

ROCKLAND COUNTY, NEW YORK

**MULTI-
JURISDICTIONAL
HAZARD MITIGATION
PLAN**



**Volume 1
OCTOBER 2024**

EXECUTIVE SUMMARY

The 2024 update to the Rockland County Hazard Mitigation Plan (HMP) was prepared in accordance with the Disaster Mitigation Act of 2000 (DMA 2000). DMA 2000 requires state and local governments to prepare HMPs to remain eligible to receive pre-disaster mitigation grant funds available in the wake of federally declared disasters. Importantly, pre-disaster mitigation grant funds are separate and distinct from federal and state funds available for direct post-disaster relief (i.e., Public Assistance [PA] and Individual Assistance [IA]). Availability of those funds remains unchanged if a federally declared disaster occurs in Rockland County; affected municipalities will still receive immediate recovery assistance regardless of their participation in this HMP. However, DMA 2000 improves the disaster planning process by (1) increasing requirements for hazard mitigation planning, and (2) necessitating that participating municipalities document their hazard mitigation planning process and identify hazards, potential losses, and mitigation needs, goals, and strategies.

Hazard Mitigation is any sustained action taken to reduce or eliminate longterm risk and effects that can result from specific hazards. FEMA defines a **Hazard Mitigation Plan** as documentation of a state or local government’s evaluation of natural hazards and strategy to mitigate such hazards.

Rockland County Multi-Jurisdictional Planning Process

Rockland County developed and adopted the Rockland County HMP in 2010, and later updated this plan in 2018. DMA 2000 regulations require that local plans be formally updated and adopted every 5 years, reassessing risk and updating local strategies to manage and mitigate those risks. To comply, Rockland County and inclusive jurisdictions actively participated in the update of the HMP. Extensive outreach efforts by the Rockland County Office of Emergency Management (OEM) resulted in full participation from all municipalities. Upon completion and approval of the HMP, participating jurisdictions will continue to address and implement the findings and recommendations of this HMP. Table ES-1 lists local governments that actively participated in the HMP update process to achieve or maintain their compliance with DMA 2000 requirements.

Table ES-1. Participating Jurisdictions in the 2024 Rockland County HMP Update

Jurisdictions			
Rockland County			
Airmont (V)	Hillburn (V)	Orangetown (T)	Stony Point (T)
Chestnut Ridge (V)	Kaser (V)	Piermont (V)	Suffern (V)
Clarkstown (T)	Montebello (V)	Pomona (V)	Upper Nyack (V)
Grand View-on-Hudson (V)	New Hempstead (V)	Ramapo (T)	Wesley Hills (V)
Haverstraw (T)	New Square (V)	Sloatsburg (V)	West Haverstraw (V)
Haverstraw (V)	Nyack (V)	Spring Valley (V)	

During this HMP update process, Rockland County and the participating jurisdictions accomplished the following:

- Developed a steering committee and planning partnership.
- Reviewed and updated the hazards of concern.
- Profiled and prioritized these hazards.
- Estimated inventory at risk and potential losses associated with these hazards.

- Reviewed and updated hazard mitigation goals and objectives Hazard Mitigation is any sustained action taken to reduce or eliminate long-term risk and effects that can result from specific hazards. FEMA defines a Hazard Mitigation Plan as documentation of a state or local government’s evaluation of natural hazards and strategy to mitigate such hazards.
- Reviewed and updated county and local mitigation strategies to address identified risks and vulnerabilities.
- Updated and developed maintenance procedures to be executed upon approval of the HMP.

As required by DMA 2000, the participating jurisdictions and Rockland County have informed the public about HMP update efforts and have provided opportunities for public comment and input regarding the planning process. In addition, numerous agencies and stakeholders have participated as core or support members to provide input and expertise to the planning process. This HMP documents the process and outcomes of the jurisdictions’ mitigation planning efforts.

Rockland County and the participating jurisdictions incorporate mitigation planning as an integral component of daily government operations through existing processes and programs. Announcements regarding the planning process were publicized via public notice and on the Rockland County HMP website ([Hazard Mitigation | Rockland County \(Rocklandhmp.com\)](https://www.rocklandhmp.com)). The website also offered the public and stakeholder groups an opportunity to provide their input through a community survey. Updates to the HMP will be similarly announced after annual plan reviews and five-year updates. The questionnaire asked quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. The Rockland County HMP Coordinator at the Rockland County OEM and local planning partnership representatives will be responsible for receiving, tracking, and filing public comments regarding this HMP.

Rockland County Hazard Mitigation Plan Adoption

Once the Federal Emergency Management Agency (FEMA) formally approves this HMP update, Rockland County and all participating jurisdictions will be required to formally adopt the updated HMP. A sample copy of an adoption resolution is included in Appendix A.

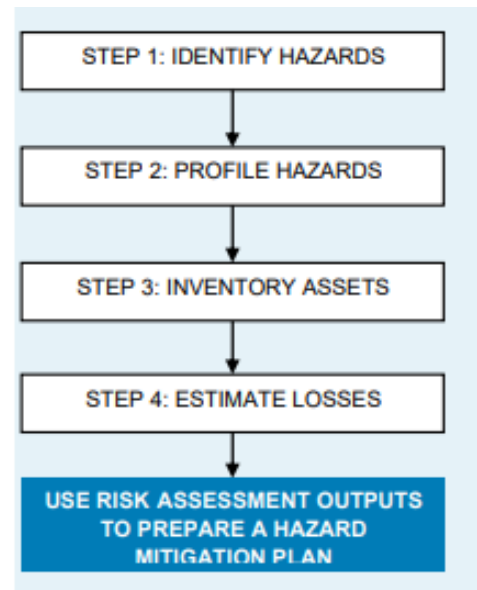
Risk Assessment

A key component of an HMP is accurate identification of risks posed by hazards and corresponding impacts on the community. The process of identifying hazards of concern, profiling hazard events, and conducting a vulnerability assessment is known as a risk assessment. The risk assessment portion of the mitigation planning process included the steps shown on Figure ES-1. The following section summarizes these steps.

Step 1: Identify hazards of concern. Rockland County considered the full range of natural and non-natural hazards that could impact the county, and then identified and ranked hazards of greatest concern. The following list of 11 hazards of concern was selected for further evaluation in the HMP:

- Dam Failure
- Disease Outbreak
- Drought
- Earthquake
- Extreme Temperature
- Flood (riverine, ice jam, flash flood)
- Landslide
- Severe Storm
- Severe Winter Storm
- Wildfire

Figure ES-1. Risk Assessment Process



Step 2: Prepare a profile of each hazard of concern. These profiles assist communities in evaluating and comparing hazards that can impact their areas. Each type of hazard has unique characteristics that vary from event to event. That is, impacts associated with a specific hazard can vary depending on the magnitude and location of each event (a hazard event is a specific, uninterrupted occurrence of a particular type of hazard). Further, probability of occurrence of a hazard at a given location affects the priority assigned to that hazard. Finally, each hazard impacts different communities in different ways, depending on geography, local development, population distribution, age of buildings, and mitigation measures already implemented.

Steps 3 and 4: Evaluate community assets and identify assets exposed or vulnerable to the identified hazards of concern. Hazard profile information combined with data regarding population, demographics, general building stock, and critical facilities at risk prepares the community to develop risk scenarios and estimate potential damages and losses from each hazard.

Overall vulnerability of Rockland County to the hazards of concern cannot be underestimated. Frequent severe storms result in wind damage and flooding that affect residents, businesses, and government services. National Flood Insurance Program (NFIP) statistics for the County, as of December 2023, identify approximately 962 NFIP policies in force, and paid claims since 1978 of nearly \$44 million.

Rockland County Mitigation Strategy

Outcomes of the risk assessment, supplemented by community input, provided a basis for reviewing past mitigation actions, future goals, and appropriate local mitigation actions.

Mission Statement, Goals, and Objectives

The 2018 HMP specified seven overarching mitigation goals that summarized hazard reduction outcomes the county and participating jurisdictions want to achieve. The Planning Partnership reviewed those seven mitigation goals and elected to edit them to the following mitigation goals:

- Goal 1.** Protect life from natural and man-made hazards through planning, preparation, mitigation, and integration.
- Goal 1.** Protect existing and future property including critical facilities, community lifelines, infrastructure, public, and private structures.
- Goal 2.** Increase hazard risk and mitigation education and awareness programs for government agencies, private sector businesses, non-profit organizations, residents, and property owners.
- Goal 3.** Preserve and restore natural systems through sustainable, cost-effective, and resilient mitigation projects and programs.
- Goal 4.** Build emergency management capabilities through continuity of operations before, during, and after hazard events.
- Goal 5.** Promote and encourage sustainability practices to reduce or eliminate impacts from natural and man-made hazard events.
- Goal 6.** Integrate the hazard mitigation plan to ensure consistency with existing and future planning documents, regulatory programs, codes, ordinances, and state and federal hazard mitigation strategies.

The 2024 HMP identified 11 objectives intended to meet these six goals. Those goals, along with their corresponding objectives, guided identification, evaluation, and prioritization of specific mitigation actions. After review of the 2018 objectives, the Planning Partnership developed a set of objectives show in Table ES-2 that align more closely with the updated goals above.

Table ES-2. Rockland County Hazard Mitigation Plan Objectives

Number	Objective
1	Enhance early notification systems and communication infrastructure to provide adequate warning and information regarding all hazards
2	Review, strengthen and enforce existing building codes, ordinances, and safety procedures to increase the resilience of construction to the impacts of hazards.
3	Identify and implement cost-effective structural and property protection projects to reduce the impacts from flooding, including acquisition, elevation, and relocation projects.
4	Develop and distribute public awareness materials about natural hazard risks, preparedness, and mitigation.
5	Ensure continuity of government operations, emergency services, and essential facilities and adequate supplies for emergency response services at the local level during and immediately after hazard events.
6	Strengthen communication and cooperation between public agencies, citizens, non-profit groups, and businesses to implement mitigation activities effectively.
7	Maintain and encourage ongoing relationships between state agencies and partners to play an active and vital role in preservation and restoration of vulnerable natural systems.
8	Pursue mitigation actions that will preserve or restore the environment’s natural abilities to absorb the impacts of natural and man-made hazards.
9	Encourage smart growth, neighborhood revitalization and economic development with an awareness of the existence and location of natural hazard areas to mitigate impacts of hazards on life, property, and the economy, while exploring sustainable development measures and preserving quality of life and existing community and neighborhood character.
10	Improve hazard data through participation in studies, research, and mapping to enhance information related to the impacts of hazards and related risks, vulnerability, and losses.
11	Continue to participate in state, regional, and local programs and efforts that focus on practices that support or enhance resiliency.

