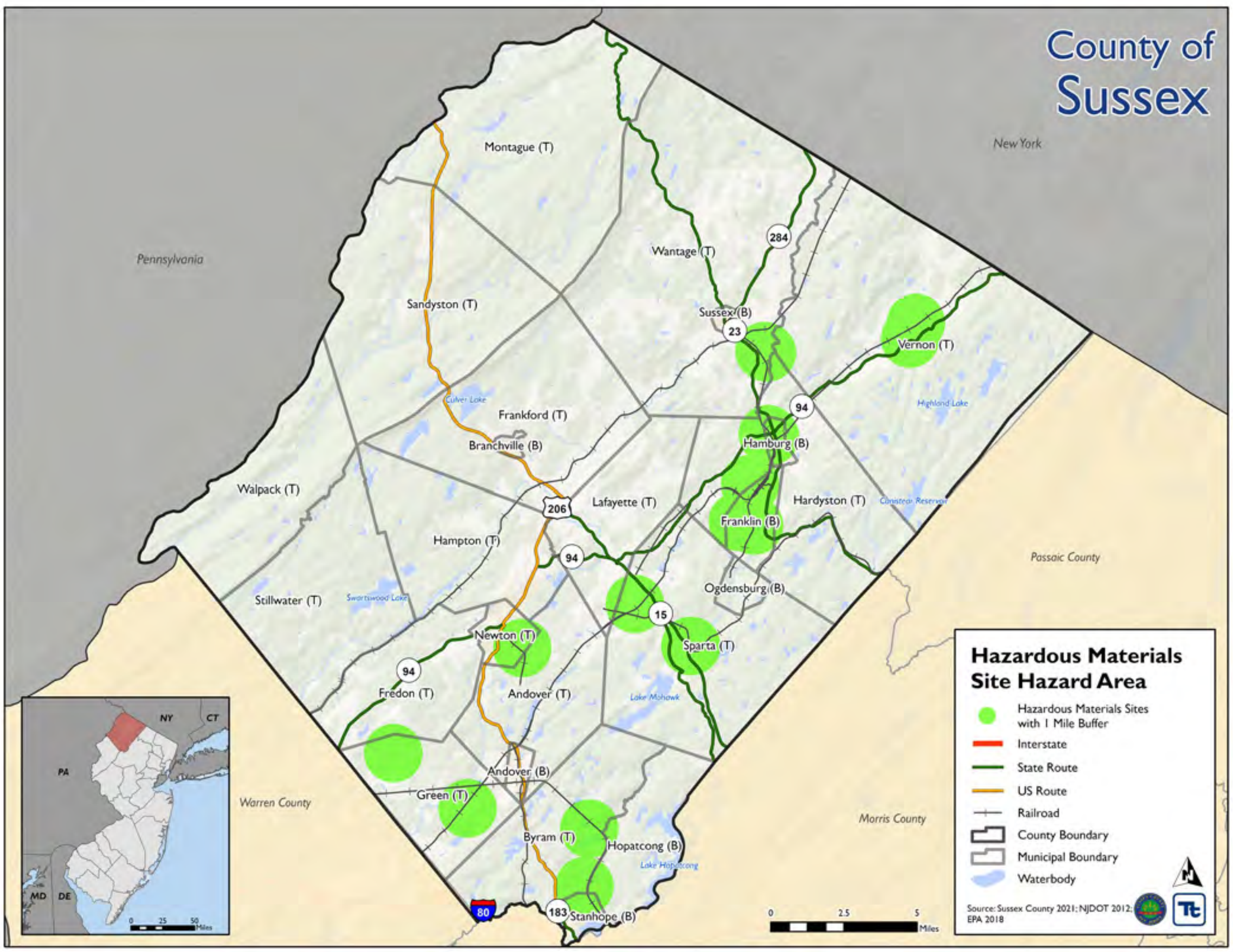
Hazardous Materials Fixed Site

The biennial EPA Hazardous Waste Report collects data on the generation, management, and minimization of hazardous waste. This report details data on the generation of hazardous waste from large quantity generators and data on waste management practices from treatment, storage, and disposal facilities. The 2021 biennial report lists seven facilities in Sussex County (U.S. EPA 2023).

The Superfund program locates the worst hazardous material sites based on the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database. CERCLIS indicates that Sussex County has 10 Superfund sites, three of which—in Sparta Township, Byram, and Franklin Borough—are on the National Priorities List (US EPA 2023).

Figure 12-1 displays hazardous materials fixed-site locations, identified through a critical facilities review by the County, with a one mile buffer to signify the area which may be directly impacted by an incident at these sites.

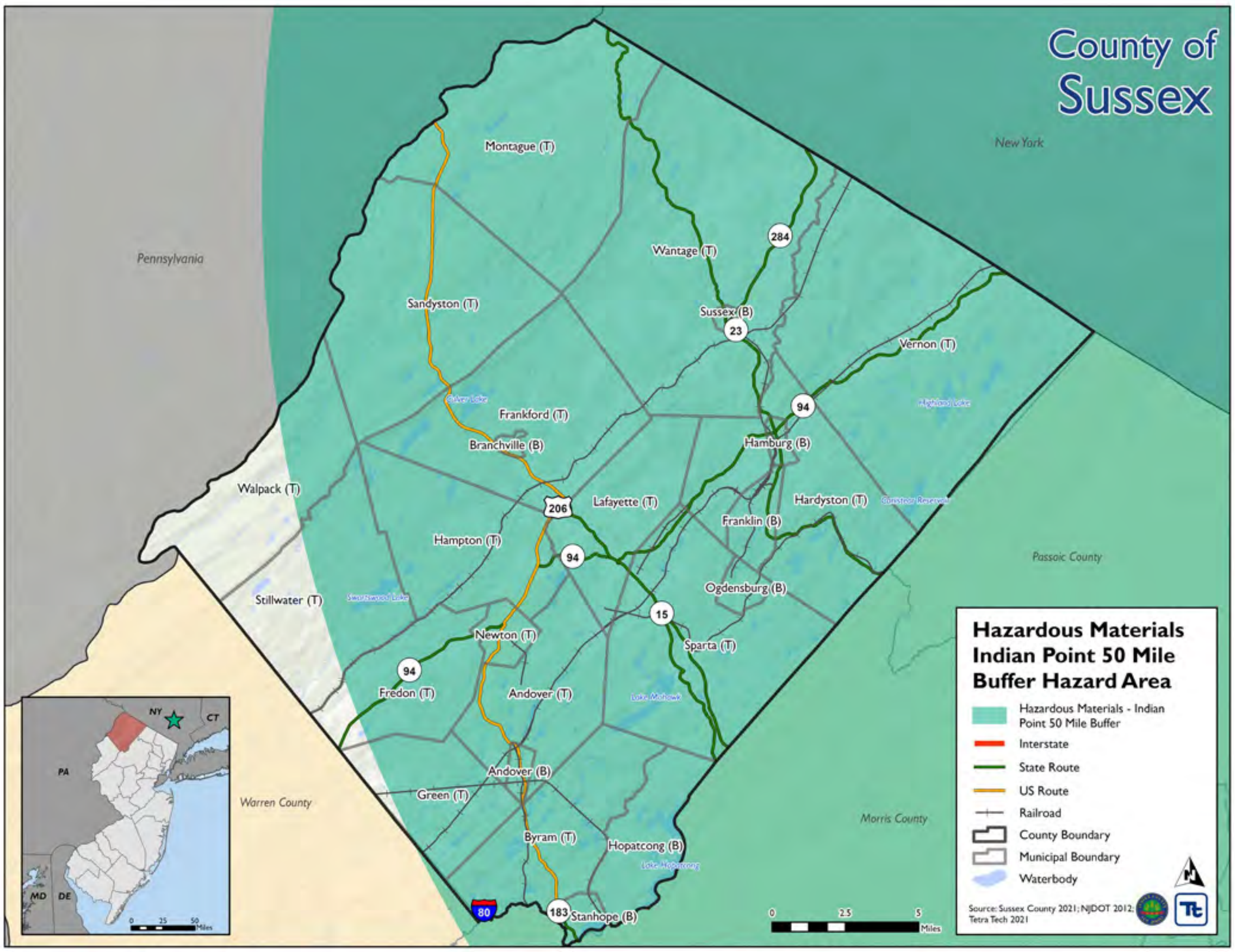
Figure 12-1. Hazardous Material Sites with One Mile Buffer in Sussex County



Nuclear Facilities

Although there are no nuclear facilities in Sussex County, the County is within the 50-mile IEP of the retired Indian Point Energy Center in Buchanan, New York, as shown in Figure 12-2 Indian Point Energy Center provided about 25 percent of the power for New York City and Westchester County, New York, before it stopped generated electricity in 2021 (US EIA 2021). Should an accident occur at that facility, the area within the IEP could receive some radioactive contamination. On October 26, 2023, the Nuclear Regulatory Commission granted Holtec Decommissioning International's request to revise the emergency preparedness plan for the Indian Point Energy Center to reflect the plant's decommissioning status.

Figure 12-2. Indian Point Energy Center's IEP



Hazardous Materials in Transit

In 2020, an estimated 11.9 million tons of domestic freight moved into, out of, or within Sussex County, by all modes of transportation (truck, rail, pipeline, water, and air). For domestic freight traveling to, from, or within Sussex County, 97 percent travels by truck, 2 percent by rail, and 1 percent by other modes (NJTPA 2020).

Roadways

Major highways in Sussex County over which hazardous materials are transported daily include U.S. Route 206 and State Highway 15. A portion of Interstate 80 runs through and near the southern portion of the County, and U.S. Route 209 runs parallel and close to the northwestern border of Sussex County although it does not enter County limits. Figure 12-3 shows major roadways in Sussex County, with a 1-mile buffer, indicating the extent of potential physical impacts. The miles of roads included in this definition of hazardous material hazard areas are summarized in Table 12-1. Out of the 1,333 miles of roads in the County, 121 miles are counted as potential hazardous materials hazard areas. The Township of Sparta has the greatest total length of roads included (20.8 miles), followed by the Township of Wantage (17.7 miles), and the Township of Hardyston (11.4 miles).

Figure 12-3. Major Roadways in Sussex County, with 1-Mile Buffer

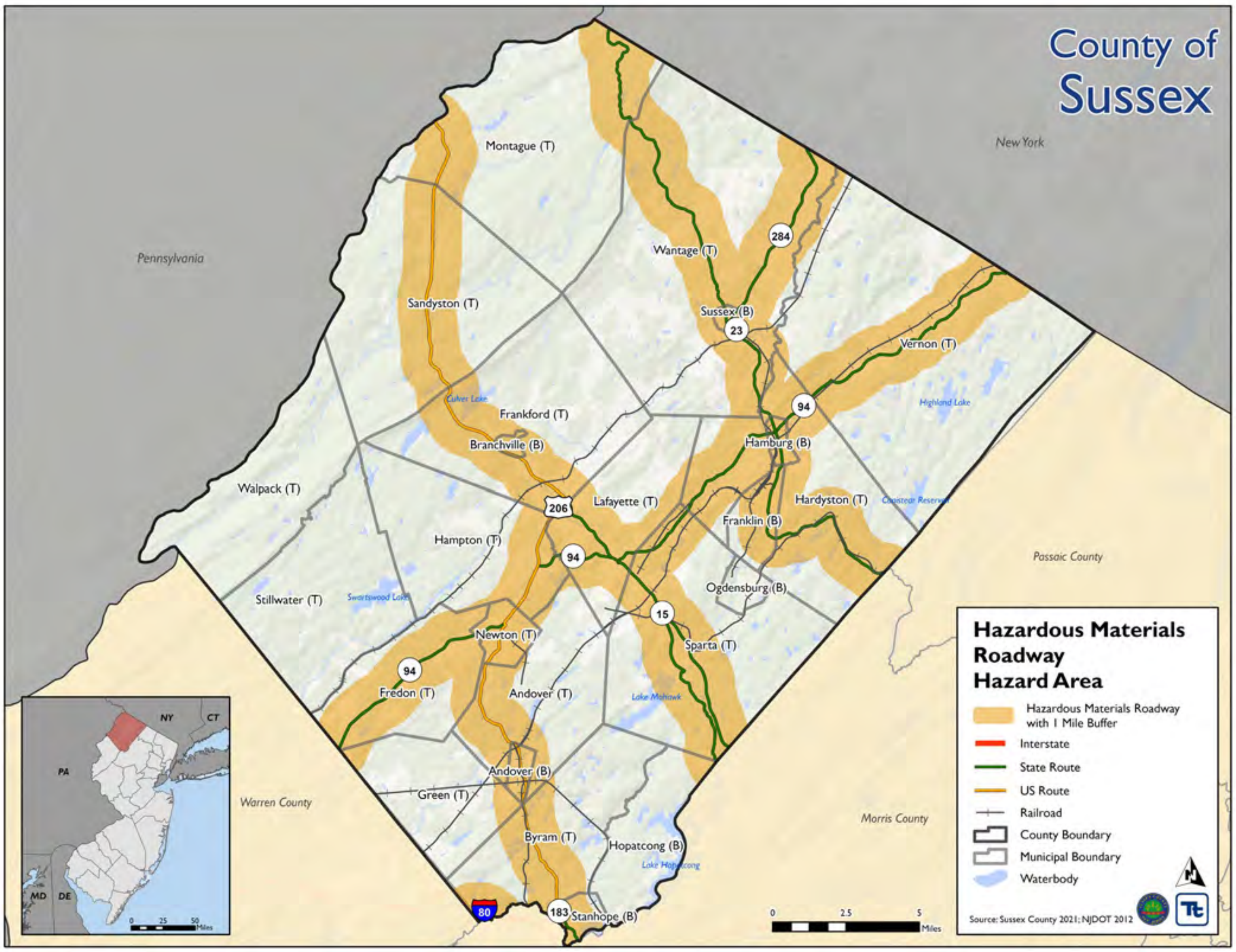


Table 12-1. Total Roadway Miles that Generate the Hazardous Materials Roadway 1 Mile Buffer Hazard Area

	Total Roadway Miles	Roadway Included in the 1 Mile Roadway Buffer Hazardous Materials Hazard Area	
		Roadway Miles	% of Jurisdiction Total
Andover (B)	7.0	2.3	33.1%
Andover (Twp)	68.3	3.2	4.7%
Branchville (B)	7.1	1.2	16.6%
Byram (Twp)	70.1	5.4	7.7%
Frankford (Twp)	98.5	6.3	6.4%
Franklin (B)	27.3	2.8	10.2%
Fredon (Twp)	50.9	6.3	12.4%
Green (Twp)	49.6	0.0	0.0%
Hamburg (B)	11.5	2.6	22.3%
Hampton (Twp)	52.5	4.4	8.3%
Hardyston (Twp)	64.4	11.4	17.8%
Hopatcong (B)	80.0	0.0	0.0%
Lafayette (Twp)	44.3	6.1	13.7%
Montague (Twp)	57.2	6.6	11.5%
Newton (T)	30.3	3.6	11.8%
Ogdensburg (B)	14.8	0.0	0.0%
Sandyston (Twp)	51.9	7.2	13.9%
Sparta (Twp)	139.1	20.8	15.0%
Stanhope (B)	17.6	2.6	14.8%
Stillwater (Twp)	60.3	0.0	0.0%
Sussex (B)	9.1	1.5	16.5%
Vernon (Twp)	126.8	8.7	6.9%
Walpack (Twp)	20.2	0.0	0.0%
Wantage (Twp)	174.2	17.7	10.2%
Sussex County (Total)	**1,333.2**	**120.7**	**9.1%**

Source: Sussex County 2021, 2023

Railways

There are freight rail lines in Sussex County, operated by regional and short line railroads. Figure 12-4 shows the locations of the railways, with a 1-mile buffer to represent the extent of potential physical impacts.

Pipelines

New Jersey has an extensive network of natural gas and petroleum pipelines. Figure 12-5 shows the extent and locations of natural gas pipelines in Sussex County.

Figure 12-4. Major Railways in Sussex County, with 1-Mile Buffer

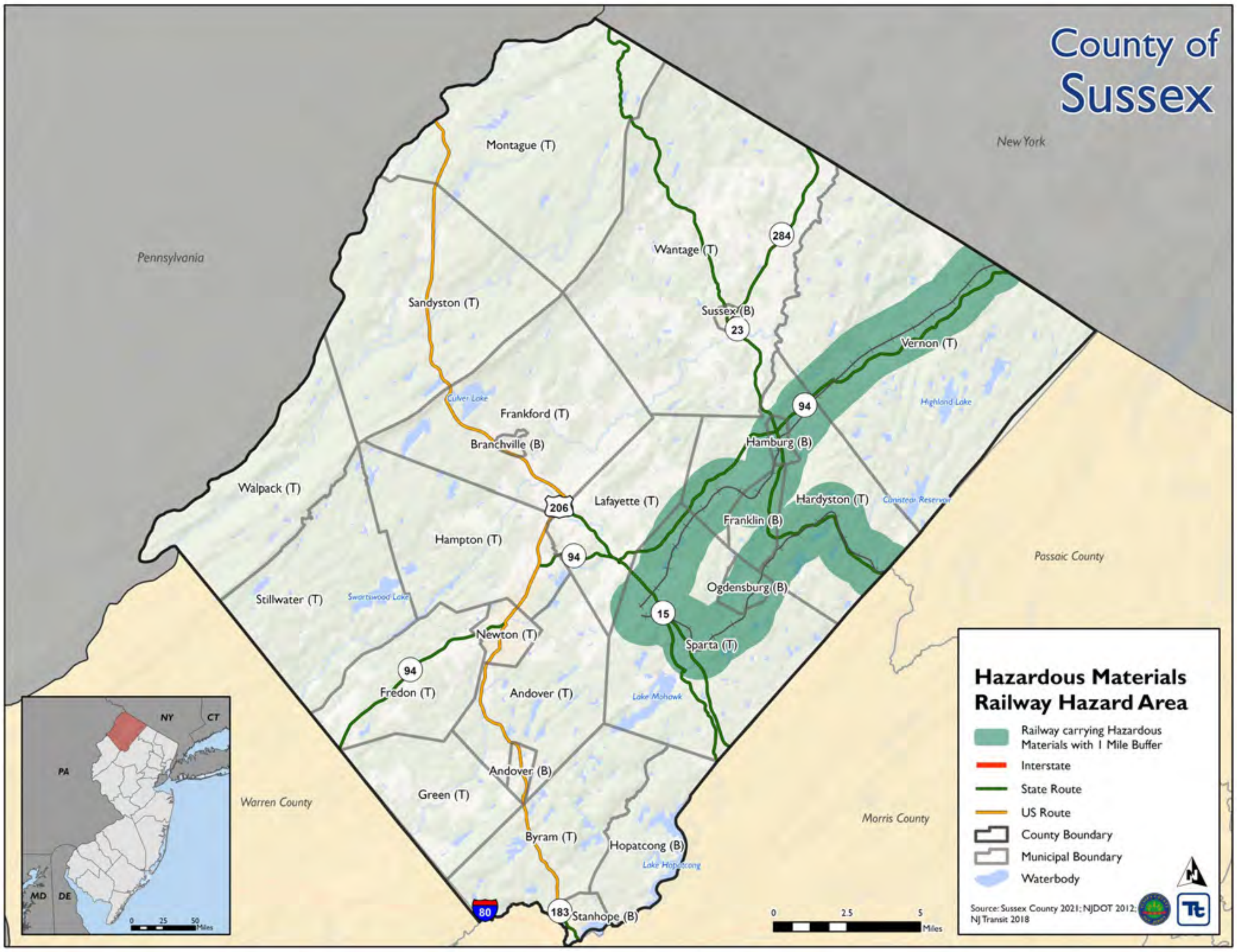
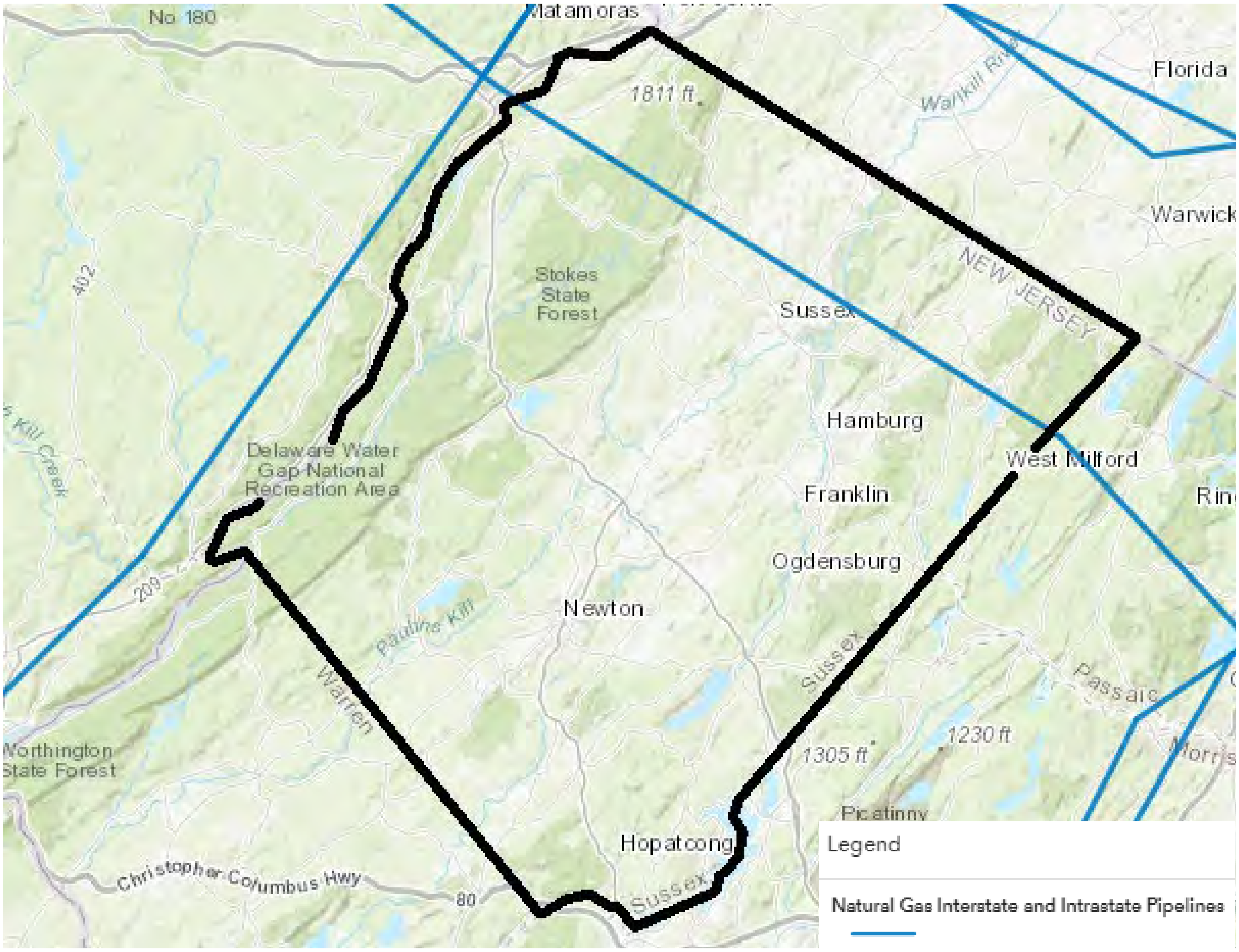


Figure 12-5. Pipelines in Sussex County



Source: USEIA 2023
Note: Sussex County is outlined in a boldened, black line

12.1.3 Extent

Hazardous materials can include toxic chemicals, radioactive substances, infectious substances, and hazardous wastes. Their release can contaminate air, water, and soils, possibly resulting in death and/or injuries. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas. The extent of a hazardous materials release will depend on whether it is from a fixed or mobile source, the size of the release, the toxicity and properties of the substance, the duration of the release, and the environmental conditions (wind, precipitation, terrain, etc.). Dispersion can take place rapidly when the hazardous material is transported by water and wind.

Mitigating conditions for hazardous materials releases are precautionary measures taken in advance to reduce the impact of a release on the surrounding environment. Primary and secondary containment or shielding by sheltering-in-place measures protects people and property from the harmful effects of a hazardous materials release. Exacerbating conditions, characteristics that can enhance or magnify the effects of a hazardous materials release, include the following:

- Weather conditions, which affect how the hazard occurs and develops
- Micro-meteorological effects of buildings and terrain, which alters dispersion of hazardous materials
- Non-compliance with applicable codes (such as building or fire codes)
- Maintenance failures (such as fire protection and containment features), which can substantially increase the damage to the facility itself and to surrounding buildings

The severity of the incident depends on the type of substance released and the distance and related response time for emergency response teams. Areas nearest to the release are at greatest risk. However, depending on the agent, a release can travel great distances or remain present in the environment for a long time—even centuries.

The occurrence of a hazardous materials incident can be sudden and without any warning, such as an explosion, or it may slowly develop, as in the case of a leaking container. Facilities that store extremely hazardous materials are required to notify local officials when an incident occurs. Local emergency responders and emergency management officials determine whether they need to evacuate the public or advise them to shelter in place. The warning time for incidents associated with hazardous materials in transit varies based on the nature and scope of the incident. If an explosion does not occur immediately following an accident, officials may have time to warn adjacent neighborhoods and facilitate appropriate protective actions.

12.1.4 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Sussex County has not been included in any major disaster (DR) or emergency (EM) declarations for hazardous materials-related events (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, Sussex County has not been included in any USDA hazardous materials-related agricultural disaster declarations (USDA 2024).

Previous Events

Known hazardous materials events that impacted Sussex County between January 2020 and June 2024 are discussed in Table 12-2. For events prior to 2020, refer to the 2021 Sussex County HMP.

12.1.5 Probability of Future Occurrences

Probability Based on Previous Occurrences

Information on previous hazardous materials occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 12-3. Based on historical records and input from the Steering Committee, the probability of occurrence for hazardous materials in the County is considered “rare.”

Hazardous material incidents can occur anytime and anywhere in Sussex County. Incidents can be sudden without any warning or develop slowly. Small spills, both fixed site and in-transit, occur throughout the year and the probability of these events is high. The risk of major incidents in a given year is rare. It is likely that the County will continue to experience direct and indirect impacts of hazardous material incidents annually.

Table 12-2. Hazardous Materials Events in Sussex County (2020 to 2024)

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
2020	N/A	N/A	Sussex County	In 2020, 284 pounds of chemicals (ethylene oxide and lead) were released on-site in Sussex County. There were no reports of off-site releases.
2021	N/A	N/A	Sussex County	In 2021, 95 pounds of chemicals (ethylene oxide and lead) were released on-site in Sussex County. There were no reports of off-site releases.
2022	N/A	N/A	Sussex County	In 2022, 204 pounds of chemicals (ethylene oxide and lead) were released on-site in Sussex County. There were no reports of off-site releases.
June 22, 2022	N/A	N/A	Town of Newton	More than 100 gallons of cooking oil were spilled from a truck in the Town of Newton.

Source: U.S. EPA 2023; Daily Mail 2022; FEMA 2023

Table 12-3. Probability of Future Hazardous Materials Events in Sussex County

Hazard Type	Number of Occurrences Between 1996[a] and 2023	Percent Chance of Occurring in Any Given Year
Hazardous Materials (fixed site)	57	100%
Hazardous Materials (in-transit)	43	100%
Total	100	100%

Sources: U.S. EPA 2023; Daily Mail 2022

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

Projected warming temperatures across New Jersey (see Section 3.3.4) can lead to excessive heat that may have adverse effects on aging structures and/or infrastructure. Excessive heat on structures or containers containing hazardous materials may alter the material properties.

In addition, hazardous materials stored at fixed locations in the floodplain may experience an increase in flood events due to the projected changes in increased precipitation events. Hazardous material sites near rivers are tentatively at the highest risk because extreme storms and higher water levels could release pollution into the environment. Many of these sites were built in locations believed to be removed from potential contamination or exposure-increasing factors. However, development, floodplain boundary change, and an increase in extreme events from climate change are increasing the possibility that water may reach hazardous material sites.

12.1.6 Cascading Impacts on Other Hazards

In the worst cases, a hazardous materials event would not be able to be controlled for hours to days, with materials being dispersed into the air and/or absorbed into the groundwater. Persons could inhale the material, which would cause adverse side effects and potable water could become contaminated, leading to a water advisory. Hundreds or thousands of persons, up to a few miles from the incident site, may need medical attention due to the inhalation of the material; responders would need to rotate operational periods and perform decontamination operations to maintain security and safe working conditions. A release may induce secondary hazards such as infrastructure deterioration or failure, water quality and supply concerns, transportation delays, and accidents.

A key part of maintaining control during a hazardous material event is to keep the public calm, and share clear, concise, and relevant information to the public through a verified method. A hazardous materials event can quickly escalate to public panic if correct information is not dispersed.

12.2 VULNERABILITY AND IMPACT ASSESSMENT

The vulnerability assessment for the hazardous materials hazard used the following defined hazard areas:

- 1-mile buffer around hazardous materials sites
- 1-mile buffer around hazardous materials rail routes
- 1-mile buffer around hazardous materials roadway routes
- 50-mile buffer around the Indian Point Energy Center

Centroids that intersected the hazard boundaries were totaled to estimate the building county, RCV, and population vulnerable to the hazardous materials hazard areas.

12.2.1 Life, Health, and Safety

Hazardous materials releases can lead to injury, illnesses, and/or death to involved persons and those living in the impacted areas. A chemical incident may also include an explosion, with additional injuries and deaths being caused by the pressure wave from the explosion. Biological agents may cause disease, depending on the nature of the agent involved, transmissibility, at-risk populations, incubation period, time before detection, and other factors. Radioactive materials can cause significant health effects in individuals, especially if the materials are taken into the body. Large releases of chemical or radiological materials can leach into soils and travel with wind, contaminating sources of potable water, crops, and livestock, and leading to a reduced local food supply.

Overall Population

Depending on the type and quantity of chemicals released and the weather conditions, a hazardous materials release can affect large areas that cross jurisdictional boundaries. Given the numerous locations of hazardous materials sites in Sussex County, the entire County is considered vulnerable to this hazard. People most at risk are those located along railways routes because of the quantities of chemicals transported on these major routes.

Table 12-4 summarizes population vulnerability to hazardous material incidents by jurisdiction. There are 26,521 persons, 19,930 persons, 68,535 persons, and 142,717 persons living within 1 mile of railways, 1 mile of hazardous material sites, 1 mile of roadways, and 50 miles of the Indian Point Energy Center, respectively. The Township of Vernon has the greatest number of people living within 1 mile of railways and 50 miles of the Indian Point Energy

Center, with 7,728 and 22,358 persons, respectively. The Town of Newton has the greatest number of people living within 1 mile of a hazardous material site and within 1 mile of a roadway, with 5,117 and 8,373 persons, respectively.

Table 12-4. Estimated Number of Persons Living in Hazardous Materials Hazard Areas

	Total Population	Within 1 Mile of Hazardous Materials Rail Route		Within 1 Mile of a Hazardous Materials Site		Within 1 mile of Hazardous Materials Roadway Routes		Within 50 Miles of Indian Point Energy Center	
		Number of People	Percent of Total	Number of People	Percent of Total	Number of People	Percent of Total	Number of People	Percent of Total
Andover (B)	595	0	0.0%	0	0.0%	594	99.8%	594	100%
Andover (Twp)	5,996	0	0.0%	600	10.0%	1,570	26.2%	5,995	100%
Branchville (B)	791	0	0.0%	0	0.0%	791	100%	791	100%
Byram (Twp)	8,028	0	0.0%	1,660	20.7%	4,632	57.7%	8,027	100%
Frankford (Twp)	5,302	0	0.0%	0	0.0%	2,453	46.3%	5,301	100%
Franklin (B)	4,912	4,748	96.7%	3,982	81.1%	4,615	94.0%	4,912	100%
Fredon (Twp)	3,235	0	0.0%	42	1.3%	2,787	86.2%	3,051	94.3%
Green (Twp)	3,627	0	0.0%	1,043	28.8%	152	4.2%	3,387	93.4%
Hamburg (B)	3,266	3,265	100.0%	2,906	89.0%	3,265	100%	3,265	100%
Hampton (Twp)	4,893	0	0.0%	0	0.0%	1,760	36.0%	4,892	100%
Hardyston (Twp)	8,125	5,217	64.2%	1,115	13.7%	6,923	85.2%	8,124	100%
Hopatcong (B)	14,362	0	0.0%	257	1.8%	0	0.0%	14,362	100%
Lafayette (Twp)	2,358	93	3.9%	105	4.5%	1,454	61.7%	2,358	100%
Montague (Twp)	3,792	0	0.0%	0	0.0%	961	25.3%	3,791	100%
Newton (T)	8,374	0	0.0%	5,117	61.1%	8,373	100%	8,373	100%
Ogdensburg (B)	2,258	2,168	96.0%	0	0.0%	0	0.0%	2,258	100%
Sandyston (Twp)	1,977	0	0.0%	0	0.0%	1,573	79.6%	1,976	100%
Sparta (Twp)	19,600	3,302	16.8%	1,263	6.4%	8,307	42.4%	19,599	100%
Stanhope (B)	3,526	0	0.0%	1,027	29.1%	3,365	95.4%	3,525	100%
Stillwater (Twp)	4,004	0	0.0%	0	0.0%	0	0.0%	2,943	73.5%
Sussex (B)	2,024	0	0.0%	0	0.0%	2,024	100%	2,024	100%
Vernon (Twp)	22,358	7,728	34.6%	684	3.1%	7,762	34.7%	22,358	100%
Walpack (Twp)	7	0	0.0%	0	0.0%	0	0.0%	1	14.3%
Wantage (Twp)	10,811	0	0.0%	129	1.2%	5,174	47.9%	10,810	100%
Sussex County (Total)	**144,221**	**26,521**	**18.4%**	**19,930**	**13.8%**	**68,535**	**47.5%**	**142,717**	**99.0%**

Source: U.S. Census Bureau 2020, 2021; NJGIN 2023; Sussex County 2021, 2023; Tetra Tech; CDC/ATSDR 2020

Socially Vulnerable Population

Older adults and young children may be more at risk due to limited mobility, communication, and dependency on others. Exposure to hazardous materials may affect those who have compromised immune systems and additional medical needs. Communities of color, certain immigrant groups, low-income groups, and those with limited English proficiency are more at risk because they may live in locations that are prone to hazardous materials exposure. Similarly, they may have limited financial resources and experience cultural, language, and citizenship barriers that may restrict communication and access to emergency information relating to hazardous materials (EPA 2023).

Table 12-5 presents the estimated socially vulnerable populations located within 1 mile of a hazardous materials site area. The following are the largest socially vulnerable populations in this hazard area:

- The Town of Newton has the highest population over 65 (1,092), the largest disabled population (730), and the greatest population of individuals living in poverty (447).
- The Borough of Franklin has the highest population under the age of 5 (184).
- The Borough of Hamburg has the largest population of non-English speaking persons (295).

Table 12-6 presents the estimated socially vulnerable populations located within 1 mile of hazardous materials rail routes. The following are the largest socially vulnerable populations in this hazard area:

- The Township of Vernon has the highest population over 65 (1,274), and the greatest population of individuals living in poverty (303), and the largest population under the age of 5 (342).
- The Borough of Franklin has the highest disabled population (822).
- The Borough of Hamburg has the largest population of non-English speaking persons (332).

Table 12-7 presents the estimated socially vulnerable populations located within 1 mile of a hazardous materials roadway. The following are the largest socially vulnerable populations in this hazard area:

- The Town of Newton has the highest population over 65 (1,787), the largest disabled population (1,196), and the greatest population of individuals living in poverty (732).
- The Township of Sparta has the highest population under the age of 5 (491).
- The Borough of Hamburg has the largest population of non-English speaking persons (332).

Table 12-8 presents the estimated socially vulnerable populations located within 50 miles of Indian Point. The following are the largest socially vulnerable populations in this hazard area:

- The Township of Vernon has the highest population over 65 (3,686), the largest disabled population (2,317), and the greatest population of individuals living in poverty (877).
- The Township of Sparta has the highest population under the age of 5 (1,159).
- The Borough of Hopatcong has the largest population of non-English speaking persons (339).