Capability Assessment

Capability assessments were prepared by Rockland County and each participating jurisdiction. A capability assessment is an inventory of a community's missions, programs, and policies and an analysis of its capacity to implement them. This assessment is an integral part of the planning process. The capability assessment process includes identification, review, and analysis of current local and state programs, policies, regulations, funding, and practices that may either facilitate or hinder mitigation.

By completing these assessments, Rockland County and participating jurisdictions learned how or whether they would be able to implement certain mitigation actions by determining the types of mitigation actions that may be prohibited by law, limitations that may hinder mitigation actions, the range of local and/or state administrative, programmatic, regulatory, financial, and technical resources available to assist in implementing their mitigation actions.

Identification, Prioritization, Analysis, and Implementation of Mitigation Actions

Rockland County has seen much success in the implementation of the 2018 HMP, particularly with actions that integrate hazard mitigation into jurisdictions' daily operations. As part of the planning process for this HMP update, all participating jurisdictions evaluated their risks and known or anticipated losses to the hazards of concern, assessed their capabilities to manage hazard risk, reviewed progress on past mitigation efforts, and identified a comprehensive range of mitigation alternatives and actions they endeavor to implement as resources are identified and available. The HMP identifies all proposed mitigation actions relevant to achievement of the goals and objectives presented above. The county and participating jurisdictions have identified appropriate local mitigation actions along with hazards mitigated, goals, and objectives met; lead agencies; estimated costs; potential funding sources; and proposed timeline. These actions are identified in Volume II, Section 9 for the county and each participating jurisdiction.

Plan Maintenance Procedures

Hazard mitigation planning is an ongoing process. Section 7 of this plan presents procedures for HMP maintenance and updates. The Planning Partnership will continue ongoing mitigation efforts to implement the HMP and revise and update the HMP as necessary.

To monitor implementation of the HMP, Planning Partnership members will meet annually to discuss the status of HMP implementation and will prepare a report summarizing the status of the HMP and any needed updates. The mitigation evaluation will address changes as new hazard events occur, as the area develops, and as more is learned about hazards and their impacts. The evaluation will include an assessment of whether the planning process and actions have been effective, whether development or other issues warrant changes to the HMP or its priorities, progress toward achievement of the communities' goals, and whether changes are warranted. The HMP will be updated at a minimum within the five-year cycle specified by DMA 2000.

Point of Contact

To request information or provide comments regarding this HMP, please contact the designated HMP coordinator at Rockland County Office of Emergency Management:

Christopher F. Jensen, Program Coordinator
Rockland County Office of Fire and Emergency Services
(845) 364-8902 | JensenC@co.rockland.ny.us

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- Appendix D Public and Stakeholder Outreach

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Appendix F	Plan Maintenance
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SECTION 1. INTRODUCTION

1.1 PURPOSE

Rockland County and its participating jurisdictions (the Planning Partnership) have prepared this hazard mitigation plan (HMP) to better protect residents and property throughout Rockland County from the effects of hazard events. The HMP demonstrates the Planning Partnership’s commitment to reducing risk from hazards, increasing resilience overall, and helping decision-makers integrate mitigation into their day-to-day processes. It also positions the Planning Partnership for eligibility for Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance (HMA) grant programs, which include the Hazard Mitigation Grant Program (HMGP), Building Resilient Infrastructure and Communities (BRIC), and Flood Mitigation Assistance (FMA). This HMP aligns with the planning elements of the National Flood Insurance Program’s (NFIP) Community Rating System (CRS), which provides for lower flood insurance premiums in participating communities.

1.2 BACKGROUND

An HMP is a living document that communities use to reduce their vulnerability to hazards. It forms the foundation for a community’s long-term strategy to reduce disaster losses and creates a framework for decision-making to reduce damage to lives, property, and the economy from future disasters. HMPs commonly recommend mitigation projects such as property acquisitions to remove structures from high-risk areas, structural elevations to protect from future flood events, upgrades to critical public facilities, or infrastructure improvements. Ultimately, such actions reduce vulnerability, and communities are able to recover more quickly from disasters. The Planning Partnership demonstrated its commitment to reducing disaster losses when it developed its initial HMP in 2013 and updated it in 2018. The partnership continues to update information upon which to base a successful mitigation strategy that will reduce the impacts of natural disasters and increase local resiliency.

Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk and effects that can result from specific hazards.

FEMA defines a **hazard mitigation plan** as the documentation of a state or local government evaluation of natural hazards and the strategies to mitigate such hazards.

The federal Disaster Mitigation Act of 2000 (DMA 2000) requires local government agencies to develop and update their HMP every five years. This plan serves as the required update to the 2018 Rockland County HMP. During the

For hazard mitigation planning, the FEMA definition of **local government** includes most governmental agencies below the state level.

For the Rockland County HMP, references to local governments generally refer to government agencies below the county level—specifically, towns and villages.

course of the planning process, the entire plan was updated with a focus on examining changes in vulnerability due to hazard events, reviewing capabilities and how they are used to implement hazard mitigation, reviewing the mitigation strategy, and identifying new initiatives to increase overall resiliency throughout Rockland County.

1.3 PLAN ORGANIZATION

The Rockland County HMP 2024 update is a three-volume plan in alignment with the 2023 FEMA Local Mitigation Planning Handbook, the FEMA Local Mitigation Plan Review Tool, the 2023 FEMA Local Mitigation Planning Policy

Guide, and planning requirements of the New York State Department of Homeland Security and Emergency Services (NYS DHSES).

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 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.

The third volume of the HMP includes appendices that present supporting information and details on the basic content of the plan. Table 1-1 describes the HMP’s content by volume, section, and appendix.

Table 1-1. Rockland County 2024 HMP Update Contents

Section Number	Section Name	Contents
Volume I		
Section 1	Introduction	Overview of the planning process and organization of the plan.
Section 2	Planning Process	Description of the HMP development process, Planning Partnership and stakeholder involvement efforts, and how the HMP will be incorporated into existing programs.
Section 3	County Profile	Overview of the County, including physical setting, past hazard events, land use trends, population trends, general building stock, and critical facilities and community lifelines.
Section 4	Risk Assessment	Documentation of the hazard identification and risk ranking process, hazard profiles, and findings of the vulnerability assessment (estimates of the impact of hazard events on life, health, and safety; general building stock; critical facilities and community lifelines; the economy; and the environment). Description of the status of local data and planned steps to improve local data to support mitigation planning.
Section 5	Capability Assessment	A summary of existing plans, programs, and regulatory mechanisms at all levels of government (federal, state, county, local) that support hazard mitigation within the County.
Section 6	Mitigation Strategy	Presentation of mitigation goals and objectives for addressing priority hazards of concern and the process by which Planning Partnership mitigation strategies have been developed.
Section 7	Plan Maintenance	System established to continue to monitor, evaluate, maintain, and update the HMP.
Volume II		
Section 8	Planning Partnership	Description of the Planning Partnership, member responsibilities, and the process of preparing jurisdictional annexes.
Section 9	Jurisdictional Annexes	Jurisdiction-specific annexes for Rockland County and participating jurisdictions, containing each jurisdiction’s hazards of concern, hazard risk ranking, capability assessment, mitigation actions, action prioritization, progress on prior mitigation activities, and prior HMP integration into local planning processes.
Appendices		
Appendix A	Plan Adoption	Resolutions from Rockland County and all participating jurisdictions, included as each formally adopts the HMP update.
Appendix B	Participation Documentation	Matrix listing who attended meetings and provided input to the HMP update. Worksheets submitted during workshops conducted throughout the planning process.
Appendix C	Meeting Documentation	Agendas, attendance sheets, minutes, and other documentation 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 process.

Section Number	Section Name	Contents
Appendix E	Mitigation Strategy Supplementary Data	Documentation of the broad range of actions identified during the mitigation process; types of mitigation actions; the mitigation catalog developed using jurisdiction input; and potential mitigation funding sources.
Appendix F	Plan Maintenance Tools	Example plan review tools and templates available to support annual plan review.
Appendix G	Critical Facilities	A full list of critical facilities identified for the update of the HMP. Due to the sensitive nature of the information, details have been redacted.
Appendix H	Linkage Procedures	Steps that fire districts, utility districts, school districts, and any other eligible local government (as defined in 44 Code of Federal Regulations [CFR] 201.2) within the County can take to join this plan as a participating jurisdiction and to achieve approved status.

1.4 THE PLAN UPDATE – WHAT IS DIFFERENT?

Both the planning process and the content of the 2018 HMP have been enhanced and updated for this 2024 HMP. This update focused on increased efforts to actively engage stakeholders and the public, as well as the continued education of the Planning Partnership about mitigation and available grant funding opportunities. The mitigation strategy was updated to include one mitigation action for every hazard of concern. Further, the sections in the 2024 HMP have been realigned to increase the readability of the plan. The following summarizes process and plan changes that differ from the 2018 process and HMP:

- There was a strong desire on the part of Rockland County for this plan to be a user-friendly document that is understandable to the general public and not overly technical and provide images and text that can easily be used as tools to better communicate local hazard risk. This was done through updating the County’s HMP webpage and developing an interactive ArcGIS Online StoryMap, which can be found at the following links:
 - <https://rocklandhmp.com/>
 - <https://www.rocklandgis.com/portal/apps/storymaps/stories/478d7d6f95eb4247a40ce78629154316>
- Section 3 (County Profile) has been streamlined and updated in the following ways:
 - Provides specific and detailed information about Rockland County.
 - Contains updated information regarding the County’s physical setting, population and demographics and trends, socially vulnerable populations, general building stock, land use and trends, and potential new development.
 - Critical facilities identified as community lifelines using FEMA’s lifeline definition and categories.
- Section 4 (Risk Assessment) includes identification of hazards of concern that impact Rockland County, methodology and tools used to conduct the risk assessment, hazard profiles and vulnerability assessment for the identified hazards of concern, and the overall hazard ranking:
 - Hazard profiles for each hazard of concern provide the following information: hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and climate change impacts.
 - The updated vulnerability assessment is based on new inventory data and hazard data.
 - FEMA community lifelines are assessed. All jurisdictions that identified critical facilities considered lifelines in accordance with FEMA’s community lifeline definition.

- The hazard ranking methodology was expanded to account for socially vulnerable populations, adaptive capacity, and climate change.
- Section 5 (Capability Assessment) is now a standalone section that has been expanded to include federal, state, and County capabilities. Jurisdiction-specific capabilities are expanded in each jurisdictional annex (Section 9).
- Section 6 (Mitigation Strategy) describes how the mitigation strategy was reviewed and updated for the 2024 HMP process. Goals and objectives were updated to align with County and local priorities and the 2019 New York State HMP. Jurisdiction-specific mitigation strategies are now included in each jurisdictional annex (Section 9).
- An enhanced mitigation strategy process was used to develop a robust action plan:
 - A mitigation toolbox was built to assist with mitigation action identification.
 - Utilizing the risk assessment and capability assessment results, problem statements were drafted by each municipality and used to inform the mitigation action development.
 - Concrete actions are identified within the strategies. Strategies provide direction, but actions are fundable under grant programs. The identified actions are designed to meet multiple measurable objectives, so that each planning partner can measure the effectiveness of its mitigation actions.
- The plan maintenance strategy (Section 7) is more clearly defined to provide a roadmap for the annual monitoring of the HMP.
- Jurisdictional annexes (Section 9) have been enhanced to include the following:
 - Expanded capability assessment to include additional state planning mechanisms as well as information regarding plan integration.
 - Identification of the NFIP floodplain administrator as part of the Planning Partnership.
 - Listing of individuals who contributed to the annex.
 - Expansion of the critical facility and lifeline flood hazard exposure table to include a mitigation action, if appropriate.
 - A user-friendly presentation of the hazard ranking results.
 - A revised previous mitigation strategy status table to more clearly identify 2018 actions to be carried over to the 2024 HMP update.
 - A more detailed mitigation action table that specifies the problem statement and the proposed solution. More detail is also reflected in the mitigation action worksheets.
 - A table that summarizes the actions by the type of action and the hazards addressed.
- To increase public and stakeholder engagement, the following efforts were made:
 - All Planning Partnership meetings were made open to the public.
 - Social media was used to inform the public meetings and to take the public survey.
 - The County maintained a website focusing on the HMP and the process. The site provided project updates, resources, links to the draft plan, and information on upcoming and previous meetings.
 - A StoryMap was developed to provide information about the HMP planning process and an opportunity for virtual public and stakeholder participation.

- Stakeholder-specific surveys were deployed to collect input from stakeholders that provide services to Rockland County.

Table 1-2 compares how federal hazard mitigation planning requirements were met in the 2018 HMP and the updated 2024 HMP.

Table 1-2. Rockland County HMP Changes Crosswalk

44 CFR Requirement	2018 Plan	2024 Updated Plan
<p>Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:</p> <ul style="list-style-type: none"> • An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval; • An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia, and other private and non-profit interests to be involved in the planning process; and • Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information. 	<p>The 2018 plan followed an outreach strategy utilizing multiple media developed and approved by the Steering Committee. This strategy involved the following:</p> <ul style="list-style-type: none"> • Public participation on an oversight Steering Committee. • Establishment of a plan informational website. • Press releases. • Use of a public information survey. • Stakeholders were identified and coordinated with throughout the process. • A comprehensive review of relevant plans and programs was performed by the Planning Partnership. 	<p>Building upon the success of the 2018 plan, the 2024 planning effort deployed the same public engagement methodology. The plan included the following enhancements:</p> <ul style="list-style-type: none"> • Using social media. • Web-deployed survey. • Informational brochure. • Public website specific to the HMP planning process. • As with the 2018 plan, the 2024 planning process identified key stakeholders and coordinated with them throughout the process. A comprehensive review of relevant plans and programs was performed by the Planning Partnership.
<p>§201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.</p>	<p>The 2018 plan included a comprehensive risk assessment of hazards of concern. Risk was defined as probability times impact, where impact is the impact on people, property, and economy of the County. All planning partners ranked risk as it pertains to their jurisdiction. The potential impacts of climate change are discussed for each hazard.</p>	<p>The same methodology, using new, updated data, was deployed for the 2024 plan update.</p>
<p>§201.6(c)(2)(i): [The risk assessment] shall include a) description of the ... location and extent of all-natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.</p>	<p>The 2018 plan presented a risk assessment of each hazard of concern. Each section included the following:</p> <ul style="list-style-type: none"> • Hazard profile, including maps of extent and location, previous occurrences, and probability of future events. • Climate change impacts on future probability. • Impact and vulnerability on life, health, safety, general building stock, critical facilities, and economy. • Impact on people, property, critical facilities, and environment. • Future growth and development. • Additional data and next steps. • Overall vulnerability assessment. 	<p>The same format, using new and updated data, was used for the 2024 plan update. Each section of the risk assessment includes the following:</p> <ul style="list-style-type: none"> • Hazard profile, including maps of extent and location, previous occurrences, and probability of future events. • Climate change impacts on future probability using the best available data for New York State. • Vulnerability assessment includes impact on life, safety, and health, general building stock, critical facilities, the economy, and the environment, as well as future changes that could impact vulnerability. • The vulnerability assessment also includes changes in vulnerability since the 2018 plan.

44 CFR Requirement	2018 Plan	2024 Updated Plan
<p>§201.6(c)(2)(ii): [The risk assessment] shall include a) description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i). This description shall include an overall summary of each hazard and its impact on the community.</p>	<p>Vulnerability was assessed for all hazards of concern. The HAZUS-MH computer model was used for the severe storm, earthquake, and flood hazards. These were Level 2 analyses using County data. Site-specific data on County-identified critical facilities was entered into the HAZUS-MH model. HAZUS-MH outputs were generated for other hazards by applying an estimated damage function to an asset inventory extracted from HAZUS-MH.</p>	<p>The same methodology was deployed for the 2024 plan update, using new and updated data and the most current version of Hazus. Dam failure was included as a stand-alone hazard of concern; previously, the hazard was included with the flood hazard.</p>
<p>§201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program insured structures that have been repetitively damaged floods.</p>	<p>A summary of NFIP-insured properties including an analysis of repetitive loss property locations was included in the plan.</p>	<p>The same methodology was deployed for the 2024 plan update using new and updated data.</p>
<p>Requirement §201.6(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure and critical facilities located in the identified hazard area.</p>	<p>A complete inventory of the numbers and types of buildings exposed was generated for each hazard of concern. The Steering Committee defined “critical facilities” for the County, and these were inventoried by exposure. Each hazard profile provides a discussion on future development trends.</p>	<p>The same methodology was deployed for the 2024 plan update using new and updated data and enhanced with the identification of community lifeline facilities.</p>
<p>Requirement §201.6(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) and a description of the methodology used to prepare the estimate.</p>	<p>Loss estimates were generated for all hazards of concern. These were generated by HAZUS-MH for the severe storm, earthquake, and flood hazards. For the other hazards, loss estimates were generated by applying a regionally relevant damage function to the exposed inventory. In all cases, a damage function was applied to an asset inventory. The asset inventory was the same for all hazards and was generated in HAZUS-MH.</p>	<p>The same methodology was deployed for the 2024 plan update using new and updated data.</p>
<p>Requirement §201.6(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.</p>	<p>There is a summary of anticipated development in the County profile, as well as in each individual annex.</p>	<p>The same methodology was deployed for the 2024 plan update using new and updated data.</p>
<p>§201.6(c)(3):[The plan shall include a mitigation strategy that provides the jurisdiction’s blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.]</p>	<p>Each planning partner identified actions that could be implemented within its capabilities. The actions were jurisdiction-specific and strove to meet multiple objectives. Each planning partner completed an assessment of its planning, regulatory, technical, and financial capabilities.</p>	<p>Each planning partner used the progress reporting from the plan maintenance and evaluated the status of actions identified in the 2018 plan. Actions that were completed or no longer considered to be feasible were removed. Remaining actions was carried over to the 2024 plan, and in some cases, new actions were added to the action plan.</p>
<p>Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.</p>	<p>The 2018 plan contained a mission statement, goals, objectives, and actions. The mission statement, goals and objectives were regional and covered all planning partners. They were targeted specifically for this HMP. These planning components supported the actions identified in the plan.</p>	<p>The Steering Committee reviewed and updated the mission statement, goals, and objectives for the plan to include a focus on increased resiliency. This resulted in the finalization of seven goals and 11 objectives to frame the plan.</p>

44 CFR Requirement	2018 Plan	2024 Updated Plan
Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.	The 2018 plan includes a hazard mitigation catalog that was developed through a facilitated process. This catalog identifies actions that manipulate the hazard, reduce exposure to the hazard, reduce vulnerability, or increase mitigation capability. The catalog further segregates actions by scale of implementation. A table in the action plan section analyzes each action by mitigation type to illustrate the range of actions selected.	The mitigation catalog was reviewed and updated by the Steering Committee for the 2024 update. As with the 2018 plan, the catalog has been included in the 2024 plan to represent the comprehensive range of alternatives considered by each planning partner. The table with the analysis of mitigation actions was used in jurisdictional annexes to the plan.
Requirement: §201.6(c)(3)(ii): [The mitigation strategy] must also address the jurisdiction’s participation in the National Flood Insurance Program, and continued compliance with the program’s requirements, as appropriate.	All municipal planning partners that participate in the NFIP identified an action stating their commitment to maintain compliance and good standing under the program.	Ongoing participation in the NFIP for municipalities was included in ongoing capabilities.
Requirement: §201.6(c)(3)(iii): [The mitigation strategy shall describe] how the actions identified in section (c)(3)(ii) will be prioritized, implemented and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.	Each recommended action was prioritized using a qualitative methodology based on the objectives the project will meet, the timeline for completion, how the project will be funded, the impact of the project, the benefits of the project, and the costs of the project.	A revised methodology based on the STAPLEE criteria (social, technical, administrative, political, legal, economic, and environmental) and using new and updated data was used for the 2024 plan update.
Requirement §201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.	The 2018 plan details steps for monitoring, evaluating, and updating the mitigation plan set forth in 44 CFR § 201.6.	The 2024 plan details a plan maintenance strategy similar to that of the initial plan.
Requirement §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.	The 2018 plan details recommendations for incorporating the plan into other planning mechanisms.	The 2024 plan details recommendations for incorporating the plan into other planning mechanisms such as the following: <ul style="list-style-type: none"> • Comprehensive Plan • Emergency Response Plan • Capital Improvement Programs • Municipal Code
Requirement §201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.	The 2018 plan details a strategy for continuing public involvement.	The 2018 plan maintenance strategy was carried over to the 2024 plan. In addition, the County will use a proprietary online tool to support the annual progress reporting of mitigation actions.
Requirement §201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).	All planning partners participated in the planning process.	The 2024 plan achieves DMA 2000 compliance for 24 planning partners. Resolutions for each partner adopting the plan can be found in Appendix A of this volume.