Table 12-5. Estimated Number of Vulnerable Persons Located within 1 mile of Hazardous Materials Site Area

	Estimated Number of Vulnerable Persons Located within 1 mile of Hazardous Materials Site Area				
	Persons Over 65	Persons Under 5	Non-English Speaking Persons	Persons with a Disability	Persons in Poverty
Andover (B)	0	0	0	0	0
Andover (Twp)	137	24	0	52	26
Branchville (B)	0	0	0	0	0
Byram (Twp)	230	92	21	126	36
Frankford (Twp)	0	0	0	0	0
Franklin (B)	951	184	106	689	231
Fredon (Twp)	8	1	0	3	2
Green (Twp)	212	35	14	135	43
Hamburg (B)	401	127	295	213	154
Hampton (Twp)	0	0	0	0	0
Hardyston (Twp)	225	44	13	126	63
Hopatcong (B)	35	10	6	27	11
Lafayette (Twp)	22	7	1	11	8
Montague (Twp)	0	0	0	0	0
Newton (T)	1,092	159	124	730	447
Ogdensburg (B)	0	0	0	0	0
Sandyston (Twp)	0	0	0	0	0
Sparta (Twp)	169	74	8	99	48
Stanhope (B)	141	65	0	88	8
Stillwater (Twp)	0	0	0	0	0
Sussex (B)	0	0	0	0	0
Vernon (Twp)	112	30	2	70	26
Walpack (Twp)	0	0	0	0	0
Wantage (Twp)	23	4	1	17	9
Sussex County (Total)	3,758	856	591	2,386	1,112

Source: U.S. Census Bureau 2020, 2021; NJGIN 2023; Sussex County 2021, 2023; EPA 2018; CDC/ATSDR 2020

Table 12-6. Estimated Number of Vulnerable Persons Located within 1 mile of Hazardous Materials Rail Routes

	Estimated Number of Vulnerable Persons Located within 1 mile of Hazardous Materials Rail Routes				
	Persons Over 65	Persons Under 5	Non-English Speaking Persons	Persons with a Disability	Persons in Poverty
Andover (B)	0	0	0	0	0
Andover (Twp)	0	0	0	0	0
Branchville (B)	0	0	0	0	0
Byram (Twp)	0	0	0	0	0
Frankford (Twp)	0	0	0	0	0
Franklin (B)	1,135	220	126	822	275
Fredon (Twp)	0	0	0	0	0
Green (Twp)	0	0	0	0	0
Hamburg (B)	451	143	332	240	174
Hampton (Twp)	0	0	0	0	0
Hardyston (Twp)	1,054	206	64	594	297
Hopatcong (B)	0	0	0	0	0
Lafayette (Twp)	20	6	1	10	7
Montague (Twp)	0	0	0	0	0
Newton (T)	0	0	0	0	0
Ogdensburg (B)	359	69	39	186	121
Sandyston (Twp)	0	0	0	0	0
Sparta (Twp)	441	195	22	261	127
Stanhope (B)	0	0	0	0	0
Stillwater (Twp)	0	0	0	0	0
Sussex (B)	0	0	0	0	0
Vernon (Twp)	1,274	342	32	801	303
Walpack (Twp)	0	0	0	0	0
Wantage (Twp)	0	0	0	0	0
Sussex County (Total)	**4,734**	**1,181**	**616**	**2,914**	**1,304**

Source: U.S. Census Bureau 2020, 2021; NJGIN 2023; Sussex County 2021, 2023; NJ Transit 2018

Table 12-7. Estimated Number of Vulnerable Persons Located within 1 mile of a Hazardous Materials Roadway

	Estimated Number of Vulnerable Persons Located within 1 mile of a Hazardous Materials Roadway				
	Persons Over 65	Persons Under 5	Non-English Speaking Persons	Persons with a Disability	Persons in Poverty
Andover (B)	80	27	13	62	31
Andover (Twp)	358	63	0	137	69
Branchville (B)	163	39	28	83	34
Byram (Twp)	641	256	59	351	102
Frankford (Twp)	462	108	0	255	68
Franklin (B)	1,103	214	123	799	267
Fredon (Twp)	549	112	24	253	151
Green (Twp)	31	5	2	19	6
Hamburg (B)	451	143	332	240	174
Hampton (Twp)	415	72	35	265	125
Hardyston (Twp)	1,399	274	85	788	394
Hopatcong (B)	0	0	0	0	0
Lafayette (Twp)	315	104	20	156	123
Montague (Twp)	213	53	20	100	44
Newton (T)	1,787	260	202	1,196	732
Ogdensburg (B)	0	0	0	0	0
Sandyston (Twp)	253	87	0	179	60
Sparta (Twp)	1,111	491	56	656	319
Stanhope (B)	461	214	0	290	28
Stillwater (Twp)	0	0	0	0	0
Sussex (B)	297	86	7	347	365
Vernon (Twp)	1,280	344	32	804	304
Walpack (Twp)	0	0	0	0	0
Wantage (Twp)	935	179	50	713	393
Sussex County (Total)	**12,304**	**3,131**	**1,088**	**7,693**	**3,789**

Source: U.S. Census Bureau 2020, 2021; NJGIN 2023; Sussex County 2021, 2023

Table 12-8. Estimated Number of Vulnerable Persons Located within 50 miles of Indian Point

	Estimated Number of Vulnerable Persons Located within 50 miles of Indian Point				
	Persons Over 65	Persons Under 5	Non-English Speaking Persons	Persons with a Disability	Persons in Poverty
Andover (B)	80	27	13	62	31
Andover (Twp)	1,369	242	0	525	265
Branchville (B)	163	39	28	83	34
Byram (Twp)	1,112	444	103	609	178
Frankford (Twp)	999	234	0	552	147
Franklin (B)	1,173	228	130	850	285
Fredon (Twp)	601	123	26	277	166
Green (Twp)	690	116	45	439	140
Hamburg (B)	451	143	332	240	174
Hampton (Twp)	1,155	201	98	737	347
Hardyston (Twp)	1,642	321	100	924	463
Hopatcong (B)	2,002	600	339	1,517	631
Lafayette (Twp)	510	170	33	253	200
Montague (Twp)	843	211	82	394	175
Newton (T)	1,787	260	202	1,196	732
Ogdensburg (B)	373	71	41	193	127
Sandyston (Twp)	318	110	0	224	75
Sparta (Twp)	2,621	1,159	134	1,550	753
Stanhope (B)	484	225	0	303	30
Stillwater (Twp)	762	71	0	407	201
Sussex (B)	297	86	7	347	365
Vernon (Twp)	3,686	991	95	2,317	877
Walpack (Twp)	1	0	0	0	0
Wantage (Twp)	1,954	374	104	1,490	821
Sussex County (Total)	**25,073**	**6,446**	**1,912**	**15,489**	**7,217**

Source: U.S. Census Bureau 2021; NJGIN 2023; Sussex County 2021, 2023; Tetra Tech

12.2.2 General Building Stock

Potential losses to the general building stock caused by a hazardous material releases may include inaccessibility, loss of service, contamination and/or potential structural and content losses if an explosion occurs. Table 12-9 through Table 12-12 show building exposure to hazardous material incidents by jurisdiction. Table 12-13 and Table 12-14 show buildings in the hazardous materials incident hazard areas by general occupancy.

Table 12-9. Estimated Number and Total Replacement Cost Value of Structures Located within 1 mile of Hazardous Materials Site Area

	Jurisdiction Total Buildings		Number of Buildings		Replacement Cost Value	
	Count	Replacement Cost Value	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Andover (B)	326	$693,607,785	0	0.0%	$0	0.0%
Andover (Twp)	2,577	$4,012,892,721	263	10.2%	$804,337,256	20.0%
Branchville (B)	426	$598,388,025	0	0.0%	$0	0.0%
Byram (Twp)	3,676	$3,162,144,221	742	20.2%	$451,197,262	14.3%
Frankford (Twp)	3,529	$3,491,793,002	0	0.0%	$0	0.0%
Franklin (B)	2,058	$2,227,977,138	1,698	82.5%	$2,067,118,882	92.8%
Fredon (Twp)	1,615	$1,542,422,915	27	1.7%	$33,484,113	2.2%
Green (Twp)	1,697	$1,821,582,866	502	29.6%	$525,212,341	28.8%
Hamburg (B)	1,593	$1,809,235,911	1,423	89.3%	$1,728,577,305	95.5%
Hampton (Twp)	2,761	$2,474,023,610	0	0.0%	$0	0.0%
Hardyston (Twp)	4,401	$3,681,458,622	683	15.5%	$857,718,698	23.3%
Hopatcong (B)	8,004	$3,432,619,930	161	2.0%	$91,727,771	2.7%
Lafayette (Twp)	1,463	$2,142,628,709	46	3.1%	$77,321,216	3.6%
Montague (Twp)	2,175	$1,659,675,649	0	0.0%	$0	0.0%
Newton (T)	2,676	$5,699,120,026	1,627	60.8%	$3,236,382,923	56.8%
Ogdensburg (B)	992	$954,409,603	0	0.0%	$0	0.0%
Sandyston (Twp)	1,526	$1,350,071,503	0	0.0%	$0	0.0%
Sparta (Twp)	8,127	$10,316,900,290	786	9.7%	$3,422,727,220	33.2%
Stanhope (B)	1,552	$1,228,753,628	441	28.4%	$235,450,332	19.2%
Stillwater (Twp)	2,487	$1,611,608,776	0	0.0%	$0	0.0%
Sussex (B)	677	$2,187,092,184	0	0.0%	$0	0.0%
Vernon (Twp)	12,039	$6,816,863,576	547	4.5%	$682,796,127	10.0%
Walpack (Twp)	51	$68,015,712	0	0.0%	$0	0.0%
Wantage (Twp)	5,509	$5,527,803,803	130	2.4%	$602,351,644	10.9%
Sussex County (Total)	**71,937**	**$68,511,090,204**	**9,076**	**12.6%**	**$14,816,403,090**	**21.6%**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; RS Means 2022; EPA 2018

Table 12-10. Estimated Number and Total Replacement Cost Value of Structures Located within 1 mile of Hazardous Materials Rail Routes

	Jurisdiction Total Buildings		Number of Buildings		Replacement Cost Value	
	Count	Replacement Cost Value	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Andover (B)	326	$693,607,785	0	0.0%	$0	0.0%
Andover (Twp)	2,577	$4,012,892,721	0	0.0%	$0	0.0%
Branchville (B)	426	$598,388,025	0	0.0%	$0	0.0%
Byram (Twp)	3,676	$3,162,144,221	0	0.0%	$0	0.0%
Frankford (Twp)	3,529	$3,491,793,002	0	0.0%	$0	0.0%
Franklin (B)	2,058	$2,227,977,138	1,994	96.9%	$2,183,300,039	98.0%
Fredon (Twp)	1,615	$1,542,422,915	0	0.0%	$0	0.0%
Green (Twp)	1,697	$1,821,582,866	0	0.0%	$0	0.0%
Hamburg (B)	1,593	$1,809,235,911	1,593	100%	$1,809,235,911	100%
Hampton (Twp)	2,761	$2,474,023,610	0	0.0%	$0	0.0%
Hardyston (Twp)	4,401	$3,681,458,622	2,890	65.7%	$2,421,898,750	65.8%
Hopatcong (B)	8,004	$3,432,619,930	0	0.0%	$0	0.0%
Lafayette (Twp)	1,463	$2,142,628,709	69	4.7%	$76,927,663	3.6%
Montague (Twp)	2,175	$1,659,675,649	0	0.0%	$0	0.0%
Newton (T)	2,676	$5,699,120,026	0	0.0%	$0	0.0%
Ogdensburg (B)	992	$954,409,603	953	96.1%	$934,085,340	97.9%
Sandyston (Twp)	1,526	$1,350,071,503	0	0.0%	$0	0.0%
Sparta (Twp)	8,127	$10,316,900,290	1,725	21.2%	$4,503,801,053	43.7%
Stanhope (B)	1,552	$1,228,753,628	0	0.0%	$0	0.0%
Stillwater (Twp)	2,487	$1,611,608,776	0	0.0%	$0	0.0%
Sussex (B)	677	$2,187,092,184	0	0.0%	$0	0.0%
Vernon (Twp)	12,039	$6,816,863,576	4,335	36.0%	$2,637,476,847	38.7%
Walpack (Twp)	51	$68,015,712	0	0.0%	$0	0.0%
Wantage (Twp)	5,509	$5,527,803,803	0	0.0%	$0	0.0%
Sussex County (Total)	**71,937**	**$68,511,090,204**	**13,559**	**18.8%**	**$14,566,725,603**	**21.3%**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; RS Means 2022; NJ Transit 2018

Table 12-11. Estimated Number and Total Replacement Cost Value of Structures Located within 1 mile of a Hazardous Materials Roadway

	Jurisdiction Total Buildings		Number of Buildings		Replacement Cost Value	
	Count	Replacement Cost Value	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Andover (B)	326	$693,607,785	326	100%	$693,607,785	100%
Andover (Twp)	2,577	$4,012,892,721	736	28.6%	$861,821,876	21.5%
Branchville (B)	426	$598,388,025	426	100%	$598,388,025	100%
Byram (Twp)	3,676	$3,162,144,221	2,121	57.7%	$2,283,729,143	72.2%
Frankford (Twp)	3,529	$3,491,793,002	1,629	46.2%	$1,767,203,202	50.6%
Franklin (B)	2,058	$2,227,977,138	1,934	94.0%	$2,151,147,719	96.6%
Fredon (Twp)	1,615	$1,542,422,915	1,387	85.9%	$1,340,461,176	86.9%
Green (Twp)	1,697	$1,821,582,866	83	4.9%	$152,650,513	8.4%
Hamburg (B)	1,593	$1,809,235,911	1,593	100%	$1,809,235,911	100%
Hampton (Twp)	2,761	$2,474,023,610	1,003	36.3%	$1,084,646,912	43.8%
Hardyston (Twp)	4,401	$3,681,458,622	3,754	85.3%	$3,351,412,648	91.0%
Hopatcong (B)	8,004	$3,432,619,930	34	0.4%	$9,324,954	0.3%
Lafayette (Twp)	1,463	$2,142,628,709	896	61.2%	$1,461,199,058	68.2%
Montague (Twp)	2,175	$1,659,675,649	608	28.0%	$686,250,273	41.3%
Newton (T)	2,676	$5,699,120,026	2,676	100%	$5,699,120,026	100%
Ogdensburg (B)	992	$954,409,603	0	0.0%	$0	0.0%
Sandyston (Twp)	1,526	$1,350,071,503	1,116	73.1%	$999,421,828	74.0%
Sparta (Twp)	8,127	$10,316,900,290	3,730	45.9%	$7,335,511,735	71.1%
Stanhope (B)	1,552	$1,228,753,628	1,483	95.6%	$1,175,327,249	95.7%
Stillwater (Twp)	2,487	$1,611,608,776	0	0.0%	$0	0.0%
Sussex (B)	677	$2,187,092,184	677	100%	$2,187,092,184	100%
Vernon (Twp)	12,039	$6,816,863,576	4,311	35.8%	$2,484,604,684	36.4%
Walpack (Twp)	51	$68,015,712	0	0.0%	$0	0.0%
Wantage (Twp)	5,509	$5,527,803,803	2,657	48.2%	$2,829,792,993	51.2%
Sussex County (Total)	**71,937**	**$68,511,090,204**	**33,180**	**46.1%**	**$40,961,949,893**	**59.8%**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; RS Means 2022

Table 12-12. Estimated Number and Total Replacement Cost Value of Structures Located within 50 miles of Indian Point

	Jurisdiction Total Buildings		Number of Buildings		Replacement Cost Value	
	Count	Replacement Cost Value	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Andover (B)	326	$693,607,785	326	100%	$693,607,785	100%
Andover (Twp)	2,577	$4,012,892,721	2,577	100%	$4,012,892,721	100%
Branchville (B)	426	$598,388,025	426	100%	$598,388,025	100%
Byram (Twp)	3,676	$3,162,144,221	3,676	100%	$3,162,144,221	100%
Frankford (Twp)	3,529	$3,491,793,002	3,529	100%	$3,491,793,002	100%
Franklin (B)	2,058	$2,227,977,138	2,058	100%	$2,227,977,138	100%
Fredon (Twp)	1,615	$1,542,422,915	1,478	91.5%	$1,388,349,664	90.0%
Green (Twp)	1,697	$1,821,582,866	1,558	91.8%	$1,674,075,648	91.9%
Hamburg (B)	1,593	$1,809,235,911	1,593	100%	$1,809,235,911	100%
Hampton (Twp)	2,761	$2,474,023,610	2,761	100%	$2,474,023,610	100%
Hardyston (Twp)	4,401	$3,681,458,622	4,401	100%	$3,681,458,622	100%
Hopatcong (B)	8,004	$3,432,619,930	8,004	100%	$3,432,619,930	100%
Lafayette (Twp)	1,463	$2,142,628,709	1,463	100%	$2,142,628,709	100%
Montague (Twp)	2,175	$1,659,675,649	2,175	100%	$1,659,675,649	100%
Newton (T)	2,676	$5,699,120,026	2,676	100%	$5,699,120,026	100%
Ogdensburg (B)	992	$954,409,603	992	100%	$954,409,603	100%
Sandyston (Twp)	1,526	$1,350,071,503	1,526	100%	$1,350,071,503	100%
Sparta (Twp)	8,127	$10,316,900,290	8,127	100%	$10,316,900,290	100%
Stanhope (B)	1,552	$1,228,753,628	1,552	100%	$1,228,753,628	100%
Stillwater (Twp)	2,487	$1,611,608,776	1,685	67.8%	$946,003,696	58.7%
Sussex (B)	677	$2,187,092,184	677	100%	$2,187,092,184	100%
Vernon (Twp)	12,039	$6,816,863,576	12,039	100%	$6,816,863,576	100%
Walpack (Twp)	51	$68,015,712	30	58.8%	$29,319,049	43.1%
Wantage (Twp)	5,509	$5,527,803,803	5,509	100%	$5,527,803,803	100%
Sussex County (Total)	**71,937**	**$68,511,090,204**	**70,838**	**98.5%**	**$67,505,207,993**	**98.5%**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; RS Means 2022; Tetra Tech

Table 12-13. Buildings in the Hazardous Sites and Rail Routes Hazardous Materials Hazard Areas by General Occupancy Class

	Buildings within 1 mile of Hazardous Materials Site Area				Buildings within 1 mile of Hazardous Materials Rail Routes			
	Residential	Commercial	Industrial	Other[a]	Residential	Commercial	Industrial	Other[a]
Andover (B)	0	0	0	0	0	0	0	0
Andover (Twp)	215	23	4	21	0	0	0	0
Branchville (B)	0	0	0	0	0	0	0	0
Byram (Twp)	692	11	1	38	0	0	0	0
Frankford (Twp)	0	0	0	0	0	0	0	0
Franklin (B)	1,465	153	8	72	1,747	166	10	71
Fredon (Twp)	16	0	0	11	0	0	0	0
Green (Twp)	396	4	2	100	0	0	0	0
Hamburg (B)	1,311	86	8	18	1,473	94	8	18
Hampton (Twp)	0	0	0	0	0	0	0	0
Hardyston (Twp)	544	66	15	58	2,545	147	16	182
Hopatcong (B)	137	8	0	16	0	0	0	0
Lafayette (Twp)	43	1	1	1	38	0	1	30
Montague (Twp)	0	0	0	0	0	0	0	0
Newton (T)	1,372	186	15	54	0	0	0	0
Ogdensburg (B)	0	0	0	0	874	49	0	30
Sandyston (Twp)	0	0	0	0	0	0	0	0
Sparta (Twp)	475	191	28	92	1,241	247	36	201
Stanhope (B)	422	3	1	15	0	0	0	0
Stillwater (Twp)	0	0	0	0	0	0	0	0
Sussex (B)	0	0	0	0	0	0	0	0
Vernon (Twp)	342	120	13	72	3,863	268	27	177
Walpack (Twp)	0	0	0	0	0	0	0	0
Wantage (Twp)	50	50	1	29	0	0	0	0
Sussex County (Total)	**7,480**	**902**	**97**	**597**	**11,781**	**971**	**98**	**709**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; EPA 2018; NJ Transit 2018; Tetra Tech

a. Other = Government, Religion, Agricultural, and Education

Table 12-14. Buildings in the Hazardous Roadways and Indian Point Hazardous Materials Incident Hazard Areas by General Occupancy Class

	Buildings within 1 mile of Hazardous Materials Roadway Routes				Buildings within 50 miles of Indian Point			
	Residential	Commercial	Industrial	Other[a]	Residential	Commercial	Industrial	Other[a]
Andover (B)	234	69	2	21	234	69	2	21
Andover (Twp)	562	54	7	113	2,146	157	14	260
Branchville (B)	339	71	1	15	339	71	1	15
Byram (Twp)	1,930	92	2	97	3,345	111	2	218
Frankford (Twp)	1,286	164	5	174	2,779	179	6	565
Franklin (B)	1,698	166	8	62	1,807	166	10	75
Fredon (Twp)	1,047	43	5	292	1,146	43	6	283
Green (Twp)	58	1	2	22	1,285	29	4	240
Hamburg (B)	1,473	94	8	18	1,473	94	8	18
Hampton (Twp)	830	81	1	91	2,307	104	1	349
Hardyston (Twp)	3,377	172	19	186	3,963	190	19	229
Hopatcong (B)	0	34	0	0	7,643	184	0	177
Lafayette (Twp)	592	93	18	193	960	98	25	380
Montague (Twp)	474	55	5	74	1,870	94	7	204
Newton (T)	2,245	286	19	126	2,245	286	19	126
Ogdensburg (B)	0	0	0	0	910	52	0	30
Sandyston (Twp)	870	70	7	169	1,093	89	7	337
Sparta (Twp)	3,122	383	33	192	7,366	427	41	293
Stanhope (B)	1,382	65	6	30	1,448	66	7	31
Stillwater (Twp)	0	0	0	0	1,454	88	0	143
Sussex (B)	554	80	6	37	554	80	6	37
Vernon (Twp)	3,880	260	21	150	11,176	402	36	425
Walpack (Twp)	0	0	0	0	2	21	0	7
Wantage (Twp)	1,998	151	3	505	4,174	192	6	1,137
Sussex County (Total)	**27,951**	**2,484**	**178**	**2,567**	**61,719**	**3,292**	**227**	**5,600**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; EPA 2018; NJ Transit 2018; Tetra Tech

a. Other = Government, Religion, Agricultural, and Education

The general building stock exposure analysis estimates indicate the following:

- There are 9,076 buildings with $14.8 billion in value within 1 mile of hazardous material sites.
- There are 13,559 buildings with $14.5 billion in value within 1 mile of railways.
- There are 33,180 buildings with $40.9 billion in value within 1 mile of roadways.
- There are 70,838 buildings with $67.5 billion in value within 50 miles of the Indian Point Energy Center.
- The Borough of Franklin has the greatest number of buildings within 1 mile of hazardous material sites (1,698).
- The Township of Vernon has the greatest number of buildings within 1 mile of railways (4,335).
- The Township of Vernon has the greatest number of buildings within 1 mile of roadways (4,311).
- The Township of Vernon has the greatest number of buildings within 50 miles of the Indian Point Energy Center (12,039).
- The residential occupancy is the most exposed to the hazardous material hazard:
  - 82 percent of the buildings within 1 mile of a hazardous materials site
  - 87 percent of the buildings within 1 mile of railway
  - 84 percent of the buildings within 1 mile of roadway
  - 87 percent of the buildings within 50 miles of Indian Point

12.2.3 Community Lifelines and Other Critical Facilities

Potential losses to critical assets caused by a hazardous material incident may include inaccessibility, loss of service, contamination and/or potential structural and content losses if an explosion occurs. Hazardous materials that get into waterways can contaminate drinking water supplies.

12.2.4 Economy

A significant hazardous materials release in an urban area may force businesses to close for an extended period because of contamination or direct damage caused by an explosion, if one occurred. As businesses close and tourists are prohibited from entering the affected area, tourism may decline and public perception of the area may be permanently affected. The closure of waterways, railroads, airports, or highways as a result of a hazardous materials release would impact the ability to deliver goods and services. Potential impacts may be local, regional, or statewide, depending on the magnitude of the event and the level of service disruptions. Radiological contamination of agriculture, livestock, or production can lead to loss of commerce with other regions of the state, country, and world.

12.2.5 Natural, Historic and Cultural Resources

Natural

Some hazardous materials can be toxic to plants and animals, damaging their habitats and food sources. Radioactive materials released into the environment could enter the food chain and ultimately contaminate the human food supply. Nuclear impacts on the environment are similar to those of radioactive materials; however, the extent of impacts can be larger due to the number of miles it can impact.

Hazardous materials that get into waterways can be deadly to aquatic species. Hazardous materials can also leach into soils and travel with wind, having impacts on the localized habitat.

Historic

Unless a hazard materials release is directly on or adjacent to an historic resource site the site, a hazardous materials incident is unlikely to affect the resource. If the incident is on or near the site, a release can pose a serious long-term threat to the resource.

Cultural

Unless a hazard materials release is directly on or adjacent to a cultura resource site the site, a hazardous materials incident is unlikely to affect the resource. If the incident is on or near the site, a release can pose a serious long-term threat to the resource.

Cultural events often take place in outdoor areas. A hazardous materials incident could impact the participants or visitors at these events and festivals or result in the event or festival becoming postponed or cancelled.

12.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

This HMP evaluated vulnerability based on hazard areas defined by buffers around railways, hazardous material fixed sites, roadways, and the Indian Point Energy Center. The previous plan update did not use these hazard areas for the vulnerability assessment.

Overall, the County's vulnerability to the hazardous material hazard has not changed, and the entire County will continue to be vulnerable to this hazard. Any change in vulnerability since the previous HMP would be attributed to changes in population density and new development. This updated HMP used updated building stock and critical asset inventories to assess the County's risk to these assets. The building inventory was updated using RSMeans 2022 values, which are more current and reflect replacement cost rather than the building stock improvement values reported in the 2021 HMP. Further, the 2021 5-year population estimates from the American Community Survey were used to evaluate the population exposed to the hazard areas.

12.4 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.

12.4.1 Potential or Planned Development

Any areas of growth could be impacted by the hazardous materials hazard. Development near hazardous materials fixed-site facilities and transportation routes increase the County's overall risk. Therefore, the County should take precautions with the location of new development and the development's proximity to hazardous material fixed sites and transportation routes. The County may also want to consider implementing designs into new development that enables improved evacuation or protection from residual impacts from the hazardous materials.

12.4.2 Projected Changes in Population

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). Any changes in the density of population can impact the number of persons living near hazardous materials fixed-site facilities and transportation routes.

12.4.3 Climate Change

As temperatures change, excessive heat on containers that contain hazardous materials may alter their material properties. In addition, hazardous materials stored at fixed locations in the floodplain may experience an increase in flood events due to projected increases in precipitation events, magnitude, and frequency. Extreme weather conditions may make in-transit hazardous material releases more likely as transportation accidents are more likely to occur.

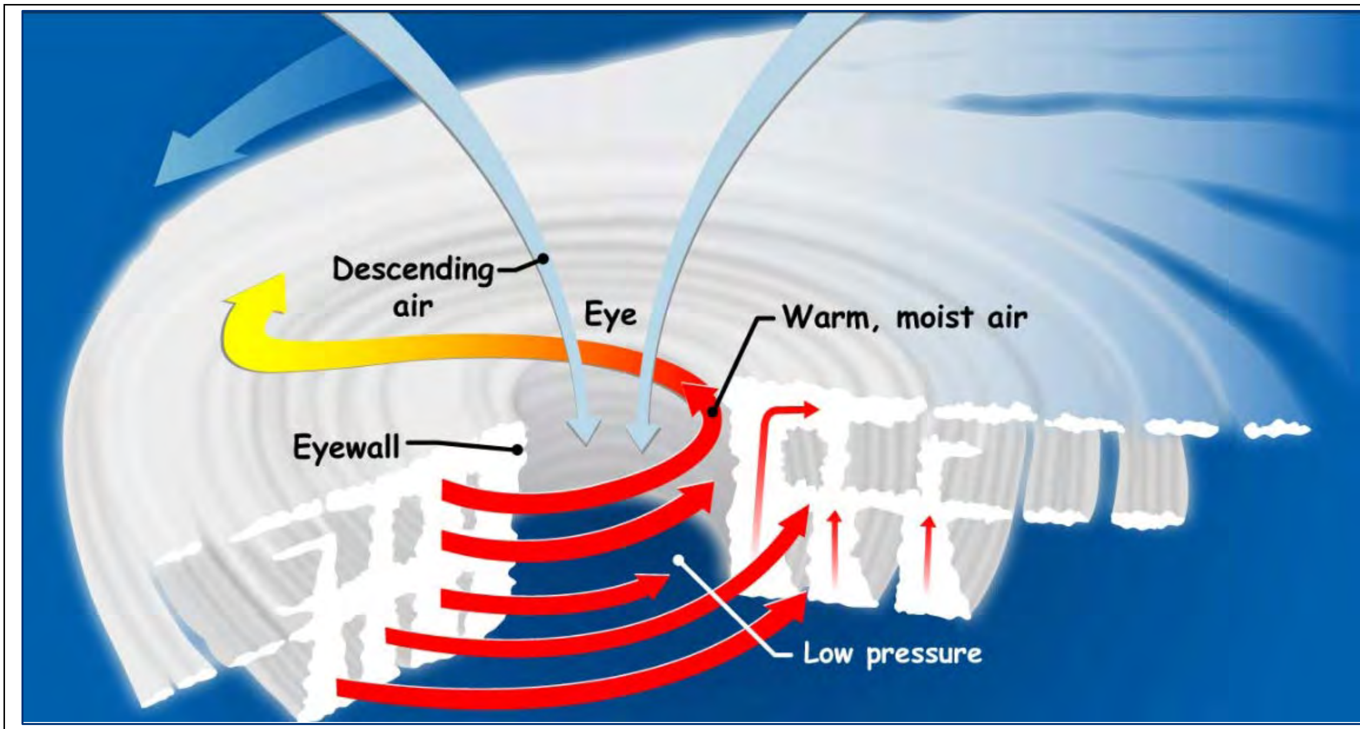
13. HURRICANE

13.1 HAZARD PROFILE

13.1.1 Hazard Description

A tropical cyclone is an organized system of clouds and thunderstorms around a warm-air core that originates in tropical or subtropical waters (between about 35 degrees latitude north and south). Tropical cyclones include hurricanes, tropical storms, and tropical depressions. They are fueled by a different heat mechanism than other cyclonic windstorms such as nor'easters and polar lows. Figure 13-1 illustrates the formation of a tropical cyclone. The characteristic that separates a tropical cyclone from another cyclonic system is that at any height in the atmosphere, the center of a tropical cyclone will be warmer than its surroundings, a phenomenon called "warm core" storm systems (NWS n.d.). Tropical cyclones strengthen when water evaporated from the ocean is released as the saturated air rises.

Figure 13-1. Formation of a Tropical Cyclone



Source: NASA 2019

Tropical cyclones can develop in the Atlantic between the Lesser Antilles and the African coast or in the warm tropical waters of the Caribbean Sea and Gulf of Mexico. These storms can move up the Atlantic coast of the United States, impacting the eastern seaboard, or move into the United States through the states along the Gulf Coast, bringing wind and rain as far north as New England before moving eastward offshore (NOAA 2020).

As storm systems strengthen into hurricanes (maximum sustained winds of at least 74 mph), the surface winds move continuously in a circular motion. Meteorologists refer to this pattern as "closed circulation." The direction of circulation is different depending on where the storm is located: it is counterclockwise in the Northern hemisphere and clockwise in the Southern hemisphere. These rotating winds lead to the development of the characteristic “eye” of the hurricane: the calm, clear center of the storm. The eye is surrounded by the eyewall, where winds are strongest.

The National Weather Service (NWS) issues hurricane and tropical storm watches and warnings, which remain in effect as long as the event poses a significant threat to life and property (NOAA NHC 2010):

- **Tropical Storm Watch** is issued when tropical storm conditions (sustained winds of 39 to 73 mph) are possible within the specified area within 48 hours.
- **Tropical Storm Warning** is issued when tropical storm conditions (sustained winds of 39 to 73 mph) are expected somewhere within the specified area within 36 hours.
- **Hurricane Watch** is issued when hurricane conditions (sustained winds of 74 mph or higher) are possible within the specified area. The watch is issued 48 hours prior to the anticipated onset of tropical storm-force winds.
- **Hurricane/Typhoon Warning** is issued when hurricane conditions (sustained winds of 74 mph or higher) are expected somewhere within the specified area. The warning is issued 36 hours in advance of the anticipated onset of tropical storm-force winds. The warning can remain in effect when dangerously high water or combination of dangerously high water and waves continue, even though winds may be less than hurricane force.

13.1.2 Location

Sussex County is not located along the Atlantic Coast, but hurricanes and tropical storms can track inland, bringing heavy rainfall, strong winds, and flooding. These storms are regional events that can impact very large areas hundreds to thousands of miles across over the life the storm. Therefore, all communities within Sussex County are equally subject to the impacts of hurricanes and tropical storms. Areas in Sussex County that are subject to flooding and wind damage are particularly vulnerable.

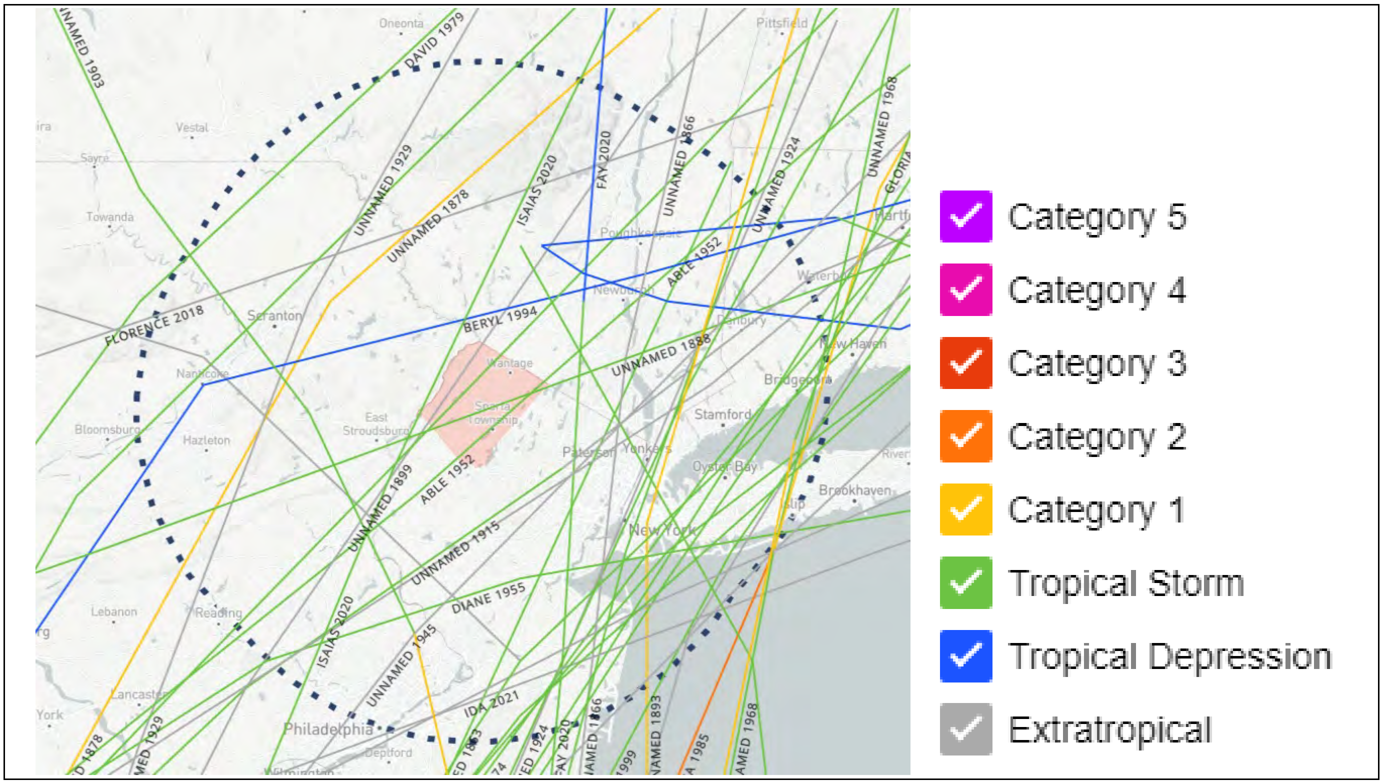
Figure 13-2 shows the paths of the centers of previous hurricanes and tropical storms that tracked within 60 nautical miles of Sussex County, a distance within which significant impacts are typically felt. Since 1861, the County has been impacted by three tropical depressions, 23 tropical storms, five hurricanes, and 13 extratropical cyclones (cyclones with that draw energy from the contrast between warm and cold air masses) (NOAA NHC 2024).

13.1.3 Extent

Hurricane Risk Index

Figure 13-3 shows a relatively low Hurricane Risk Index for Sussex County from FEMA’s National Risk Index (FEMA 2019).

Figure 13-2. Historical Tropical Storm and Hurricane Tracks 1861 to 2023



Source: NOAA NHC 2023

Figure 13-3. National Risk Index, Hurricane Risk Index Score

Source: FEMA 2019
Note: Sussex County is outlined in a blue border.

Wind-Based Scale

The extent of a tropical cyclone is measured using the Saffir-Simpson Hurricane Wind Scale. This scale is used to estimate the potential property damage and flooding expected when a tropical cyclone makes landfall. Based on a storm's sustained wind speed, it designates a tropical depression, tropical storm, or hurricane category 1 to 5, as shown in Table 13-1. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Tropical storms and Category 1 and 2 storms are still dangerous and require preventative measures (NOAA 2020).

Table 13-1. Saffir-Simpson Wind Scale

Category	Wind Speed
Tropical Depression	38 mph or less
Tropical Storm	39 to 73 mph
Hurricane Category 1	74 to 95 mph
Hurricane Category 2	96 to 110 mph
Hurricane Category 3	111 to 129 mph
Hurricane Category 4	130 to 156 mph
Hurricane Category 5	157 mph or higher

Source: NOAA 2020

Mean Return Period

In evaluating the potential for hazard events of a given magnitude, a mean return period (MRP) is often used. The MRP provides an estimate of the frequency of an event that may occur within any given year based on past recorded events. Figure 13-5 and Figure 13-6 show the estimated maximum three-second gust wind speeds that can be anticipated in the study area associated with the 100- and 500-year MRP events. These peak wind speed projections were generated using FEMA's Hazus v6 wind model. The estimated hurricane track for the 100- and 500-year event is also shown. The maximum three-second gust wind speeds for Sussex County for both the 100- and 500-year MRP events are 74 to 95 mph (Category 1 hurricane).

13.1.4 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Sussex County has been included in eight major disaster (DR) or emergency (EM) declarations for hurricane-related events, as listed in Table 13-2.

Table 13-2. FEMA Declarations for Hurricane Events in Sussex County

Event Date	Declaration Date	Declaration Number	Description
September 16 – 18, 1999	September 17, 1999	EM-3148	New Jersey Hurricane Floyd
August 26 – September 5, 2011	August 27, 2011	EM-3332	Hurricane Irene in New Jersey

Event Date	Declaration Date	Declaration Number	Description
August 26 – September 5, 2011	August 27, 2011	DR-4021	Hurricane Irene in New Jersey
October 26 – November 8, 2012	October 28, 2012	EM-3354	New Jersey Hurricane Sandy
October 26 – November 8, 2012	October 30, 2012	DR-4086	New Jersey Hurricane Sandy
August 4, 2020	December 11, 2020	DR-4574	Tropical Storm Isaias
September 1 - 3, 2021	September 2, 2021	EM-3573	Remnants of Hurricane Ida
September 1 - 3, 2021	September 5, 2021	DR-4614	Remnants of Hurricane Ida

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 hurricane-related agricultural disaster declarations (USDA 2024).

Previous Events

Known hurricane events that impacted Sussex County between January 2020 and June 2024 are listed in Table 13-3. For events prior to 2020, refer to the 2021 Sussex County HMP.

Figure 13-4. Wind Speeds for the 100-Year Mean Return Period Event

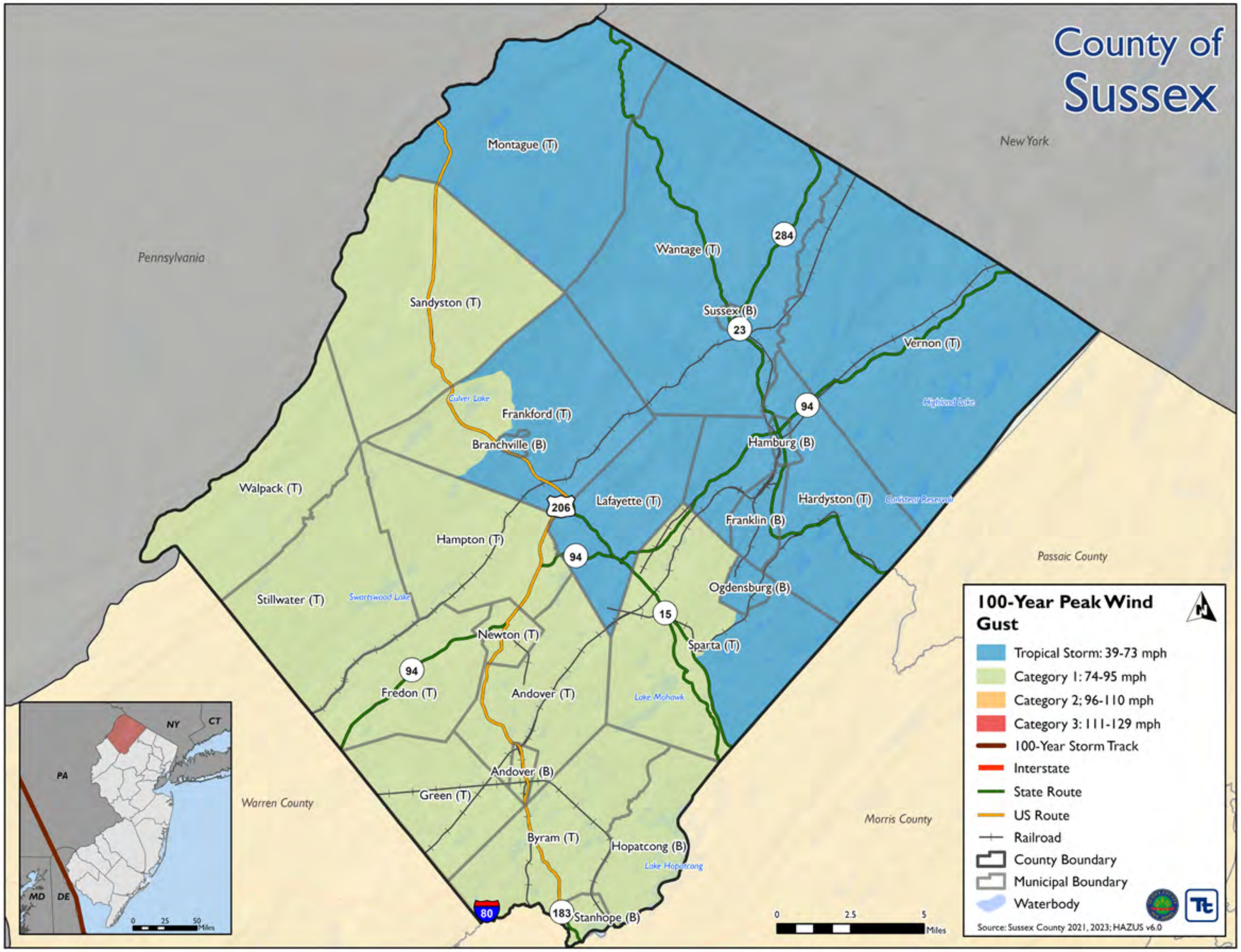


Figure 13-5. Wind Speeds for the 500-Year Mean Return Period Event

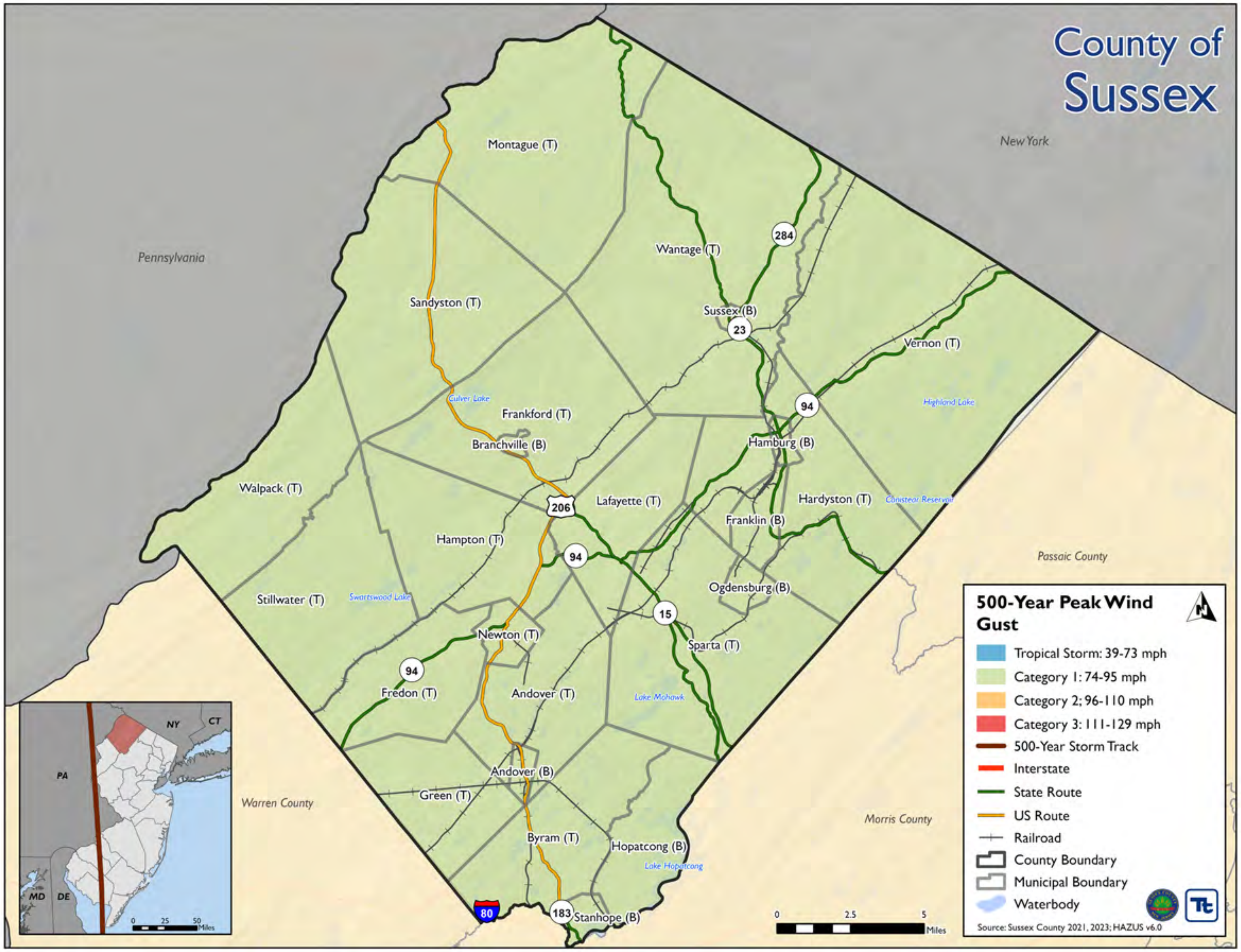


Table 13-3. Hurricane Events in Sussex County (2020 to 2024)

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
July 10, 2020	N/A	N/A	Sussex County	Tropical Storm Fay moved northward along the coasts of Delaware and New Jersey. The storm produced rainfall up to 6 inches in New Jersey, with the highest totals in the southern part of the state. Some areas also experienced a period of tropical storm force winds, especially near the coast. Overall impacts from wind were limited.
August 4, 2020	EM-3573-NJ, DR-4614-NJ	Yes	Sussex County	Tropical Storm Isaias brought high winds, heavy rain, tornadoes, and coastal flooding to the mid-Atlantic region, becoming the most impactful tropical cyclone to impact most of the region since Sandy in 2012. Several reports of downed trees and power lines were made.
September 1 - 3, 2021	EM-3573-NJ, DR-4614-NJ	Yes	Sussex County	Post-Tropical Cyclone Ida brought heavy rain to New Jersey on September 1. Rainfall totals were as high as 10 inches. The heavy rain caused significant flash flooding, mainly in the northern half of the state. It resulted in widespread property damage and several fatalities.

Source: FEMA 2024; National Oceanic and Atmospheric Administration 2024

13.1.5 Probability of Future Occurrences

Probability Based on Previous Occurrences

Information on previous hurricane occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 13-4. Based on historical records and input from the Steering Committee, the probability of occurrence for hurricane in the County is considered “occasional.” It is estimated that Sussex County will continue to experience direct and indirect impacts of hurricanes and tropical storms such as flooding, extreme wind, infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays.

Table 13-4. Probability of Future Hurricane Events in Sussex County

Hazard Type	Number of Occurrences Between 1842 and 2024	Percent Chance of Occurring in Any Given Year
Tropical Depression	3	1.6%
Tropical Storm	23	12.6%
Hurricanes (all categories)	5	2.7%
Total	**31**	**16.9%**

Sources: FEMA 2024; NOAA NHC 2024

Effect of Climate Change on Future Probability

Climate change may result in changes to the frequency of coastal storms. In the past decade, warmer ocean temperatures have resulted in many tropical systems taking place outside of the typical hurricane season. Eight of the last nine years have featured a tropical system occurring before the official start of the season (Sullivan 2023). In 2016, a rare winter hurricane named Alex developed in the middle of January (BBC 2019). According to NOAA's database, 39 storms formed in the Atlantic Basin before June 1 from 1851 through 2020, a long-term average of one such early storm every four to five years. The 2010s had the most such storms, and there has been a steady increase since the 1990s. However, the 1950s had six such storms, the 1930s had four and there was another four preseason storm streak from 1887 through 1890. It is possible there were other such storms in the era before satellites – before the mid-1960s – that were missed by ship observations or reports from areas impacted. It remains to be seen if expansion of the traditional hurricane season is a long-term trend or a common occurrence (Erdman 2020).

13.1.6 Cascading Impacts on Other Hazards

Hurricanes can interact with the following hazards of concern identified for this HMP:

- **Flood**—Hurricane rainfall can contribute to severe flooding
- **Geological Hazards—**Hurricane rainfall can lead to unstable ground, causing landslides. The oversaturation of the ground can also increase the likelihood of sinkhole events, depending on the soil composition.
- **Health—**Impacts of flooding associated with hurricanes may include exposure to pathogens such as mold. Floodwaters can be contaminated by pollutants such as sewage, human and animal feces, pesticides, fertilizers, oil, asbestos, and rusting building materials.

13.2 VULNERABILITY AND IMPACT ASSESSMENT

A probabilistic assessment was conducted for the 100- and 500-year MRPs through a Level 2 analysis in HAZUS v6 to estimate potential losses associated with these high-wind events. The Hazus methodology for hurricanes is described in Section 4.3.2. The impacts on population, existing structures, critical facilities, and the economy are presented below.

13.2.1 Life, Health, and Safety

Overall Population

The impact of a hurricane on life, health, and safety is dependent upon the severity of the event and whether adequate warning time is provided to residents. For the purposes of this HMP, the entire population of Sussex County (144,221 people) is exposed to hurricanes.

For the 100-year MRP event, Hazus estimates no households in Sussex County will be displaced and temporary shelter will not be required. However, as shown in Table 13-5, the 500-year MRP event may result in 3 displaced households and 1 person seeking temporary shelter. In addition, downed trees, damaged buildings, and debris carried by high winds can lead to injury or loss of life.

Table 13-5. Displaced Households and Persons Seeking Shelter Caused by the 500-Year MRP Hurricane Event

	500-Year Mean Return Period Hurricane	
	Displaced Households	Persons Seeking Short-Term Sheltering
Andover (B)	0	0
Andover (T)	0	0
Branchville (B)	0	0
Byram (T)	0	0
Frankford (T)	0	0
Franklin (B)	0	0
Fredon (T)	0	0
Green (T)	0	0
Hamburg (B)	0	0
Hampton (T)	0	0
Hardyston (T)	0	0
Hopatcong (B)	1	1
Lafayette (T)	0	0
Montague (T)	0	0
Newton (T)	0	0
Ogdensburg (B)	0	0
Sandyston (T)	0	0
Sparta (T)	1	0
Stanhope (B)	0	0
Stillwater (T)	0	0
Sussex (B)	0	0
Vernon (T)	1	0
Walpack (T)	0	0
Wantage (T)	0	0
Sussex County (Total)	**3**	**1**

Source: Hazus v6.0
Note: Results for population are rounded down.

Socially Vulnerable Population

Socially vulnerable populations are most susceptible to the hurricane hazard, based on factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Economically disadvantaged populations are more vulnerable because they are likely to lack funds to evacuate. The population over the age of 65 is also more vulnerable and might physically have more difficulty evacuating. The older population generally requires extra time or outside assistance during evacuations and is more likely to need medical attention that might not be available due to isolation during a hurricane event.

Without a quantitative assessment of potential impacts of a hurricane 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 13-6 summarizes highlights of this information. For planning purposes, it is reasonable to assume that percentages and distribution of socially vulnerable populations affected by a hurricane will be similar to the countywide numbers.

Table 13-6. 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
			Vernon (T)	Walpack (T)	Walpack (T)	Sparta (T)
Population Over 65	**25,451**	**17.65%**	**3,687**	**100.00%**	**7**	**13.38%**
			Sparta (T)	Lafayette (T)	Walpack (T)	Walpack (T)
Population Under 5	**6,500**	**4.51%**	**1,160**	**7.21%**	**0**	**0.00%**
Non-English-			Hopatcong (B)	Hamburg (B)	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack
Speaking Population	**1,922**	**1.33%**	**339**	**10.17%**	**0**	**0.00%**
Population With			Vernon (T)	Franklin (B)	Walpack (T)	Walpack (T)
Disability	**15,697**	**10.88%**	**2,318**	**17.32%**	**0**	**0.00%**
Population Below			Vernon (T)	Sussex (B)	Walpack (T)	Walpack (T)
Poverty Level	**7,320**	**5.08%**	**877**	**18.03%**	**0**	**0.00%**
Households Below			Vernon (T)	Sussex (B0	Branchville (B)	Green (T)
ALICE Threshold	**14,428**	**21%**	1,833	**48%**	90	**14%**

13.2.2 General Building Stock

Building construction plays a major role in the extent of damage resulting from a hurricane event. Due to differences in construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings, in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. High-rise buildings are also very vulnerable structures. Mobile homes are the most vulnerable to damage, even if tied down, and offer little protection to people inside.

The Hazus wind model was run to estimate potential losses to buildings. Damage to buildings is a direct result of wind speed, direction, and duration, which is dependent upon the storm's intensity and track. Expected building damage was evaluated across the wind damage categories described in Table 13-7. Building damage as a result of the 100-year and 500-year MRP hurricane wind events was estimated using Hazus, as summarized in Table 13-8. The analysis found that no buildings will be severely or completely destroyed by the 100-year MRP event, 1 will be moderately damaged, and 293 will have minor damage. For the 500-year MRP event, the analysis estimates that 2 buildings will be completely destroyed, 2 will experience severe damage, 219 will be moderately damaged, and 4,028 will have minor damage. The majority of the losses are estimated to the residential occupancy class for both MRP events.

Table 13-9 summarizes the damage estimated for the 100- and 500-year MRP events. The total estimated damage to buildings for all occupancy types across Sussex County is $25.5 million for the 100- MRP event and $130.6 million for the 500- MRP event. Most of these losses are to residential buildings. The damage counts include buildings damaged at all severity levels from minor damage to destruction. Total dollar damage reflects the overall impact on buildings at an aggregate level. The Township of Vernon is estimated to experience the greatest damage in a 100-year and 500-year MRP event: $4.2 million and $25.3 million, respectively.

Table 13-7. Description of Damage Categories

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
No Damage or Very Minor Damage Little or no visible damage from the outside. No broken windows, or failed roof deck. Minimal loss of roof cover, with no or very limited water penetration.	≤2%	No	No	No	No	No
Minor Damage Maximum of one broken window, door or garage door. Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring painting or patching for repair.	>2% and ≤15%	One window, door, or garage door failure	No	<5 impacts	No	No
Moderate Damage Major roof cover damage, moderate window breakage. Minor roof sheathing failure. Some resulting damage to interior of building from water.	>15% and ≤50%	> one and ≤ the larger of 20% & 3	1 to 3 panels	Typically 5 to 10 impacts	No	No
Severe Damage Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water.	>50%	> the larger of 20% & 3 and ≤50%	>3 and ≤25%	Typically 10 to 20 impacts	No	No
Destruction Complete roof failure and/or, failure of wall frame. Loss of more than 50% of roof sheathing.	Typically >50%	>50%	>25%	Typically >20 impacts	Yes	Yes

Source: FEMA 2022

Table 13-8. Expected Damages from 100 and 500-Year MRP Events

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	100-year		500-year	
			Building Count	Percent Buildings in Occupancy Class	Building Count	Percent Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	62,412	None	62,137	99.6%	58,295	93.4%
		Minor	274	0.4%	3,905	6.3%
		Moderate	1	<0.1%	210	0.3%
		Severe	0	0.0%	1	<0.1%
		Complete Destruction	0	0.0%	2	<0.1%
Commercial Buildings	3,345	None	3,328	99.5%	3,223	96.4%
		Minor	17	0.5%	114	3.4%
		Moderate	0	0.0%	8	0.2%
		Severe	0	0.0%	1	0.0%
		Complete Destruction	0	0.0%	0	0.0%
Industrial Buildings	227	None	225	99.1%	217	95.6%
		Minor	2	0.9%	9	4.1%
		Moderate	0	0.0%	1	0.3%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%
Other[a]	5,953	None	5,942	99.8%	5,768	96.9%
		Minor	11	0.2%	182	3.0%
		Moderate	0	0.0%	4	0.1%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%

Source: Hazus v6.0; NJGIN 2023; Sussex County 2023

a. Other = Government, Religion, Agricultural, and Education

Table 13-9. Estimated Building Damage by General Occupancy for the 100-Year and 500-Year MRP Events

	Estimated Building Losses (Residential)		Estimated Building Losses (Commercial)		Estimated Building Losses (Industrial)		Estimated Building Losses (All Other Occupancies)		Estimated Building Losses (All Occupancies)	
	100-Year MRP Event	500-Year MRP Event	100-Year MRP Event	500-Year MRP Event	100-Year MRP Event	500-Year MRP Event	100-Year MRP Event	500-Year MRP Event	100-Year MRP Event	500-Year MRP Event
Andover (B)	$124,213	$505,254	$11,610	$135,227	$149	$903	$1,157	$12,608	$137,129	$653,992
Andover (Twp)	$947,670	$3,640,348	$111,633	$1,129,615	$2,792	$17,039	$9,760	$158,804	$1,071,855	$4,945,806
Branchville (B)	$136,160	$576,475	$17,205	$101,787	$603	$1,631	$2,349	$50,555	$156,317	$730,447
Byram (Twp)	$1,198,237	$4,959,633	$65,130	$798,412	$178	$1,084	$9,253	$87,833	$1,272,798	$5,846,961
Frankford (Twp)	$981,262	$4,107,485	$86,212	$494,144	$3,367	$10,085	$11,009	$234,434	$1,081,851	$4,846,148
Franklin (B)	$705,506	$3,763,067	$48,707	$1,056,578	$3,301	$40,162	$7,310	$143,381	$764,825	$5,003,189
Fredon (Twp)	$531,232	$1,864,558	$2,701	$18,277	$1,840	$7,459	$2,116	$69,601	$537,890	$1,959,895
Green (Twp)	$781,875	$2,647,775	$6,760	$31,105	$3,861	$15,678	$4,659	$93,451	$797,156	$2,788,008
Hamburg (B)	$561,875	$2,856,840	$45,782	$1,165,287	$4,128	$64,695	$9,334	$111,528	$621,120	$4,198,350
Hampton (Twp)	$707,823	$2,928,374	$60,618	$281,735	$653	$2,002	$11,805	$133,482	$780,899	$3,345,592
Hardyston (Twp)	$1,628,732	$7,771,379	$52,075	$902,341	$4,666	$55,942	$9,625	$236,371	$1,695,099	$8,966,034
Hopatcong (B)	$2,559,577	$10,692,852	$48,121	$696,361	$0	$0	$16,104	$184,881	$2,623,802	$11,574,094
Lafayette (Twp)	$559,534	$2,402,518	$47,297	$332,742	$5,883	$27,712	$10,334	$342,041	$623,048	$3,105,013
Montague (Twp)	$303,156	$1,685,416	$14,864	$80,543	$641	$1,943	$7,765	$48,403	$326,426	$1,816,305
Newton (T)	$968,964	$3,810,773	$149,651	$926,359	$11,363	$56,628	$31,053	$167,910	$1,161,030	$4,961,670
Ogdensburg (B)	$328,245	$1,772,158	$19,572	$446,084	$0	$0	$6,019	$48,544	$353,836	$2,266,786
Sandyston (Twp)	$182,137	$761,697	$11,481	$33,744	$1,582	$4,564	$11,328	$41,462	$206,529	$841,467
Sparta (Twp)	$3,380,932	$15,065,780	$249,699	$3,726,895	$9,398	$74,552	$28,365	$404,374	$3,668,394	$19,271,601
Stanhope (B)	$672,875	$2,593,770	$12,302	$178,920	$6,050	$45,394	$6,204	$50,968	$697,431	$2,869,052
Stillwater (Twp)	$397,330	$1,484,059	$4,599	$29,307	$0	$0	$3,597	$30,471	$405,527	$1,543,838
Sussex (B)	$276,243	$1,690,860	$139,523	$1,056,064	$3,866	$23,131	$11,983	$100,953	$431,615	$2,871,007
Vernon (Twp)	$4,113,941	$23,410,648	$49,571	$1,220,367	$5,159	$91,640	$26,746	$658,889	$4,195,417	$25,381,543
Walpack (Twp)	$6,087	$25,456	$384	$1,128	$53	$153	$379	$1,386	$6,902	$28,122
Wantage (Twp)	$1,857,475	$9,298,375	$73,026	$671,401	$1,027	$5,448	$32,128	$817,157	$1,963,657	$10,792,382
Sussex County (Total)	$23,911,084	$110,315,549	$1,328,522	$15,514,424	$70,562	$547,845	$270,383	$4,229,486	$25,580,551	$130,607,303

Source: Hazus v6.0; Sussex County 2023; RS Means 2022; NJOGIS, Civil Solutions, Spatial Data Logic

13.2.3 Community Lifelines and Other Critical Facilities

Utility infrastructure could suffer damage from hurricane high winds associated with falling tree limbs or other debris, resulting in the loss of power. Loss of service can impact residents and business operations alike. Interruptions in heating or cooling utilities can affect populations such as the young and elderly, who are particularly vulnerable to temperature-related health impacts. Loss of power can impact other public utilities, including potable water, wastewater treatment, and communications. In addition to public water services, property owners with private wells might not have access to potable water due to pump failure until power is restored. Lack of power to emergency facilities, including police, fire, EMS, and hospitals, will inhibit a community's ability to effectively respond to an event and maintain the safety of its citizens.

Table 13-10 and Table 13-11 summarize the damage state probabilities for critical facilities during the 100-year and 500-year MRP events, respectively. For both events, there are no days predicted for loss of function of any lifeline.

Table 13-10. Estimated Impacts on Critical Facilities for the 100-Year MRP Hurricane Event

		Average Percent Probability of Sustaining Damage 100-Year Mean Return Period Hurricane			
	Loss of Days	Minor	Moderate	Severe	Complete
Communications	0	0.3%	<0.1%	0.0%	0.0%
Energy	0	0.7%	<0.1%	0.0%	0.0%
Food, Hydration, Shelter	0	1.0%	0.1%	0.0%	0.0%
Hazardous Materials	0	0.8%	<0.1%	<0.1%	0.0%
Health and Medical	0	0.3%	<0.1%	0.0%	0.0%
Safety and Security	0	0.7%	<0.1%	0.0%	0.0%
Transportation	0	0.1%	0.0%	0.0%	0.0%
Water Systems	0	0.6%	<0.1%	0.0%	0.0%

Source: Hazus v6.0; NJGIN 2023; Sussex County 2021, 2023

Table 13-11. Estimated Impacts on Critical Facilities for the 500-Year MRP Hurricane Event

		Average Percent Probability of Sustaining Damage 500-Year Mean Return Period Hurricane			
	Loss of Days	Minor	Moderate	Severe	Complete
Communications	0	4.4%	0.7%	0.1%	0.0%
Energy	0	3.7%	0.4%	<0.1%	0.0%
Food, Hydration, Shelter	0	5.6%	0.9%	<0.1%	0.0%
Hazardous Materials	0	3.6%	0.6%	0.2%	<0.1%
Health and Medical	0	2.2%	0.3%	0.0%	0.0%
Safety and Security	0	3.0%	0.3%	<0.1%	0.0%
Transportation	0	4.2%	0.1%	0.0%	0.0%
Water Systems	0	3.1%	0.3%	<0.1%	0.0%

Source: Hazus v6.0; NJGIN 2023; Sussex County 2021, 2023

As a result of a 100-year MRP event, Hazus estimates that the Food, Hydration, Shelter lifeline has the greatest chance of sustaining minor damage (1 percent probability), followed by the Energy and Safety and Security lifelines (both at 0.7 percent probability). Food, Hydration, Shelter lifelines also have the greatest chance of moderate damage, at an approximate 0.1 percent probability. Severe damage to lifelines is negligible, and no complete damage is predicted.

As a result of a 500-year MRP event, Hazus estimates that Food, Hydration, Shelter lifelines have the greatest chance of sustaining minor damage (5.6 percent) and moderate damage (0.9 percent). Severe damage to all lifelines is negligible, with the greatest chance for Hazardous Materials lifelines (0.2 percent probability). Similarly, complete damage is negligible, with potential only for Hazardous Materials lifelines (<0.1 percent).

13.2.4 Economy

Damage to structures from hurricane flooding and wind can have long-lasting impacts on the economy. When a business is closed during storm recovery, there is lost economic activity in the form of day-to-day business and wages to employees. Economic impacts include loss of business function (e.g., tourism, recreation), damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. During Hurricane Sandy, the State of New Jersey, including Sussex County, lost millions of dollars in wages and economic activity.

Long-term impacts on transportation lifelines affect day-to-day commuting and goods transport. Utility infrastructure (power lines, gas lines, electrical systems) damage can result in the loss of power, which can impact business operations.

Debris management can be costly and impact the local economy. Hazus estimates the amount of debris that might be produced as result of the 100- and 500-year MRP wind events. Table 13-12 summarizes the estimated debris by municipality. Because the estimated debris production does not include debris generated by flooding, this is likely a conservative estimate. For both MRP events, debris production from trees is the greatest, with the 100-year MRP creating an estimated 4,230 tons of debris, and the 500-year MRP event creating 169,744 tons.

13.2.5 Natural, Historic and Cultural Resources

Natural

The impacts of hurricane related winds on the environment typically take place over a larger 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. Hurricanes can also destroy terrestrial species habitats and the aquatic species that relied on a waterbody, such as the Delaware River, for a habitat.

Historic

Winds associated with hurricanes can cause damage or destruction to the County’s historical infrastructure. Many historical buildings may not be built to withstand high winds. Historic buildings also face structural damage during flood events caused by the rains from a hurricane. Historic resources and structures were often built close to waterways, increasing their flood risk. Hurricane-induced flooding could bring devastating loss of life and property to the area in and around historical landmarks.

Table 13-12. Debris Production for 100- and 500-Year Mean Return Period Event Winds

	Brick and Wood (tons)		Concrete and Steel (tons)		Tree (tons)		Eligible Tree Volume (cubic yards)	
	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Andover (B)	11	60	0	0	64	763	178	2,136
Andover (Twp)	103	527	0	0	234	6,504	656	13,782
Branchville (B)	18	81	0	0	0	1,248	0	1,872
Byram (Twp)	88	513	0	0	724	8,952	1,713	21,083
Frankford (Twp)	97	483	0	0	0	8,550	0	15,611
Franklin (B)	66	516	0	0	0	1,475	0	7,931
Fredon (Twp)	41	182	0	0	0	3,435	0	4,810
Green (Twp)	52	230	0	0	0	4,167	0	6,251
Hamburg (B)	52	435	0	0	0	336	0	2,958
Hampton (Twp)	55	286	0	0	0	7,528	0	12,305
Hardyston (Twp)	115	862	0	0	770	14,012	1,232	23,157
Hopatcong (B)	154	1,077	0	0	223	4,388	380	18,264
Lafayette (Twp)	73	365	0	0	0	5,169	0	6,203
Montague (Twp)	15	138	0	0	0	14,909	0	11,927
Newton (T)	123	554	0	0	0	649	0	4,677
Ogdensburg (B)	25	215	0	0	0	862	0	4,568
Sandyston (Twp)	11	76	0	0	0	12,437	0	9,950
Sparta (Twp)	272	1,878	0	0	549	14,999	1,189	41,526
Stanhope (B)	42	254	0	0	0	602	0	4,456
Stillwater (Twp)	11	126	0	0	0	4,514	0	7,223
Sussex (B)	56	326	0	0	0	120	0	1,029
Vernon (Twp)	237	2,353	0	0	1,666	33,630	3,083	67,509
Walpack (Twp)	0	3	0	0	0	416	0	333
Wantage (Twp)	185	1,138	0	0	0	20,079	0	24,648
Sussex County (Total)	**1,902**	**12,678**	**0**	**0**	**4,230**	**169,744**	**8,431**	**314,209**

Source: Hazus v6.0; Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic

Cultural

Winds associated with hurricanes can cause damage or destruction to the County's cultural resources. Cultural resources may be located inside historical buildings, which may not be built to withstand high winds. Outdoor events are likely to be postponed or cancelled as the result of hurricane conditions.

13.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

Overall, the County's vulnerability to the earthquake hazard has not changed, and the entire County will continue to be vulnerable to this hazard. Any change in vulnerability since the previous HMP would be attributed to changes in population density and new development. The risk assessment for hurricane winds was performed in Hazus v6 for Sussex County and was based on the most current and best available data, including building and critical facility inventories. The building inventory was updated using RSMeans 2022 values, which are more current and reflect replacement cost rather than the building stock improvement values reported in the 2021 HMP. Further, the 2021 5-year population estimates from the American Community Survey were used to evaluate the population exposed to the hazard areas.

13.4 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.

13.4.1 Potential or Planned Development

As discussed in Chapter 3, areas targeted for future growth have been identified across the County. It is anticipated that any new development will be exposed to the hurricane hazard. However, due to increased standards and codes, new development might be less vulnerable to wind and flood-related hazards compared to the aging building stock.

13.4.2 Projected Changes in Population

Changes in the density of population can impact the number of persons exposed to the hurricane 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).

13.4.3 Climate Change

Since the 1970s, there has been a global increase in tropical cyclone intensity and duration, correlated with increased sea surface temperature. This suggests that future increases of tropical sea surface temperature might lead to future increases in tropical cyclone intensity and duration. However, there is a high level of uncertainty regarding the relationship between climate change and storm events (Emanuel, Kerry 2005). Future improvements in modeling smaller scale climatic processes can be expected and will lead to improved understanding of how the changing climate will alter temperature, precipitation, and storm events in New Jersey. It remains to be seen if factors such as steering currents (the winds directing or pushing the storm), atmospheric shear (change in direction and speed of winds at increasing heights), and the presence of Saharan dust (the dust suppresses cloud formation by inhibiting convection) will increase or decrease the risk of hurricanes (NJDEP 2020).

14. INFESTATION

14.1 HAZARD PROFILE

14.1.1 Hazard Description

For the purpose of this HMP, an infestation is defined as a state of being overrun by any organism (insect, mammal, bird, parasite/pathogen, fungus, non-native species) that is a threat to other living species in its environment. Infestations can destroy natural habitats and cropland, impact human health, and cause disease and death among native plants, wildlife, and livestock. They result when pest organisms occupy affected areas in quantities large enough to be harmful, threatening, or obnoxious to native plants, animals, and humans. Pests compete for natural resources, and they may transmit diseases to humans, crops, and livestock.

The infestation hazard profile for this HMP focuses on the seven pests described in the sections below, which have had historical presence in Sussex County. For more information on human health impacts caused by infestations, refer to Chapter 7 (Disease Outbreak).

Hemlock Woolly Adelgid

Source: NJDEP 2023

The hemlock woolly adelgid (*Adelges tsugae*) is a tiny insect from Asia that was first discovered in the Pacific Northwest in the 1920s and has since spread across the United States. Its preferred host tree is hemlock, but it may also attack spruce. A tree infested with hemlock woolly adelgid will develop gray-green needles and cotton-like wool tufts under the needles. Frequent inspection of susceptible trees for signs of hemlock woolly adelgid may allow for intervention to prevent the tree from dying (USDA 2005, NJDEP 2023).

Mosquitoes

Mosquito infestations can result in the spread of disease such as West Nile virus, eastern equine encephalitis, and Zika virus. Mosquitos typically lay eggs in or near standing water (CDC 2016). For more information on infectious disease spread by mosquitoes, refer to Chapter 7 (Disease Outbreak).

Emerald Ash Borer

Source: New Jersey Department of

Emerald ash borer (*Agrilus planipennis* or EAB) was first discovered in Somerset County in 2014 and has spread through the northern half of New Jersey. This Asian beetle infests and kills North American ash tree species, including green, white, black, and blue as (NJDEP 2023). The insect is typically present from late May through early September and is most common in June and July. Signs of infection include tree canopy dieback and yellowing and browning of leaves. Most trees die within two to four years of becoming infested. The New Jersey Department of Agriculture (NJDA) is coordinating New Jersey's EAB biocontrol program (New Jersey Department of Agriculture 2016).

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).

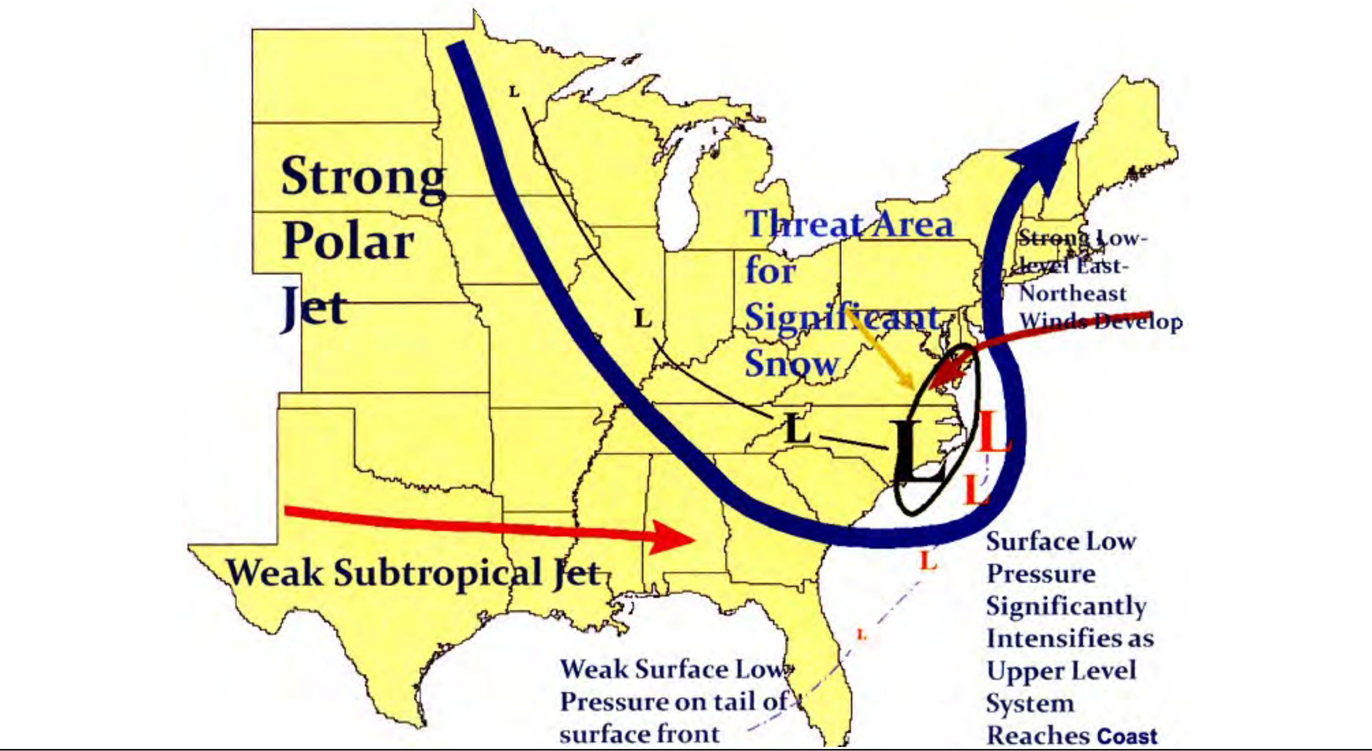
15.1.2 Location

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

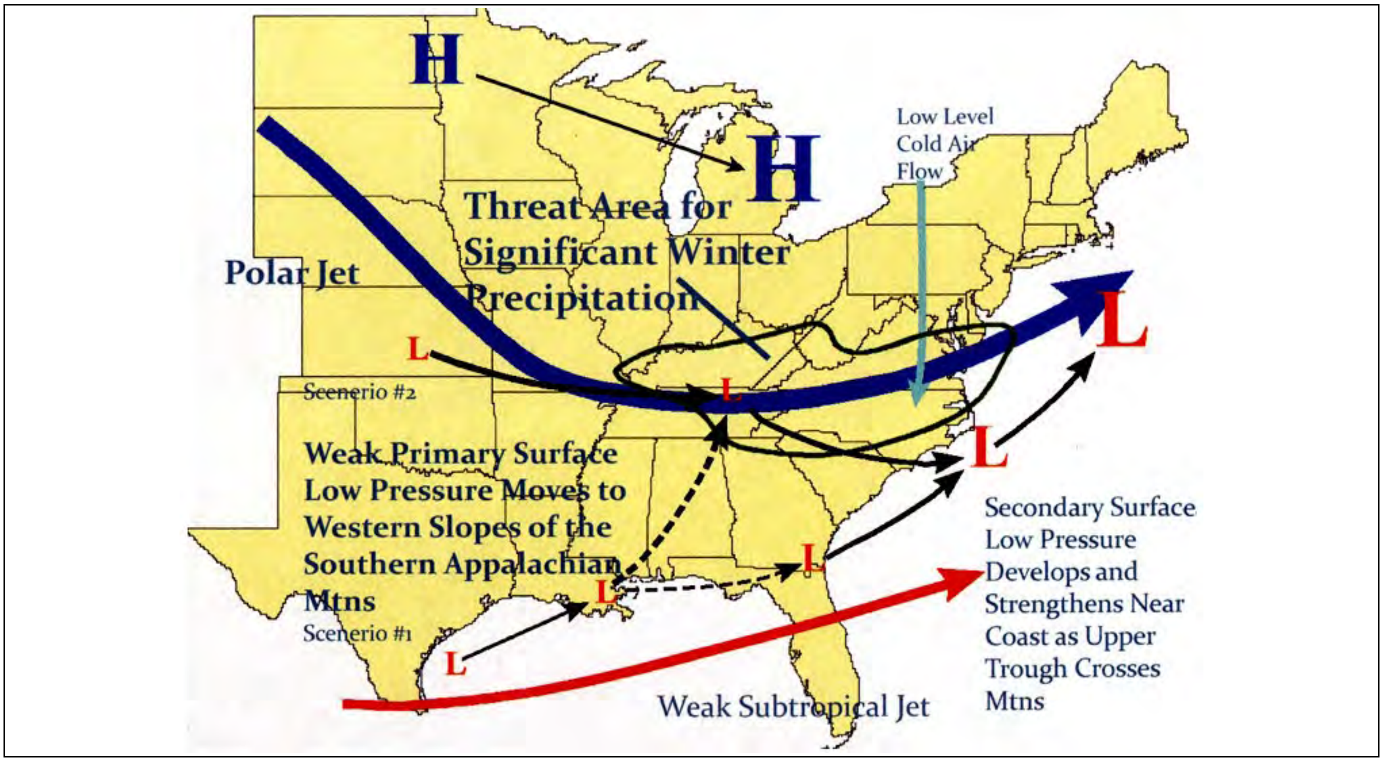
The magnitude of a nor’easter depends on climatological patterns related to wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day, and time of season. Nor’easters are classified into two major categories—Miller Types A and B—which were developed by researcher 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.