SECTION 2. PLANNING PROCESS

The hazard mitigation strategies identified in this update to the Rockland County Hazard Mitigation Plan (HMP) were developed through an extensive planning process involving local, county, and regional agencies, residents, and stakeholders. Developing the HMP consisted of the phases shown in Figure 2-1. This section describes Phases 1 and 3 and part of Phase 6, including the following steps:

- Organization of key participants
- Planning activities
- Stakeholder outreach and involvement
- Public outreach and involvement
- Use of existing plans and information
- Integration into existing planning mechanisms and programs
- Continued public involvement

Figure 2-1. Rockland County HMP Process



2.1 INTRODUCTION

This HMP meets all federal hazard mitigation planning requirements as well as the goal of having all jurisdictions in the County covered under a comprehensive and cohesive county-wide HMP. To achieve those ends, an approach to the planning process and plan documentation was developed to meet the following objectives:

- The plan is multi-jurisdictional, with the intention of including all municipalities in the County. Rockland County invited all jurisdictions in the County to join in the planning process. All 23 local municipal governments in the County (see Table 2-1) participated in the 2024 plan update process. The format of this plan is such that other entities can readily join in the regulatory five-year plan update process, as identified in Section 7 (Plan Maintenance).
- The plan considers all-natural hazards facing the area, thereby satisfying federal requirements for natural hazards mitigation planning.
- The plan was developed following processes outlined by Federal Emergency Management Agency (FEMA) regulations and prevailing FEMA and New York State Department of Homeland Security and Emergency Services (NYS DHSES) guidance. Following these processes ensures that all the requirements are met and supports plan review. This plan also meets criteria for the National Flood Insurance Program (NFIP) Community Rating System (CRS) and the Flood Mitigation Assistance (FMA) program.

Table 2-1. Participating Rockland County Jurisdictions

Rockland County	Village of Kaser	Town of Ramapo
Village of Airmont	Village of Montebello	Village of Sloatsburg
Village of Chestnut Ridge	Village of New Hempstead	Village of Spring Valley
Town of Clarkstown	Village of New Square	Town of Stony Point
Village of Grand-View-on-Hudson	Village of Nyack	Village of Suffern
Town of Haverstraw	Town of Orangetown	Village of Upper Nyack
Village of Haverstraw	Village of Piermont	Village of Wesley Hills
Village of Hillburn	Village of Pomona	Village of West Haverstraw

The Rockland 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. An HMP Steering Committee (see Section 2.2.2) 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.

2.2 ORGANIZATION OF KEY PARTICIPANTS

2.2.1 County and Consultant

Rockland County applied for and was awarded a multi-jurisdictional planning grant under the Hazard Mitigation Grant Program (HMGP) (HMGP Project #4567-0017), which supported the development of this HMP. The Rockland

County Office of Fire and Emergency Services assumed responsibility of project management and grant administration. A contract planning consultant (Tetra Tech) was tasked with the following activities:

- Assistance with the organization of a Steering Committee and municipal Planning Partnership
- Assistance with the development and implementation of a public and stakeholder outreach program
- Data collection
- Facilitation and attendance at meetings (Steering Committee, municipal, stakeholder, public and other)
- Review and update of the hazards of concern, hazard profiling, and risk assessment
- Assistance with the review and update of mitigation planning goals and objectives
- Assistance with the review of past mitigation strategies progress
- Assistance with the screening of mitigation actions and the identification of appropriate actions
- Assistance with the prioritization of mitigation actions
- Authoring of the draft and final plan documents

2.2.2 Steering Committee

Rockland 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 government leadership and the constituency within the planning area. The Steering Committee acted as the point of contact for all participating jurisdictions and the various interest groups in the planning area.

Table 2-2 presents the members of the Steering Committee. These members were charged with the following:

- Providing guidance and oversight of the planning process
- Attending and participating in Steering Committee meetings
- Assisting with the development and completion of certain planning elements, including:
 - Reviewing and updating the hazards of concern
 - Developing a public and stakeholder outreach program
 - Assuring 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 NYS DHSES and FEMA.

2.2.3 Planning Partnership

In September 2023, the County notified all its municipalities of the pending planning process and invited them to formally participate. All municipalities in the County participating in the planning process make up the Planning Partnership. Jurisdictions were asked to formally notify the County by letter of their intent to participate and to identify a planning point of contact to facilitate their participation and represent their interests. All municipalities in the County actively participate in the NFIP and have a designated NFIP floodplain administrator. These administrators were informed of the planning process, reviewed the plan documents, and provided direct input to the plan update. The Steering Committee members also are part of the overall project Planning Partnership, jointly serving as points of contact on behalf of Rockland County.

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

Name	Title	Affiliation
Christopher Jensen	Program Coordinator	Rockland County Office of Fire and Emergency Services
Allie Manigo	Data Entry Operator	Rockland County Office of Fire and Emergency Services
Scott Lounsbury	GIS Coordinator	Rockland County GIS (geographic information system)
Jacki Scott	Director	Rockland County Office for People with Disabilities
Andrew M. Connors	Deputy Superintendent	Rockland County Highway Department
Jake Palant	Associate Planner	Rockland County Department of Planning
Rich Schiafo	Deputy Commissioner	Rockland County Department of Planning
Doug Schuetz	Acting Commissioner	Rockland County Department of Planning
Jacob King	GIS Technician	Rockland County Department of Planning
Michael DiMola	Park Operations Manager	Rockland County Division of Environmental Resources
Brianna Rosamilia	Environmental Resource Assistant / District Manager	Rockland County Division of Environmental Resources/ Soil & Water Conservation District (SWCD)
Kevin McGuiness	Coordinator / Executive Director	Rockland County Division of Environmental Resources/SWCD
Vincent Altieriv	Executive Director	Rockland County Drainage Agency
Eric Medina	Director Emergency Preparedness	Rockland County Health Department
Alfred Carnevale	Deputy Superintendent of Highways	Rockland County Highway Department
Mary Ellen DiStefano	Special Project Asst.	Rockland County Office for the Aging
Martha Robles	Director	Rockland County Office for the Aging
Joseph DiCarlo	Director	Rockland County Probation
Stephen Papas	CEO	United Way Rockland County
Daniel Eudene	Executive Director	Catholic Charities Community Services of Rockland
Alex Obremski	Director	Rockland County Community Development
Jennifer Zunino-Smith	Environmental Educator	Cornell University Cooperative Extension, Rockland County
Dan Maloney	Seargent	Clarkstown Police Department
Catherine Murray	Director of Finance	Town of Stony Point

In addition to the Steering Committee members listed in Table 2-2, Table 2-3 shows the members of the Planning Partnership. The Planning Partnership members were charged with the following:

- Representing their jurisdiction 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 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 initiatives
- Reporting on the progress of integrating 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 2-3. Rockland County Hazard Mitigation Planning Partnership Members

Jurisdiction	Name	Title	Department/Agency	Primary Point of Contact	Alternate Point of Contact
Airmont (V)	John Queenan, P.E.	Village Engineer	Lanc & Tully P.C.	X	
	Beth Ricker	Administrative Assistant	Lanc & Tully P.C.		
Chestnut Ridge (V)	Martin Spence	Village Engineer	Spence Engineering	X	
	Haris Aljovic	Village Engineer	Spence Engineering		X
Clarkstown (T)	Dan Maloney	Seargent	Clarkstown Police Department	X	
	James Fay	Captain	Clarkstown Police Department		X
	Christopher Wagner	Director of Engineering	Town of Clarkstown		X
Grand View-on-Hudson (V)	Julie Pagliaroli	Village Clerk/Treasurer	Village of Grand View-on-Hudson	X	
	Jonathan Bell	Trustee	Village of Grand View-on-Hudson		X
Haverstraw (T)	George Behn	Building Inspector	Town of Haverstraw	X	
	Michael Gamboli	Director Finance	Town of Haverstraw		X
Haverstraw (V)	Michael Kohut	Mayor	Village of Haverstraw	X	
	Isabel Gonzalez-Soto	Clerk	Village of Haverstraw		X
Hillburn (V)	Joseph P. Tursi	Mayor	Village of Hillburn	X	
	Bernadette Tarantino	Deputy Mayor	Village of Hillburn		X
Kaser (V)	Binyomin Mermelstein	Deputy Clerk	Village of Kaser	X	
	Allie Pinkasovits	Clerk/Treasurer	Village of Kaser		X
Montebello (V)	Martin Spence	Village Engineer	Spence Engineering	X	
	Lance N. Millman	Mayor	Village of Montebello		X
New Hempstead (V)	Abe Sicker	Mayor	Village of New Hempstead	X	
	Carole Vasquez	Village Clerk	Village of New Hempstead		X
New Square (V)	David Breuer	Municipal Clerk	Village of New Square	X	
	Aaron Kaff	Director of Emergency Services	Village of New Square		X
Nyack (V)	Andy Stewart	Village Administrator	Village of Nyack	X	
	Ann Mari Tlsty	Assistant to Village Administrator	Village of Nyack		X
Orangetown (T)	James Dean	Superintendent of Highways	Orangetown Highway Department	X	
	Stephen Munno	Senior Administrative Assistant	Town of Orangetown		X
Piermont (V)	Lisa DeFeciani	Trustee and Committee Member	Village of Piermont	X	
	Jennifer DeYorgi	Village Clerk and Treasurer	Village of Piermont		X
Pomona (V)	Frances Arsa Artha	Village Clerk	Village of Pomona	X	
	Brett Yagel	Mayor	Village of Pomona		X
Ramapo (T)	Joshua Hans	Program Coordinator	Town of Ramapo	X	
	Mona Montal	Chief of Staff	Town of Ramapo		X
Sloatsburg (V)	Jessica Oms	Deputy Clerk and Treasurer	Village of Sloatsburg	X	
	George Thamsen	Building Inspector, Code Enforcement Officer, and Fire Inspector	Village of Sloatsburg		X
Spring Valley (V)	Adam McCarey	Village Commissioner	Village of Spring Valley	X	
	Raymond Canario	Building and Public Works	Village of Spring Valley		X
Stony Point (T)	Jim Monaghan	Supervisor	Town of Stony Point	X	
	Paul Joachim	Deputy Supervisor	Town of Stony Point		X
Suffern (V)	Michael Curely	Mayor	Village of Suffern	X	
	Charles Sawicki	Director of Public Works	Suffern Department of Public Works		X
Upper Nyack (V)	Georgia Grandstaff	Village Clerk	Village of Upper Nyack	X	
	Dennis Letson, P.E.	Engineer	Village of Upper Nyack		X
Wesley Hills (V)	Camille Guido-Downey	Village Clerk/Treasurer	Village of Wesley Hills	X	

Jurisdiction	Name	Title	Department/Agency	Primary Point of Contact	Alternate Point of Contact
West Haverstraw	Marshall Katz	Mayor	Village of Wesley Hills		X
	Anthony Sparta	DPW Superintendent	West Haverstraw Department of Public Works	X	
	Robert R. D'Amelio	Mayor	Village of West Haverstraw		X

Rockland County jurisdictions have differing levels of capabilities and resources available to apply to the plan update process. They also have differing exposure and vulnerability to the natural hazards being considered in this HMP. Rockland County encouraged every jurisdiction to participate and aimed to accommodate their specific needs and limitations while still meeting the intents and purpose of the plan update. Such accommodations included establishing the Steering Committee, engaging a contracted consultant to assume certain elements of the plan update process on behalf of the jurisdictions, and providing alternative mechanisms to achieve the purposes of mitigation planning.