Figure 15-1. Nor'easter Miller Classification: Type A



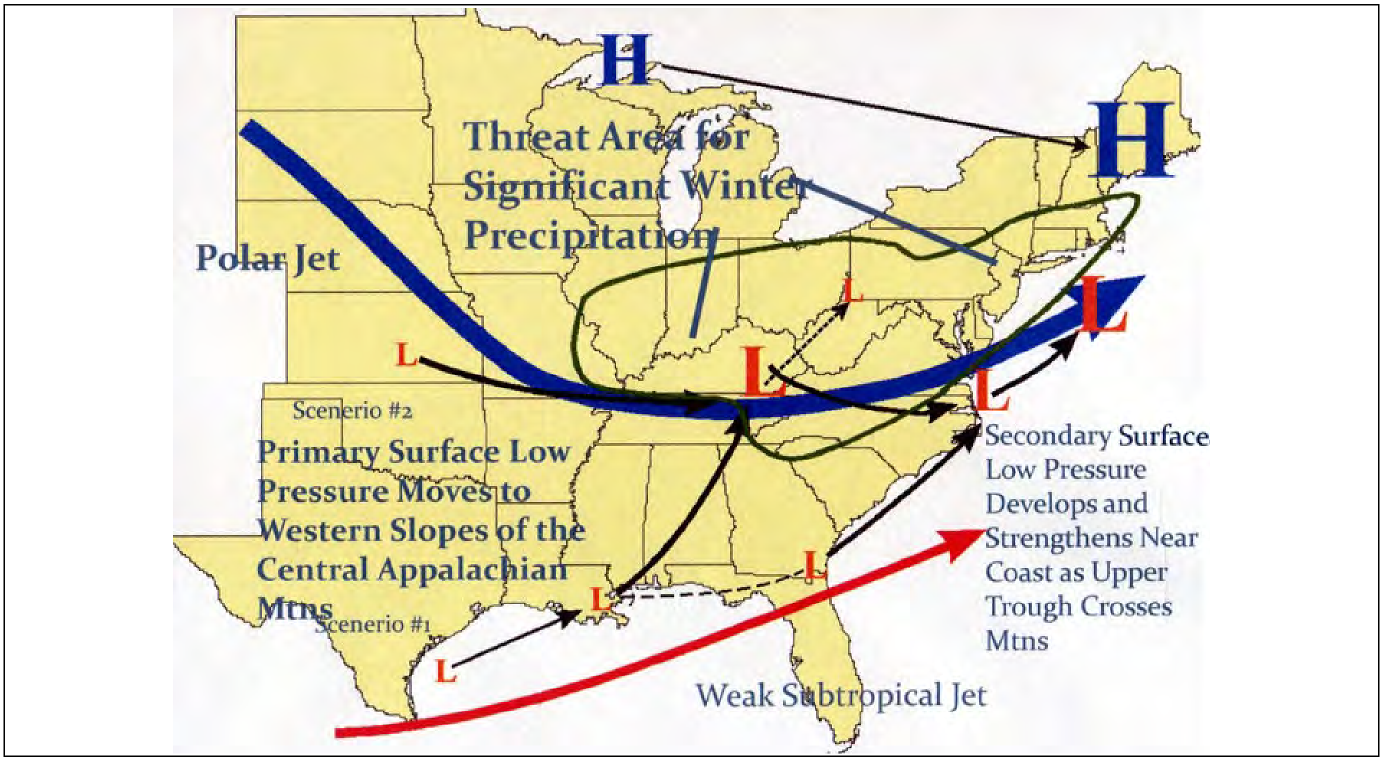
Source: Siebers n.d.

Figure 15-2. Nor'easter Miller Classification: Type B



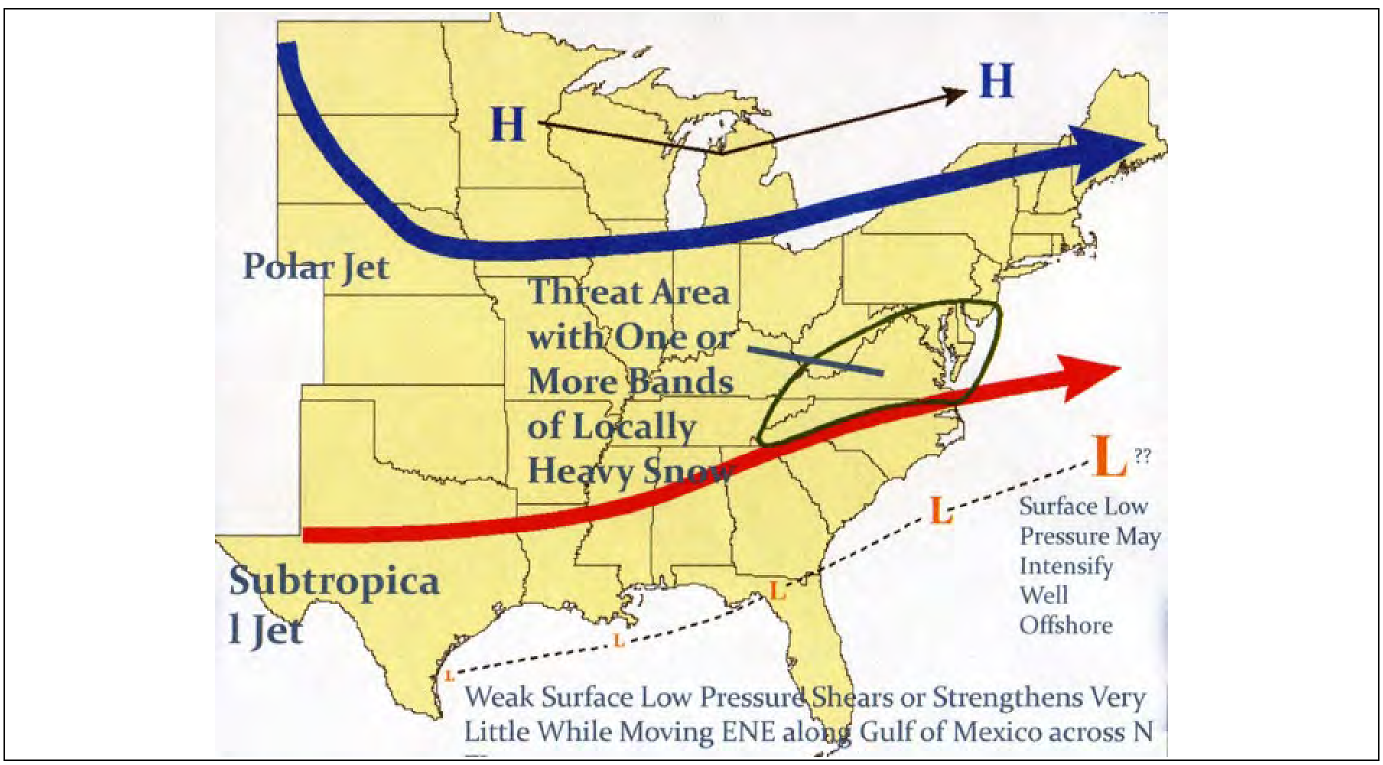
Source: Siebers n.d.

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



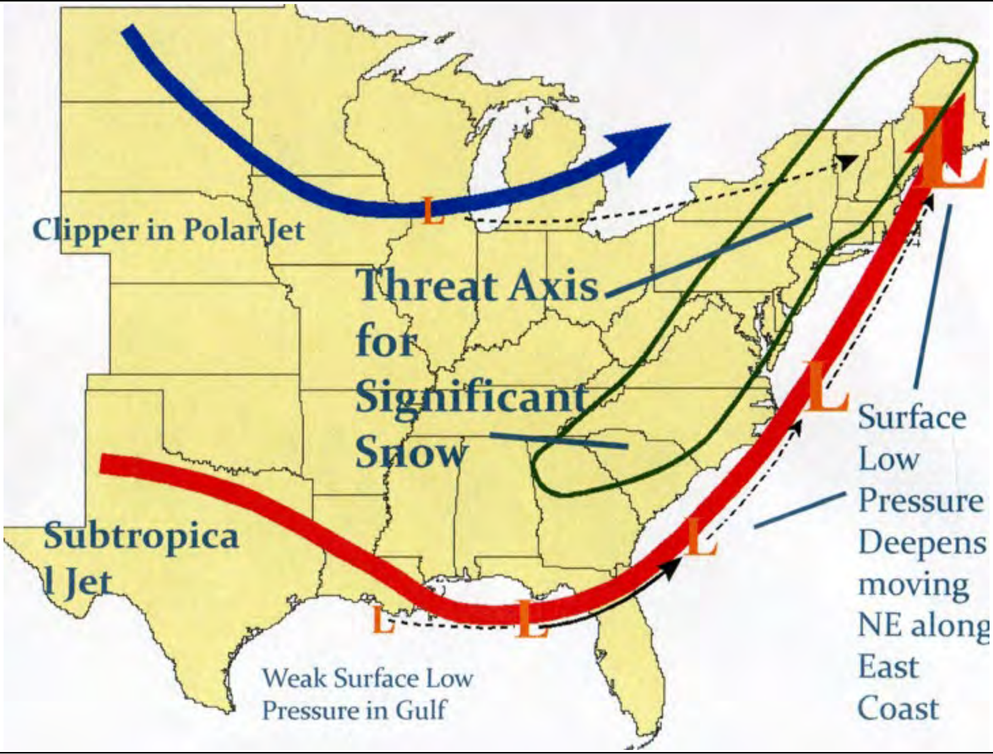
Source: Siebers n.d.

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

16. SEVERE WEATHER

16.1 HAZARD PROFILE

16.1.1 Hazard Description

For this HMP update, the severe weather hazard includes thunderstorms, lightning, hail, high winds, tornadoes, and extreme temperatures, as defined in the following sections.

Thunderstorms

A thunderstorm is a rain shower that features thunder and lightning. Thunderstorms form when warm, moist surface air rises, causing the water vapor in it to cool and condense into clouds. These clouds eventually grow upward into areas with temperatures below freezing. There, the condensed water vapor eventually builds up enough to fall as rain. Typical thunderstorms are 15 miles in diameter and last an average of 30 minutes (National Weather Service 1994).

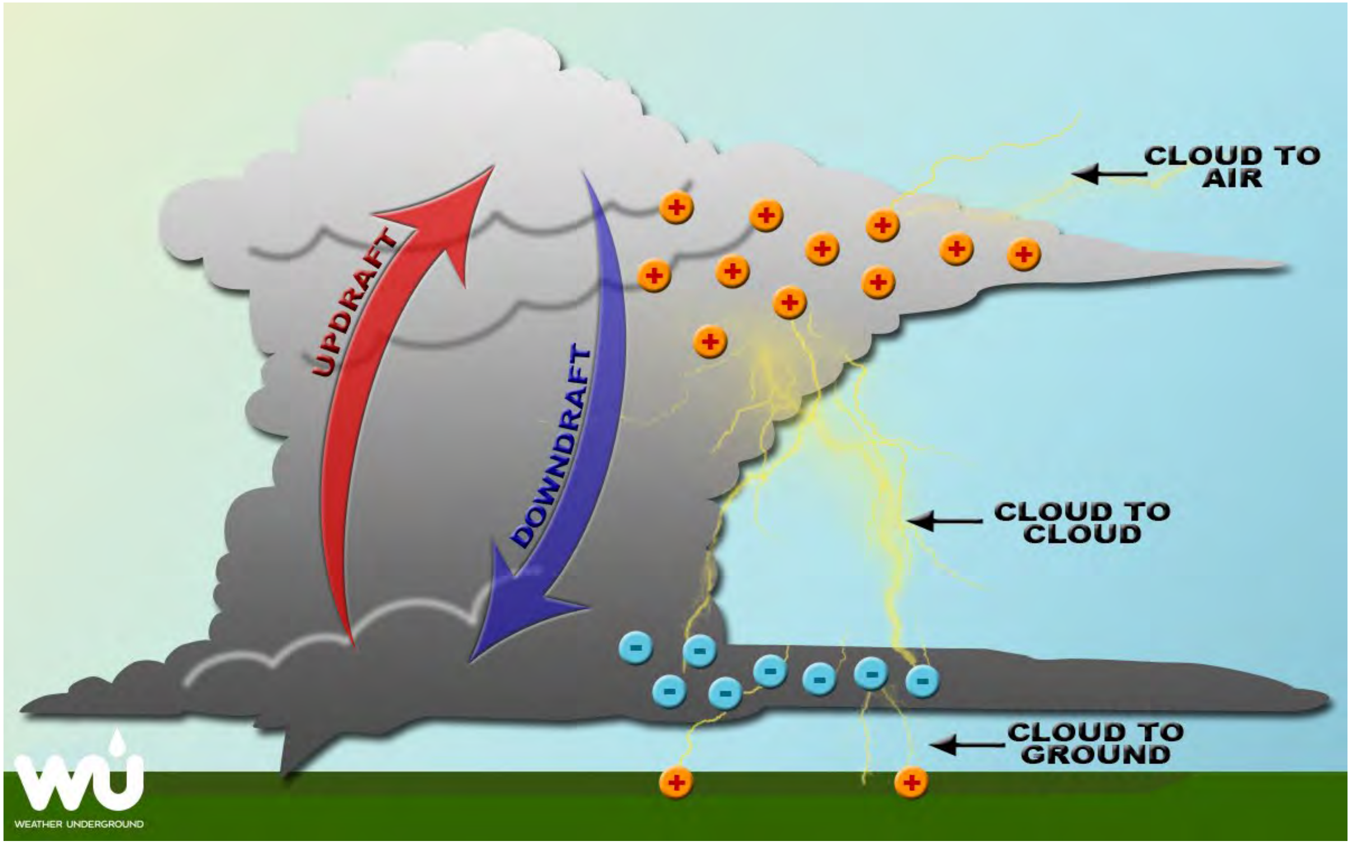
Lightning

Lighting is a bright flash of electrical energy produced by a thunderstorm. Inside the storm, when two water/ice particles collide, they bounce off each other. Many collisions by these particles build up regions of electric charges, causing bolts of lightning (National Oceanic and Atmospheric Administration 2023). The resulting clap of thunder is the result of a shockwave created by the rapid heating and cooling of the air around the electrical discharge. As shown in Figure 16-1, lightning can be produced wherever there are varying electrical charges, whether it be cloud to air, cloud to cloud, or cloud to ground (National Oceanic and Atmospheric Administration 2014, Royal Meteorological Society 2017):

- **Cloud-to-Ground Lightning** is the most common form of lightning. It occurs when a negative charge hits the ground. As the negative charge nears the ground, a positive charge (normally from taller objects in the area, such as a tree, house, or telephone pole) will connect, causing the powerful electric current.
- **Cloud-to-Air Lightning** refers to a discharge that jumps from a cloud into clear air and terminates abruptly.
- There are two forms of **Cloud-to-Cloud Lightning**:
  - **Intercloud lightning** refers to long, horizontal moving flashes often seen on the underside of stratiform clouds.
  - **Intracloud lightning** refers to lightning embedded within a single storm cloud, which jumps between different charge regions in the cloud.

Cloud-to-ground and intra-cloud lightning flashes are detected and mapped in real-time by two networks in the United States: National Lightning Detection Network (NLDN) and the Earth Networks Total Lightning Network. These systems detect radio waves emitted by fast electric currents within a cloud or in a channel to ground (National Oceanic and Atmospheric Administration n.d.)..

Figure 16-1. Types of Lightning



Source: Weather Underground n.d.

Hail

Hail forms inside a storm with strong updrafts of warm air. If a falling water droplet is picked up by the updrafts, it can be carried into higher air with temperatures below the freezing level. There the droplet freezes and begins to fall. At the bottom of the storm, the droplet may begin to thaw but then be picked up by another updraft and carried back into the cold air to re-freeze. With each trip above and below the freezing level, the frozen droplet adds another layer of ice. The frozen droplet, with many layers of ice, eventually falls to the ground as hail when it becomes heavy enough to overcome the strength of the thunderstorm updraft and is pulled to the earth by gravity.

High Winds

Wind is air movement caused by the differences in air pressure that result from uneven heating of the Earth's surface. Wind occurs at all scales, from local breezes lasting a few minutes to global winds resulting from solar heating of the Earth. High winds are often associated with other severe weather events such as thunderstorms, tornadoes, hurricanes, and tropical storms (National Weather Service 2012). The following are common types of high wind events (National Oceanic and Atmospheric Administration 2023).

- **Straight-line wind** refers to any thunderstorm wind that is not associated with rotation; this term is used mainly to differentiate from tornado winds.
- A **microburst** is a small, concentrated downburst that produces an outward burst of strong winds at or near the surface. Microbursts are typically less than 3 miles across and last only 5 to 10 minutes. Their maximum wind speeds sometimes exceed 100 miles per hour (mph). There are two kinds of microbursts:

- A wet microburst is accompanied by heavy precipitation at the surface.
- Dry microbursts occur with little or no precipitation at the ground.

- **Derechos** are widespread, long-lived windstorms that are associated with a band of rapidly moving showers or thunderstorms. A typical derecho consists of numerous microbursts, downbursts, and downburst clusters. A wind event may be classified as a derecho if the wind damage swath extends more than 240 miles and includes wind gusts of at least 58 mph along most of its length.

Tornadoes

A tornado is a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 250 mph. Damage paths can be greater than a mile wide and 50 miles long. Tornadoes typically develop from either a severe thunderstorm or hurricane as cool air rapidly overrides a layer of warm air. Tornadoes typically move at speeds between 30 and 125 mph and can generate combined wind speeds (forward motion plus the speed of the whirling winds) exceeding 300 mph. The lifespan of a tornado rarely is longer than 30 minutes (National Weather Service 2010).

Extreme Temperatures

Extreme Cold

Extreme cold events occur when temperatures drop well below what is normal for an area. For example, near-freezing temperatures are considered extreme cold in regions unaccustomed to winter weather. In regions that are subjected to temperatures below freezing on a more regular basis, extreme cold might be used to describe temperatures below 0 °F. For the purposes of this HMP, extreme cold refers to ambient air temperature of about 0 °F or below (NWS n.d.).

Extreme cold temperatures in New Jersey generally accompany winter storm events. These conditions typically manifest when arctic air masses under high atmospheric pressure move southward from central Canada (Cornell University n.d.).

Extreme Heat

Extreme heat is defined as temperatures that remain 10 °F or more above the normal high temperature of a region for several weeks (Centers for Disease Control and Prevention 2016).

Heat Waves

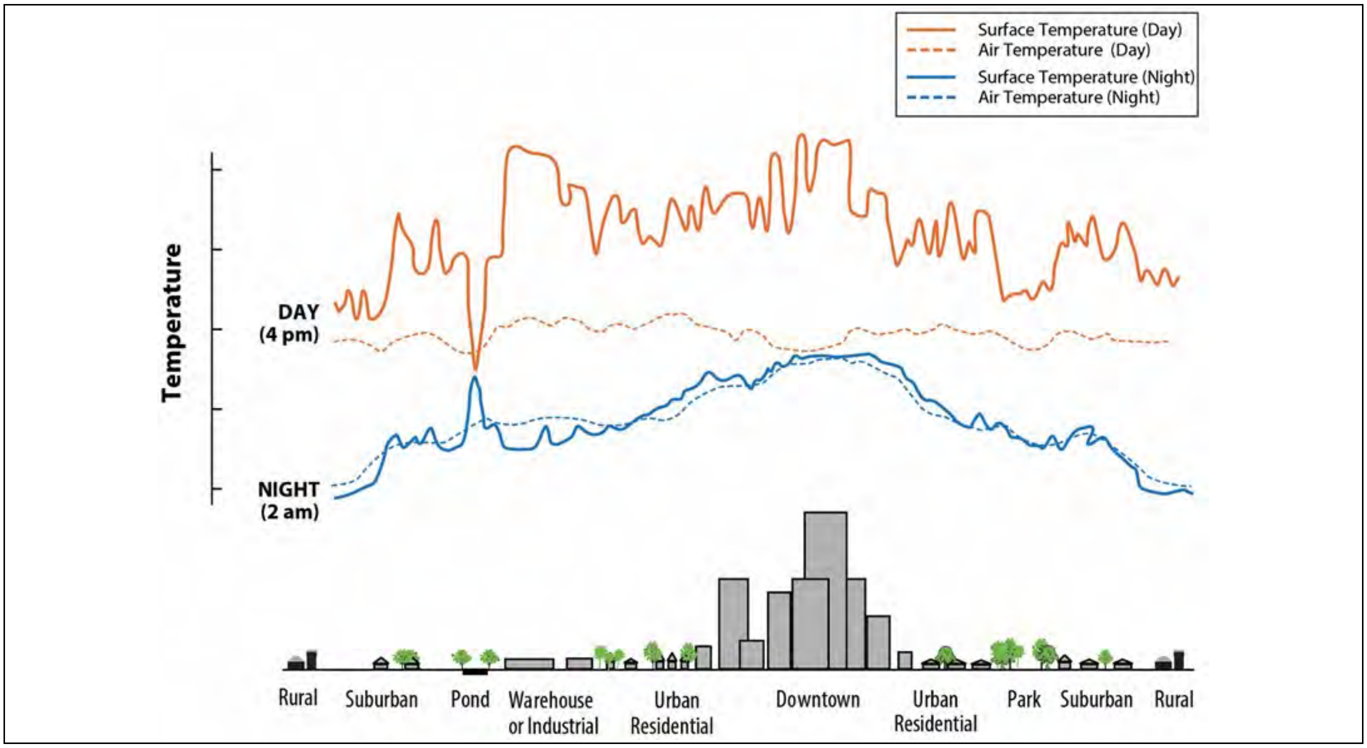
A heat wave is a period of abnormally and uncomfortably hot and unusually humid weather. Humid conditions occur when a dome of high atmospheric pressure traps hazy, damp air near the ground. A heat wave will typically last two or more days (National Oceanic and Atmospheric Administration 2009).

Heat Islands

Urbanized areas face increased risks related to extreme heat. As urban areas develop and change, buildings, roads, and other infrastructure replace open land and vegetation. Surfaces that were once permeable and moist become impermeable and dry, causing urban areas to be warmer than the surrounding areas. This process effectively forms a “heat island” of higher temperatures (United States Environmental Protection Agency 2019). Heat islands are areas that are hotter than nearby less developed areas.

Heat islands occur on the surface and in the atmosphere. The annual mean air temperature of a city with more than one million people can be between 1.8 ºF and 5.4 ºF warmer than its surrounding areas. In the evening, the difference in air temperatures can be as high as 22 ºF. On a hot, sunny day, the sun can heat dry, exposed urban surfaces to temperatures 50 ºF to 90 ºF hotter than the air. As shown in Figure 16-2, surface temperatures vary more than atmospheric air temperatures during the day, but they are generally similar at night. The dips and spikes in surface temperatures over the pond area in the figure show how water maintains a nearly constant temperature day and night because it does not absorb the sun's energy the same way as buildings and paved surfaces. Parks, open land, and bodies of water can absorb more energy, creating areas that feel cooler throughout a city.

Figure 16-2. Urban Heat Island Profile



Source: US EPA 2023

Heat islands can affect communities by increasing peak energy demand during the summer, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and death, and water quality degradation (United States Environmental Protection Agency 2019).

16.1.2 Location

All of Sussex County is exposed to severe weather events (thunderstorms, lightning, hail, high winds, tornadoes, and extreme temperatures).

Thunderstorms

Thunderstorms affect relatively small, localized areas, rather than large regions like winter storms and hurricane events. They tend to take place in spring and summer and during the warmest times of the day (late afternoon and early evening) (National Oceanic and Atmospheric Administration n.d.). It is assumed for this HMP that the thunderstorm risk is the same everywhere in Sussex County.

Lightning

Severe storm events occur throughout the State of New Jersey and are not bound by geographic extent. The likelihood of these events affecting Sussex County depends on storm conditions. Lightning occurs with thunderstorms, so it is most likely during spring and summer, and during the warmest times of the day (National Oceanic and Atmospheric Administration n.d.). Figure 16-3 shows a relatively moderate Lightning Risk Index for Sussex County from FEMA's National Risk Index (FEMA 2019).

Figure 16-3. National Risk Index Lightning Risk

Source: FEMA 2019
Note: Sussex County is outlined in a blue border.

Hail

Hailstorms can form anywhere; however, they are more likely to fall in areas that have the most thunderstorms. Figure 16-4 shows a very low Hail Risk Index for Sussex County from FEMA's National Risk Index (FEMA 2019).

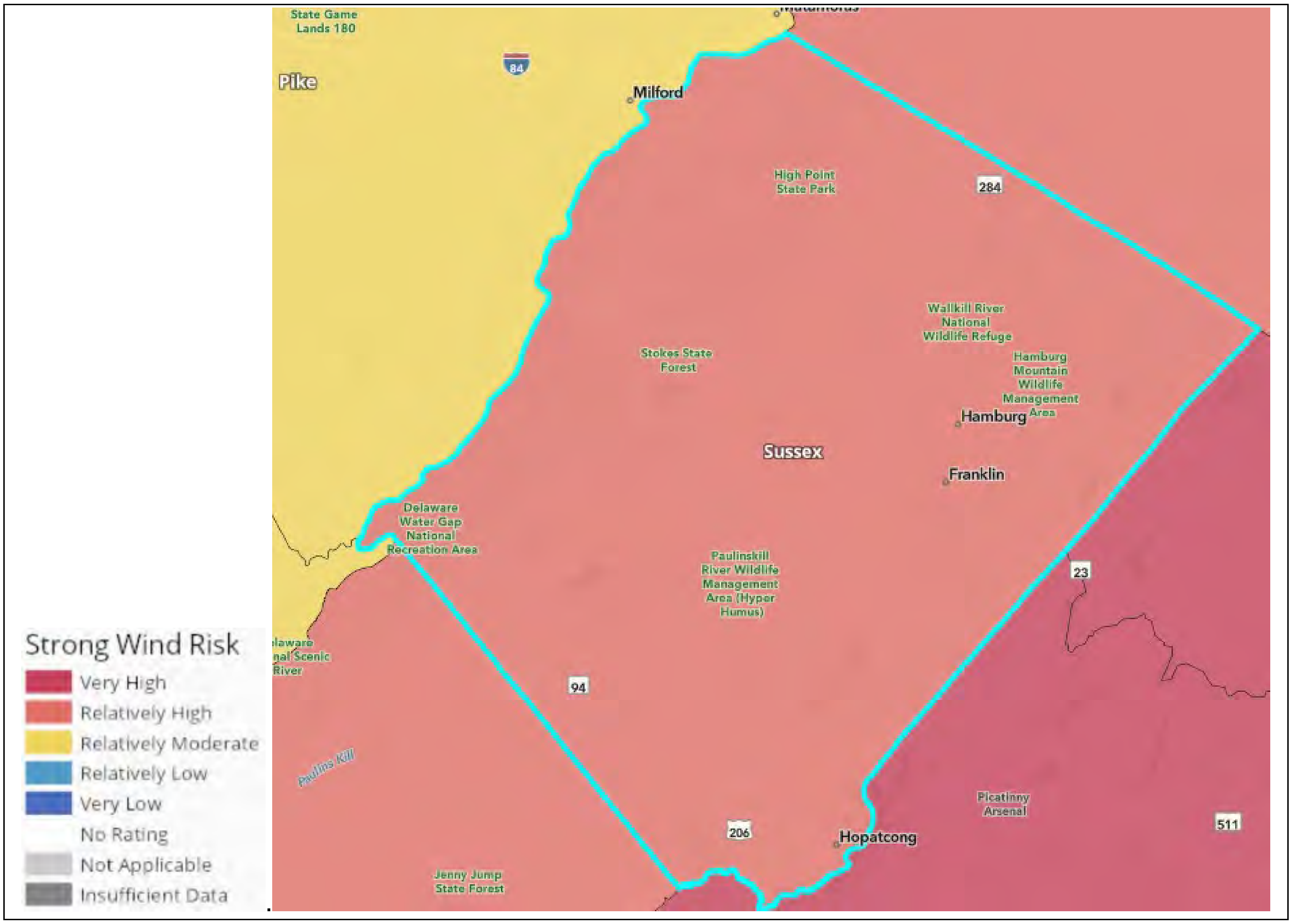
Figure 16-4. National Risk Index Hail Risk

Source: FEMA 2019
Note: Sussex County is outlined in a blue border.

High Winds

All of Sussex County is subject to high winds from severe weather events. Figure 16-5 shows a relatively high Strong Wind Risk Index for Sussex County from FEMA's National Risk Index (FEMA 2019).

Figure 16-5. National Risk Index Strong Wind Risk



Source: FEMA 2019
Note: Sussex County is outlined in a blue border.

Tornadoes

Like thunderstorms, tornadoes do not have any specific geographic boundary and can occur anywhere in Sussex County. Figure 16-6 shows a relatively low Tornado Risk Index for Sussex County from FEMA's National Risk Index (FEMA 2019).

Figure 16-6. National Risk Index Tornado Risk

Source: FEMA 2019
Note: Sussex County is outlined in a blue border.

Extreme Temperatures

Extreme Cold

Being in the northernmost portion of the state, and with small mountains up to 1,800 feet in elevation, Sussex County normally exhibits a colder temperature regime than other New Jersey counties. In winter, average temperatures in the County can be more than 10 °F cooler than in other parts of the state (Rutgers University 2019). Figure 16-7 shows a relatively low Extreme Cold, or Cold Wave, Risk Index for Sussex County from FEMA's National Risk Index (FEMA 2019).

Extreme Heat

Extreme heat events usually cover a large area, such as an entire county. However, there can be spot locations that are somewhat cooler (e.g., a shady park near a stream) or hotter (e.g., urban areas because their built environment holds heat). Figure 16-8 shows a relatively moderate Extreme Heat, or Heat Wave, Risk Index for Sussex County from FEMA's National Risk Index (FEMA 2019).

Figure 16-7. National Risk Index Cold Wave Risk

Source: FEMA 2019
Note: Sussex County is outlined in a blue border.

Figure 16-8. National Risk Index Heat Wave Risk

Source: FEMA 2019
Note: Sussex County is outlined in a blue border.

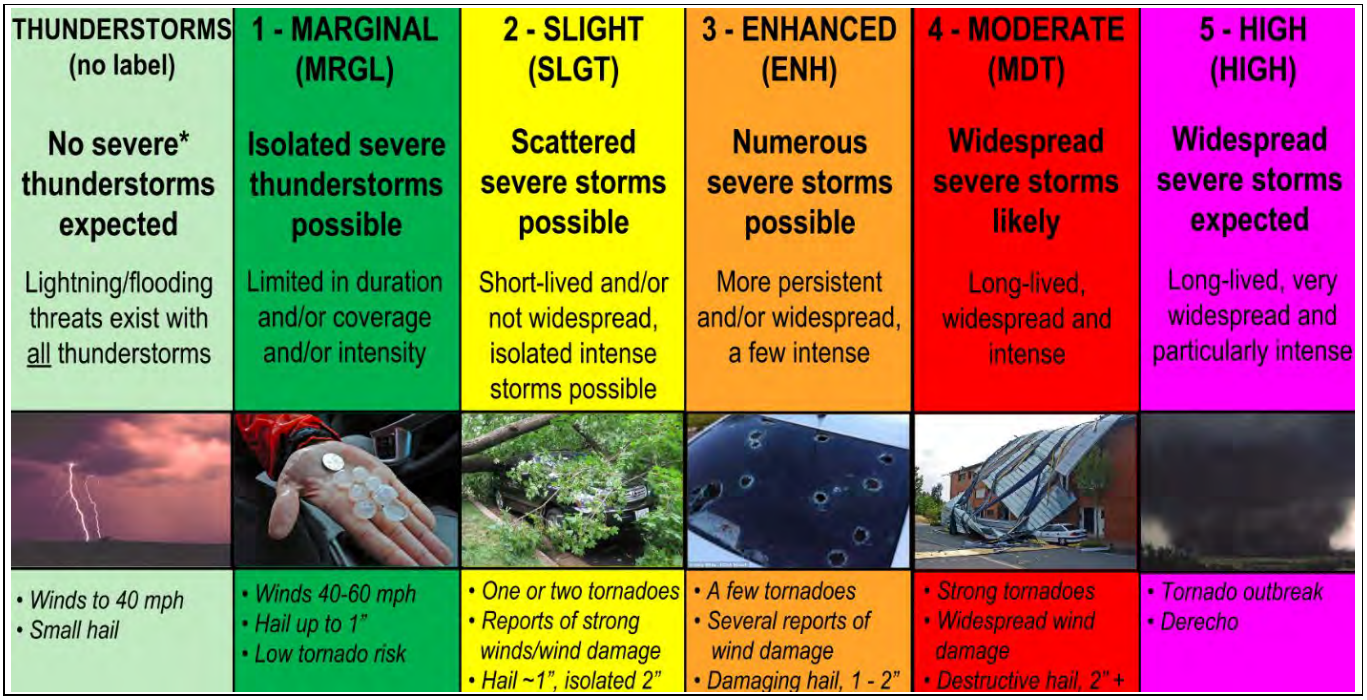
16.1.3 Extent

Thunderstorms

Thunderstorms are a common hazard for Sussex County and pose a wide variety of threats to affected communities, including rain-induced flooding, landslides, strong winds, and lightning. There have been reports of property damage, injury, and, in some cases, death caused by thunderstorms and lightning in the County.

When a thunderstorm features a tornado, wind gusts of 58 mph or more, or hail 1 inch or more in diameter, the National Weather Service (NWS) defines it as a severe thunderstorm. The NWS has five risk categories for severe thunderstorm—marginal, slight, enhanced, moderate, and high—as shown in Figure 16-9.

Figure 16-9. Severe Thunderstorm Risk Categories



Source: National Oceanic and Atmospheric Administration n.d.

The local NWS office and the Storm Prediction Center issue the following severe thunderstorm alerts (National Weather Service 2023):

- **Special Weather Statements** are issued for strong storms that are below severe levels but may have impacts. Usually reserved for the threat of wind gust of 40 to 57 mph or hail of 0.5 inches to 0.99 inches in diameter.
- **Severe Thunderstorm Watches** are issued when severe thunderstorms are possible in and near watch areas.
- **Severe Thunderstorm Warning** indicates a storm is imminent or occurring; it is either detected by weather radar or reported by storm spotters. A warning means to take shelter.

Lightning

Lightning ranks as one of the top weather killers in the United States, killing approximately 50 people and injuring hundreds each year (NWS n.d.). Lightning-based deaths and injuries typically involve heart damage, inflated lungs, or brain damage, as well as loss of consciousness, amnesia, paralysis, and burns, depending on the severity of the strike. Most people struck by lightning survive, although they may have severe burns and internal damage. Over 22,000 fires caused by lightning occurred annually throughout the U.S. between 2007 and 2011, which was valued at approximately $450 million of damages per year (National Fire Protection Association 2013).

Hail

As shown in Table 16-1, the NRI hail risk ranges from very low to relatively low at the census tract scale across Sussex County. The NRI identifies hail risk countywide as very low.

Most hailstorms are made up of a mix of different sizes, and only the very largest hail stones pose serious risk to people caught in the open (National Oceanic and Atmospheric Administration 2021). Large hail can damage aircraft, homes, or cars and can be deadly to livestock and people. Wind-driven hail can tear up siding on houses, break windows and blow into houses, break side windows on cars, and cause severe injury and/or death to people and animals. Hail size is often estimated by comparing the size of a single hailstone to a known object, as shown in Table 16-1.

Table 16-1. Hail Size

Description	Diameter (in inches)	Description	Diameter (in inches)
Pea	0.25	Golf ball	1.75
Marble or Mothball	0.50	Tennis ball	2.5
Penny or Dime	0.75	Baseball	2.75
Nickel	0.88	Tea cup	3.00
Quarter	1.00	Softball	4.00
Ping Pong Ball	1.25	Grapefruit	4.50

Source: National Oceanic and Atmospheric Administration 2023

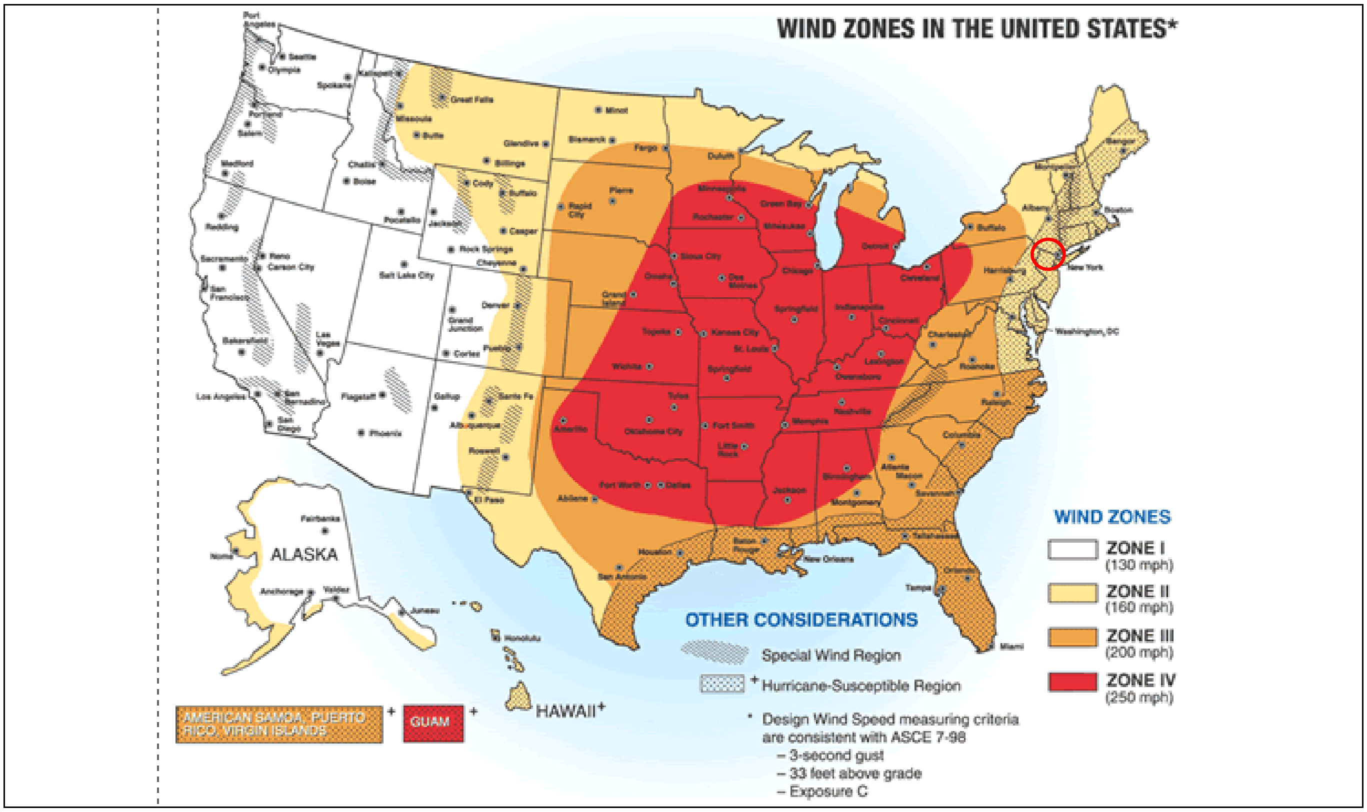
High Wind

As shown in **Error! Reference source not found.**, the NRI strong wind risk ranges from relatively moderate to very high at the census tract scale across Sussex County. The NRI identifies strong wind risk countywide as relatively high.

According to FEMA's "Winds Zones of the United States" map, Sussex County is located in Wind Zone II, where wind speeds can reach up to 160 mph (see Figure 16-10).

Table 16-2 provides the descriptions of winds and their associated sustained wind speed used by the NWS during wind-producing events. The Beaufort wind scale, developed in 1805, is also used today to classify wind conditions, and is provided in Appendix H (Supplementary Data).

Figure 16-10. Wind Zones in the United States



Source: National Institute of Standards and Technology 2011
Note: The red circle indicates the approximate location of Sussex County.

Table 16-2. NWS Wind Descriptions

Descriptive Term	Sustained Wind Speed (mph)
Strong, dangerous, or damaging	≥40
Very windy	30 to 40
Windy	20 to 30
Breezy, brisk, or blustery	15 to 25
None	5 to 15 or 10 to 20
Light or light and variable wind	0 to 5

Source: National Weather Service 2010

In New Jersey, NWS issues high wind alerts as follows when wind speeds may pose a hazard or may be life threatening (National Weather Service 2012):

- **Wind Advisories** are issued when sustained winds of 30 to 39 mph are forecast for one hour or longer, or wind gusts of 46 to 57 mph for any duration.
- **High Wind Watches** are issued when there is the possibility that high wind warning criteria may be met 24 to 48 hours out.
- **High Wind Warnings** are issued when sustained wind speeds of 40 mph or greater lasting for one hour or longer, winds of 58 mph or greater for any duration, or widespread damage are possible.

Tornado

As shown in **Error! Reference source not found.**, the NRI tornado risk ranges from very low to relatively moderate at the census tract scale across Sussex County. The NRI identifies tornado risk countywide as relatively low.

Tornadoes can disrupt daily activities of the public and service industries, causing injuries or damage to critical infrastructure and property. Most of the damage from tornadoes in Sussex County is caused by windblown debris.

The magnitude or severity of a tornado is categorized using the Enhanced Fujita Tornado Intensity Scale (EF Scale). This scale determines tornado ratings by comparing wind speed and actual damage. **Error! Reference source not found.** illustrates the relationship between EF ratings, wind speed, and expected tornado damage.

Figure 16-11. Enhanced Fujita Tornado Intensity Scale Ratings, Wind Speeds, and Expected Damage

EF Rating	Wind Speeds	Expected Damage
EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.

Source: National Weather Service 2015

Tornado watches and warning are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar. The current average lead time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly that little, if any, advance warning is possible (National Oceanic and Atmospheric Administration 2011).

Extreme Temperatures

Extreme Cold

Prolonged exposure to extreme cold temperatures can cause the following dangerous health conditions (Occupational Safety and Health Administration n.d.):

- **Frostbite** is damage to body tissue caused by extreme cold. A wind chill of -20 °F will cause frostbite in roughly 30 minutes. Frostbite can cause a loss of feeling and a white or pale appearance of exposed skin.
- **Hypothermia** is a condition brought on when the body temperature drops to less than 95 °F and is deadly. Warning signs of hypothermia include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness, and exhaustion.

The 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, 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 (National Oceanic and Atmospheric Administration 2023). Figure 16-12 shows WCT based on temperature and wind speed. Three shaded areas of frostbite danger indicate how long a person can be exposed before frostbite develops (National Weather Service 2021).

Figure 16-12. NWS Wind Chill Index

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

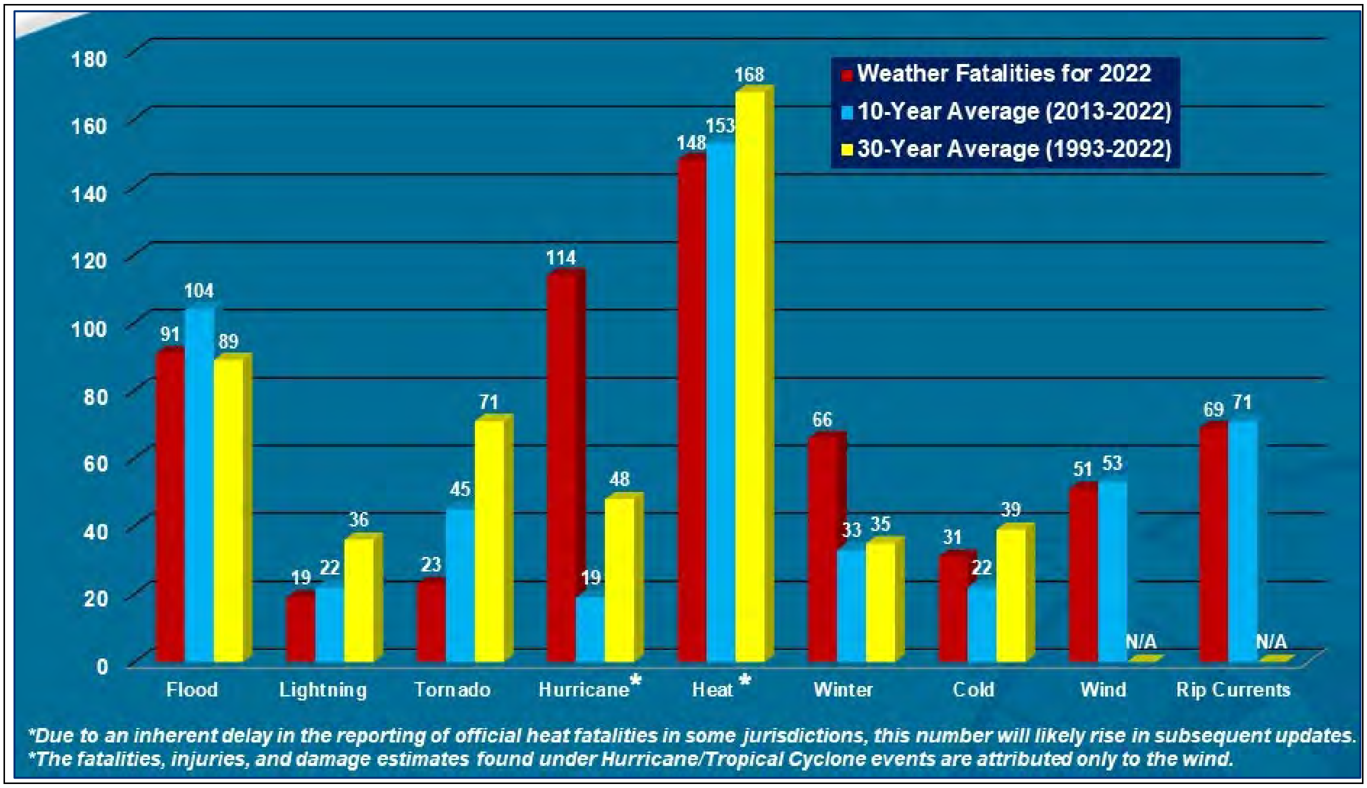
Frostbite Times: 30 minutes; 10 minutes; 5 minutes

Source: National Weather Service 2021

Extreme Heat

Extreme heat is the number one weather-related cause of death in the U.S. On average, about 150 people die each year in the United States from excessive heat (National Weather Service n.d.). In 2022, 148 people died from heat related illnesses as shown in **Error! Reference source not found.**.

Figure 16-13. Weather Related Fatalities in the United States in 2022



Source: National Weather Service n.d.

The following health hazards are related to extreme heat temperatures (FEMA 2024):

- **Heat exhaustion** is the body's response to an excessive loss of water and salt, usually through excessive sweating. Symptoms can include headache, cramping, dizziness, and weakness.
- **Heat stroke** is the most serious heat-related illness. It occurs when the body can no longer control its temperature: body temperature rises rapidly and the sweating mechanism fails. Body temperature can rise to 106 °F within 10 to 15 minutes. Heat stroke can cause permanent disability or death if the person does not receive emergency treatment.

Workers who are exposed to extreme heat or work in hot environments may be at risk of heat stroke, heat exhaustion, heat cramps, or heat rashes. Workers at greater risk of these conditions include those who are 65 years of age or older, are overweight, have heart disease or high blood pressure, or take medications that may be affected by extreme heat. Heat can also increase the risk of injuries in workers as it may result in sweaty palms, fogged-up safety glasses, and dizziness. Burns may occur as a result of accidental contact with hot surfaces (Centers for Disease Control and Prevention 2020, Centers for Disease Control and Prevention 2018).

The NWS heat index, shown in Figure 16-13, indicates apparent temperature of the air as it increases with relative humidity in shady, light wind conditions. This index provides a measure of how temperatures feel. Figure 16-14 denotes the effects of prolonged exposure to heat on the human body.

Figure 16-14. NWS 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										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Source: National Weather Service 2023

Table 16-3. Adverse Effects of Prolonged Exposure to Heat

Category	Heat Index	Effects on the Body
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity
Extreme Caution	90 °F – 103 °F	Heat stroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity
Danger	103 °F – 124 °F	Heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity
Extreme Danger	125 °F or higher	Heat stroke highly likely

Source: National Weather Service 2023

Extreme Temperature Alerts

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

The NWS issues the following freeze/cold alerts depending on the severity of the wind chill and the time of the year (National Weather Service 2021):

- **A Wind Chill Advisory** is issued when seasonably cold wind chill values, but not extremely cold values are expected or occurring.
- **A Wind Chill Watch** is issued when dangerously cold wind chill values are possible.

- **A Wind Chill Warning** is issued when dangerously cold wind chill values are expected or occurring.
- **A Frost Advisory** indicates that areas of frost are expected or occurring and are posing a threat to sensitive vegetation.
- **A Freeze Watch** is issued when there is a potential for significant, widespread freezing temperatures within the following 24 to 36 hours.
- **A Freeze Warning** is typically issued when temperatures are forecasted to go below 32 °F for a long period of time.
- **A Hard Freeze Warning** is issued when temperatures are expected to drop below 28 °F, which typically kills most commercial crops and residential plants.

The NWS issues the following heat alerts depending on the severity of the heat index (National Weather Service 2020):

- An **Excessive Heat Outlook** is issued when potential exists for an excessive heat event within the following three to seven days.
- A **Heat Advisory** is issued within 12 hours of the onset of extremely dangerous heat conditions. This advisory is typically issued when the maximum heat index temperature is expected to be 100 °F or higher for at least 2 days, and nighttime air temperatures will not drop below 75 °F.
- An **Excessive Heat Watch** is issued when conditions are favorable for an excessive heat event within the following 24 to 72 hours. This watch is typically issued when risk of a heat wave has increased, but the timing and occurrence is still uncertain.
- An **Excessive Heat Warning** is issued within 12 hours of the onset of extremely dangerous heat conditions. This warning is typically issued when the maximum heat index temperature is expected to be 105 °F or higher for two consecutive days with night temperatures not dropping below 75 °F.

16.1.4 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2024, Sussex County was included in seven major disaster (DR) or emergency (EM) declarations for severe weather-related events, as shown in Table 16-4. None of them occurred since the previous County HMP (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 severe weather-related agricultural disaster declarations.

Previous Events

Known hazard events that impacted Sussex County between January 2020 and June 2024 are listed in Table 16-5. For events prior to 2020, refer to the 2021 Sussex County HMP.

Table 16-4. FEMA Declarations for Severe Weather Events in Sussex County (1954 to 2024)

Event Date	Declaration Date	Declaration Number	Description
August 12 – August 21, 2000	August 17, 2000	DR-1337	Severe Storms, Flooding and Mudslides
September 18 – October 1, 2004	October 1, 2004	DR-1563	Tropical Depression Ivan
April 1-3, 2005	April 19, 2005	DR-1588	Severe Storms and Flooding
June 23 – July 10	July 7, 2006	DR-1653	Severe Storms and Flooding
April 14-20, 2007	April 26, 2007	DR-1694	Severe Storms and Inland and Coastal Flooding
September 28 – October 6, 2011	October 14, 2011	DR-4039	Remnants of Tropical Storm Lee
October 29, 2011	November 30, 2011	DR-4048	Severe Storm

Sources: FEMA 2024

Table 16-5. Severe Weather Events in Sussex County (2020 to 2024)

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
February 7, 2020	N/A	N/A	Sussex County	Winds up to 62 mph occurred in areas of Sussex County.
June 3, 2020	N/A	N/A	Libertyville, Vernon	A derecho produced damaging winds in excess of 60 mph. Frequent cloud to ground lightning and heavy downpours were also reported throughout the area. Reported wind gusts associated with these thunderstorms generally ranged between 45 and 65 mph. Several reports of tree limbs and power lines down near Route 515, Vernon Crossing Road, Route 519, and Neilson Road.
June 19, 2020	N/A	N/A	Sparta	Scattered thunderstorms produced isolated wind damage. Reports of trees and wires down near Underrock Road near Sparta.
June 28, 2020	N/A	N/A	Colesville, Glenwood	Thunderstorms produced strong to severe winds and heavy rain; a few thunderstorms contained large hail. Dime to ping-pong ball sized hail was reported in Montague. Several reports of power lines down and power outages in the Vernon Valley area northwest of Wawayanda State Park.

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
July 3, 2020	N/A	N/A	Glenwood, Independence Corner, McAfee	Severe thunderstorms and heavy rain showers developed. Wires down on McAfee-Glenwood Road and Glenwood Road. Trees and wires were downed near Tall Timbers Road, Valley View Drive, and Hemlock Drive where a tree fell on a trailer; power outages were reported in both areas. A downed tree on NJ-284 southbound cause lane restrictions to be put in place.
July 22, 2020	N/A	N/A	Montague, Colesville	Widespread thunderstorms developed into a squall line that produced numerous reports of wind damage. A large tree was split at a residence on Red Hill Road. Hail up to half dollar size was reported. A tree was downed on Deckerton Turnpike near the intersection with County Route 675. Several reports of downed trees and wires were made in Montague Twp. Downed tree limbs and wires were reported near Lake Marcia. Ping pong ball size hail fell in Montague.
August 18, 2020	N/A	N/A	Montague	A cluster of severe thunderstorms with damaging winds impacted portions of northern New Jersey. Trees and wires were downed on Fox Hollow Road near Montague.
August 25, 2020	N/A	N/A	Colesville, Quarryville, Owens, Vernon	Storms produced wind damage. Several reports were made of downed trees and wires near Mount Salem Road, Moore Road, Glenwood Mount Road, and Ponddeddy Road.
November 15, 2020	N/A	N/A	Hardystonville, Highland Lakes	Storms produced widespread wind gusts of around 60 mph, with a number of reports of downed trees and power lines and localized property damage.
April 28, 2021	N/A	N/A	Sussex, McAfee	Storms produced damaging wind. Some trees were downed in the vicinity of Opsal Lane in Wantage Twp. and of Evergreen Trail in Vernon Twp. Power outages were reported.
June 4, 2021	N/A	N/A	Swartswood	Severe storms caused damaging winds and hail. Trees and wires were downed near West Shore Drive.
June 14, 2021	N/A	N/A	Andover, Franklin	Severe storms caused damaging winds and some hail. Trees and wires were downed near Tranquility Road in Andover. Wires were reported down near Franklin.
June 21, 2021	N/A	N/A	Hainesville, Yellow Frame, Fredon, Halsey, Newton, Beemerville	Severe storms produced damaging winds, with numerous reports of downed trees and power lines. Trees and power lines were downed on Flatbrook Road, Yellow Frame Road, Phil Hardin Road, Newton Swartswood Road, and Wantage Avenue.
July 6, 2021	N/A	N/A	Frankford Plain, Newton, Tranquility, Fredon, South Ogendensburg, Beaver Lake, Highland Lakes	Severe storms produced damaging winds, some hail, and prolific lightning. Multiple trees and wires were downed. Reports of hail up to quarter size were received.

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
July 12, 2021	N/A	N/A	Highland Lakes, Lake Mohawk	Severe storms produced damaging wind. There was a report of a lightning strike to a house. Trees and wires were downed near Springbrook Trail.
July 16, 2021	N/A	N/A	Ownes, Vernon	Thunderstorms produced at least two strong microbursts. Many trees were snapped near Vernon due to what was likely a strong microburst. Power outages were also reported. Wind speeds were estimated to be 70 mph but may have been higher. This storm earlier produced a measured 64 mph wind gust with another microburst.
July 27, 2021	N/A	N/A	Libertyville, Independence Corner, Glenwood	Severe thunderstorms produced damaging wind. Tree limbs were downed onto wires with a fire reported on Armstrong Road. Several tree limbs were downed with lane blockages along Route 517 in Glenwood.
August 12, 2021	N/A	N/A	Five Points	Scattered thunderstorms produced instances of damaging winds. There were multiple reports of trees and wires down.
May 16, 2022	N/A	N/A	Quarryville	Severe storms produced a few instances of damaging winds up to 60 mph and hail.
July 12, 2022	N/A	N/A	Brookwood	A storm produced scattered wind damage along its path. There was a report of a downed tree and utility pole fire in Byram.
July 24, 2022	N/A	N/A	Five Points	Thunderstorms produced isolated wind damage. Tree and wires were blown down on Possum Hill Road.
December 23-24, 2022	N/A	N/A	Sussex County	Temperatures fell into the single digits and teens with wind chills ranging from -5 °F to -20 °F in New Jersey. The lowest wind chills occurred at the higher elevations of Sussex County.
February 3-4, 2023	N/A	N/A	Sussex County	Low temperatures and windy conditions resulted in dangerously low wind chills ranging from -10 °F to -20 °F. Temperatures fell into the lower single digits to just below zero across Sussex County.
March 7, 2023	N/A	N/A	Sussex County	Strong winds developed behind a storm system. A New Jersey Weather station at High Point measured a gust of 67 mph.
April 22, 2023	N/A	N/A	Montague	Showers and thunderstorms produced gusty winds and small to medium sized hail. The average hail size was 0.50 inches, and the largest was 0.75 inches.
June 26, 2023	N/A	N/A	Lafayette, Vernon	Storms moved over the region and multiple trees and wires were downed in Lafayette Township. Additional trees and wires were downed on New Jersey 94 at the intersection with Vernon Crossing Road.
July 13, 2023	N/A	N/A	Vernon	Severe thunderstorms produced damaging wind gusts up to 60 mph and hail up to 1 inch in diameter.
July 14, 2023	N/A	N/A	Brookwood	Severe thunderstorms produced damaging wind gusts up to 60 mph in parts of New Jersey, causing multiple wires to be blown down.

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
July 16, 2023	N/A	N/A	Hopatcong	Slow-moving showers and thunderstorms produced damaging wind gusts across parts of New Jersey. A large tree fell down on Hopatchung Road.
July 25, 2023	N/A	N/A	Hamburg	Thunderstorms produced damaging winds of up to 60 mph across parts of New Jersey. Downed tree on NJ 94 northbound north of NJ 23 in Hardyston Twp.
July 29, 2023	N/A	N/A	Libertyville	Severe storms produced damaging wind gusts. There was a report of multiple 3- to 5-inch tree limbs broken with power lines down at intersection of Libertyville Road and County Route 519 in Wantage.

Source: FEMA 2023; NOAA NCEI 2023

16.1.5 Probability of Future Occurrences

Probability Based on Previous Occurrences

Information on previous severe weather occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 16-6. Probability of Future Severe Weather Events in Sussex County

. Based on historical records and input from the Steering Committee, the probability of occurrence for severe weather in the County is considered “frequent.”

Effect of Climate Change on Future Probability

Projections of climate change for New Jersey predict higher temperatures, more intense rainfall events, and increases in total annual precipitation (see Section 3.3.4) (NJDEP 2020). A warmer atmosphere means storms have the potential to be more intense and occur more often. Most of these events occur in the warmer months between April and October. Extreme cold events might decrease in frequency, while extreme heat events might increase in frequency; the shift in temperatures could result in hotter extreme heat events.

Table 16-6. Probability of Future Severe Weather Events in Sussex County

Hazard Type	Number of Occurrences Between 1996[a] and 2024	Percent Chance of Occurring in Any Given Year
Cold/Wind Chill	32	100
Excessive Heat	8	28.57
Extreme Cold/Wind Chill	3	10.71
Hail	35	100
Heat	43	100
Heavy Rain	48	100
High/Strong Wind	138	100
Lightning	20	71.43
Thunderstorm Wind	152	100

Hazard Type	Number of Occurrences Between 1996[a] and 2024	Percent Chance of Occurring in Any Given Year
Tornado / Funnel Cloud	6	21.42
Total	**485**	**100**

Source: NOAA NCEI 2023

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

16.1.6 Cascading Impacts on Other Hazards

Direct and indirect impacts of severe weather events may induce secondary hazards such as flooding, dust storms, droughts, wildfires, water shortages, power outages, infrastructure deterioration or failure, utility failures, water quality and supply concerns, and transportation issues.

Severe winds can breach power lines and disconnect utility systems. Severe weather may carry extreme rainfall that exacerbates flooding. Fallen trees from severe weather events can contribute to an increase in fuel for wildfires. Fallen vegetation also reduces the soil stability of steep slopes, which can lead to an increased risk of landslides. Extreme heat contributes to the risk of drought conditions. The compounding impacts from extreme heat and drought make areas more susceptible to wildfires, which can be triggered by lightning.

16.2 VULNERABILITY AND IMPACT ASSESSMENT

For the severe weather 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.

16.2.1 Life, Health, and Safety

Overall Population

The entire population of Sussex County (144,221 people) is exposed to severe weather events. Risks are particularly high for people who are outdoors during severe weather events, whether for work or recreation. These people are vulnerable to hailstorms, thunderstorms, and tornadoes because there is little to no warning, and shelter might not be available. Downed trees, damaged buildings, and debris carried by high winds can lead to injury or loss of life. People outdoors may overexert through work or exercise during extreme heat events or experience hypothermia during extreme cold events (CDC 2022, CDC 2005).

Heavy rain, lightning, hail, high winds, and extreme temperatures all can pose a greater threat to employees in the construction industry. Employers should prepare for the hazards associated with adverse weather conditions that may require special facilities and safety equipment being provided to employees who work outdoors, or in some instances, work stoppage to ensure the safety and health of workers (Hazwoper 2020).

Socially Vulnerable Population

Extreme cold can adversely affect susceptible populations, such as those without shelter or a vehicle, or those who live in a home that is poorly insulated or without heat (such as mobile homes) (CDC 2012). According to the Centers for Disease Control and Prevention, populations most at risk to extreme cold and heat events include the following (CDC 2022, CDC 2005):

- The elderly, who are less able to withstand temperature extremes due to their age, health conditions, and limited mobility to access shelters
- Infants and children up to 4 years of age
- Individuals with chronic medical conditions (e.g., heart disease, high blood pressure)
- Low-income persons that cannot afford proper heating and cooling.

Without a quantitative assessment of potential impacts of a severe weather 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 16-7 summarizes highlights of this information. For planning purposes, it is reasonable to assume that percentages and distribution of socially vulnerable populations affected by a severe weather event will be similar to the countywide numbers.

Table 16-7. 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
			Vernon (T)	Walpack (T)	Walpack (T)	Sparta (T)
Population Over 65	**25,451**	**17.65%**	**3,687**	**100.00%**	**7**	**13.38%**
			Sparta (T)	Lafayette (T)	Walpack (T)	Walpack (T)
Population Under 5	**6,500**	**4.51%**	**1,160**	**7.21%**	**0**	**0.00%**
Non-English-			Hopatcong (B)	Hamburg (B)	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack
Speaking Population	**1,922**	**1.33%**	**339**	**10.17%**	**0**	**0.00%**
Population With			Vernon (T)	Franklin (B)	Walpack (T)	Walpack (T)
Disability	**15,697**	**10.88%**	**2,318**	**17.32%**	**0**	**0.00%**
Population Below			Vernon (T)	Sussex (B)	Walpack (T)	Walpack (T)
Poverty Level	**7,320**	**5.08%**	**877**	**18.03%**	**0**	**0.00%**
Households Below			Vernon (T)	Sussex (B0	Branchville (B)	Green (T)
ALICE Threshold	**14,428**	**21%**	1,833	**48%**	90	**14%**

16.2.2 General Building Stock

All buildings are exposed to severe weather hazards such as hailstorms and lightning strikes. 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).

While hailstorms are not frequently known to cause major damage in New Jersey, an extreme event can carry hail stones traveling at speeds greater than 100 miles per hour (National Weather Service 2019). This could cause structural damage for the general building stock in the County. Severe weather that causes lightning could be a threat to the County's general building stock if the lightning starts a fire.

Extreme heat generally does not impact buildings, but increased demand for cooling can cause damage from overheating of heating, ventilation, and air conditioning (HVAC) systems. Extreme cold temperatures can damage buildings through freezing/bursting of pipes and freeze/thaw cycles, as well as increasing vulnerability to home fires.

16.2.3 Community Lifelines and Other Critical Facilities

Critical facilities are at risk of being impacted by high winds associated with structural damage, or falling tree limbs/flying debris, which can result in the loss of power. Loss of power can impact public utilities, including potable water, wastewater treatment, and communications. Emergency personnel such as police, fire, and EMS will not be able to effectively respond in a power loss event to maintain public safety unless backup power and fuel sources are available.

All critical facilities in the County are exposed to the same extreme temperature risks as those discussed for the general building stock. Extreme heat can sometimes cause short periods of utility failures, commonly referred to as brownouts, due to increased usage from air conditioners, appliances, etc. Backup power is recommended for critical facilities and infrastructure. Where backup power is needed for critical facilities that provide essential services, municipalities identified mitigation actions in Volume II of this HMP.

16.2.4 Economy

Severe weather can have short- and long-lasting impacts on the economy. Hailstorms, tornados, high winds, and flooding due to extreme rainfall all have the potential to damage key infrastructure, shopping centers, or transportation hubs, with potentially high public or private costs for repair. When businesses close during storm recovery, there is lost economic activity in the form of day-to-day business and wages to employees. Overall, economic impacts include the loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Impacts on transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting and goods transport) transportation needs. Weather-related loss of power can impact business operations and heating or cooling provision to the population.

Extreme temperature events also have impacts on the economy, including building damage requiring repairs (e.g., pipes bursting), higher than normal utility bills, or business interruption due to power failure (i.e., loss of electricity, telecommunications). Extreme heat and cold events can damage crops. Based on the 2017 Census of Agriculture, Sussex County farms had a total market value of $10.8 million in crop sales and $7.4 million in livestock sales (United States Department of Agriculture 2017).

In 2014, the State of New Jersey established the Energy Resilience Bank (ERB), to address significant energy infrastructure vulnerabilities arising in the aftermath of Superstorm Sandy. Utilizing $200 million through New Jersey’s second Community Development Block Grant-Disaster Recovery (CDBG-DR) allocation, the ERB supports the development of distributed energy resources at critical facilities throughout the state that will enable them to remain operational during future outages.

16.2.5 Natural, Historic and Cultural Resources

Natural

Severe weather that includes heavy rainfall can erode natural banks along waterways and degrade soil stability for terrestrial species. Tornadoes can tear apart habitats, causing fragmentation across ecosystems (United States Environmental Protection Agency 2023). Freezing and warming weather patterns can create changes in natural processes. Extreme heat events can have negative impacts on aquatic systems, contributing to fish kills, aquatic plant die offs, and increased likelihood of harmful algal blooms. Extreme temperature events can also affect surrounding ecosystems, which can destroy food webs and deplete resources in the environment.

Historic

Winds associated with severe weather can cause damage or destruction to the County's historical assets, especially historical buildings not built to modern building code standards to withstand high winds. Historic buildings also may be susceptible to damage from extreme temperatures. Proper strategies help safeguard buildings and their contents. Sudden and dramatic fluctuations in heating or cooling should be minimized. Slower heating and cooling give building materials and stored contents time to acclimate to new temperatures in the building and corresponding new humidity levels (CCAHA 2019).

Extreme heat can increase the risk of ignition and propagation of fires. Under extreme heat, stones can face both macro (e.g., cracking of stones, soot accumulation, color change in stone containing iron) and micro degradation (e.g., mineralogical and textural changes), leading to structural instability. The long-term impacts include weakened stones and increased susceptibility to deterioration processes such as salt weathering and temperature cycling (Sesana, et al. 2021).

Cultural

Outdoor cultural events are likely to be postponed or cancelled as the result of severe weather conditions. Winds associated with severe weather can cause damage or destruction to the County's cultural assets, especially historical buildings not built to modern building code standards to withstand high winds.

16.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

Overall, Sussex County's vulnerability to severe weather has not changed, and the entire County will continue to be exposed and vulnerable to severe weather events. Any perceived or actual changes in vulnerability may be attributed to changes in population numbers and density.

16.4 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.

16.4.1 Potential or Planned Development

The ability of new development to withstand severe weather hazard impacts lies in sound land use practices, building design considerations (e.g., Leadership in Energy and Environmental Design), and consistent enforcement of codes and regulations for new construction. New development will change the landscape where buildings, roads, and other infrastructure potentially replace open land and vegetation. Surfaces that were once permeable and moist will become impermeable and dry, potentially making them more susceptible to fires caused by lightning. These changes also cause urban areas to become warmer than the surrounding areas in the form of heat islands. Green space preservation will need to continue to be a priority to mitigate increased heat islands.

As discussed in Section 3 (County Profile), areas targeted for future growth and development have been identified across the County. All such areas of growth are vulnerable to severe weather. New development sites should adhere to proper building codes to protect against severe weather, such as high wind protection and flood proofing measures.

16.4.2 Projected Changes in Population

Changes in the density of population can impact the number of persons exposed to the severe weather hazard. Densely populated areas of the County may require utility system upgrades to keep up with utility demands (e.g., water, electric) during extreme temperature events to prevent increased stresses on these systems.

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).

16.4.3 Climate Change

Climate change has the potential to alter the prevalence and severity of severe weather events. Most studies project that the State of New Jersey will see an increase in average annual temperatures and precipitation. Annual precipitation amounts in the region are projected to increase, primarily in the form of heavy rainfalls, which have the potential to flood critical transportation corridors and other infrastructure.

With increased temperatures, people could face increased health impacts. Additionally, as temperatures rise, more buildings, facilities, and infrastructure systems may exceed their ability to cope with the heat. Thus, building efficiency and upgrading heating and cooling technology/HVAC will become an increasingly important issue for businesses and homeowners over the coming years.

Researchers are finding that the long-term impacts of more severe weather can be destructive to the natural environment. For example, severe weather that creates longer periods of rainfall can erode natural banks along waterways and degrade soil stability for terrestrial species (United States Environmental Protection Agency 2023). Researchers also believe that a greater number of diseases will spread across ecosystems because of impacts that severe weather and climate change will have on water supplies (United States Climate Resilience Toolkit 2016). Overall, as the physical environment becomes more altered, species will begin to contract or migrate in response, which may cause additional stressors to the entire ecosystem within Sussex County.

Climate change is a potential threat to cultural heritage sites as it may aggravate the physical, chemical, and biological mechanisms causing degradation by affecting the structure or composition of building materials. Changes in temperature, precipitation, atmospheric moisture, and wind intensity, and the interaction between climatic changes and air pollution, have been identified as concerns by the United Nations (Sesana, et al. 2021).

17. SEVERE WINTER WEATHER

17.1 HAZARD PROFILE

17.1.1 Hazard Description

Severe winter weather is any storm system that produces significant snowfall, ice, and/or freezing rain, typically accompanied by high winds. Some severe winter weather events are large enough to immobilize an entire region, while others may only affect a single community. Affected communities experience cold temperatures, flooding, closed or blocked roadways, downed utility lines, and power outages. The aftermath can impact a community or region for days, weeks, or even months, For this HMP, the severe winter weather hazard includes heavy snow, blizzards, and ice storms (sleet and freezing rain).

Heavy Snow

A heavy snowstorm is defined as a snowstorm with accumulations of 4 inches or more of snow in a 6-hour period, or 6 inches or more of snow in a 12-hour period (NWS 2009). The quantity of precipitation varies by elevation; mountainous areas have higher thresholds for defining heavy snowfall.

Snow is precipitation in the form of ice crystals (NSIDC 2023). It originates in clouds when temperatures are below the freezing point (32 °F). There, water vapor from the air condenses directly into ice without going through the liquid stage. Once an ice crystal has formed, it absorbs and freezes additional water vapor from the surrounding air, growing into snow crystals or snow pellets, which then fall to the earth. Snowflakes are clusters of ice crystals that form from a cloud. Snow pellets are opaque ice particles that form when ice crystals fall through super-cooled cloud droplets that are below freezing but remain a liquid. The cloud droplets then freeze to the crystals.

Blizzards

A blizzard is a winter snowstorm with sustained or frequent wind gusts of 35 miles per hour (mph) or more, accompanied by falling or blowing snow reducing visibility to or below a quarter mile (NWS n.d.). These conditions must be predominant over a three-hour period. Extremely cold temperatures are often associated with blizzard conditions but are not a formal part of the definition. Associated risks significantly increase when temperatures are below 20 °F. A severe blizzard is categorized as having temperatures near or below 10 °F, winds exceeding 45 mph, and visibility reduced by snow to near zero.

Storm systems powerful enough to cause blizzards usually form when the jet stream dips far to the south, allowing cold air from the north to clash with warm, moister air from the south. Blizzard conditions often develop on the northwest side of an intense storm system. The difference between the lower pressure in the storm and the higher pressure to the west creates a tight pressure gradient, resulting in strong winds and extreme conditions caused by the blowing snow (NWS n.d.).

Ice Storms

An ice storm consists of damaging accumulations of ice during freezing rain situations. Significant accumulations of ice pull down trees and utility lines, resulting in loss of power and communications. These accumulations of ice make walking and driving extremely dangerous. Significant ice accumulations are usually 0.25 inches or greater (National Weather Service 2009). Ice storms can consist of precipitation in the following forms:

- **Sleet** is made up of drops of rain that freeze into ice as they fall. They are usually smaller than 0.30 inch in diameter (NSIDC 2013). A sleet storm involves significant accumulations of solid pellets, which form from the freezing of raindrops or partially melted snowflakes, causing slippery surfaces that pose a hazard to pedestrians and motorists (NWS 2009).
- **Freezing Rain** occurs when rain falls into areas that are below freezing and turns to ice on the ground and other surfaces. For this to occur, ground-level temperatures must be colder than temperatures aloft. Freezing rain can also occur when the air temperature is slightly above freezing but the surface that the rain lands upon is still below freezing from prior cold air temperatures (NWS 2009).

17.1.2 Location

Heavy Snow

The trajectory of a snow storm's center determines the intensity and the duration of snowfall over the state. The southeastern third of Sussex County receives slightly less snowfall than the rest of the County, most likely due to the coastal influences moderating temperatures slightly. Snow may fall from about October 15 to April 30 in the Northern Highlands counties, which includes Sussex (Rutgers University 2021).

Blizzards

A blizzard's trajectory—whether it passes close to the New Jersey coast or at a distance—largely determines which portion of the County receives the heaviest amount of snow. Severe winter weather events tend to have the heaviest snowfall within a 150-mile-wide swath to the northwest of what are generally southwest to northeast moving storms.

Ice Storms

All regions of New Jersey are subject to ice storms. The distribution of ice storms often coincides with general distribution of snow within several zones in the state. As a coastal storm moves northeastward offshore, a cold rain may be falling over the southern portion of the state, freezing rain over the central region, and snow over the northern counties. A locality's distance from the passing storm center is often the crucial factor in determining the temperature and type of precipitation during severe winter weather (Changnon and Karl 2003).

17.1.3 Extent

The magnitude or severity of severe winter weather depends on snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day, and time of season. In Sussex County the average yearly snowfall is between 40 and 50 inches, with significant variation from year to year. February is the month when maximum accumulations on the ground are usually reached.

NOAA's National Climatic Data Center (NCDC) produces the Regional Snowfall Index (RSI) for significant snowstorms across the eastern two-thirds of the United States. The RSI ranks snowstorm impacts on a scale from Category 1 to 5, as listed in Table 17-1. RSI is based on the spatial extent of the storm, the amount of snowfall, and the affected population. The NCDC has analyzed and assigned RSI values to over 500 storms since 1900 (NOAA NCEI 2023).

Table 17-1. RSI Ranking Categories

Category	Description	RSI Value
1	Notable	1-3
2	Significant	3-6
3	Major	6-10
4	Crippling	10-18
5	Extreme	18.0+

Source: NOAA-NCEI 2023

Sleet accumulation is measured and tracked in a method similar to snow. Ice accumulation is determined by taking the average from the thickest and thinnest portions of ice on a sample used for measurement. Ice does not coat the surface of objects evenly, as gravity typically forces rainwater to the underside of an object before it freezes. Wind can also force rainwater downward prior to freezing, resulting in a thicker coating of ice on one side of the object than the other side (NWS n.d.).

The NWS operates a widespread network of observing systems that feed into computer models to forecast weather for the upcoming hours and days. NWS meteorologists analyze the model output and disseminate forecasts (NWS n.d.). The NWS issues alerts to help people anticipate approaching storms:

- A ***winter storm watch*** is issued when severe winter conditions (heavy snow, ice, etc.) may affect a certain area, but its occurrence, location, and timing are uncertain. A watch is issued to provide 24 to 72 hours of notice of the possibility of severe winter weather.
- A ***winter storm warning*** is issued when hazardous winter weather, in the form of heavy snow, heavy freezing rain, or heavy sleet, is imminent or occurring. A warning is usually issued 12 to 24 hours before the event is expected to begin.
- A ***winter weather advisory*** is issued when a hazardous winter weather event is occurring, is imminent, or has a greater than 80 percent chance of occurrence. Advisories are used to inform people that winter weather conditions are expected to cause significant inconveniences and that conditions may be hazardous. These conditions may refer to sleet, freezing rain, or ice storms, in addition to snow events (NWS n.d.).
- NWS may issue a ***blizzard warning*** when snow and strong winds combine to produce the potential for blinding snow, deep drifts, and wind chill (NWS 2009).

Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Sussex County has been included in four major disaster (DR) or emergency (EM) declarations for severe winter weather-related events (FEMA 2024), as listed in Table 17-2.

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 was not included in any USDA severe winter weather-related agricultural disaster declarations (USDA 2024).

Table 17-2. FEMA Declarations for Severe Winter Weather Events in Sussex County (1954 to 2024)

Event Date	Declaration Date	Declaration Number	Description
March 13-17, 1993	March 17, 1993	EM-3106	Severe Blizzard
January 7-12, 1996	January 13, 1996	DR-1088	Blizzard of 96 (Severe Snowstorm)
February 16-17, 2003	March 20, 2003	EM-3181	Snow
January 31 – February 2, 2021	April 28, 2021	DR-4597	Severe Winter Storm and Snowstorm

Sources: FEMA 2024

Previous Events

Known hazard events that impacted Sussex County between January 2020 and June 2024 are listed in Table 17-3. For events prior to 2020, refer to the 2021 Sussex County HMP.

Table 17-3. Severe Winter Weather Events in Sussex County (2020 to 2024)

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
January 18, 2020	N/A	N/A	Sussex County	Up to 3 inches of snow was observed throughout the County with light ice accumulation.
January 25, 2020	N/A	N/A	Sussex County	Light ice accumulation was seen throughout the County, especially in high elevation areas at High Point.
February 6, 2020	N/A	N/A	Sussex County	Freezing rain was seen across the County. Sussex Airport Automated Surface Observing Systems (ASOS) reported 0.03 inches of ice accretion.
December 16, 2020	N/A	N/A	Sussex County	Heavy snow was seen across the County ranging from 8 to 12 inches. 12.3 inches of snowfall was recorded at COOP side in Highland Lakes.
January 1, 2021	N/A	N/A	Sussex County	Sleet and freezing rain were observed throughout the County. Sussex Airport ASOS reported 0.10 inches of ice accretion.
January 26, 2021	N/A	N/A	Sussex County	Light snow and freezing rain were observed throughout the County. Sussex Airport ASOS reported 0.01 inches of ice accretion and up to 1.5 inches of snow.
January 31, 2021	N/A	N/A	Sussex County	Snow was observed throughout the County lasting several days.
February 1, 2021	N/A	N/A	Sussex County	There were several reports of 24 to 32 inches across the County during this major winter storm event. Total snowfall was over 32 inches in Andover.
February 7, 2021	N/A	N/A	Sussex County	Light snow was seen throughout the County. Heavier snowfall occurred in the southern portion. Up to 3.7 inches of snow was reported in Hopatcong.
February 9, 2021	N/A	N/A	Sussex County	Light snow was seen across the County with up to 4 inches of snowfall throughout. Township of Wantage reported 3.8 inches of snowfall.