Jurisdictional participation is evidenced by a completed annex of the HMP (see Volume II). In the annexes, jurisdictions have individually identified their planning points of contact, evaluated their risk to the hazards of concern, identified their capabilities to effect mitigation in their community, and identified and prioritized an appropriate suite of actions to mitigate their hazard risk. Jurisdictional participation also includes formal adoption of the updated plan via resolution.

Appendix B (Participation Matrix) identifies the individuals who represented the municipalities during this planning effort and indicates how each contributed to the planning process. Local floodplain administrators are identified in the jurisdictional annexes, as well as in Appendix B (Participation Matrix).

2.3 PLANNING ACTIVITIES

Members of the Planning Partnership (individually and as a whole), as well as key stakeholders, met or otherwise communicated as needed to share information. They participated in workshops to identify hazards, assess risks, review existing critical facility inventories and identify new critical facilities, assist in updating and developing new mitigation goals and strategies, and provide continuity through the process to ensure that hazard vulnerability information and appropriate mitigation strategies were incorporated. 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. Documentation of meetings (agendas, sign-in sheets, minutes, etc.) may be found in Appendix C (Public and Stakeholder Outreach).

After completion of the plan, the Planning Partnership assumes responsibility for plan implementation and ongoing maintenance, as described in Section 7 (Plan Maintenance). The Planning Partnership is 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 update process.

Table 2-4 summarizes planning activities conducted during the plan development process. It also identifies which federal requirements the activities satisfy. This summary table identifies only the formal meetings and milestone events during the plan update process. It does not reflect all planning activities conducted by individuals and groups throughout the process. In addition to these meetings, there was a great deal of communication between

Planning Partnership members and the contracted consultant through individual local meetings, phone, and email.

Table 2-4. Summary of Mitigation Planning Activities

Date	Federal Requirement	Description of Activity	Participants
August 16, 2023	-	Meetings with NYS DHSES to discuss planning process timeline, NYS, and FEMA requirements.	Rockland County Department of Fire & Emergency Services, NYS DHSES, Tetra Tech
August 25, 2023	2	Project Start-Up Meeting: Discuss proposed planning process and scope of work including documenting participation, schedule, and public and stakeholder outreach and involvement.	Rockland County Department of Fire & Emergency Services, Tetra Tech
August 2023	2	Update HMP website: https://rocklandhmp.com/	Rockland County Department of Fire & Emergency Services, Tetra Tech
September 2023	1c, 2	Steering Committee members and all municipalities invited to participate in the planning process; interested jurisdictions submit Letters of Intent to Participate in this planning process, acknowledging municipal participation requirements and identifying planning point(s) of contact.	Refer to Appendix B (Participation Matrix) and Appendix C (Meeting Materials)
Bi-Weekly	-	Project status meeting to discuss action items in support of the expedited planning process.	Rockland County Department of Fire & Emergency Services, Tetra Tech
September 26, 2023	1b, 2, 3a, 3b, 3c, 4a, 5c	Steering Committee Kick-Off Meeting: Review project schedule; review municipal participation, discuss municipal Kick Off meeting and local data collection; review and discuss sources and availability of County and regional data; discuss public and stakeholder outreach efforts.	Refer to Appendix B (Participation Matrix) and Appendix C (Meeting Materials)
October 4, 2023	1b, 2, 3a, 3b, 3c, 4a	Planning Partnership Kick-Off Meeting: Complete overview of planning process, plan participant expectations, review of hazards and hazards of concern identification, discussion of data needs and data collection process explaining all provided worksheets, discussion of public and stakeholder outreach efforts.	County and municipal representatives and stakeholders. Refer to Appendix B (Participation Matrix) and Appendix C (Meeting Materials)
October 2023	2	Online Public Hazard Preparedness and Mitigation survey developed and deployed.	Rockland County Department of Fire & Emergency Services, Tetra Tech
October 2023	2	Online Stakeholder Hazard Mitigation surveys developed and deployed.	Rockland County Department of Fire & Emergency Services, Tetra Tech
October 2023	2	Online Neighboring County Mitigation survey developed and deployed.	Rockland County Department of Fire & Emergency Services, Tetra Tech
December 13, 2023	1a, 3a, 3b, 3c, 3d	Steering Committee Risk Assessment Meeting: Review and discuss the risk assessment completed for each hazard of concern; collect input on the results from the Steering Committee to incorporate into the plan accordingly.	Refer to Appendix B (Participation Matrix) and Appendix C (Meeting Materials)
December 13, 2023	1a, 3a, 3b, 3c, 3d	Planning Partnership Risk Assessment Meeting: Review and discuss the risk assessment completed for each hazard of concern; collect input on the results from the Planning Partnership to incorporate into the plan accordingly.	Refer to Appendix B (Participation Matrix) and Appendix C (Meeting Materials)
December 13, 2023	1a, 2, 4a, 4b, 4c	Mitigation Strategy Workshop: Discussed the mitigation strategy process and worked together to identify and develop mitigation strategies at the county and local level.	Refer to Appendix B (Participation Matrix) and Appendix C (Meeting Materials)
December 18, 2023	2	Meeting with Rockland County Maps and Highway GIS Division and Rockland County Department of Fire & Emergency Services to discuss the StoryMap for the HMP update.	Rockland County Department of Fire & Emergency Services, Rockland County Maps and Highway GIS Division, Tetra Tech

Date	Federal Requirement	Description of Activity	Participants
March 20, 2024	2	Draft plan posted to public project website	Public and Stakeholders
April 15, 2024	1b, 2, 3, 4, 5	Steering Committee Meeting - Plan Maintenance, Draft Plan Review	Refer to Appendix B (Participation Matrix) and Appendix C (Meeting Materials)
April 15, 2024	1b, 2, 3, 4, 5	Planning Partnership Meeting – draft plan presentation and collect input/comments from planning partners, public, and stakeholders	Refer to Appendix B (Participation Matrix) and Appendix C (Meeting Materials)
April 18, 2024	1b, 2	Public and stakeholder comments to draft plan received and incorporated into final plan.	Public and Stakeholders
TBD	All requirements	Final plan submitted to NYS DHSES and FEMA Region 2	NYS DHSES, FEMA Region 2
Upon plan approval by FEMA	1a	Plan adoption by resolution by the governing bodies of all participating municipalities	All plan participants

Note: TBD = to be determined.

Each number in column 2 identifies specific DMA 2000 requirements, as follows:

- 1a – Prerequisite – Adoption by the Local Governing Body
- 1b – Public Participation
- 2 – Planning Process – Documentation of the Planning Process
- 3a – Risk Assessment – Identifying Hazards
- 3b – Risk Assessment – Profiling Hazard Events
- 3c – Risk Assessment – Assessing Vulnerability: Identifying Assets
- 3d – Risk Assessment – Assessing Vulnerability: Estimating Potential Losses
- 3e – Risk Assessment – Assessing Vulnerability: Analyzing Development Trends
- 4a – Mitigation Strategy – Local Hazard Mitigation Goals
- 4b – Mitigation Strategy – Identification and Analysis of Mitigation Measures
- 4c – Mitigation Strategy – Implementation of Mitigation Measures
- 5a – Plan Maintenance Procedures – Monitoring, Evaluating, and Updating the Plan
- 5b – Plan Maintenance Procedures – Implementation through Existing Programs
- 5c – Plan Maintenance Procedures – Continued Public Involvement

2.4 STAKEHOLDER OUTREACH AND INVOLVEMENT

2.4.1 Outreach Activities

Stakeholders are the individuals, agencies, and jurisdictions that have a vested interest in the recommendations of the HMP, including all planning partners. Diligent efforts were made to ensure broad regional, county, and local representation in this planning process. To that end, a comprehensive list of stakeholders was developed with the support of the Planning Partnership. Stakeholder outreach was performed early on, and continually throughout the planning process. This HMP update includes information provided by these stakeholders where appropriate.

Key elements of outreach to stakeholders were as follows:

- All Planning Partnership meetings were open to the public and advertised via the [Rockland County HMP website](#).
- In October 2023, the County deployed a [StoryMap](#) (see Figure 2-2) to provide information regarding the hazard mitigation planning process and an opportunity for virtual public participation. The StoryMap also

provides an interactive platform to learn about the hazards of concern and view hazard maps prepared for the HMP.

Figure 2-2. Rockland County HMP StoryMap



- Directed response surveys were distributed to the following sectors: academia, fire departments, EMS, hospitals and healthcare organizations, business and commercial interests, and utilities and law enforcement. A summary of survey results is provided later in this section. Full results and the survey itself are provided in Appendix C of this plan.
- In November 2023, over 60 stakeholders and neighboring communities were emailed to notify them of the planning process and invite them to complete a mitigation survey regarding vulnerabilities, capabilities, and mitigation projects. Stakeholders included academia, state and local government, businesses, non-profits, emergency services, public works, transportation, and utility providers. Neighboring communities included Orange County (NY), Passaic County (NJ), Putnam County (NY), Westchester County (NY), Sullivan County (NY), Bergen County (NJ), Upper Saddle River, NJ, Alpine, NJ, Woodbury, NY, Northvale, NJ, River Vale, NJ, Ossining, NY, Old Tappan, NJ, Rockleigh, NJ, Montvale, NJ, Greenburgh, NY, Mahwah, NJ, Philipstown, NY, Cortlandt, NY, Highlands, NY, Tuxedo, NY, Peekskill, NY, and Mount Pleasant, NY. The County received input from 37 stakeholders and four neighboring communities. All responses to the stakeholder surveys may be found in Appendix D (Public and Stakeholder Outreach).
- In November 2023, the Steering Committee and Planning Partnership were provided materials to publicize the planning process. These included five social media posts (see Figure 2-3), two informational graphics for municipal websites, and one flyer for printing and distribution in government offices (see Figure 2-4). The outreach materials included information on the HMP process and a link to the public survey. Between November 2023 and January 2024, the County and participating jurisdictions publicized the HMP on their webpages, social media accounts, and flyers placed throughout the County. As a result, over 200 members of the public completed the survey.

- In March 2024, the draft plan was posted on the [Rockland County HMP website](#) and advertised using jurisdictional websites and social media platforms. Additionally, regional stakeholders and neighboring counties were emailed to notify them that the draft HMP is available for review and input.