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
February 15, 2021	N/A	N/A	Sussex County	Freezing rain occurred throughout the County. Township of Wantage reported 0.38 inches of ice accretion. Sussex Airport ASOS reported 0.34 inches of ice accretion.
February 18, 2021	N/A	N/A	Sussex County	Light snow was observed throughout the County. Andover reported up to 5.6 inches of snowfall.
February 22, 2021	N/A	N/A	Sussex County	Snow fell countywide. Andover reported 4.9 inches of snowfall.
December 21, 2021	N/A	N/A	Sussex County	Freezing rain occurred throughout the County. Township of Wantage reported 0.06 inches of ice accretion. Sussex Airport ASOS reported 0.01 inches of ice accretion.
December 25, 2021	N/A	N/A	Sussex County	Freezing rain was observed throughout the County. Sussex Airport ASOS reported up to 0.03 inches of ice accretion.
December 27, 2021	N/A	N/A	Sussex County	Trace amounts of icing occurred in parts of the County. Data was compiled using radar and surface observations.
January 5, 2022 – January 9 2022	N/A	N/A	Sussex County	Freezing rain occurred over the eastern portion of the County. Up to 4 inches of snowfall was recorded countywide. Stockholm reported the highest snowfall of 4 inches. Sussex Airport ASOS reported 0.03 inches of ice accretion.
January 16, 2022	N/A	N/A	Sussex County	Snow and freezing rain fell across the County. Maximum snowfall was recorded at 7 inches in Township of Wantage. Sussex Airport ASOS reported 0.09 inches of ice.
January 28, 2022	N/A	N/A	Sussex County	Up to 5 inches of snowfall was recorded countywide. Highland Lakes reported up to 7.8 inches of snow.
February 4, 2022	N/A	N/A	Sussex County	Freezing rain was observed countywide. Township of Wantage reported 0.10 inches of ice accretion.
February 13, 2022	N/A	N/A	Sussex County	Up to 4 inches of snowfall was recorded across the County. Andover reported up to 4.4 inches of snowfall.
February 25, 2022	N/A	N/A	Sussex County	Snow and sleet were recorded across the County. A total of up to 2.5 inches of snowfall and freezing rain were observed.
March 9, 2022	N/A	N/A	Sussex County	Up to 4 inches of snowfall was seen countywide. High Point received up to 4.3 inches.
March 12, 2022	N/A	N/A	Sussex County	A range of 3 to 6 inches of snowfall was recorded across the County. High Point received up to 5.3 inches. Wind gusts were measured over 60 mph near High Point and resulted in several power outages.
March 23, 2022	N/A	N/A	Sussex County	Icing was observed in high elevations on the northern portion of the County. Up to 0.30 inches of ice accretion was seen in High Point.
November 15, 2022	N/A	N/A	Sussex County	Light snow, sleet, and freezing rain was observed countywide.

Event Date	FEMA Declaration or State Proclamation Number	Sussex County included in declaration?	Location Impacted	Description
December 11, 2022	N/A	N/A	Sussex County	Countywide coating of up to 3 inches of snowfall was observed. Township of Montague reported up to 3.8 inches of snow.
December 15, 2022	N/A	N/A	Sussex County	Up to 7 inches of snowfall was recorded in higher elevations of the County. High Point reported up to 7.2 inches. Sleet and freezing rain also occurred countywide.
December 23, 2022	N/A	N/A	Sussex County	Wind chill ranging from -10 to -20 °F was observed in the area. The lowest wind chills were recorded at the higher elevations of Sussex County.
January 23, 2023	N/A	N/A	Sussex County	Up to 3 inches of snowfall was recorded at lower elevations of the County. Higher elevations saw up to 4 inches. Stockholm reported up to 4.5 inches of snowfall.
January 25, 2023	N/A	N/A	Sussex County	Township of Sparta reported up to 1.2 inches of snowfall in a 4-mile radius.
February 3, 2023	N/A	N/A	Sussex County	Temperatures dropped to below zero across Sussex County. The combined wind conditions also resulted in dangerous wind chills ranging from -10 to -15 °F.
February 27, 2023	N/A	N/A	Sussex County	Total snow accumulations ranged from 4 to 6 inches across the County. The highest reported snow accumulation was seen in Highland Lakes and Township of Vernon at 6.9 inches. Light freezing rain and sleet was also observed.
March 7–14, 2023	N/A	N/A	Sussex County	Southern portion of the County received up to 4 inches of snowfall. Township of Sparta recorded up to 4.5 inches. High Point reported up to 7.8 inches in the start of the winter storm. By the end of the winter storm event High Point had received up to 9.3 inches of snow accumulation.

Source: NOAA NCEI 2024; FEMA 2024

17.1.4 Probability of Future Occurrences

Probability Based on Previous Occurrences

Information on previous severe winter weather occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 17-4. Based on historical records and input from the Steering Committee, the probability of occurrence for severe winter weather in the County is considered “frequent.”

Table 17-4. Probability of Future Severe Winter Weather Events in Sussex County

Hazard Type	Number of Occurrences Between 1996[a] and 2024	Percent Chance of Occurring in Any Given Year
Freezing Fog	3	10.34%
Frost Freeze	2	6.90%
Heavy Snow	47	100%
Ice Storm	10	34.48%
Winter Storm	77	100%
Winter Weather	249	100%
Total	**388**	**100%**

Sources: 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

Projections of climate change for New Jersey predict higher temperatures, more intense rainfall events, and increases in total annual precipitation (see Section 3.3.4) (NJDEP 2020). There is a lack of quantitative data to predict how future climate change will affect snowfall and ice storms in New Jersey. It is likely that the number of winter weather events will decrease and the winter weather season will shorten. However, it is also possible that the intensity of winter weather events may increase. The exact effect on winter weather is still highly uncertain (Sustainable Jersey Climate Change Adaptation Task Force 2011). Future enhancements in climate modeling will provide an improved understanding of how the climate will change and impact Sussex County.

17.1.5 Cascading Impacts on Other Hazards

The freezing and thawing of snow and ice associated with winter weather events can create major flooding issues in the County. Mitigating winter weather hazards through snow and ice removal could minimize the potential risk of flooding during a warming period. Severe winter weather events can escalate the impacts of utility failure. Ice and snow accumulation can be destructive to the functionality of utilities through falling tree branches under the weight of winter precipitations, often breaching power lines and disconnecting the utility systems.

17.2 VULNERABILITY AND IMPACT ASSESSMENT

All of Sussex County is vulnerable to severe winter weather events. 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.

17.2.1 Life, Health, and Safety

Overall Population

The entire population of Sussex County (144,221 people) is exposed to severe winter weather events. Winter weather indirectly kills hundreds of people in the United States each year. People can die in traffic accidents on icy roads, heart attacks while shoveling snow, or hypothermia from prolonged exposure to cold.

Socially Vulnerable Population

The homeless and elderly populations are most susceptible to the severe winter weather hazard. The elderly are susceptible due to their increased risk of injuries and death from falls, overexertion, or hypothermia while clearing snow and ice. Homeless people and residents below the poverty level may not have access to housing or their housing could be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply).

Without a quantitative assessment of potential impacts of a severe winter weather 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 17-5 summarizes highlights of this information. For planning purposes, it is reasonable to assume that percentages and distribution of socially vulnerable populations affected by a severe winter weather event will be similar to the countywide numbers.

Table 17-5. 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
			Vernon (T)	Walpack (T)	Walpack (T)	Sparta (T)
Population Over 65	**25,451**	**17.65%**	**3,687**	**100.00%**	**7**	**13.38%**
			Sparta (T)	Lafayette (T)	Walpack (T)	Walpack (T)
Population Under 5	**6,500**	**4.51%**	**1,160**	**7.21%**	**0**	**0.00%**
Non-English-			Hopatcong (B)	Hamburg (B)	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack	Andover, Frankford, Sandyston, Stanhope, Stillwater, Walpack
Speaking Population	**1,922**	**1.33%**	**339**	**10.17%**	**0**	**0.00%**
Population With			Vernon (T)	Franklin (B)	Walpack (T)	Walpack (T)
Disability	**15,697**	**10.88%**	**2,318**	**17.32%**	**0**	**0.00%**
Population Below			Vernon (T)	Sussex (B)	Walpack (T)	Walpack (T)
Poverty Level	**7,320**	**5.08%**	**877**	**18.03%**	**0**	**0.00%**
Households Below			Vernon (T)	Sussex (B0	Branchville (B)	Green (T)
ALICE Threshold	**14,428**	**21%**	1,833	**48%**	90	**14%**

17.2.2 General Building Stock

The entire general building stock inventory is exposed and vulnerable to the severe winter weather hazard. 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).

An extreme blizzard or snowstorm event can deposit significant amounts of snow that are heavy enough to damage roofs and aging buildings. In general, the structural impacts include partial damage to roofs and building frames, rather than an entire building. Aging infrastructure could be more at risk.

17.2.3 Community Lifelines and Other Critical Facilities

Heavy accumulations of snow and ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Bridges and overpasses are particularly dangerous because they freeze before other surfaces (NWS 2019). Heavy snow can immobilize a region and paralyze a city, shutting down all air and rail transportation and disrupting medical and emergency services (NOAA 2023).

Full functionality of critical facilities such as police, fire, and medical facilities is essential for response during and after a severe winter weather event. These critical facility structures are largely constructed of concrete and masonry; therefore, they should suffer only minimal structural damage from severe winter weather events. Because power interruption can occur, backup power is recommended.

Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming conditions that can damage roads over time. Severe snowfall requires the clearing roadways and alerting citizens to dangerous conditions. Following the winter season, resources are required for road maintenance and repair of winter weather related damage, including cracks and potholes caused by freezing and plowing (NWS 2019).

17.2.4 Economy

Depending on the severity and duration of the severe winter weather event, damage to the general building stock, critical facilities, and community lifelines can include roof damage from heavy snow loads, structural damage from downed trees, and power outages.

The cost of snow and ice removal, roadway treatments (salt and brine) and repair of roads from the freeze/thaw process and plowing damages can drain local financial resources. In addition to snow removal costs, severe winter weather affects the ability of persons to commute into and out of the area for work or school. The loss of power and closure of roads prevents the commuter population traveling to work within and outside of the County and may cause a loss in economic productivity. The economic impact of winter weather each year is huge, with costs for snow removal, damage, and loss of business in the millions (NOAA 2023).

According to FEMA’s National Risk Index, Sussex County’s expected annual loss from ice storms is $89,000 and its expected annual loss from winter weather is $92,000 (FEMA 2019).

17.2.5 Natural, Historic and Cultural Resources

Natural

Severe winter weather can have a major impact on the environment. For example, an excess amount of snowfall and earlier warming periods may affect natural processes such as flow within water resources. The residual impacts of a community’s methods of winter weather maintenance may also have an impact on the environment. (NSIDC n.d.). Road-salt runoff can cause groundwater salinization, modify the soil structure, and result in loss or reduction in lake turnover. Additionally, road salt can cause changes in the composition of aquatic invertebrate assemblages and pose threats to birds, roadside vegetation, and mammals (Tiwari and Rachlin 2018).

Rain-on-snow following winter weather events can exacerbate runoff rates. These excess volumes of water can erode banks, tear apart habitat along banks, and disrupt terrestrial plants and animals (Tiwari and Rachlin 2018).

Historic

Historic buildings may be susceptible to damage from severe winter weather conditions, especially if they were not built to modern building standards for snow loading (CCAHA 2019).

Cultural

Cultural buildings may be susceptible to damage from severe winter weather conditions, especially if they were not built to modern building standards for snow loading (CCAHA 2019).

17.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

Overall, Sussex County's exposure and vulnerability have not changed, and the entire County will continue to be exposed and vulnerable to severe winter weather events. Any perceived or actual changes in vulnerability may be attributed to changes in population numbers and density.

17.4 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.

17.4.1 Potential or Planned Development

As discussed in Section 3 (County Profile), areas targeted for future growth and development have been identified across the County. All such areas of growth are vulnerable to severe winter weather. New development sites should adhere to proper building codes to protect against severe weather, such as snow-load protection.

17.4.2 Projected Changes in Population

Changes in the density of population can impact the number of persons exposed to the severe winter weather 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).

Climate Change

Climate change has the potential to alter the prevalence and severity of extremes such as winter weather. While predicting changes of severe winter weather events 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 (NASA 2023).

Climate change is a potential threat to cultural heritage sites as it may aggravate the physical, chemical, and biological mechanisms causing degradation by affecting the structure or composition of building materials. Changes in temperature, precipitation, and atmospheric moisture have been identified as concerns by the United Nations (Sesana, et al. 2021).

18. WILDFIRE

18.1 HAZARD PROFILE

18.1.1 Hazard Description

A wildfire is any non-structural fire that occurs in forested, semi-forested, or less developed areas (NPS 2023). Wildfires can be highly destructive and difficult to control, resulting in the uncontrolled destruction of forests, brush, field crops, grasslands, real estate, and personal property. They also threaten homeowners who live in or adjacent to forest environments (NJFFS 2023).

Each year, an average of 1,500 wildfires damage 7,000 acres of New Jersey's forests. Some are naturally caused (typically by lightning) and others are caused by human activities. Human-caused wildfires include prescribed burns, which are intentionally set to achieve wildland management objectives, as well as wildfires caused by accident, carelessness, or arson. Most wildfires in New Jersey are caused by humans (NPS 2023).

The height of wildfire season in New Jersey runs from March through May, corresponding with the driest live fuel moisture periods of the year (NJOEM 2019). However, wildfires can occur every month of the year. Drought, snow pack, and local weather conditions can expand the length of the fire season. Early and late season fires usually are human-caused. Lightning generally is the cause of most fires in the peak season (NJOEM 2019).

The New Jersey Forest Fire Service (NJFFS), a division of the New Jersey Department of Environmental Protection (NJDEP) under the direction of the state fire warden, is responsible for protecting the 3.15 million acres of wildland in the state. NJFFS has 85 full-time employees that provide an array of services including staffing the state's 21 fire towers, which are operational during in March, April, May, October, and November.

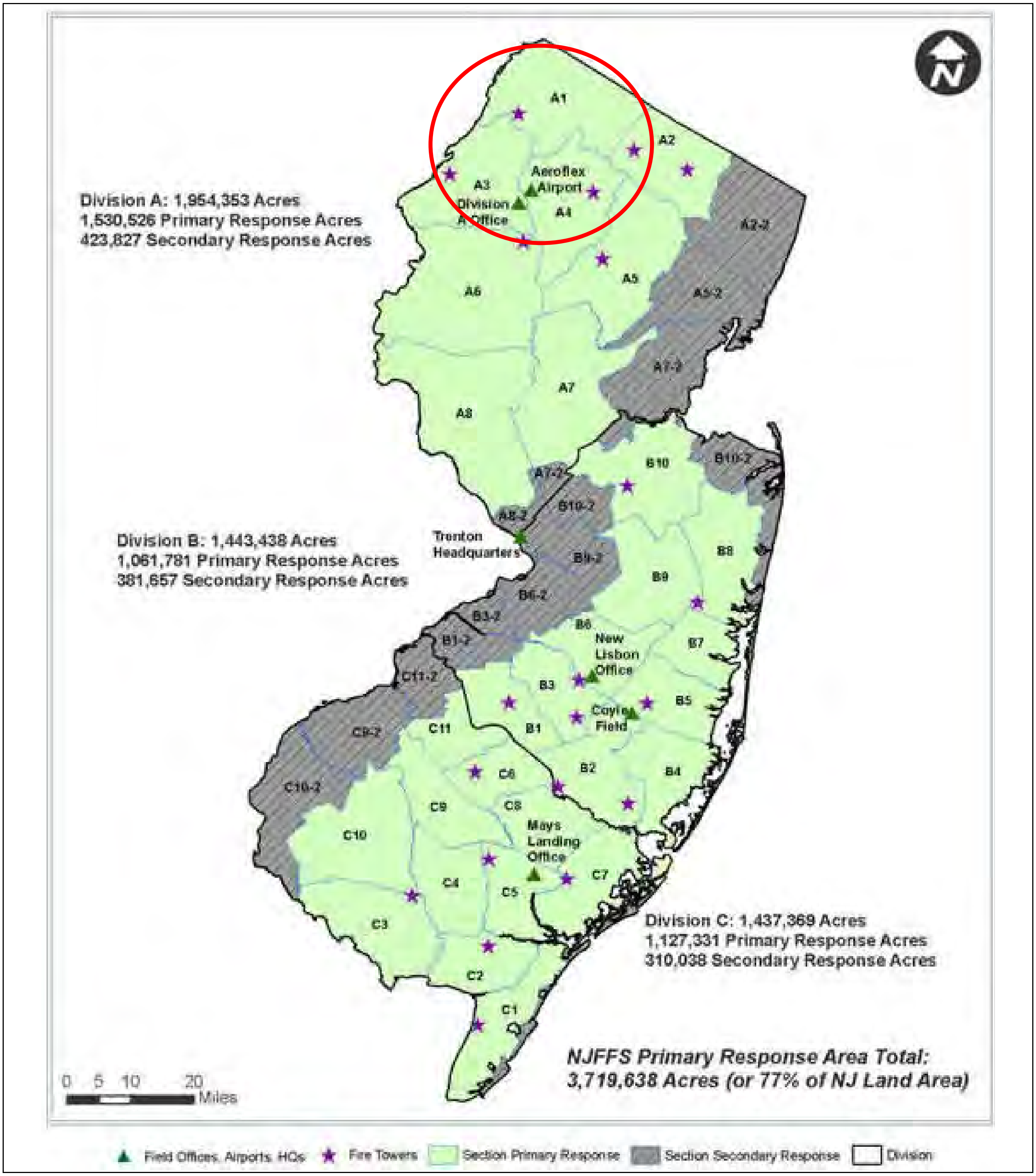
18.1.2 Location

NJFFS divides the State into three regions (A - Northern, B - Central, C - Southern) each totaling about 1,250,000 acres. The regions are further divided into 29 sections of about 125,000 acres with a forest fire warden in each and 269 districts of 15,000 to 20,000 acres. The 29 section forest fire wardens, 269 district forest fire wardens, and 2,000 trained crew members respond to fires on an as-needed basis (NJFFS 2020). Figure 18-1 shows the NJFFS regions and sections. Wildfire risks varies from region to region, due to a combination of factors, including climate, poverty, education, demographics, and other causal factors (USFA 2013). In Sussex County, located in Division A – Northern, wildfires have the potential to occur anywhere in the County.

Wildfire Fuel Hazard Areas and Wildfire Hazard Potential

NJFFS developed Wildfire Fuel Hazard data for the entire state (NJHC 2000). Figure 18-2 shows the fuel hazard areas in Sussex County. NJFFS also created the New Jersey Wildfire Risk Assessment as a consistent, comparable set of scientific results to be used as a foundation for wildfire mitigation and prevention planning in the state. This assessment tool was used to prepare a report for the wildfire hazard potential (WHP) for Sussex County, as shown in Figure 18-3. The WHP quantifies the relative potential for wildfire that may be difficult to control. Table 18-1 shows the number of acres of each WHP category in Sussex County

Figure 18-1. Fire Divisions of New Jersey



Source: NJDEP 2013

Note: The red circle indicates the approximate location of Sussex County, in Fire Division A.

Figure 18-2. Wildfire Fuel Hazard for Sussex County

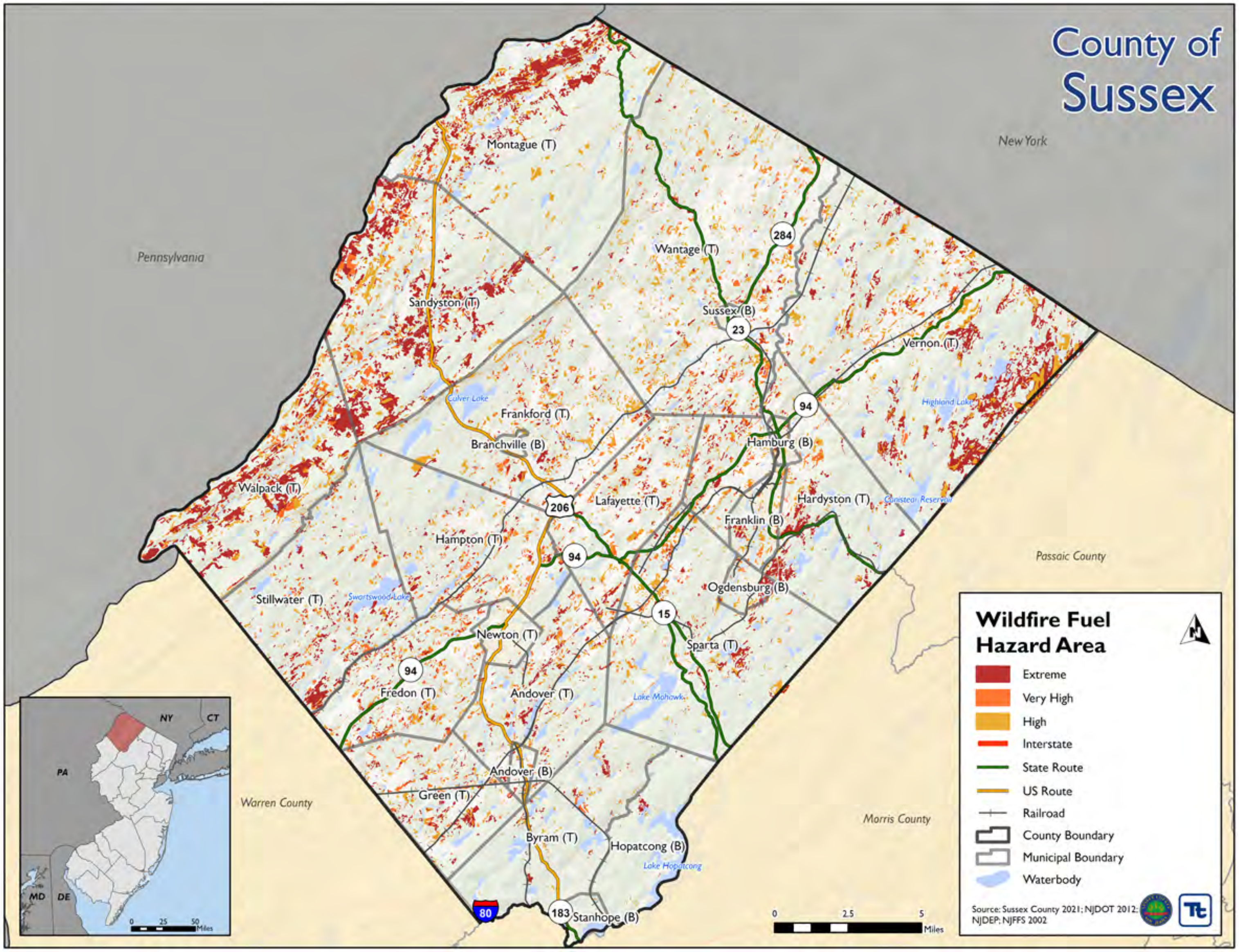
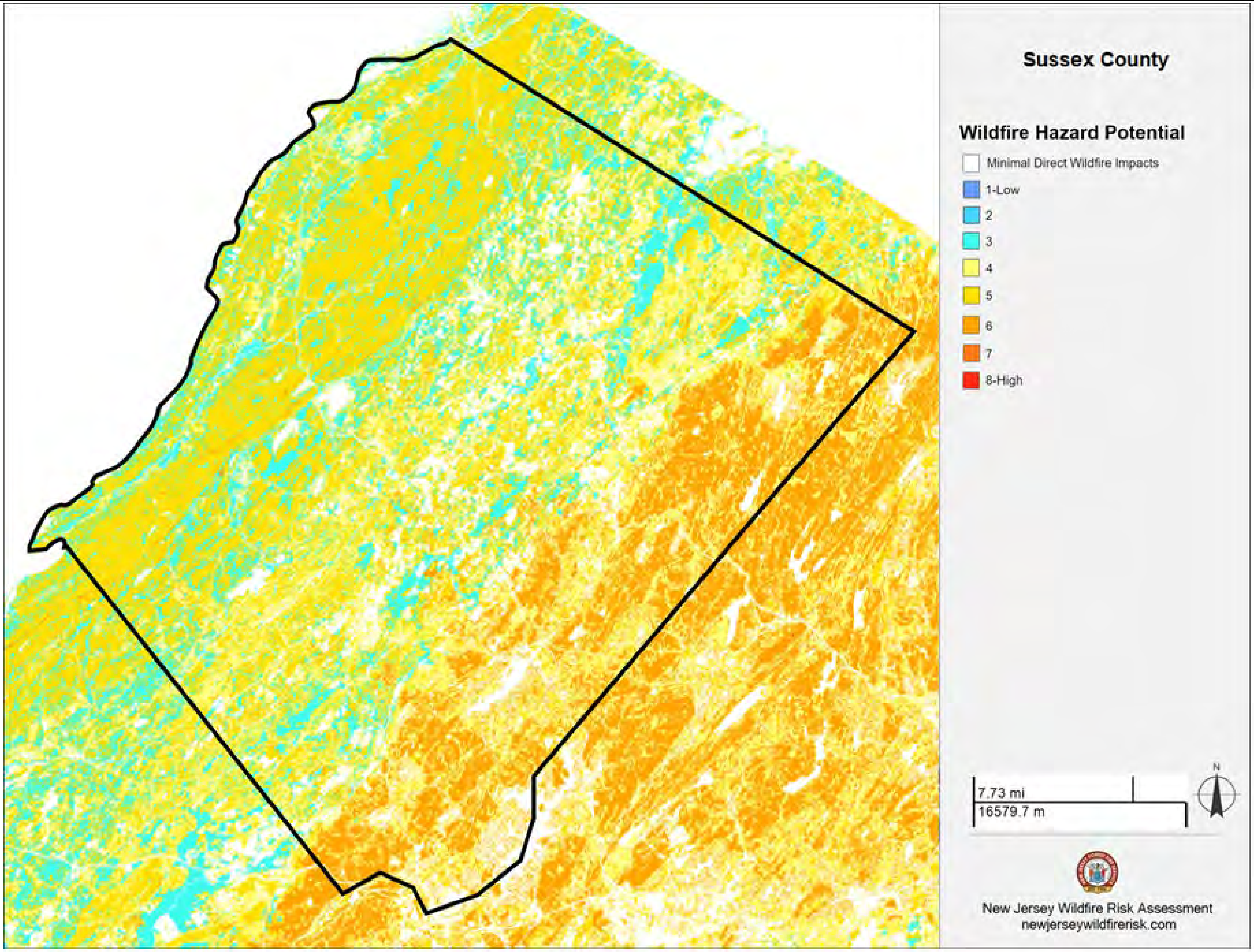


Figure 18-3. Wildfire Hazard Potential in Sussex County



Source: New Jersey Forest Fire Service 2024

Table 18-1. Wildfire Hazard Potential in Sussex County

	Wildfire Hazard Potential Category	Acres	Percent
	Minimal Direct Wildfire Impacts	53,647	15.8 %
	1-Low	0	0.0 %
	2	0	0.0 %
	3	47,753	14.0 %
	4	65,309	19.2 %
	5	128,722	37.8 %
	6	44,514	13.1 %
	7	160	0.0 %
	8-High	4	0.0 %
	Total	**340,109**	**100.0 %**

Source: New Jersey Forest Fire Service 2024

Burn Probability

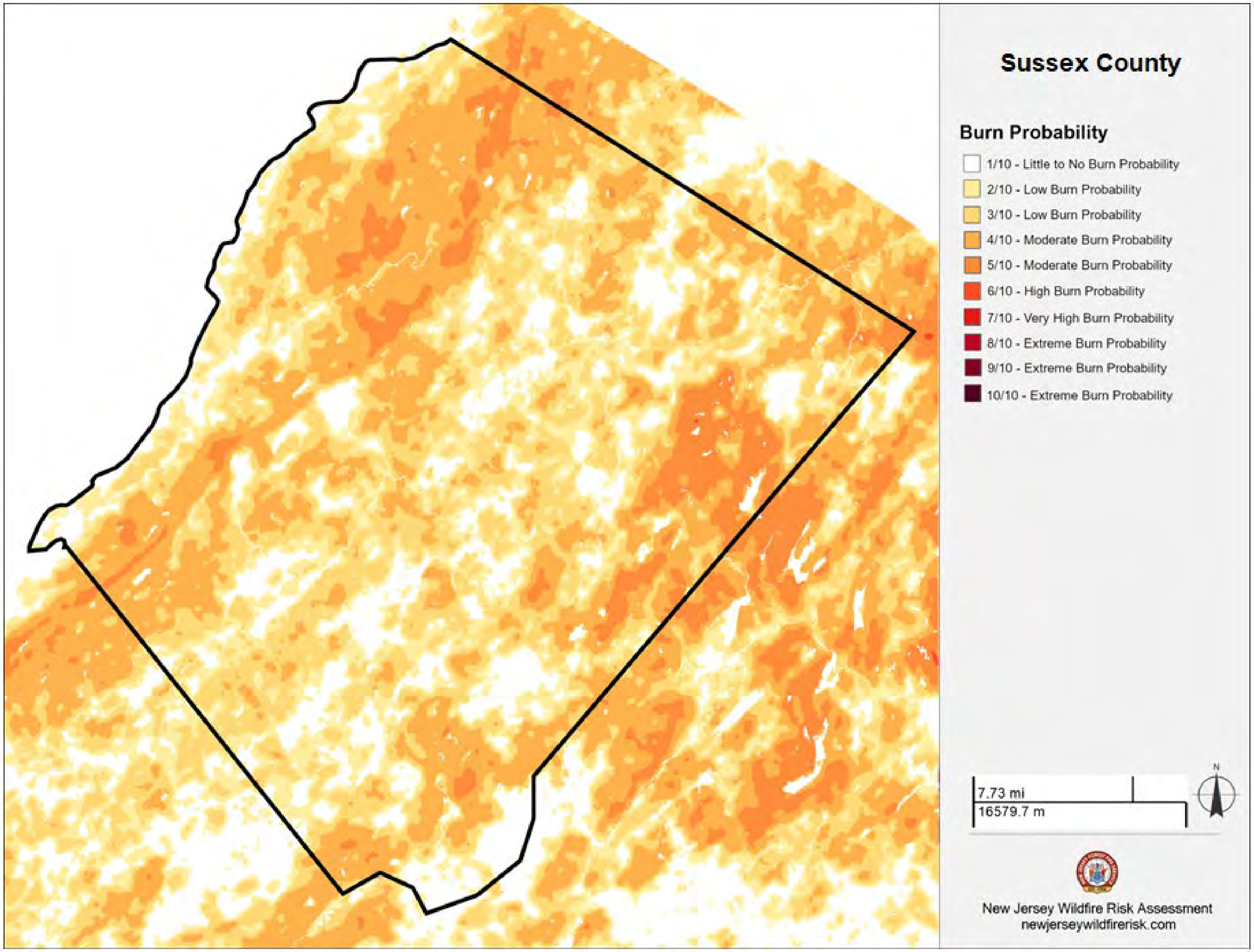
Burn probability is the annual probability of wildfire burning in a specific location, based on fire behavior modeling across thousands of simulations of possible fire seasons. Each simulation varies the factors contributing to the probability of a fire—including weather, topography, and ignitions—based on observations in recent decades (New Jersey Forest Fire Service 2024). Burn probability is not predictive and does not reflect any currently forecasted weather or fire danger conditions. Rather, it is a probability that any specific location may experience wildfire in any given year. It does not indicate the intensity of fire if it occurs (New Jersey Forest Fire Service 2024). Burn probability in Sussex County is listed in Table 18-2 and mapped in Figure 18-4.

Table 18-2. Sussex County Burn Probability

	Burn Probability Category	Acres	Percent
	1/10 - Little to No Burn Probability	53,946	15.9 %
	2/10 - Low Burn Probability	69,156	20.3 %
	3/10 - Low Burn Probability	98,676	29.0 %
	4/10 - Moderate Burn Probability	96,337	28.3 %
	5/10 - Moderate Burn Probability	21,966	6.5 %
	6/10 - High Burn Probability	11	0.0 %
	7/10 - Very High Burn Probability	0	0.0 %
	8/10 - Extreme Burn Probability	0	0.0 %
	9/10 - Extreme Burn Probability	0	0.0 %
	10/10 - Extreme Burn Probability	0	0.0 %
	Total	**340,092**	**100.0 %**

Source: New Jersey Forest Fire Service 2024

Figure 18-4. Sussex County Burn Probability



Source: New Jersey Forest Fire Service 2024

18.1.3 Extent

The extent (i.e., magnitude or severity) of wildfires depends on climate factors, such as dryness or presence of drought, and human activity. The NJFFS uses two indices to monitor the dryness of forest fuels and the possibility of fire ignitions becoming wildfires:

- The National Fire Danger Rating Systems Buildup Index reflects the combined cumulative effects of daily drying and precipitation fuels with a 10-day time lag constant. It is a rating of the total amount of fuel available for combustion (National Wildfire Coordinating Group 2023).
- The Keetch-Byram Drought Index determines forest fire potential based on a daily water balance, where a drought factor is balanced with precipitation and soil moisture (assumed to have a maximum storage capacity of 8 inches). It is expressed in hundredths of an inch of soil moisture depletion (NOAA NIDIS 2023).

Both indices are used for fire preparedness planning, which includes campfire and burning restrictions, fire patrol assignments, staffing of fire lookout towers, and readiness status for observation and firefighting aircraft.

The NJFFS also uses the National Fire Danger Rating System to provide a relative measure of the daily fire danger for a given area in the state (Western Fire Chiefs Association 2023). The rating system uses a five-color coded system to help the public understand fire potential. The NJFFS slightly adapted the color system; Table 18-3 shows the rating system, with the NJFFS color scheme.

Figure 18-5 and Table 18-10 visualize surface fuels in Sussex County (New Jersey Forest Fire Service 2024). Surface fuels are generally defined as burnable materials less than 6 feet above the ground. They typically are categorized into one of the following fuel types based on the primary carrier of the surface fire:

- Grass
- Grass/shrub
- Shrub
- Timber/understory
- Timber litter
- Slash

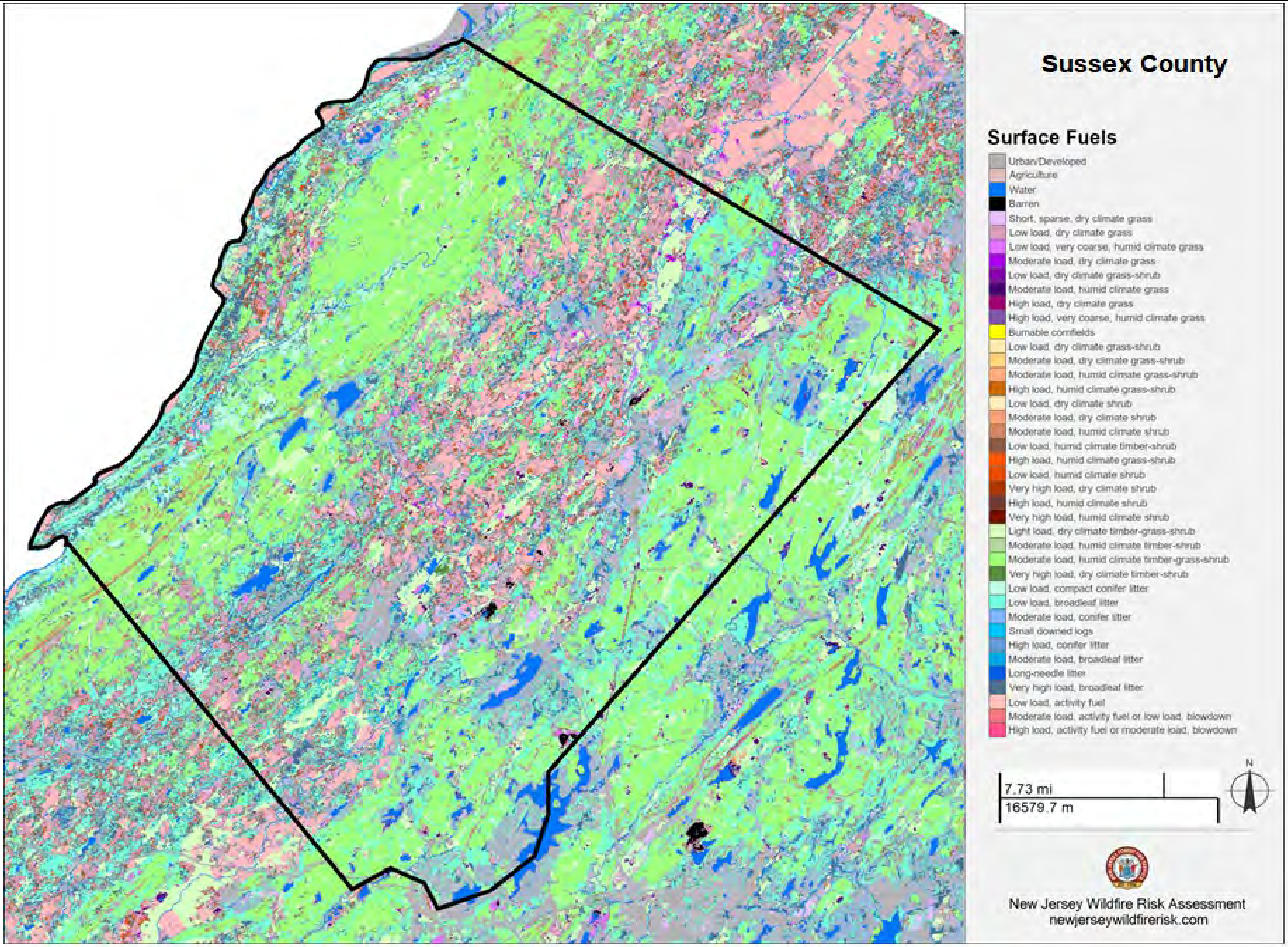
Surface fuels are defined by fire behavior fuel models, which contain parameters required by a surface fire spread model to compute surface fire behavior characteristics such as rate of spread, flame length, fire line intensity, and other fire behavior metrics.

Table 18-3. Fire Danger Rating and Color Code

Fire Danger Rating and Color Code	Description
Low (L) (Green)	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting (burning embers being transported by wind).
Moderate (M) (Blue)	Fires can start from most accidental causes, but except for lightning fires in some areas, the number of starts is generally low. Fires in open-cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.
High (H) (Yellow)	All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High (VH) (Orange)	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme (E) (Red)	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash (trunks, branches, and treetops) or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes, or the fuel supply lessens.