Figure 2-3. Social Media Post Example

Figure 2-4. Printed HMP Materials for Residents at West Haverstraw



2.4.2 Summary of Stakeholder Involvement

The following subsections identify the stakeholders that were invited to participate in the development of this HMP update and discusses how they participated. The summary listings demonstrate the scope and breadth of the stakeholder outreach efforts. Refer to Appendix D for additional details on the public and stakeholder outreach, including responses received to the surveys. Refer to Appendix B (Participation Documentation) for further details regarding regional and local stakeholder agency attendance at meetings.

The stakeholders who provide services to socially vulnerable populations in Rockland County are noted in the summaries. Socially vulnerable populations often need additional emergency assistance in disaster events due to lack of ability to evacuate or housing that does not meet modern building requirements.

Government Agencies

Federal Agencies

FEMA Region 2 provided updated planning guidance; provided summary and detailed NFIP data for the planning area; presented preliminary regulatory flood products to municipalities and the public; attended meetings; participated in a mitigation strategy workshop; and conducted plan review.

Information regarding hazard identification and the risk assessment for this HMP update was requested and received or incorporated by reference from the following agencies and organizations:

- 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)

State Agencies

NYS DHSES (Headquarters and Region II) administered the planning grant for this updated; facilitated FEMA review; provided updated planning guidance; attended meetings; participated in the mitigation strategy workshop; and provided review of the draft and final plan.

New York State Department of Environmental Conservation provided data and information on the number and locations of dams.

County Agencies and Departments

County agencies and departments invited to participate in the HMP update process are listed in Table 2-5. Those that served on the Steering Committee or Planning Partnership or that provide services to the socially vulnerable in Rockland County are noted accordingly.

The stakeholders listed in the table below provide services to all populations in Rockland County, including socially vulnerable populations.

Table 2-5. County Agencies and Departments

Department/Agency	Participation
Rockland County Office of Fire and Emergency Services	This department led the HMP update and worked with the contract consultant to oversee the planning process. The program coordinator and data entry coordinator served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Rockland County GIS Division	The GIS coordinator served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Rockland County Office for People with Disabilities	The director served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Rockland County Highway Department	The deputy superintendent served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Rockland County Department of Planning	The commissioner, deputy commissioner, associated planner, and GIS technician served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Rockland County Division of Environmental Services	The SWCD manager and parks operations manager served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.

Department/Agency	Participation
Rockland County Drainage Agency	The executive director served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Rockland County Department of Health	The director of emergency preparedness served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Rockland County Office for the Aging	The director and special project associate served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Rockland County Department of Probation	The director served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Rockland County Office of Community Development	The director served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.

Regional and Local Stakeholders

Over 60 regional and local stakeholders invited to participate in the HMP update process are listed below. Of those invited to participate, 37 stakeholders from 34 different agencies provided input through the online survey. Those that served on the Steering Committee or Planning Partnership, those that provide services to the socially vulnerable in Rockland County, or those that completed the survey are noted accordingly.

The stakeholders listed in the tables below provide services to all populations in Rockland County, including socially vulnerable populations.

Academia

Schools, universities, and other academia institutions invited to attend planning process meetings and asked to complete the stakeholder survey are listed in Table 2-6.

Table 2-6. Academia

Department/Agency	Participation
Clarkstown Central School District	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Cornell University Cooperative Extension, Rockland County	The environmental educator served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Nanuet Union Free School District	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
North Rockland School District	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Pearl River School District	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Ramapo Central School District	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Rockland BOCES (Board of Cooperative Educational Services)	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
South Orangetown Central School District	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.

Department/Agency	Participation
Suffern Central School District	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.

Business, Commercial, Non-Profit, and Sustainability Organizations

Business, commercial, non-profit, and sustainability organizations invited to participate in the HMP update process are listed in Table 2-7.

Table 2-7. Business, Commercial, Non-Profit, and Sustainability Organizations

Department/Agency	Participation
Rockland Business Association	Notified of the planning process and invited to complete the online survey.
Rockland Community Foundation	Notified of the planning process and invited to complete the online survey.
Rockland County Community Development	The director served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Stormwater Consortium of Rockland County	The environmental educator served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
United Way Rockland County	The CEO served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
American Red Cross	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Catholic Charities Community Services of Rockland	The executive director served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County.
Center for Safety and Change	Notified of the planning process and invited to complete the online survey.
Dominican Sisters of Sparkill	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Tolstoy Foundation Rehabilitation and Nursing Center	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Lower Hudson Coalition of Conservation Districts	Notified of the planning process and invited to complete the online survey.
People to People	Notified of the planning process and invited to complete the online survey.
St. Joseph's Home	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.

Emergency Services

Police, fire, and emergency medical services (EMS) providers invited to participate in the HMP update process are listed in Table 2-8.

Table 2-8. Emergency Services

Department/Agency	Participation
Clarkstown Police Department	The police sergeant served on the Steering Committee and Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the County and the Town.
Hatzolah EMS of Rockland County	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.

Department/Agency	Participation
Haverstraw Fire Department	Notified of the planning process and invited to complete the online survey.
Nanuet Fire Department	Notified of the planning process and invited to complete the online survey.
New City Volunteer Ambulance Corps/Rescue Squad	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Nyack Community Ambulance Corps	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Orangeburg Fire	Notified of the planning process and invited to complete the online survey.
RACES (Radio Amateur Civil Emergency Services)	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Tappan Fire District	Notified of the planning process and invited to complete the online survey.
Village of Piermont	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.

Healthcare

Healthcare providers and facilities invited to participate in the HMP update process are listed in Table 2-9.

Table 2-9. Healthcare

Department/Agency	Participation
All Care Home Health Services LLC	Notified of the planning process and invited to complete the online survey.
EverCare at Home Certified Home Health Agency	Notified of the planning process and invited to complete the online survey.
Fresenius Dialysis Valley Cottage	Notified of the planning process and invited to complete the online survey.
Fresenius Medical Care	Notified of the planning process and invited to complete the online survey.
Friedwald Center for Nursing & Rehabilitation	Notified of the planning process and invited to complete the online survey.
Home Care	Notified of the planning process and invited to complete the online survey.
Helen Hayes Hospital	Notified of the planning process and invited to complete the online survey.
Old Peoples Home of the Russian Orthodox Convent “Novo-Diveevo”	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Occupational Safety and Health Administration Compliance Officer	Notified of the planning process and invited to complete the online survey.
Revival Home Health Care	Notified of the planning process and invited to complete the online survey.
Rockland County Dialysis - Davita	Notified of the planning process and invited to complete the online survey.
Tappan Zee Manor	Notified of the planning process and invited to complete the online survey.
Tolstoy Foundation Rehabilitation & Nursing Center	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
United Hospice	Notified of the planning process and invited to complete the online survey.
Village of New Square Ambulance Service	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.

Public Works and Transportation

County and local highway and public works departments invited to participate in the HMP update process are listed in Table 2-10.

Table 2-10. Public Works and Transportation

Department/Agency	Participation
Piermont Department of Public Works	The superintendent of public works served on the Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the Village.
Town of Haverstraw Highway Department	The superintendent of highways served on the Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the Town.
Village of Haverstraw Department of Public Works	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Village of Nyack Administrator	The village administrator served on the Planning Partnership throughout the planning process, completed the stakeholder survey, provided input throughout the HMP update, and identified mitigation actions for the Village.
Village of Nyack Department of Public Works	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Town of Ramapo Department of Public Works	Notified of the planning process and invited to complete the online survey.
Town of Sloatsburg Department of Public Works	Notified of the planning process and invited to complete the online survey.

Utilities

Utility providers that serve Rockland County and its municipalities invited to participate in the HMP update process are listed in Table 2-11.

Table 2-11. Utility Providers

Department/Agency	Participation
Rockland County Solid Waste Management Authority (Rockland Green)	Notified of the planning process and invited to complete the online survey.
Rockland County Sewer District #1	Notified of the planning process and invited to complete the online survey.
NRG Bowline LLC	Notified of the planning process and invited to complete the online survey.

Adjacent Communities

Rockland County made efforts to keep the surrounding counties and communities apprised of the project. Table 2-12 lists those who were invited to take the stakeholder survey and given opportunity to provide input to this planning process.

Table 2-12. Adjacent Communities

Department/Agency	Participation
Alpine, NJ	Notified of the planning process and invited to complete the online survey.
Bergen County (NJ) Office of Emergency Management	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Cortlandt, NY	Notified of the planning process and invited to complete the online survey.
Greenburgh, NY	Notified of the planning process and invited to complete the online survey.
Highlands, NY	Notified of the planning process and invited to complete the online survey.
Mahwah, NJ	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Montvale, NJ	Notified of the planning process and invited to complete the online survey.

Department/Agency	Participation
Mount Pleasant, NY	Notified of the planning process and invited to complete the online survey.
Northvale, NJ	Notified of the planning process and invited to complete the online survey.
Old Tappan, NJ	Notified of the planning process and invited to complete the online survey.
Orange County (NY) Department of Planning	Notified of the planning process and invited to complete the online survey.
Orange County (NY) Division of Emergency Management	Notified of the planning process and invited to complete the online survey.
Ossining, NY	Notified of the planning process and invited to complete the online survey.
Passaic County (NJ) Office of Emergency Management/Public Safety Academy	Notified of the planning process and invited to complete the online survey.
Passaic County (NJ) Planning	Notified of the planning process and invited to complete the online survey.
Peekskill, NY	Notified of the planning process and invited to complete the online survey.
Philipstown, NY	Notified of the planning process and invited to complete the online survey.
Putnam County (NY) Bureau of Emergency Services	Notified of the planning process and invited to complete the online survey.
Putnam County (NY) Planning	Notified of the planning process and invited to complete the online survey.
River Vale, NJ	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Rockleigh, NJ	Notified of the planning process and invited to complete the online survey.
Sullivan County Division of Planning, Community Development, and Environmental Management	Notified of the planning process and invited to complete the online survey.
Sullivan County Office of Emergency Management/Homeland Security	Notified of the planning process and invited to complete the online survey.
Tuxedo, NY	Notified of the planning process and invited to complete the online survey.
Upper Saddle River, NJ	Notified of the planning process and invited to complete the online survey.
Westchester County (NY) Department of Emergency Services	Notified of the planning process and invited to complete the online survey; completed the survey and provided input during the process.
Westchester County (NY) Planning Department	Notified of the planning process and invited to complete the online survey.
Woodbury, NY	Notified of the planning process and invited to complete the online survey.

2.4.3 Stakeholder and Neighboring County Survey Summaries

The following provides a summary of the results and feedback received by stakeholders who completed the survey. Feedback was reviewed by the Steering Committee and integrated where appropriate in the plan.

Stakeholder Survey

The stakeholder survey was designed to help identify general needs for hazard mitigation and resiliency within Rockland 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 the various county and municipal departments and agencies. As of March 6, 2024, 36 stakeholders completed the survey, with respondents coming from the academic/research sector, business/commerce sector, emergency services sector, health and human services, hospitals/medical services, non-profit organizations, and public works. Many respondents represented groups that served Rockland County as a whole (44.4 percent).

When asked if the organization maintains or manages anything within their designated service area, 31.4 percent said they do not manage any facilities. Those that reported that they do manage facilities indicated the following

types: buildings, bridges, roads, stormwater infrastructure, or water/sewer plants. The remaining respondents noted work in utilities, including gas and electric services and a power plant.

Hazard and Damage Identification

Of respondents, 50 percent indicated that buildings, facilities, or structures their organization is involved with have been impacted by a natural hazard. Of these, respondents noted flood damage to buildings and utilities; road closures and damage to bridges and retaining walls from floods, severe weather, and winter weather; and power outages from severe weather and winter weather.

Stakeholders were asked what areas they believe to be the most vulnerable to natural hazards, and the problems they face. The respondents identified hazards and impacts as follows:

- Flooding causing water damage and blocking roads
- Flash floods causing sanitary sewer mains to be overwhelmed
- Water treatment centers becoming impacted by floodwaters
- Damage to overhead utility lines
- Tree damage and fall, especially impacting transportation and power supply
- Power outages causing a halt in internet services
- Upstream dams and reservoirs

Asked about the level at which their facilities are prepared to withstand natural disasters, 26.4 percent indicated they do not know, 47 percent said their facilities are not adequately prepared, and 26 percent said their facilities are prepared.

Community Preparedness

Results showed that 62.5 percent of respondents work with socially vulnerable populations and 36.7 percent are aware of the location and number of socially vulnerable populations in their community or operating area. Examples of this work included the following:

- Work with the local and national deaf communities
- Support for individuals with disabilities
- Support for refugees, the economically disadvantaged, developmentally disabled, and those diagnosed with HIV/AIDS
- Housing and services to the homeless population
- Drug and alcohol addiction services
- Services and support for individuals with autism
- Youth and young adult support including sheltering, crisis nurseries, and transitional living
- Reentry programs for prison release
- Support for those with mental health challenges
- Food distribution

Additionally, 59.4 percent of respondents reported being part of an emergency operations plan and 40.6 percent reported being part of a continuity of operations/government plan; 28 percent were unsure if their organization was a part of any emergency plans.

Project Identification

Respondents identified the following projects or programs that could reduce their organization's vulnerability to damage, including operation of service:

- Free and easily accessible training for hazard events
- Upgrades for communication infrastructure, particularly internet connectivity
- Flood and stormwater controls
- Emergency generators

Neighboring Community Survey

The neighboring community survey was sent to the communities surrounding Rockland because the impact of hazard events on them would be similar to the impact on Rockland County. As of March 6, 2024, four communities responded to the survey: Westchester County, New York; Bergen County, New Jersey; River Vale, New Jersey; and Mahwah Township, New Jersey.

The survey included four sections: Emergency Operations and Continuity of Operations Planning; Information Sharing; Projects, Grants, Education and Outreach; and Evacuation and Sheltering. Summary results are presented below.

Emergency Operations and Continuity of Operations Planning

Bergen County indicated there are mutual aid agreements in place with Rockland County, including for fire services, EMS services, and reception centers; Mahwah Township indicated there is a mutual aid agreement in place with Rockland County for fire services. All communities except River Vale noted that Rockland County is involved in their community's emergency operations planning and vice versa. Westchester County and Mahwah Township noted that Rockland County is involved in their continuity of operations planning; however, West Chester County is not involved in Rockland County's.

Information Sharing

Respondents noted that they have access to Rockland County's emergency operations centers at the county and local levels.

Projects, Grants, Education, and Outreach

Bergen County stated that flooding is a concern shared with Rockland County, noting that the water that flows from Rockland County into Bergen County can be one of the main agents of erosion of land and property around infrastructure. Westchester County notes that Hudson River flooding is a concern shared with Rockland County. Respondents share information on potential shared mitigation projects during emergency management coordination meetings. Respondents did not identify any projects as requiring cross-collaboration between county boundaries.

Evacuation and Sheltering

Bergen County indicated that there is collaboration with Rockland County on evacuation scenarios involving schools and that they consult with Rockland County before making evacuation decisions. Respondents noted that sheltering decisions are not made in coordination with Rockland County.

2.5 PUBLIC OUTREACH AND INVOLVEMENT

2.5.1 Outreach Activities

Community input on the HMP increases the likelihood of hazard mitigation becoming one of the standard considerations in the growth of the County. To facilitate better coordination between the Planning Partnership and citizens and to involve the public in the planning process, meeting dates and locations were made available to the public via the [Rockland County HMP website](#), [StoryMap](#), and social media. The draft HMP also was made available on the Rockland County HMP website and StoryMap. The Planning Partnership made the following efforts toward public participation in the development and review of the HMP:

- The public was informed of the hazard mitigation planning effort commencement at the kickoff meeting and through press releases, news articles, and public service announcements released throughout the planning process. Copies of these announcements may be found in Appendix C.
- Media releases were produced and delivered to local news sources to provide the public with an additional means of being informed about the plan update.
- To inform the public and County agencies of the ongoing plan update effort, updates regarding the mitigation planning process have been made at county-wide meetings, including those of the Rockland County Stormwater Coalition.
- The public HMP website (see Figure 2-5) is being maintained to facilitate communication between the Steering Committee, the planning partnership, the public, and stakeholders. The website contains a project overview, County and local contact information, access to the citizens survey and stakeholder surveys, and sections of the HMP for public review and comment.
- The HMP will be available to the public through a variety of venues. A printed version of the Plan will be maintained at the Rockland County Office of Fire and Emergency Services.

Figure 2-5. Rockland County HMP Website



- All participating municipalities were encouraged to distribute press releases on the project, including links to the project webpage and citizen and stakeholder surveys. Municipalities posting information and supporting online outreach include the following:
 - Village of Hillburn
 - Town of Stony Point
 - Village of Wesley Hills
 - Village of West Haverstraw
- An online natural hazards preparedness citizen survey was developed to gauge household preparedness that may impact Rockland County and to assess the level of knowledge of tools and techniques to assist in reducing risk and loss from those hazards. The survey asks quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. The survey also asks demographic questions to help analyze trends.
- The survey was posted on the County website in December 2023, and was available through February 2024 for public input. All participating municipalities were requested to advertise the availability of the survey via local homepage links and other available public announcement methods (e.g., Facebook, Twitter, email blasts, etc.). Roughly 240 responses were collected. A summary of survey results is provided later in this section, with full results provided in Appendix C of this plan.
- The draft plan was posted to the public website as of __[DATE]__, for public review and comment. All public comments were directed to the Rockland County Office of Fire and Emergency Services for collection and review by the Steering Committee. All public comments received were forwarded to the appropriate jurisdiction and/or agency and incorporated into the final plan as appropriate.
- Once submitted to NYS DHSES and 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 at the locations identified in Section 7 (Plan Maintenance).

2.5.2 Public Survey Summary

The public survey was developed to assess the level of knowledge about hazards and about tools and techniques that can be used to reduce losses from those hazards. The County advertised the survey on their website and social media accounts. As of March 2024, the survey received 236 responses. Refer to Appendix D (Public and Stakeholder Outreach) for the full list of survey questions and responses. Municipality-specific responses can be found in the jurisdictional annexes in Volume II.

Demographically, survey respondents were from 22 municipalities within Rockland County, with 57 percent having lived in the County for 20 years or more. The most self-selected jurisdictions respondents indicated that they live in include the Village of Nyack, Village of Wesley Hills, Town of Clarkstown, Town of Orangetown, Town of Stony Point, and Village of Upper Nyack. The most common (48.6 percent) age of respondents was over the age of 60.

The majority (69.3 percent) of residents receive information concerning a natural hazard through the internet. Over half (62 percent) receive information through mass notification systems.

Survey results indicated the following about respondents' experience of and concern about hazards:

- Most frequently experienced natural hazard events in Rockland County over the past 10 years (percent of respondents who included the hazard among the top five):

- Disease outbreak (73 percent)
- Severe storms (55 percent)
- Winter storms (55 percent)
- Street flooding (50 percent)
- Extreme wind (40 percent)
- Hazards about which respondents have the greatest levels of concern:
 - Flood
 - Severe storms
 - Hurricane/tropical storm
 - Extreme wind

Respondents identified the following as desired measures for reducing the damage due to natural hazards (percent of respondents saying they favor each measure):

- Enforce the disclosure of natural hazard risks during real estate transactions (55 percent)
- Implement steps to safeguard the local economy following a disaster (53.6 percent)
- Use local tax dollars to reduce risks and losses from natural hazards (50 percent)
- Adopt policies that prohibit development in areas subject to natural hazards (49.7 percent)
- Develop local inventory of at-risk buildings and infrastructure (49.5 percent)

Respondents were given the opportunity to propose other measures they would like to see implemented in Rockland County. Suggestions included assisting lakeshore property owners with flood protection, stormwater infrastructure upgrades, and electrical utility improvements.

Respondents were asked which activities have been performed to mitigate hazard impacts to their homes. Approximately 95 percent of respondents have installed smoke detectors; roughly 63 percent have talked with other household members about what to do in case of a natural disaster or emergency; 52 percent have become trained in first aid and/or CPR; 51 percent have attended meetings or received information on natural disasters or emergency preparedness; and 45 percent have developed an emergency plan for the household to decide what will be done in the event of a disaster or emergency.

Please list any additional types of projects you believe local, county, state or federal government agencies could be doing in order to reduce the damage and disruption of natural disasters in Rockland County.

“School districts must have sufficient back up power”

“increased drainage and flood projects in low areas of river towns”

Respondents were also asked about their property’s location within the floodplain and if they have flood insurance. Of those who answered this question, 6.25 percent indicated that their property is located in a designated floodplain, 5.29 percent indicated their home is covered by flood insurance, and 16.83 percent indicated they do not have flood insurance.

2.6 USE OF EXISTING PLANS AND INFORMATION

The Rockland County HMP uses the best available technical information, plans, studies, and reports to support hazard profiling; risk and vulnerability assessment; review and evaluation of mitigation capabilities; and the identification, development, and prioritization of County and local mitigation strategies.

The asset and inventory data used for the risk and vulnerability assessments is presented in Section 3 (County Profile). Details of the sources of this data, along with technical information on how the data was used to develop the risk and vulnerability assessment, is presented in Sections 4.2 and 4.3. Complete data sources are listed in the References at the end of this volume.