Source: NJFFS 2023

Figure 18-5. Surface Fuels in Sussex County



Source: New Jersey Forest Fire Service 2024

Table 18-4. Surface Fuels in Sussex County

Surface Fuel Model	Description	Acres	Percent	Surface Fuel Model	Description	Acres	Percent
NB1	Urban/Developed	24,711	7.3 %	SH5	High load, humid climate grass-shrub	0	0.0 %
NB3	Agriculture	18,056	5.3 %	SH6	Low load, humid climate shrub	7,056	2.1 %
NB8	Water	10,486	3.1 %	SH7	Very high load, dry climate shrub	0	0.0 %
NB9	Barren	375	0.1 %	SH8	High load, humid climate shrub	0	0.0 %
GR1	Short, sparse, dry climate grass	7,321	2.2 %	SH9	Very high load, humid climate shrub	0	0.0 %
GR2	Low load, dry climate grass	17,284	5.1 %	TU1	Light load, dry climate timber-grass-shrub	31,682	9.3 %
GR3	Low load, very coarse, humid climate grass	4,026	1.2 %	TU2	Moderate load, humid climate timber-shrub	925	0.3 %
GR4	Moderate load, dry climate grass	526	0.2 %	TU3	Moderate load, humid climate timber-grass-shrub	94,492	27.8 %
GR5	Low load, dry climate grass-shrub	0	0.0 %	TU5	Very high load, dry climate timber-shrub	214	0.1 %
GR6	Moderate load, humid climate grass	1,544	0.5 %	TL1	Low load, compact conifer litter	10,619	3.1 %
GR7	High load, dry climate grass	0	0.0 %	TL2	Low load, broadleaf litter	53,162	15.6 %
GR8	High load, very coarse, humid climate grass	0	0.0 %	TL3	Moderate load, conifer litter	6,849	2.0 %
AG9	Burnable cornfields	0	0.0 %	TL4	Small downed logs	0	0.0 %
GS1	Low load, dry climate grass-shrub	829	0.2 %	TL5	High load, conifer litter	71	0.0 %
GS2	Moderate load, dry climate grass-shrub	613	0.2 %	TL6	Moderate load, broadleaf litter	9,207	2.7 %
GS3	Moderate load, humid climate grass-shrub	0	0.0 %	TL8	Long-needle litter	351	0.1 %
GS4	High load, humid climate grass-shrub	0	0.0 %	TL9	Very high load, broadleaf litter	27,399	8.1 %
SH1	Low load, dry climate shrub	31	0.0 %	SB1	Low load, activity fuel	0	0.0 %
SH2	Moderate load, dry climate shrub	168	0.0 %	SB2	Moderate load, activity fuel or low load, blowdown	0	0.0 %
SH3	Moderate load, humid climate shrub	7,739	2.3 %	SB3	High load, activity fuel or moderate load, blowdown	0	0.0 %
SH4	Low load, humid climate timber-shrub	4,381	1.3 %				
					Total	**340,117**	**100.0 %**

Source: New Jersey Forest Fire Service 2024

18.1.4 Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Sussex County has not been included in any major disaster (DR) or emergency (EM) declarations for wildfire-related events (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 wildfire-related agricultural disaster declarations (USDA 2024).

Previous Events

The NJFFS keeps records of wildfires and prescribed burns in the State of New Jersey. Events that impacted Sussex County between 2018 and 2023 are listed in Table 18-5. For events prior to 2018, refer to the 2021 Sussex County HMP.

Table 18-5. Wildfires and Prescribed Burns in Sussex County 2018-2023

Year	Wildfires		Prescribed Burns	
	Number of Fires	Acres Burned	Number of Treatments	Acres Treated
2018	19	6.75	26	389
2019	33	16.5	24	125
2020	91	32.75	29	230
2021	57	21.25	12	24
2022	53	35.5	14	57
2023	108	53.25	38	583
Total	**361**	**166**	**143**	**1,408**

Source: New Jersey Forest Fire Service 2024

18.1.5 Probability of Future Occurrences

Probability Based on Previous Occurrences

Information on previous wildfire occurrences in the County was used to calculate the probability of future occurrence of such events, as summarized in Table 18-6. Based on historical records and input from the Steering Committee, the probability of occurrence for wildfire in the County is considered “occasional.”

Table 18-6. Probability of Future Wildfire Events in Sussex County

Hazard Type	Number of Occurrences Between 2018 and 2023	Percent Chance of Occurring in Any Given Year
Wildfire	361	100%

Sources: New Jersey Forest Fire Service 2024

Effect of Climate Change on Future Probability

A gradual change in temperatures will alter the growing environment of many tree species, reducing the growth of some trees and increasing the growth of others. Tree growth and regeneration may be affected more by extreme weather events and climatic conditions than by gradual changes in temperature or precipitation. Warmer temperatures may lead to longer dry seasons and multi-year droughts, creating triggers for wildfires, insects, and invasive species. An increase in invasive species, such as the emerald ash borer, can lead to the destruction and death of ash trees, adding more fuel for fires. Increased temperature and change in precipitation will also affect fuel moisture during wildfire season and the length of time during while wildfires can burn during a given year (US EPA 2022).

Climate change may also increase the frequency of lightning strikes. A warmer atmosphere holds more moisture which is one of the key items for triggering a lightning strike. If the frequency of lightning strikes increases, the potential for wildfires from these strikes also increases (National Geographic 2014).

According to the temperature projections for Northern New Jersey, including Sussex County, this area can expect warmer and drier conditions, which may increase the frequency and intensity of wildfires. Higher temperatures are expected to increase the amount of moisture that evaporates from land and water. These changes have the potential to lead to more frequent and severe droughts, which, in turn, increases the likelihood of wildfires (US EPA 2022).

18.1.6 Cascading Impacts on Other Hazards

Debris and ash left after a wildfire can form mudflows. During and after a rain event, as water moves across charred and denuded ground, it can pick up soil and sediment and carry it in a stream of floodwaters. These mudflows have the potential to cause significant damage to impacted areas. Areas directly affected by fires and those located below or downstream of burn areas are most at risk (FEMA 2020).

Wildfires, particularly large-scale fires, can dramatically alter the terrain and ground conditions, making land already devastated by fire susceptible to floods. Normally, vegetation absorbs rainfall, reducing runoff. However, wildfires leave the ground charred, barren, and unable to absorb water, creating conditions perfect for flash flooding. Flood risk in these impacted areas remains significantly higher until vegetation is restored, which can take up to five years after a wildfire (FEMA 2016).

When wildfire hits in drought-stricken areas, watersheds and reservoirs can be further impacted by ash and debris flows, water treatment facilities may shut down with damage or loss of power, crops can be destroyed, and smoke can affect animal and human health (NIDIS 2023).

Intense wildfire events that destroy existing ecosystems can result in an increase in invasive species that may be able to move into an area with a lack of natural competitors (U.S. Department of the Interior 2012).

18.2 VULNERABILITY AND IMPACT ASSESSMENT

A spatial analysis was conducted using the 2009 NJDEP Wildfire Fuel Hazard spatial layer. For this risk assessment, the high, very high, and extreme areas were defined as the wildfire hazard area (see Figure 18-2). The boundaries of this hazard area were overlaid on the centroids of inventoried assets. Centroids that intersected the wildfire boundaries were totaled to estimate the building RCV and population vulnerable to the wildfire inundation areas.

18.2.1 Life, Health, and Safety

Overall Population

Wildfires have the potential to impact human health and life. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility. First responders and nearby residents are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather.

Table 18-7 summarizes the estimated population living in the extreme, high, and very high wildfire fuel hazard areas, by municipality. An estimated 2,834 residents, or 2 percent of the County's population, live in this wildfire hazard area. The Township of Hardyston has the greatest number of individuals in the hazard area (541 persons).

Socially Vulnerable Population

Economically disadvantaged populations are more vulnerable to wildfire because they are likely to lack financial resources for evacuation. 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 wildfire event, and they may have more difficulty evacuating. Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases.

Table 18-8 presents the estimated socially vulnerable populations located within the wildfire hazard area. There are 523 persons over the age of 65 years, 115 persons under the age of 5 years, 36 non-English speakers, 302 persons with a disability, and 141 living in poverty located in these areas.

18.2.2 General Building Stock

Buildings located within the NJFFS identified extreme, very high, or high wildfire fuel hazard areas are considered vulnerable to the wildfire hazard. Buildings constructed of wood or vinyl siding are generally more likely to be impacted by the fire hazard than buildings constructed of brick or concrete. Table 18-9 summarizes the estimated building stock inventory located in the defined hazard area by municipality. These buildings total 3.5 percent ($2.3 million) of the County's building replacement cost value. The Township of Hardyston has the greatest number of buildings located in the wildfire hazard area (277 structures, 6.3 percent of the township total).

Table 18-10 lists buildings in the wildfire hazard area by general occupancy. The residential occupancy is the most exposed to the wildfire hazard, with 1,262 structures, accounting for 84.7 percent of the buildings located in the extreme, very high, or high wildfire fuel risk hazard area.

Table 18-7. Population Living in the High, Very High, and Extreme Wildfire Fuel Hazard Areas

	Total Population	Population Living in the Wildfire Hazard Area	
		Number of Persons	% of Jurisdiction Total
Andover (B)	595	0	0.0%
Andover (Twp)	5,996	114	1.9%
Branchville (B)	791	4	0.5%
Byram (Twp)	8,028	28	0.3%
Frankford (Twp)	5,302	118	2.2%
Franklin (B)	4,912	32	0.7%
Fredon (Twp)	3,235	151	4.7%
Green (Twp)	3,627	131	3.6%
Hamburg (B)	3,266	181	5.5%
Hampton (Twp)	4,893	53	1.1%
Hardyston (Twp)	8,125	541	6.7%
Hopatcong (B)	14,362	26	0.2%
Lafayette (Twp)	2,358	49	2.1%
Montague (Twp)	3,792	267	7.0%
Newton (T)	8,374	3	<0.1%
Ogdensburg (B)	2,258	27	1.2%
Sandyston (Twp)	1,977	97	4.9%
Sparta (Twp)	19,600	284	1.4%
Stanhope (B)	3,526	0	0.0%
Stillwater (Twp)	4,004	109	2.7%
Sussex (B)	2,024	7	0.3%
Vernon (Twp)	22,358	206	0.9%
Walpack (Twp)	7	0	0.0%
Wantage (Twp)	10,811	406	3.8%
Sussex County (Total)	**144,221**	**2,834**	**2.0%**

Source: U.S. Census Bureau 2020, 2021; Sussex County 2021, 2023; NJDEP, NJFFS 2002; CDC/ATSDR 2020

Table 18-8. Vulnerable Persons Living in the High, Very High, and Extreme Wildfire Fuel Hazard Areas

	Vulnerable Persons Living in the Wildfire Hazard Area				
	Persons Over 65	Persons Under 5	Non-English Speaking Persons	Persons with a Disability	Persons in Poverty
Andover (B)	0	0	0	0	0
Andover (Twp)	26	4	0	10	5
Branchville (B)	0	0	0	0	0
Byram (Twp)	3	1	0	2	0
Frankford (Twp)	22	5	0	12	3
Franklin (B)	7	1	0	5	1
Fredon (Twp)	29	6	1	13	8
Green (Twp)	26	4	1	17	5
Hamburg (B)	25	7	18	13	9
Hampton (Twp)	12	2	1	7	3
Hardyston (Twp)	109	21	6	61	30
Hopatcong (B)	3	1	0	2	1
Lafayette (Twp)	10	3	0	5	4
Montague (Twp)	59	14	5	27	12
Newton (T)	0	0	0	0	0
Ogdensburg (B)	4	0	0	2	1
Sandyston (Twp)	15	5	0	11	3
Sparta (Twp)	38	16	1	22	10
Stanhope (B)	0	0	0	0	0
Stillwater (Twp)	28	2	0	15	7
Sussex (B)	1	0	0	1	1
Vernon (Twp)	33	9	0	21	8
Walpack (Twp)	0	0	0	0	0
Wantage (Twp)	73	14	3	56	30
Sussex County (Total)	523	115	36	302	141

Table 18-9. Number and Total Replacement Cost Value of Structures in the High, Very High, and Extreme Wildfire Fuel Hazard Areas

	Jurisdiction Total Buildings		Buildings in the Wildfire Hazard Area			
			Number of Buildings		Replacement Cost Value	
	Number of Buildings	Replacement Cost Value (RCV)	Count	% of Jurisdiction Total	Value	% of Jurisdiction Total
Andover (B)	326	$693,607,785	0	0.0%	$0	0.0%
Andover (Twp)	2,577	$4,012,892,721	53	2.1%	$106,111,462	2.6%
Branchville (B)	426	$598,388,025	2	0.5%	$1,190,044	0.2%
Byram (Twp)	3,676	$3,162,144,221	18	0.5%	$16,243,016	0.5%
Frankford (Twp)	3,529	$3,491,793,002	83	2.4%	$110,691,634	3.2%
Franklin (B)	2,058	$2,227,977,138	12	0.6%	$6,335,788	0.3%
Fredon (Twp)	1,615	$1,542,422,915	64	4.0%	$52,476,394	3.4%
Green (Twp)	1,697	$1,821,582,866	57	3.4%	$100,333,480	5.5%
Hamburg (B)	1,593	$1,809,235,911	83	5.2%	$38,470,860	2.1%
Hampton (Twp)	2,761	$2,474,023,610	38	1.4%	$48,497,898	2.0%
Hardyston (Twp)	4,401	$3,681,458,622	277	6.3%	$179,629,490	4.9%
Hopatcong (B)	8,004	$3,432,619,930	18	0.2%	$7,018,353	0.2%
Lafayette (Twp)	1,463	$2,142,628,709	28	1.9%	$38,953,064	1.8%
Montague (Twp)	2,175	$1,659,675,649	143	6.6%	$163,256,398	9.8%
Newton (T)	2,676	$5,699,120,026	5	0.2%	$43,312,741	0.8%
Ogdensburg (B)	992	$954,409,603	12	1.2%	$6,012,657	0.6%
Sandyston (Twp)	1,526	$1,350,071,503	66	4.3%	$91,496,892	6.8%
Sparta (Twp)	8,127	$10,316,900,290	144	1.8%	$838,435,991	8.1%
Stanhope (B)	1,552	$1,228,753,628	1	0.1%	$35,728	0.0%
Stillwater (Twp)	2,487	$1,611,608,776	64	2.6%	$23,920,038	1.5%
Sussex (B)	677	$2,187,092,184	2	0.3%	$1,669,287	0.1%
Vernon (Twp)	12,039	$6,816,863,576	122	1.0%	$256,853,458	3.8%
Walpack (Twp)	51	$68,015,712	8	15.7%	$22,151,059	32.6%
Wantage (Twp)	5,509	$5,527,803,803	194	3.5%	$219,231,358	4.0%
Sussex County (Total)	**71,937**	**$68,511,090,204**	**1,494**	**2.1%**	**$2,372,327,088**	**3.5%**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; RS Means 2022; NJDEP, NJFFS 2002

Table 18-10. Number of Structures in the High, Very High, and Extreme Wildfire Fuel Hazard Areas, by Occupancy Class

	Buildings in the Wildfire Hazard Area			
	Residential	Commercial	Industrial	Other[a]
Andover (B)	0	0	0	0
Andover (Twp)	41	3	3	6
Branchville (B)	2	0	0	0
Byram (Twp)	12	0	0	6
Frankford (Twp)	62	3	0	18
Franklin (B)	12	0	0	0
Fredon (Twp)	57	1	0	6
Green (Twp)	50	1	1	5
Hamburg (B)	82	0	0	1
Hampton (Twp)	25	1	0	12
Hardyston (Twp)	264	4	2	7
Hopatcong (B)	14	0	0	4
Lafayette (Twp)	20	1	1	6
Montague (Twp)	132	3	0	8
Newton (T)	1	1	1	2
Ogdensburg (B)	11	0	0	1
Sandyston (Twp)	54	3	1	8
Sparta (Twp)	107	28	1	8
Stanhope (B)	0	0	0	1
Stillwater (Twp)	54	0	0	10
Sussex (B)	2	0	0	0
Vernon (Twp)	103	8	2	9
Walpack (Twp)	0	3	0	5
Wantage (Twp)	157	2	0	35
Sussex County (Total)	**1,262**	**62**	**12**	**158**

Source: Sussex County 2023; NJOGIS, Civil Solutions, Spatial Data Logic; NJDEP, NJFFS 2002

a. Other = Government, Religion, Agricultural, and Education

18.2.3 Community Lifelines and Other Critical Facilities

Wildfires can have an impact on the water supplies because of residual pollutants like char or debris landing in water resources, which can clog wastewater pipes, culverts, etc. Wildfires may also impact transportation routes, blocking residents and commuters from getting in and out of the County during a wildfire event because of char and debris in the air making it difficult to drive, or the flames near roadways making the route unsafe. Roads and bridges in the areas of fire risk provide ingress and egress to large areas and, in some cases, to isolated neighborhoods. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers.

18.2.4 Economy

Wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business. These events may cost thousands of taxpayer dollars to suppress and control and may involve hundreds of operating hours on fire apparatus and thousands of volunteer man hours from the volunteer firefighters. There are also direct and indirect costs to local businesses that excuse volunteers from work to fight these fires.

18.2.5 Natural, Historic and Cultural Resources

Natural

While wildfire is a necessary part of ecosystem health in Sussex County, intense wildfire that burns too hot can result in severe damage to the environment, including burning and killing of plant and animal life. Intense fire can also heat narrow and shallow waterways, resulting in damage to aquatic systems. Post-fire runoff polluted with debris and contaminants can be harmful to terrestrial ecosystems and aquatic life (USGS 2023). Intense wildfire events that destroy ecosystems can result in an increase in invasive species that may be able to move into an area with a lack of natural competitors (U.S. Department of the Interior 2012).

Historic

Wildfires are a major threat to historic resources, with the potential to cause extensive damage, and in some cases, complete destruction. The potential impacts on historic resources, particularly infrastructure, from wildfire depend heavily on the materials used for construction. Many historic structures are made of wood, which is a highly flammable material.

Cultural

Wildfires are a major threat to cultural resources, with the potential to cause extensive damage, and in some cases, complete destruction. The potential impacts on cultural resources from wildfire depend heavily on the materials used to construct the facility in which cultural resources are located. Many historic structures are made of wood, which is a highly flammable material. In many instances, historic structures house cultural resources and artifacts that also may be destroyed by fire. Outdoor events are likely to be postponed or cancelled as the result of wildfire conditions, as smoke conditions can have harmful impacts on the human body.

18.3 CHANGE OF VULNERABILITY SINCE 2021 HMP

Overall, the County's vulnerability to wildfire has not changed, and the entire County will continue to be vulnerable to this hazard. The NJDEP Wildfire Fuel Hazard spatial layer has not been updated since the last HMP; therefore, any changes in wildfire hazard exposure are attributed to changes in population density and new development. This updated HMP used updated building stock and critical asset inventories to assess the County's risk to these assets. The building inventory was updated using RSMeans 2022 values, which are more current and reflect replacement cost rather than the building stock improvement values reported in the 2021 HMP. Further, the 2021 5-year population estimates from the American Community Survey were used to evaluate the population exposed to the geological hazard areas.

18.4 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.

18.4.1 Potential or Planned Development

Areas targeted for future growth and development have been identified across the County. Any changes in development can impact the County's risk to the wildfire hazard of concern.

Fire suppression capabilities are high at the state and local levels, but new development with a mix of additional structures, ornamental vegetation, and wildland fuels will require continued assessment of the hazard and mitigation risk. The County should implement wildfire management strategies in existing building code to protect structures against the residual impacts from wildfire such as heat, debris, and char. Furthermore, development should be built with access to transit routes that will enable easier evacuation during a wildfire event.

18.4.2 Projected Changes in Population

The New Jersey Department of Labor and Workforce Development produced populations 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). Any changes in the density of population can impact the number of persons living near wildfire hazard areas.

18.4.3 Climate Change

Climate change will likely alter the atmospheric patterns that affect fire weather. Changes in fire patterns will, in turn, impact carbon cycling, forest structure, and species composition. Climate change associated with warmer temperatures, changes in rainfall, and increased periods of drought may create an atmospheric and fuel environment that is more conductive to large, severe fires (United Nations 2021).

Understanding the climate/fire/vegetation interactions is essential for addressing issues associated with climate change that include (USFS 2011):

- Effects on regional circulation and other atmospheric patterns that affect fire weather
- Effects of changing fire regimes on the carbon cycle, forest structure, and species composition
- Complications from land use change, invasive species and increasing area of interface between urban development and wildland areas

Average temperatures are anticipated to increase in New Jersey, with potential impacts on the suitability of habitats for specific types of trees, altering the fire regime and resulting in more frequent fire events and changes in intensity. Prolonged and more frequent heat waves and droughts have the potential to increase the likelihood of a wildfire. The increased potential combined with stronger winds may make it harder to contain fires and thus increase the County's vulnerability to this hazard.

19. HAZARD RANKING

Each jurisdiction participating in this HMP has differing levels of vulnerability to and potential impacts from each of the hazards assessed in this plan. Each jurisdiction needs to recognize the hazards that pose the greatest risk to its community and direct its attention and resources accordingly to manage risk and reduce losses. Hazard rankings are one of the bases for identifying the jurisdictional hazard mitigation strategies included in Volume II.

The hazards of concern were ranked using methodologies promoted by FEMA's hazard mitigation planning guidance and input from all participating jurisdictions. These rankings may vary among the jurisdictions. For example, a hazard may be ranked low in one municipality but due to differences in vulnerability and impact, be ranked as high for the County or another municipality. Jurisdictional ranking results are presented in each jurisdictional annex in in Volume II.

19.1 HAZARD RANKING METHODOLOGY

19.1.1 Categories Used in Ranking

The ranking methodology is based on four risk assessment categories, with the following scoring parameters defined for each category:

- **Level**—The level is a qualitative description of how each hazard rates in each category (such as low to high, or unlikely to frequent)
- **Benchmark value**—The benchmark values are clearly determinable quantities or descriptions that define which level should apply to each hazard
- **Numeric value**—The numeric value is the hazard's score in each category, based on the assigned level
- **Weighting**—The weighting is a multiplier applied to each hazard's numeric value in each category, to represent the relative importance of the category (the higher the weighting, the more important the category)

The following sections describe the categories and their associated scoring parameters.

Probability of Occurrence

The probability of occurrence of each hazard was estimated by calculating the likelihood of annual occurrence based on the historical record of hazard events and professional judgment. Table 19-1 summarizes the scoring parameters for probability of occurrence.

The hazard ranking methodology for some hazards of concern is based on a scenario event that only impacts specific areas (such as a floodplain), while others are based on their potential risk to the County as a whole. In order to account for these differences, the quantitative hazard ranking methodology was adjusted using professional judgement and subject-matter input. The limitations of this analysis are recognized given the scenarios do not have the same likelihood of occurrence; nonetheless, there is value in summarizing and comparing the hazards using a standardized approach to evaluate relative risk.

Table 19-1. Values and Weights for Probability of Occurrence

Level	Benchmark Value	Numeric Value	Weighting
Unlikely	Less than a 1 percent annual probability of a hazard event occurring	0	30%
Rare	Between 1 and 10 percent annual probability of a hazard event occurring	1	
Occasional	Between 10 and 100 percent annual probability of a hazard event occurring	2	
Frequent	100 percent annual probability; a hazard event may occur multiple times per year	3	

Consequence

Consequence represents the expected vulnerability or impact associated with the hazard. This is rated for three subcategories: vulnerability of people; vulnerability of property; and economic impacts on the community. A numeric value based on defined benchmarks is assigned for each subcategory, and a factor is applied to those values representing the relative importance of each subcategory. The total numeric value for consequence is the sum of the factored numeric values for each subcategory. Table 19-2 summarizes the scoring parameters for consequence.

Table 19-2. Values and Weights for Consequence

Level	Benchmark Value	Numeric Value	Factor	Weighting
Population (Numeric Value x 3)				**30%**
None	No population lives within the area vulnerable to measurable life-safety impact from the hazard	0	3	
Low	14 percent or less of population lives within the area vulnerable to measurable life-safety impact from the hazard	1		
Medium	15 to 29 percent of population lives within the area vulnerable to measurable life-safety impact from the hazard	2		
High	30 percent or more of population lives within the area vulnerable to measurable life-safety impact from the hazard	3		
Property (Numeric Value x 2)				
None	No structures located in the area vulnerable to measurable damage from the hazard	0	2	
Low	Fewer than 14 percent of structures in the community located in the area vulnerable to measurable damage from the hazard	1		
Medium	15 to 29 percent of structures in the community located in the area vulnerable to measurable damage from the hazard	2		
High	30 percent or more of structures in the community located in the area vulnerable to measurable damage from the hazard	3		
Economy (Numeric Value x 1)				
None	No estimated loss due to the hazard	0	1	
Low	Estimated loss due to the hazard is 9 percent or less of the total replacement cost value for the community	1		
Medium	Estimated loss due to the hazard is 10 to 19 percent of the total replacement cost value for the community	2		
High	Estimated loss due to the hazard is 20 percent or more of the total replacement cost value for the community	3		

Adaptive Capacity

Adaptive capacity is a jurisdiction's administrative, technical, planning/regulatory and financial ability to protect from or withstand a hazard event. Mitigation measures that can increase a jurisdiction's capacity to withstand and rebound from events include codes or ordinances with higher standards to withstand hazards due to design or location; deployable resources; or plans and procedures for responding to an event.

A rating of "weak" for adaptive capacity means a jurisdiction does not have the capability to effectively respond, which increases vulnerability. A "strong" adaptive capacity means the jurisdiction does have the capability to effectively respond, which decreases vulnerability. These ratings were assigned using the results of the core capability assessment, with input from each jurisdiction. Table 19-3 summarizes the scoring parameters for adaptive capacity.

Table 19-3. Values and Weights for Adaptive Capacity

Level	Benchmark Value	Numeric Value	Weighting
Weak	Weak, outdated, or inconsistent plans, policies, codes, or ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	1	30%
Moderate	Plans, policies, codes, or ordinances in place that meet minimum requirements; mitigation strategies identified but not implemented on a widespread scale; jurisdiction can recover but needs outside resources; moderate jurisdiction capabilities.	0	
Strong	Plans, policies, codes, or ordinances in place that exceed minimum requirements; mitigation/protective measures in place; jurisdiction has ability to recover quickly because resources are readily available, and capabilities are high.	-1	

Climate Change

Current climate change projections were evaluated as part of the hazard ranking to account for potential increases in severity or frequency of the hazard. This is important because the hazard ranking helps guide and prioritize the mitigation strategy as a long-term future vision for mitigating the hazards of concern. The potential impacts that climate change may have on each hazard of concern are discussed in the risk assessment chapters for each hazard. Table 19-4 summarizes the scoring parameters for climate change.

Table 19-4. Values and Weights for Climate Change

Level	Benchmark Value	Numeric Value	Weighting
Low	No local data are available; modeling projects are uncertain on whether there is increased future risk; confidence level is low (inconclusive evidence).	1	10%
Medium	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change; confidence level is medium to high (moderate evidence).	2	
High	Studies and modeling projections indicate exacerbated conditions and increased future risk due to climate change; very high confidence level (strong evidence, well documented, and acceptable methods).	3	

19.1.2 Total Ranking Score

The total ranking score based on the categories described above is calculated using the following equation:

Risk Ranking Score Equation

Ranking Score= [(Consequence on Population x 3) + (Consequence on Property x 2) + (Consequence on Economy x 1) x 0.3] + [Adaptive Capacity x 0.3] + [Climate Change x 0.1] + [Probability of Occurrence x 0.3]

Using this equation, the highest possible ranking score is 6.9. The higher the number, the greater the relative risk. Based on the score for each hazard, a hazard ranking is assigned to each hazard of concern as follows:

- Low = Values less than 3.9
- Medium = Values between 3.9 and 4.9
- High = Values greater than 4.9.

All Planning Partners applied the same methodology to develop the hazard rankings to ensure consistency in the overall ranking of risk. However, each jurisdiction had the ability to alter rankings based on local knowledge and experience in handling each hazard.

19.2 PRELIMINARY HAZARD RANKING RESULTS

Using the methodology described above, the hazard ranking for the identified hazards of concern was determined for each planning partner. The hazard ranking for Sussex County is detailed in the following tables that present the step-wise process for the ranking:

- Table 19-5 shows the unweighted numeric values assigned for the probability of occurrence for each hazard.
- Table 19-6 shows the numeric values assigned for each subcategory of consequence for each hazard. Results are shown for applying the subcategory factors, but not the category-wide weighting.
- Table 19-7 shows the unweighted numeric values assigned for adaptive capacity and climate change for each hazard.
- Table 19-8 shows the total weighted hazard ranking scores for each hazard of concern.

The countywide hazard ranking includes the entire planning area and may not reflect the highest risk for all Planning Partners. The overall ranking for each jurisdiction is included in Table 7-9 and in the annexes in Volume II. For final hazard rankings, which take into account jurisdictional input, please refer to the jurisdictional annexes in Volume II.

Table 19-5. Probability of Occurrence for Hazards of Concern for Sussex County

Hazard of Concern	Probability	Numeric Value
Dam Failure	Occasional	2
Disease Outbreak	Occasional	2
Drought	Occasional	2
Earthquake	Rare	1
Flood	Frequent	3
Geological Hazards	Rare	1
Hazardous Materials	Rare	1
Hurricane	Occasional	2
Infestation	Occasional	2
Nor’easter	Occasional	2
Severe Weather	Frequent	3
Severe Winter Weather	Frequent	3
Wildfire	Occasional	2

Table 19-6. Consequence Rating for Hazards of Concern for Sussex County

Hazard of Concern	Population			Property			Economy			Total Impact Rating (Population + Property + Economy)
	Consequence	Numeric Value	Multiplied by Factor (3)	Consequence	Numeric Value	Multiplied by Factor (2)	Consequence	Numeric Value	Multiplied by Factor (1)	
Dam Failure	Medium	2	6	Medium	2	4	Medium	2	2	12
Disease Outbreak	Medium	2	6	Low	1	2	Low	1	1	9
Drought	Medium	2	6	Low	1	2	Low	1	1	9
Earthquake	Medium	2	6	Medium	2	4	Low	1	1	11
Flood	Medium	2	6	Medium	2	4	Low	1	1	11
Geological Hazards	Low	1	3	Medium	2	4	Medium	2	2	9
Hazardous Materials	Medium	2	6	Medium	2	4	Medium	2	2	12
Hurricane	Medium	2	6	Medium	2	4	High	3	3	13
Infestation	Low	1	3	Low	1	2	Low	1	1	6
Nor'easter	Medium	2	6	High	3	6	High	3	3	15
Severe Weather	High	3	9	High	3	6	High	3	3	18
Severe Winter Weather	High	3	9	High	3	6	High	3	3	18
Wildfire	Medium	2	6	Medium	2	4	Medium	2	2	12

Table 19-7. Adaptive Capacity and Climate Change Ratings for Hazards of Concern for Sussex County

Hazard of Concern	Adaptive Capacity		Climate Change	
	Level	Numeric Value	Level	Numeric Value
Dam Failure	Medium	0	Medium	2
Disease Outbreak	Medium	0	Medium	2
Drought	Medium	0	High	3
Earthquake	Medium	0	Medium	1
Flood	Medium	0	High	3
Geological Hazards	Medium	0	Medium	2
Hazardous Materials	Medium	0	Low	1
Hurricane	Medium	0	High	3
Infestation	Medium	0	Low	1
Nor'easter	Medium	0	High	3
Severe Weather	Medium	0	High	3
Severe Winter Weather	Medium	0	High	3
Wildfire	Medium	0	High	3

Table 19-8. Total Hazard Ranking Scores for the Hazards of Concern for Sussex County

Hazard of Concern	Probability x 30%	Total Consequence x 30%	Adaptive Capacity x 30%	Changing Future Conditions x 10%	Total Hazard Ranking Score
Dam Failure	0.6	3.6	0	0.2	4.4
Disease Outbreak	0.6	2.7	0	0.2	3.5
Drought	0.6	2.7	0	0.3	3.6
Earthquake	0.3	3.3	0	0.1	3.7
Flood	0.9	3.3	0	0.3	4.5
Geological Hazards	0.3	2.7	0	0.2	3.2
Hazardous Materials	0.3	3.6	0	0.1	4.0
Hurricane	0.6	3.9	0	0.3	4.8
Infestation	0.6	1.8	0	0.1	2.5
Nor'easter	0.6	4.5	0	0.3	5.4
Severe Weather	0.9	5.4	0	0.3	6.6
Severe Winter Weather	0.9	5.4	0	0.3	6.6
Wildfire	0.6	3.6	0	0.3	4.5

Note: Low (yellow) = Values less than 3.9; Medium (orange) = Values between 3.9 and 4.9; High (red) = Values greater than 4.9

Table 19-9. Overall Ranking of Hazards by Jurisdiction

	Dam Failure	Disease Outbreak	Drought	Earthquake	Flood	Geological Hazards	Hazardous Material	Hurricane	Infestation	Nor'easter	Severe Weather	Severe Winter Weather	Wildfire
Andover (B)	Low	Low	Low	Low	Low	Medium	Medium	Medium	Low	High	High	High	Low
Andover (Twp)	Medium	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Medium
Branchville (B)	Low	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Medium
Byram (Twp)	Medium	Low	Low	Low	Low	Medium	Medium	Medium	Low	High	High	High	Medium
Frankford (Twp)	Low	Low	Low	Low	Medium	Low	Medium	Medium	Low	High	High	High	Medium
Franklin (B)	Medium	Low	Low	Low	Medium	Medium	Low	Medium	Low	High	High	High	Medium
Fredon (Twp)	Low	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Medium
Green (Twp)	Medium	Low	Low	Low	Low	Medium	Medium	Medium	Low	High	High	High	Low
Hamburg (B)	Low	Low	Low	Low	Medium	Medium	Low	Medium	Low	High	High	High	Medium
Hampton (Twp)	Medium	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Medium
Hardyston (Twp)	Medium	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Low
Hopatcong (B)	Low	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Medium
Lafayette (Twp)	Low	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Medium
Montague (Twp)	Medium	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Medium
Newton (T)	Medium	Low	Low	Low	Medium	Low	Low	Medium	Low	High	High	High	Medium
Ogdensburg (B)	Medium	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Medium
Sandyston (Twp)	Low	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Medium
Sparta (Twp)	Medium	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Low
Stanhope (B)	Low	Low	Low	Low	Medium	Low	Medium	Medium	Low	Medium	High	Medium	Medium
Stillwater (Twp)	Medium	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Medium
Sussex (B)	Medium	Low	Low	Low	Medium	Low	Medium	Medium	Low	High	High	High	Medium
Vernon (Twp)	Medium	Low	Low	Low	Medium	Medium	Medium	Medium	Low	High	High	High	Medium
Walpack (Twp)	Low	Low	Low	Low	High	Medium	Low	Medium	Low	High	High	High	Medium
Wantage (Twp)	Medium	Low	Low	Low	Medium	Low	Medium	Medium	Low	High	High	High	Medium
Sussex County	**Medium**	**Low**	**Low**	**Low**	**Medium**	**Low**	**Medium**	**Medium**	**Low**	**High**	**High**	**High**	**Medium**

Note: Low (yellow) = Values less than 3.9; Medium (orange) = Values between 3.9 and 4.9; High (red) = Values greater than 4.9.

20. CAPABILITY ASSESSMENT

A capability assessment is an inventory of a community's missions, programs, and policies and an analysis of its capacity to carry them out (FEMA 2003). This assessment is an integral part of the planning process. It enables identification, review, and analysis of current local and state programs, policies, regulations, funding, and practices that could either facilitate or hinder mitigation. Through assessing its capabilities, a jurisdiction learns how or whether it can implement certain mitigation actions by determining the following:

- Limitations that may exist on undertaking actions
- The range of local and/or state administrative, programmatic, regulatory, financial, and technical resources available to assist in implementing their mitigation actions
- Actions that are infeasible because they are outside the scope of current capabilities
- Types of mitigation actions that may be technically, legally, administratively, politically, or fiscally challenging or infeasible
- Opportunities to enhance local capabilities to support long-term mitigation and risk reduction

This chapter presents a summary of plans, programs, and regulatory mechanisms at all levels of government (federal, state, county, local) that reduce hazard risks and support hazard mitigation within the planning area. These capabilities are presented in three categories:

- Planning and regulatory capabilities
- Administrative and technical capabilities
- Fiscal capabilities

20.1 CAPABILITY ASSESSMENT PROCESS

Each participating jurisdiction's annex in Volume II includes a capability assessment specific to those jurisdictions. In addition to the capability categories in this chapter, the annexes review capabilities in the more localized categories of adaptive capacity and education and outreach. All participating jurisdictions were tasked with developing or updating their capability assessment for this update, evaluating the effectiveness of their capabilities in supporting hazard mitigation and identifying opportunities to enhance local capabilities. Each jurisdiction identified how it has integrated hazard mitigation into its existing planning, regulatory, and operational/administrative framework and how it intends to promote ongoing integration.

The contracted consultant met with Sussex County and each jurisdiction virtually to review the capability assessment from the 2021 HMP and update accordingly. The consultant also reviewed plans, codes, and ordinances to enhance the information provided by the jurisdictions.

20.2 PLANNING AND REGULATORY CAPABILITIES

Planning and regulatory capabilities are based on ordinances, policies, local laws, state statutes, plans, and programs that relate to managing growth and development. Planning and regulatory capabilities refer not only to current plans and regulations, but also to the jurisdiction's ability to change and improve those plans and regulations

21. MITIGATION STRATEGY

This chapter describes the process of preparing mitigation strategies to reduce potential vulnerability and losses identified as concerns in the risk assessment portion of this plan. The Planning Partners reviewed the risk assessment and capability assessment to identify and develop their mitigation strategies, which are included in the annexes in Volume II.

Hazard mitigation reduces the potential impacts of, and costs associated with, emergency and disaster-related events. Mitigation actions address a range of impacts, including impacts on the population, property, the economy, and the environment.

Mitigation actions can include activities such as revisions to land-use planning, training and education, and structural and nonstructural safety measures.

21.1 PAST MITIGATION ACCOMPLISHMENTS

Sussex County, through previous and ongoing hazard mitigation activities, has demonstrated that it is proactive in protecting its physical assets and citizens against losses from natural hazards. Examples of previous and ongoing actions and projects include the following:

- The County facilitated the development of the original Sussex County HMP. The current planning process represents the regulatory five-year plan update process, which includes the participation of 24 jurisdictions in the County, along with key County and regional stakeholders.
- All municipalities participating in this HMP update participate in the National Flood Insurance Program (NFIP), which requires the adoption of FEMA floodplain mapping and certain minimum standards for building within the floodplain.
- Reports, plans, and studies relating to or including information on natural hazards or natural hazard policies affecting Sussex County have been reviewed and incorporated into this plan update as appropriate, as discussed in Chapter 2 and References.

21.2 REVIEW AND UPDATE OF MITIGATION GOALS AND OBJECTIVES

This section describes the process of updating the Planning Partners' goals and objectives for reducing long-term vulnerabilities to identified hazards. For the purposes of this plan, goals and objectives are defined as follows:

"The hazard mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards."

44 CFR 201.6(c)(3)(i)

- **Goals** are general guidelines that explain what is to be achieved. They ar… nt global visions. Goals help define the be… n, once implemented, should be measured… he actual benefits in terms of hazard mitigat…
- **Objectives** are short-term aims that form a strategy or course of action to meet a goal. Unlike goals, objectives are stand-alone measurements of the effectiveness of a mitigation action. The objectives also are used to help establish priorities. Broadly defined mitigation objectives were eliminated from the updated strategy unless accompanied by discrete actions.

The Steering Committee reviewed the 2021 goals and objectives and made revisions for the 2025 update based on the following considerations:

- Hazard events and losses since the 2021 plan
- The updated hazard profiles and risk assessment
- The goals and objectives established in the New Jersey 2019 HMP
- The Planning Partnership's interests in integrating this plan with other planning mechanisms, including Sussex County and local risk management plans
- Direct input from the Steering Committee, stakeholders, and the public on how the County and jurisdictions need to move forward to best manage their hazard risk
- Discussions and research on existing authorities, policies, programs, resources
- Support for mitigation through the protection of natural systems

As a result of this review process, the goals and objectives for the 2025 update were updated, as shown in Table 21-1 and Table 21-2, respectively.

Table 21-1. 2025 Goals

Goal Number	2025 Goals
1	Protect life
2	Protect property
3	Increase public preparedness and awareness
4	Develop and maintain an understanding of increased risk from climate change impacts on natural hazards
5	Enhance mitigation capabilities to reduce hazard vulnerabilities
6	Support continuity of operations before, during, and after hazard events
7	Reduce the risk of natural hazards for socially vulnerable populations
8	Address long-term vulnerabilities from high hazard dams

Table 21-2. 2025 Objectives

Objective Number	2025 Objectives
1	Develop, enhance, and protect early warning and emergency communications systems
2	Improve and support Comprehensive Regional Evacuation Plan
3	Strengthen County and local planning, building codes, ordinances, and enforcement
4	Identify the need for, and acquire, any special emergency services, training, and equipment to enhance response capabilities for specific hazards
5	Enhance sheltering capabilities at the local level
6	Protect, maintain, and increase resilience of infrastructure and critical facilities
7	Reduce repetitive and severe repetitive losses
8	Ensure coordination between communities and encourage shared services in acquiring, maintaining and providing emergency services
9	Reduce the risk of utility failure

Objective Number	2025 Objectives
10	Review existing local laws and ordinances, safety inspection procedures, and applicable rules to help ensure that they employ the most recent and generally accepted standards for the protection of buildings and environmental resources
11	Identify and pursue funding opportunities to develop and implement local and county mitigation activities
12	Provide or improve flood protection with flood control structures and drainage maintenance plans
13	Enhance stakeholder education and training about hazard risks and mitigation
14	Review and incorporate updated hazard data into the County Hazard Mitigation Plan and other county and local planning mechanisms
15	Increase support for the development of local mitigation planning and projects that provide co-benefits and support a healthy and equitable environment
16	Better characterize flood/stormwater hazard events by conducting additional hazard studies and identify inadequate stormwater facilities and poorly drained areas
17	Prevent or discourage new development in hazardous areas or ensure that if building occurs in high-risk areas it is done in such a way as to minimize risk
18	Strengthen understanding of, and adaptation to, a changing climate
19	Encourage the use of green and natural infrastructure
20	Coordinate with local, County, state, federal, international, and other stakeholder agencies to maintain natural systems, including wetlands, parks, and riverine and coastal areas
21	Ensure continuity of government operations, emergency services and essential facilities during and immediately after disaster and hazard events
22	Increase resiliency by facilitating rapid disaster recovery
23	Support and encourage the implementation of alternative energy sources
24	Implement mitigation measures that promote the reliability of lifeline systems
25	Promote sustainable and equitable land development practices that direct future development away from vulnerable areas
26	Encourage and support multi-jurisdictional mitigation projects that leverage funding and support from multiple levels of government and community organizations
27	Encourage the establishment of policies to help ensure the prioritization and implementation of mitigation actions and/or projects designed to benefit socially vulnerable populations and underserved communities
28	Ensure that dam infrastructure is maintained
29	Support the identification and access to funding to repair, rehabilitate, or replace dams

21.3 MITIGATION STRATEGY DEVELOPMENT AND UPDATE

21.3.1 Update of Local Jurisdiction Mitigation Strategies

Review of Previous Actions

FEMA defines ***Mitigation Actions*** as specific actions that help to achieve the mitigation goals and objectives.

To evaluate progress on local mitigation actions, each planning partner was provided with a Mitigation Action Plan Review Worksheet, pre-populated with the actions identified for their jurisdiction in the prior (2021) plan. The Planning Partners were asked to indicate the status of each action ("No Progress," "In Progress," "Continuous," "Completed," "Discontinued"). They v ts to quantify the extent of progress and provide reasons for the level of progress or why actions were discontinued. This information is included in the jurisdictional annexes.

Mitigation actions identified as “Complete” or “Discontinued” have been removed from the Planning Partners’ updated mitigation strategies. Actions identified as “No Progress” or “In Progress” have been carried forward in their local updated mitigation strategies. Planning partners were asked to provide further details on these projects to help better define the projects, identify benefits and costs, and improve implementation.

Certain continuous or ongoing actions (Ongoing Capabilities) from the previous plan that represent programs that are now fully integrated into the normal operational and administrative framework of the community are identified in the capabilities assessment of each annex and removed from the updated mitigation strategy (marked as “Discontinued”).

Identifying New Actions

At the kickoff and during subsequent local level planning meetings, all participating jurisdictions were surveyed to identify potential new mitigation actions. Communities also were made aware of potential new mitigation actions as such actions became evident during the plan update process (e.g., through the capability assessment, risk assessment, or the public and stakeholder outreach process).

Developing the Overall Strategy

Members of the Steering Committee and contract consultants worked directly with each jurisdiction (by phone, email, or virtual meetings) to update their annex with mitigation strategies that focus on well-defined, implementable projects that meet the definition or characteristics of mitigation. Mitigation actions were selected with a careful consideration of benefits (risk reduction, losses avoided), costs, and possible funding sources (including mitigation grant programs).

Three annex support meetings were held for Planning Partners to assist in the development of additional actions, foster collaboration between neighboring jurisdictions for mitigation actions, discuss actions that involve cooperation between the County and jurisdictions, and identify steps needed to complete the jurisdictional annexes.

Addressing Known Vulnerabilities

To help support the selection of an appropriate risk-based mitigation strategy, each annex includes a summary of hazard vulnerabilities. These were identified during the plan update process by planning partner representatives, through review of available plans and reports, or through the hazard profiling and risk assessment process.

A mitigation strategy workshop was conducted on May 8, 2024, for all participating jurisdictions to support the development of focused problem statements based on the impacts of natural hazards in the County and their communities. These problem statements provide a detailed description of a problem area, including its impacts on the jurisdiction; past damage; loss of service; etc. An effort was made to include the street address of the problem location, adjacent streets, water bodies, and well-known structures as well as a brief description of existing conditions (topography, terrain, hydrology) of the site. These problem statements form a bridge between the hazard risk assessment, which quantifies impacts on each community, and the development of actionable mitigation strategies.

Incorporating a Range of Action Types

Concerted efforts were made to ensure that Planning Partners develop updated mitigation strategies that cover the range of mitigation action types described in recent FEMA planning guidance (FEMA "Local Mitigation Planning Handbook" March 2013):

- **Local Plans and Regulations**—Actions that include government authorities, policies or codes that influence the way land and buildings are developed and built.
- **Structure and Infrastructure Project**—Actions that involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as community lifelines and other critical facilities. This type of action also involves projects to construct structures to reduce the impact of hazards.
- **Natural Systems Protection**—Actions that minimize damage and losses to natural systems and preserve or restore their functions.
- **Education and Awareness Programs**—Actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as the National Flood Insurance Program, Community Rating System, StormReady (NOAA), and Firewise (NFPA) Communities.

Efforts were also made to develop mitigation strategies that cover the range of mitigation action types described in recent CRS guidance (FEMA 2018):

- **Preventive Measures**—Government, administrative or regulatory actions, or processes that influence the way land and buildings are developed and built. Examples include planning and zoning, floodplain local laws, capital improvement programs, open space preservation, and storm water management regulations.
- **Property Protection**—Actions that include public activities to reduce hazard losses or actions that involve modification of existing buildings or structures to protect them from a hazard or removal of the structures from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass.
- **Public Information**—Actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and educational programs for school-age children and adults.
- **Natural Resource Protection**—Actions that minimize hazard loss and also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- **Structural Flood Control Projects**—Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, setback levees, floodwalls, retaining walls, and safe rooms.
- **Emergency Services**—Actions that protect people and property during and immediately following a disaster or hazard event. Services include warning systems, emergency response services, and the protection of essential facilities

Protecting Critical Facilities

Planning partner mitigation actions that address vulnerable critical facilities have been proposed in consideration of protection against 500-year events or worst-case scenarios. However, in the case of projects funded through federal mitigation programs, the level of protection may be influenced by cost-effectiveness as determined through a formal benefit-cost analysis. In the case of "self-funded" projects, local jurisdiction discretion must be recognized. Further, it must be recognized that the County and jurisdictions have limited authority with regard to mitigation at any level of protection over privately owned critical facilities.

Accounting for Climate Change

As discussed in the hazard profiles in this HMP, the long-term effects of climate change are anticipated to exacerbate the impacts of weather-related hazards (e.g., flood, severe storm, severe winter storm, and wildfire). Communities are working to evaluate and recognize these long-term implications and to incorporate their mitigation strategies into planning and capital improvement updates.

21.3.2 Update of County Mitigation Strategy

The update of the County-level mitigation strategy included a review of progress on the actions identified in the 2021 HMP using a process similar to that used to review local jurisdiction mitigation strategy progress. The County, through its department representatives, was provided with a Mitigation Action Plan Review Worksheet identifying all County-level actions and initiatives from the 2021 plan. The County reviewed each action and provided progress, in order to identify actions to be carried over into the updated mitigation strategy. Additional regional and County-level mitigation actions were identified by the following processes:

- Review of the results and findings of the updated risk assessment
- Review of available regional and County plans, reports, and studies
- Direct input from County departments and other regional agencies, including:
  - Newton Medical Center
  - Rutgers Cooperative Extension of Sussex County
  - Sussex County Community College
  - Sussex County Department of Planning and Economic Development
  - Sussex County Department of Public Health
  - Sussex County Division of Community and Youth Services
  - Sussex County Division of Emergency Management
  - Sussex County Division of Engineering
  - Sussex County Division of Public Works
  - Sussex County Division of Senior Services
  - Sussex County Facilities Management
  - Sussex County Municipal Utilities Authority
  - Sussex County Open Space Committee
  - Sussex County Sheriff's Office
  - Sussex Rural Electric Coop
- Input received through the public and stakeholder outreach process

Various County departments and agencies included mitigation actions to address vulnerable critical facilities, with the same considerations as described above for local jurisdiction mitigation strategies. The County has included mitigation actions to address the long-term implications and potential impacts of climate change, including continuing and long-term planning and emergency management support.

21.3.3 Mitigation Best Practices

Catalogs of hazard mitigation best practices were developed that present a broad range of alternatives to be considered for use in the mitigation strategies, in compliance with 44 CFR Section 201.6(c)(3)(ii). One catalog was developed for each hazard of concern evaluated in this plan. The catalogs present alternatives that are categorized in two ways:

- By who would have responsibility for implementation:
  - Individuals—personal scale
  - Businesses—corporate scale
  - Government—government scale
- By what the alternatives would do:
  - Manipulate the hazard
  - Reduce vulnerability to the hazard
  - Reduce impacts from the hazard
  - Build local capacity to respond to or be prepared for the hazard

The alternatives include actions that will mitigate current risk from hazards and actions that will help reduce risk from changes in the impacts of these hazards resulting from climate change. Hazard mitigation actions recommended in this plan were selected from among the alternatives presented in the catalogs. The catalogs provide a baseline of mitigation alternatives that are backed by a planning process, are consistent with the established goals and objectives, and are within the capabilities of the Planning Partners to implement. Some of these actions may not be feasible based on the selection criteria identified for this plan. The purpose of the catalogs was to provide a list of what could be considered to reduce risk from natural hazards within the planning area. Actions in the catalog that are not included for the partnership's mitigation strategy were not selected for one or more of the following reasons:

- The action is not feasible
- The action is already being implemented
- There is an apparently more cost-effective alternative
- The action does not have public or political support.

The catalogs are included in Appendix I.

21.3.4 Mitigation Strategy Evaluation and Prioritization

FEMA guidance for hazard mitigation establishes how mitigation strategies are to be prioritized, implemented, and administered by local jurisdictions. For this plan update, each mitigation strategy was prioritized using suitable criteria. This provided a systematic approach that considered the opportunities and constraints of implementing each mitigation action.

Evaluation Criteria

The Steering Committee chose the following evaluation criteria for the prioritization process:

1. Life Safety—How effective will the action be at protecting lives and preventing injuries? Will the proposed action adversely affect one segment of the population?
2. Property Protection—How significant will the action be at eliminating or reducing damage to structures and infrastructure?
3. Cost-Effectiveness—Are the costs to implement the action commensurate with the benefits achieved?
4. Political—Is there overall public support for the action? Is there the political will to support it? Is the action at odds with development pressures?
5. Legal—Does the jurisdiction have the authority to implement the action?
6. Fiscal—Is funding for the action available under existing program budgets or would it require a new budget authorization or funding from another source, such as grants?
7. Environmental—What are the potential environmental impacts of the action? Will it comply with environmental regulations? Are there co-benefits of this action?
8. Social Vulnerability—Does the action benefit socially vulnerable populations and underserved communities?
9. Administrative—Does the jurisdiction have the staff and administrative capabilities to implement the action and maintain it or will outside help be necessary? Does the scale and scope of the action align with the jurisdiction's capabilities?
10. Hazards of Concern—Does the action address one or more of the jurisdiction's high-ranked hazards?
11. Climate Change—Does the action incorporate climate change projections? Is the action designed to withstand or address long-term conditions?
12. Timeline—Can the action be completed in less than five years?
13. Community Lifelines—Does the action benefit community lifelines?
14. Other Local Objectives—Does the action advance other local objectives, such as capital improvements, economic development, environmental quality, or open space preservation? Does it support the policies of other plans and programs?

Benefit/Cost Review

FEMA guidance for hazard mitigation requires that the prioritization of the mitigation strategy emphasize a benefit/cost review of the proposed actions (Criterion 3 in the list above). For all actions identified in the local strategies, jurisdictions identified the associated costs and benefits as follows:

- **Costs** presented include the total project estimation. This can include administrative, construction (engineering, design, and permitting), and maintenance costs.
- **Benefits** are the savings from losses avoided attributed to project implementation. These can include life safety, structure and infrastructure damages, loss of service or function, and economic and environmental damage and losses.

When possible, jurisdictions were asked to identify the actual or estimated dollar costs and associated benefits. Where estimates of costs and benefits were available, the ratings were defined follows:

Low < = $10,000 Medium = $10,000 to $100,000 High > = $100,000

Often numerical costs and/or benefits could not be quantified at the current level of development. In this case, jurisdictions were asked to evaluate project cost-effectiveness using qualitative *high*, *medium*, and *low* ratings based on the definitions in Table 21-3.

Table 21-3 Qualitative Cost and Benefit Ratings

Costs	
High	Existing funding levels are not adequate to cover the costs of the proposed project, and implementation would require an increase in revenue through an alternative source (e.g., bonds, grants, and fee increases).
Medium	The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
Low	The project could be funded under the existing budget. The project is part of or can be part of an existing, ongoing program.
Benefits	
High	Project will have an immediate impact on the reduction of risk exposure to life and property.
Medium	Project will have a long-term impact on the reduction of risk exposure to life and property or will provide an immediate reduction in the risk exposure to property.
Low	Long-term benefits of the project are difficult to quantify in the short-term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-effective.

For some of the Sussex County actions identified, the Planning Partnership may seek financial assistance under FEMA's Hazard Mitigation Assistance (HMA) programs. These programs require detailed benefit/cost analysis as part of the application process. The benefit/cost review applied for the prioritization of actions in this update did not include the level of detail required by FEMA for project grant eligibility under HMA grant programs. These analyses will be performed when funding applications are prepared, using FEMA's Benefit-Cost Analysis model.

The Planning Partnership is committed to implementing mitigation strategies with benefits that exceed costs. For projects not seeking financial assistance from grant programs that require this sort of analysis, the Planning Partnership reserves the right to define benefits according to parameters that meet its needs and the goals and objectives of this plan.

Priority Scoring

Participating jurisdictions were asked to use these criteria to prioritize their identified mitigation actions. For each mitigation action, the jurisdictions assigned a numeric score for each of the 14 evaluation criteria:

- 1 = Highly effective or feasible
- 0 = Neutral
- -1 = Ineffective or not feasible

Jurisdictions were asked to provide a brief summary of the rationale behind the numeric rankings assigned. The numerical results were totaled and then used by each jurisdiction to help prioritize the action or strategy as *low*, *medium*, or *high*. Actions that had a numerical value between 0 and 6 were categorized as *low priority*; actions with numerical values between 7 and 10 were categorized as *medium priority*; and actions with numerical values between 11 and 14 were categorized as *high priority*. While this provided a consistent, systematic methodology to support the evaluation and prioritization of mitigation actions, jurisdictions may have additional considerations that could influence their overall prioritization of mitigation actions.

For this plan update there was an effort to develop clear, action-oriented mitigation strategies that include actions seen by the community as the most effective approaches to achieve mitigation goals and objectives.

For that reason, many of the actions in the updated mitigation strategy were ranked as *high* or *medium* priority. This reflects the community's intent to implement them, available resources notwithstanding. In general, actions that would

It is noted that jurisdictions may be carrying forward mitigation actions from prior mitigation strategies that were prioritized using a different, but not inherently contradictory, approach. At their discretion, jurisdictions carrying forward prior actions were encouraged to re-evaluate their priority, particularly if conditions that would affect the prioritization criteria had changed.

22. PLAN MAINTENANCE AND IMPLEMENTATION PROCEDURES

This chapter details the formal process that will ensure that the updated HMP remains an active and relevant document and that the Planning Partnership maintains its eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. In addition, this chapter describes how public participation will be integrated throughout the plan maintenance and implementation process. It explains how the mitigation strategies outlined in this plan update will be incorporated into existing community planning mechanisms and programs.

22.1 HMP COORDINATOR AND JURISDICTION POINTS OF CONTACT

The HMP Coordinator is assigned to manage the maintenance and update of the plan during its approval period (the five-year period between FEMA's approval of the plan and its expiration), with the following responsibilities:

- Convene the Planning Partnership
- Be the prime point of contact for questions regarding the plan and its implementation
- Coordinate the incorporation of additional information into the plan
- Manage the monitoring, evaluation, and updating responsibilities identified in this section

Currently, the Sussex County HMP Coordinator is designated as:

Steven Sugar, Division of Emergency Management
Sussex County Sheriff's Office
135 Morris Turnpike
Newton, New Jersey 07860
(973) 579-0380 x2530
Email: ssugar@sussexcountysheriff.com

Primary and secondary mitigation planning representatives (points of contact) are identified in each jurisdictional annex in Volume II. It will be the responsibility of each jurisdiction and its representatives to inform the HMP Coordinator of any changes in representation.

22.2 MAINTENANCE AND IMPLEMENTATION TASKS

The plan maintenance matrix shown in Table 22-1 provides a synopsis of responsibilities for plan monitoring, integration, evaluation, and update, which are discussed in further detail in the sections below.

Table 22-1. Plan Maintenance Matrix

Task	Approach	Timeline	Lead Responsibility	Support Responsibility
Monitoring	Planning partners to recommend update of mitigation strategies, progress toward implementation of actions, identification of new actions, and update of information on funding opportunities.	Each June or after the occurrence of a presidentially declared disaster	Jurisdictional points of contact identified in Volume II	Jurisdictional implementation lead identified in Volume II
Integrating	Distribute the safe growth worksheet (see Table 22-2) for annual review and update by all participating jurisdictions.	June each year with interim email reminders to address integration in county and municipal activities	HMP Coordinator and jurisdictional points of contact identified in Volume II	
Evaluating	Review the status of previous actions, as submitted by the monitoring task lead, and assess the effectiveness of the plan; compile and finalize update of mitigation strategy.	Updated progress report completed by September 30 of each year	Jurisdictional points of contact identified in Volume II	Alternate jurisdictional points of contact
Updating	Reconvene the Planning Partners to guide a comprehensive update to review and revise the plan.	Every 5 years or upon major update to Comprehensive Plan or after the occurrence of a major disaster	HMP Coordinator	Jurisdictional points of contacts identified in Volume II
Grant Monitoring	Notify Planning Partners about grant opportunities, maintain a list of eligible jurisdiction-specific projects for funding consideration, and notify Planning Partners of fiscal year mitigation priorities.	Continuously as grant opportunities are identified	HMP Coordinator	Jurisdictional points of contacts identified in Volume II
Public Involvement	Maintain the HMP, inform the public of hazard events via social media outlets, promote educational workshops on hazard topics, and track and file public comments received regarding the HMP.	Continuously	HMP Coordinator and jurisdictional points of contact identified in Volume II	Alternate jurisdictional points of contact

22.2.1 Monitoring

The Planning Partnership will be responsible for monitoring and documenting annual progress on the plan. Each year, beginning one year after plan development, Sussex County and local Planning Partnership representatives will collect and process information from the persons responsible for initiating or overseeing the mitigation projects in each department, agency, and organization involved in implementing mitigation actions identified in their jurisdictional annexes. In the first year of the approval period, this will be accomplished using an online performance progress reporting system (the BATool^{SM}), which will enable each planning partner to:

- Directly access mitigation actions
- Easily update the status of each project
- Document successes or obstacles to implementation
- Add or delete projects to maintain mitigation strategy implementation

Participating partners will be prompted by the tool to update progress on a quarterly basis, providing an incentive for them to refresh their mitigation strategies and to continue implementation of actions. This reporting system facilitates the sorting and prioritization of projects and will support the submittal of an increased number of project grant fund applications. Planning Partnership representatives will be expected to document the following:

- Progress on the implementation of mitigation actions
- Obstacles or impediments to implementation of actions
- Any grant applications filed on behalf of any of the participating jurisdictions
- Hazard events and losses occurring in their jurisdiction
- Additional mitigation actions believed to be appropriate and feasible
- Public and stakeholder input

Plan monitoring for years 2 through 4 of the approval period will be addressed via the BATool^SM or manually.

22.2.2 Integrating the HMP into Municipal Planning Mechanisms

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. Within the County, there are many existing plans and programs that support hazard risk management, and it is critical that this HMP integrate and coordinate with and complement those existing plans and programs.

The Capability Assessment (Chapter 20) provides a summary and description of the existing plans, programs, and regulatory mechanisms at all levels of government (federal, state, county, and local) that support hazard mitigation within the County. In the jurisdictional annexes in Volume II, each planning partner identified how it has integrated hazard risk management into its existing planning, regulatory, and administrative framework ("existing integration") and how they intend to promote this integration further ("opportunities for future integration").

It is the intention of the Planning Partners to incorporate mitigation planning as an integral component of daily government operations. Planning Partner representatives will work with other local government officials to integrate the newly adopted hazard mitigation goals and actions into the general operations of government and partner organizations. The sample adoption resolution (Appendix A – Adoption Resolution) includes a resolution item stating the intent of the local governing body to incorporate mitigation planning as an integral component of government and partner operations. By doing so, the Planning Partnership anticipates that:

- Hazard mitigation planning will be formally recognized as an integral part of overall emergency management efforts.
- The HMP, comprehensive plans, emergency management plans and other relevant planning mechanisms will become mutually supportive documents that work in concert to meet the goals and needs of county residents.

Other planning processes and programs to be coordinated with the recommendations of the HMP include the following:

- Emergency response plans
- Training and exercise of emergency response plans
- Debris management plans
- Recovery plans

- Capital improvement programs
- Municipal codes
- Community design guidelines
- Water-efficient landscape design guidelines
- Stormwater management programs
- Water system vulnerability assessments
- Community wildfire protection plans
- Comprehensive flood hazard management plans
- Resiliency plans
- Community Development Block Grant Disaster Recovery action plans
- Public information and improved public participation
- Educational programs
- Continued interagency coordination

During the HMP annual review process, each participating jurisdiction will be asked to document how it is utilizing and incorporating the HMP into its day-to-day operations and planning and regulatory processes. Each municipality will identify additional policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions and include these findings and recommendations in the annual HMP progress report. The checklist presented in Table 22-2, adapted from FEMA's 2013 Local Mitigation Handbook, will help a community analyze how hazard mitigation is integrated into local plans, ordinances, regulations, and policies. Completing the checklist will help jurisdictions identify areas that currently integrate hazard mitigation and where to make improvements and reduce vulnerability for future development.

Table 22-2. Safe Growth Check List

Planning Mechanisms	Yes	No	How is it being done or how will this be utilized in the future?
Operating, Municipal, and Capital Improvement Program Budgets			
When constructing upcoming budgets, are hazard mitigation actions funded as budget allows?			
Are construction projects evaluated to see if they meet the hazard mitigation goals?			
Does the municipality review mitigation actions when allocating funding during annual budget adoption processes?			
Do budgets limit expenditures on projects that would encourage development in areas vulnerable to natural hazards?			
Do infrastructure policies limit extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards?			
Do budgets provide funding for hazard mitigation projects identified in the HMP?			
Human Resource Manual			
Do any job descriptions specifically include identifying and/or implementing mitigation projects/actions or other efforts to reduce natural hazard risk?			

Planning Mechanisms	Yes	No	How is it being done or how will this be utilized in the future?
Building and Zoning Ordinances			
Prior to zoning changes or development permitting, does the municipality review the HMP and other hazard analyses to ensure consistent and compatible land use?			
Does the zoning ordinance discourage development or redevelopment within natural areas, including wetlands, floodways, and floodplains?			
Does the zoning ordinance contain natural overlay zones that set conditions			
Does the zoning ordinance require developers to take additional actions to mitigate natural hazard risk?			
Do rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use?			
Does the zoning ordinance prohibit development within or filling of wetlands, floodways, and floodplains?			
Subdivision Regulations			
Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas?			
Do the regulations provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources?			
Do the regulations allow density transfers where hazard areas exist?			
Comprehensive Plan			
Are the goals and policies of the plan related to those of the HMP?			
Does the plan provide adequate space for expected future growth in areas located outside natural hazard areas?			
Land Use			
Does the future land use map clearly identify natural hazard areas?			
Do the land use policies discourage development or redevelopment in natural hazard areas?			
Transportation Plan			
Does the transportation plan limit access to hazard areas?			
Is transportation policy used to guide growth to safe locations?			
Are transportation systems designed to function under disaster conditions (e.g., evacuation)?			
Environmental Management			
Are environmental systems that protect development from hazards identified and mapped?			
Do environmental policies maintain and restore protective ecosystems?			
Do environmental policies provide incentives to development located outside protective ecosystems?			
Grant Applications			
Are data and maps used as supporting documentation in grant applications?			

Planning Mechanisms	Yes	No	How is it being done or how will this be utilized in the future?
Municipal Ordinances			
Is hazard mitigation a priority when updating municipal ordinances?			
Economic Development			
Does the local economic development group take into account information regarding identified hazard areas when assisting new businesses in finding a location?			
Public Education and Outreach			
Does the municipality have any public outreach mechanisms/ programs in place to inform citizens on natural hazards, risk, and ways to protect themselves during such events?			

22.2.3 Evaluating

Evaluation of the mitigation plan is an assessment of whether the planning process and actions have been effective, whether the HMP goals are being achieved, and whether changes are needed. The HMP Coordinator will consult with the Planning Partners to evaluate the effectiveness of the plan implementation and to reflect changes that could affect mitigation priorities or available funding. These evaluations will assess whether:

- Goals and objectives address current and expected conditions
- The nature or magnitude of the risks has changed
- Current resources are appropriate for implementing the HMP and if different or additional resources are now available
- Actions were cost effective
- Schedules and budgets are feasible
- Implementation problems are present, such as technical, political, legal, or coordination issues with other agencies
- Outcomes have occurred as expected
- Changes in local resources impacted plan implementation (e.g., funding, personnel, and equipment)
- New agencies, departments, and staff are included, involving other local governments

The status of the HMP will be discussed and documented at an annual plan review meeting of the Planning Partnership to be held either in person or via teleconference approximately one year from the date of local adoption of this update and successively thereafter. The HMP Coordinator will be responsible for calling participants and coordinating the annual plan review meeting and soliciting input regarding progress toward meeting plan goals and objectives. At least two weeks before the meeting, the HMP Coordinator will advise Planning Partnership members of the meeting date, agenda, and expectations of the members. At the meeting, the Planning Partnership will review the mitigation goals, objectives, and activities using performance-based indicators, including the following:

- New agencies/departments
- Project completion
- Underspending/overspending
- Achievement of the goals and objectives
- Resource allocation

- Timeframes
- Budgets
- Lead/support agency commitment
- Resources
- Feasibility

Finally, the Planning Partnership will evaluate how other programs and policies have conflicted with or augmented planned or implemented mitigation actions and will identify policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions. Other programs and policies can include those that address:

- Economic development
- Environmental preservation
- Historic preservation
- Redevelopment
- Health and safety
- Recreation
- Land use and zoning
- Public education and outreach
- Transportation

The Planning Partnership should refer to evaluation forms in the FEMA 386-4 guidance document to assist in the evaluation process (Worksheets #2 and #4; see Appendix F – Plan Maintenance). Further, the Planning Partnership should refer to any process and plan review deliverables developed by the County or participating jurisdictions as a part of the plan review processes for prior or other existing local HMPs within the county.

The HMP Coordinator will be responsible for preparing an annual HMP progress report for each year of the approval period based on the information provided by the Planning Partners and other information as appropriate. These annual reports will provide data for the five-year update of this HMP and will assist in pinpointing any implementation challenges. By monitoring the implementation of the HMP, the Planning Partnership will be able to assess which actions are completed, which are no longer feasible, and which require additional funding.

Following any major disasters, the HMP will be evaluated and revised to determine if the recommended actions remain relevant and appropriate. The risk assessment will also be revisited to see if any changes are necessary based on the pattern of disaster damage or if data listed in the hazard profiles of this plan has been collected to facilitate the risk assessment. This is an opportunity to increase the community's disaster resistance and build a better and stronger community.

22.2.4 Updating

FEMA guidance for hazard mitigation requires that local hazard mitigation plans be reviewed, revised as appropriate, and resubmitted for approval to remain eligible for benefits awarded under DMA 2000. It is the intent of the Sussex County HMP Planning Partnership to update this plan on a five-year cycle from the date of initial plan adoption.

To facilitate the update process, the HMP Coordinator, with support of the Planning Partnership, will use the second annual Planning Partnership meeting to develop and commence the implementation of a detailed plan update program. Prior to the five-year update, the HMP Coordinator will invite representatives from the New Jersey Office of Emergency Management to provide guidance on plan update procedures. At a minimum, this will establish who will be responsible for managing and completing the plan update effort, items that need to be included in the updated plan, and a detailed timeline with milestones to ensure that the update is completed according to regulatory requirements. At this meeting, the project team will determine what resources will be needed to complete the update and seek to secure these resources.

Following each 5-year update of the HMP, the updated plan will be distributed for public comment. After all comments are addressed, the HMP will be revised and distributed to all Planning Partners for formal approval.

22.2.5 Grant Monitoring and Coordination

Sussex County intends to be a resource to the Planning Partnership in the support of project grant writing and development. The degree of this support will depend on the level of assistance requested by the Planning Partners during openings for grant applications. As part of grant monitoring and coordination, Sussex County intends to provide the following:

- Notification to Planning Partners about impending grant opportunities
- A current list of eligible, jurisdiction-specific projects for funding pursuit consideration
- Notification about mitigation priorities for the fiscal year to assist the Planning Partners in the selection of appropriate projects.

22.2.6 Continued Public Involvement

The Planning Partners are committed to the continued involvement of the public in the hazard mitigation process. This HMP update will continue to be posted online at the following link: www.sussexcountynjhmp.com. In addition, public outreach and dissemination of the HMP will include the following:

- Links to the plan on local websites of each jurisdiction with capability
- Continued utilization of existing social media outlets (Facebook, X, etc.) to inform the public of natural hazard events, such as floods and severe storms; the public can be educated via the jurisdictional websites on how these applications can be used in an emergency situation
- Promotion of articles or workshops on hazards to educate the public and keep them aware of the dangers of hazards

The HMP Coordinator will be responsible for receiving, tracking, and filing public comments regarding this HMP. The public will have an opportunity to comment on the plan via the hazard mitigation website at any time. The HMP Coordinator will ensure that:

- Public and stakeholder comments and input on the plan, and hazard mitigation in general, are collected, recorded, and addressed as appropriate
- The Sussex County HMP website is maintained and updated as appropriate
- Copies of the latest approved plan are available for review at appropriate county facilities, along with instructions to facilitate public input and comment on the plan

Public notices, including media releases, are made (as appropriate) to inform the public of the availability of the plan, particularly during plan update cycles.

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GLOSSARY

%	Percent
ACS	American Community Survey
APA	Approval Pending Adoption
ASOS	Automated Surface Observation Systems
ALICE	Asset Limited, Income Constrained, Employed
ASDSO	Association of State Dam Safety Officials
ATSDR	Agency for Toxic Substances and Disease Registry
BCA	Benefit Cost Analysis
BCEGS	Building Code Effectiveness Grading Schedule
BFE	Base Flood Elevation
BRIC	Building Resilient Infrastructure and Communities
BPU	Board of Public Utilities
CAC	Community Assistance Contacts
CASA	Court Appointed Special Advocate
CAV	Community Assisted Visit
CCAHA	Conservation Center for Art and Historic Artifacts
CDBG	Community Development Block Grant
CDBG-DR	Community Development Block Grant Disaster Recovery
CDC	Centers for Disease Control
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CR	County Route
CRREL	Cold Regions Research and Engineering Laboratory
CRS	Community Rating System
CRTK	Community Right to Know

COVID	Coronavirus Disease
CPR	Cardiopulmonary Resuscitation
DEM	Digital Elevation Model
DEM	Division of Emergency Management
DFIRM	Digital Flood Insurance Rate Map
DMA 2000	Disaster Mitigation Act of 2000
DPW	Department of Public Works
DR	Major Disaster Declaration (FEMA)
DWSRF	Drinking Water State Revolving Fund
EAB	Emerald Ash Borer
EAP	Emergency Action Plan
EEE	Eastern Equine Encephalitis
EEOC	Equal Employment Opportunity Commission
EF	Enhanced Fujita Scale
EM	Emergency Declaration (FEMA)
EMPG	Emergency Management Program Grant
EMS	Emergency Medical Services
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ERB	Energy Resilience Bank
EOC	Emergency Operation Center
EOP	Emergency Operation Plan
ES	Executive Summary
ESF	Emergency Support Function
ESRI	Environmental Systems Research Institute
EWP	Emergency Watershed Protection Program
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission

FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIA	Flood Insurance Administration
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FPA	Floodplain Administrator
FTA	Federal Transit Authority
FY	Fiscal Year
GDRO	Governor's Disaster Recovery Office
GIS	Geographic Information System
GPS	Global Positioning System
HAB	Harmful Algal Bloom
HAZMAT	Hazardous Materials
HAZUS	Hazards U.S.
HAZUS-MH	Hazards U.S. Multi-Hazard
HHPD	High Hazard Potential Dam
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HSGP	Homeland Security Grant Program
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating, Ventilation, and Air Conditioning
IA	Individual Assistance
IEP	Ingestion Exposure Pathway
InSAR	Interferometric Synthetic Aperture Radar
KBDI	Keetch-Bryam Drought Index
LEPC	Local Emergency Planning Committee
LWCF	Land and Water Conservation Fund

MLUL	Municipal Land Use Law
MMI	Modified Mercalli Intensity Scale
MRP	Mean Return Period
N/A	Not Applicable
NA	Not Available
NASA	National Aeronautics and Space Administration
NCDC	National Climate Data Center
NCEI	National Centers for Environmental Information
NDMC	National Drought Mitigation Center
NDSP	National Dam Safety Program
NEHRP	National Earthquake Hazards Reduction Program
NESEC	Northeast States Emergency Consortium
NFDRS	National Fire Danger Rating System
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NGO	Non-Governmental Organization
NHC	National Hurricane Center
NHTSA	National Highway Traffic Safety Administration
NID	National Inventory of Dams
NIDIS	National Integrated Drought Information System
NJ	New Jersey
NJAC	New Jersey Administrative Code
NJADAPT	New Jersey Climate Adaptation Alliance
NJCEP	New Jersey Clean Energy Program
NJDA	New Jersey Department of Agriculture
NJDCA	New Jersey Department of Community Affairs
NJDEP	New Jersey Department of Environmental Protection

NJDOH	New Jersey Department of Health
NJDOT	New Jersey Department of Transportation
NJFFS	New Jersey Forest Fire Service
NJFHADF	New Jersey Flood Hazard Area Design Flood
NJGIN	New Jersey Geographic Information Network
NJGWS	New Jersey Geological and Water Survey
NJOEM	New Jersey Office of Emergency Management
NJOIT	New Jersey Office of Information Technology
NJOGIS	New Jersey Office of Geographic Information Systems
NJPDES	New Jersey Pollutant Discharge Elimination System
NJRA	New Jersey Redevelopment Authority
NJSA	New Jersey Statutes Annotated
NJTPA	New Jersey Transportation Planning Authority
NLDN	National Lightning Detection Network
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List (EPA)
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRI	National Risk Index
NRI	Natural Resources Inventory
NSIDC	National Snow and Ice Data Center
NWS	National Weather Service
NY	New York
NYCEM	New York City Emergency Management
OEM	Office of Emergency Management
ONJSC	Office of the New Jersey State Climatologist
PA	Pennsylvania
PA	Public Assistance

PDM	Pre-Disaster Mitigation Program
PDSI	Palmer Drought Severity Index
PGA	Peak Ground Acceleration
PSAF	Pandemic Severity Assessment Framework
RAISE	Rebuilding American Infrastructure with Sustainability and Equity
RCV	Replacement Cost Value
RCRCD	Riverside-Corona Resource Conservation District
RL	Repetitive Loss
RLF	Revolving Loan Fund
RMC	Registered Municipal Clerk
RPPR	Release and Pollution Prevention Report
RSI	Regional Snowfall Index
SARA	Superfund Amendments and Reauthorization Act
SCPB	Sussex County Planning Board
SCMUA	Sussex County Municipal Utilities Authority
SFHA	Special Flood Hazard Area
SHMT	State Hazard Mitigation Team
SR	State Route
SLE	St. Louis Encephalitis
SPC	Storm Prediction Center
SSBG	Social Services Block Grant
SSVF	Supportive Service for Veteran Families
TBD	To Be Determined
THIRA	Threat Hazard Identification and Risk Assessment
TR	Tributary
TRI	Toxic Chemical Release Inventory
UCC	Uniform Construction Code
USACE	United States Army Corps of Engineers

US	United States
US DHS	United States Department of Homeland Security
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USDOT	United State Department of Transportation
USEDA	United States Economic Development Administration
USEIA	United States Energy Information Administration
USFS	United States Fire Service
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WMA	Watershed Management Area
WCT	Wind Chill Index
WFO	Weather Forecast Office
WHO	World Health Organization
WHP	Wildfire Hazard Potential
WIC	Women, Infants, and Children
WNV	West Nile Virus
WUI	Wildland/Urban Interface
YAP	Youth Advocate Program