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, or stakeholders involved in the planning effort. The County and participating jurisdictions updated the inventory of their planning and regulatory capabilities (see Capability Assessment section of each jurisdictional annex in Volume II) and provided relevant documents. Documents—including plans, reports, and ordinances—were reviewed to identify:

- Existing municipal capabilities
- Needs and opportunities to develop or enhance capabilities, which may be identified within the County or local mitigation strategies
- Mitigation-related goals or objectives, considered in the review and update of the overall goals and objectives
- Proposed, in-progress, or potential mitigation projects, actions, and initiatives to be incorporated into the updated County and local mitigation strategies

The following local regulations, codes, ordinances, and plans were reviewed during this process 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
- 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
- New York State 2019 Standard Multi-Hazard Mitigation Plan

Reviews were conducted of all relevant plans contributing to the capability of the County and participating jurisdictions to integrate effective mitigation efforts into the daily governmental activities. Documentation of this review is reflected in the capability assessment tables in the jurisdictional annexes.

2.7 INTEGRATION INTO EXISTING 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 plans and programs in Rockland County support

hazard risk management, and it is critical that this hazard mitigation plan integrate and coordinate with those existing plans and programs.

The capability assessment section of Chapter 6 provides a summary and description of 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, the County and participating jurisdictions have identified how they have already integrated hazard risk management into existing planning, regulatory and operational/administrative frameworks and how they intend to promote additional integration in the future.

A further discussion of ongoing efforts to develop and promote a comprehensive approach to hazard risk management and mitigation is presented in Section 7.

2.8 CONTINUED PUBLIC INVOLVEMENT

Rockland County and participating jurisdictions are committed to the continued involvement of the public in the hazard mitigation process. This MP update will be posted online (at <https://www.rocklandhmp.com/>), and municipalities will be encouraged to maintain links to the plan website. Further, the County will make hard copies of the HMP available for review at public locations as identified on the HMP 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.

The public will have an opportunity to comment on the plan as a part of the annual mitigation planning evaluation process and the next five-year mitigation plan update. Each jurisdiction's governing body will be responsible for receiving, tracking, and filing public comments regarding this plan. Further details regarding continued public involvement are provided in Section 7.

A designated HMP Coordinator is responsible for coordinating a plan evaluation meeting, soliciting feedback, collecting, and reviewing comments, and ensuring their incorporation in the five-year plan update as appropriate. Members of the Planning Partnership will assist the HMP Coordinator in these efforts. Additional meetings may be held as deemed necessary by the Planning Partnership to provide the public an opportunity to express concerns, opinions, and ideas about the plan. Contact information for the currently designated coordinator is:

Mailing Address: Rockland County Office of Fire and Emergency Services
35 Firemen's Memorial Drive, Pomona, NY 10970

Contact Name: Christopher Jensen

Email Address: JensenC@co.rockland.ny.us

Telephone: (845) 364-8902

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.

SECTION 3. COUNTY PROFILE

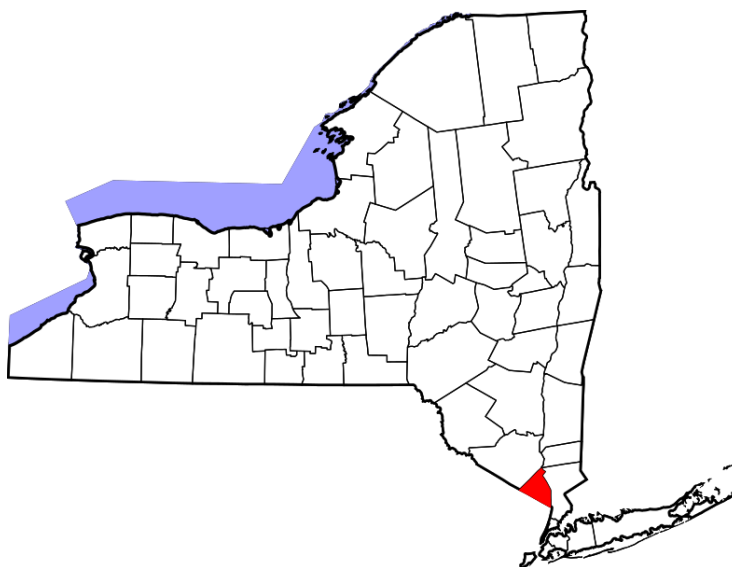
This section provides general information about Rockland County, including its physical setting, general building stock, land use, population, demographics, population trends, and community lifelines. Analyzing this information leads to an understanding of the study area, including economic, structural, and population assets at risk, and of concerns that could be related to hazards analyzed in this plan (e.g., low-lying areas prone to flooding, high percentage of vulnerable persons in an area).

3.1 GENERAL INFORMATION

3.1.1 Geography

Rockland County is located in southern New York State, approximately 30 miles northwest of Manhattan, and is bordered by the Hudson River on the east, Bergen and Passaic Counties in New Jersey to the south, and Orange County to the northwest (refer to Figure 3-1). Westchester and Putnam Counties are located across the Hudson River to the east and northeast, respectively. The County is considered the gateway to the Hudson Valley and is linked to the region by the New York State Thruway (Interstate 87/287), the Palisades Parkway, Route 9-West, and the Garden State Parkway Extension. Rockland County consists of five towns, 19 incorporated villages, and 17 unincorporated hamlets, as shown in Figure 3-2 (Rockland County 2011).

Figure 3-1. Location of Rockland County



Source: Rockland County Economic Development & Tourism 2024

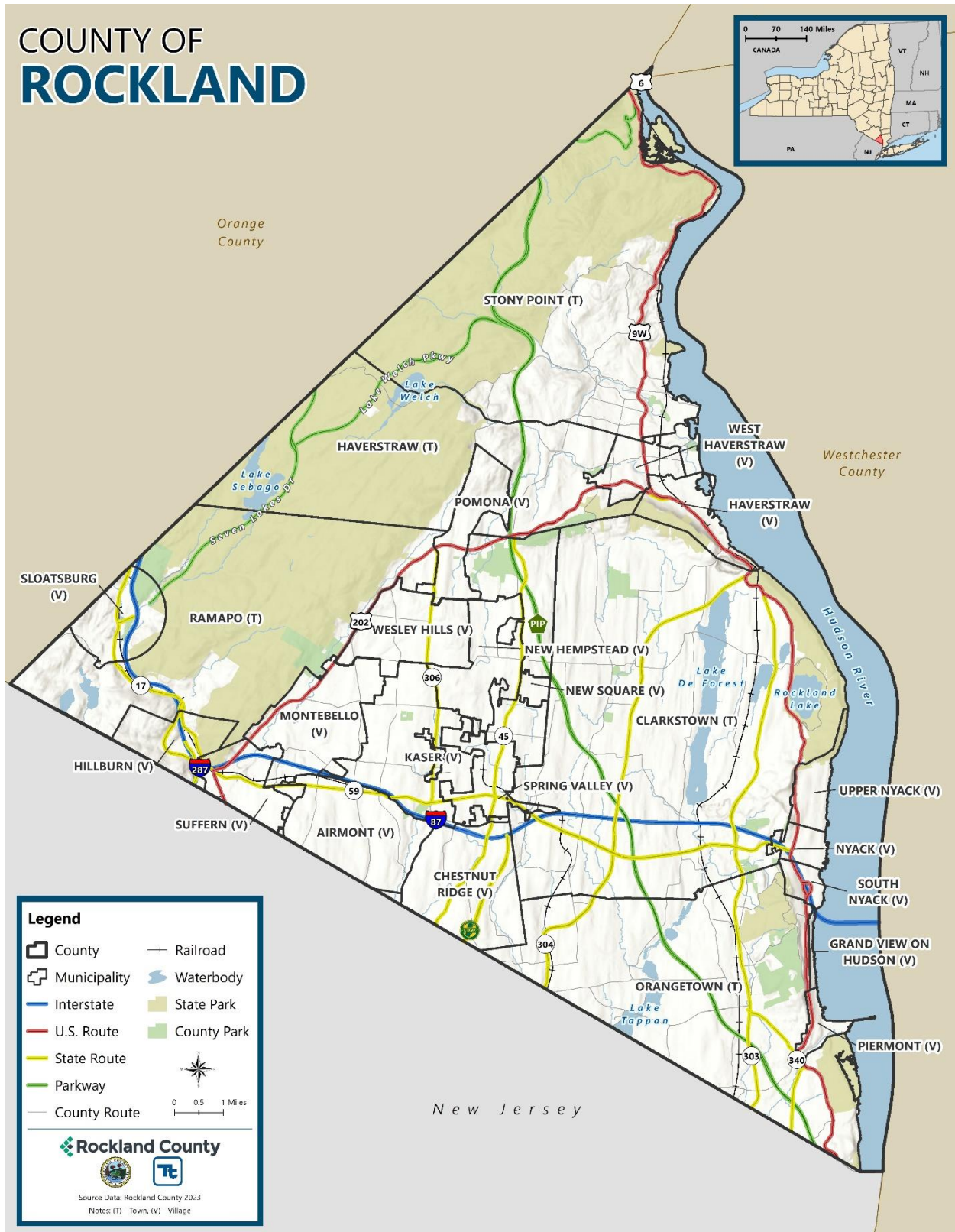
Note: Rockland County is shown in red.

The County is 176 square miles in size, the smallest county by area in New York State. With nearly one-third of its land area devoted to preserved parkland and approximately 40 miles of Hudson River waterfront, Rockland County is known for its natural and scenic resources. The Hudson River contains significant biodiversity areas, including endangered animals and plants, and helps contribute to the County's economic well-being. The river also acts as a transportation route for commuters to New York City and for commercial shipping (Rockland County 2011).

3.1.2 History

The first recorded residents of Rockland County were the Native Americans of the Delaware, or Lenni Lenape, nation. European settlement began after Henry Hudson, under commission by the Dutch East India Company, explored the region in 1609. The Dutch settled in the lower Hudson area until the territory was given over to the English in 1664. Dutch influence can be seen today in the form of sandstone homes in the county. The area that is Rockland County was originally part of Orange County, which was established in 1686, but Rockland separated from Orange County in 1798.

Figure 3-2. Rockland County



3.2 MAJOR PAST HAZARD EVENTS

Presidential disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses, and public entities. Some of the programs are matched by state programs. Review of presidential disaster declarations helps establish the probability of reoccurrence for each hazard. Table 3-1 shows FEMA disaster declarations that included Rockland County through 2023 (records date back to 1954).

Table 3-1. History of FEMA Declarations in Rockland County

Disaster Number	Event Date	Declaration Date	Incident Type	Title
DR-204-NY	August 18, 1965	August 18, 1965	Drought	New York Water Shortage
DR-311-NY	September 13, 1971	September 13, 1971	Flood	New York Severe Storms, Flooding
DR-338-NY	June 23, 1972	June 23, 1972	Flood	New York Tropical Storm Agnes
DR-487-NY	October 2, 1975	October 2, 1975	Flood	New York Severe Storms, Heavy Rain, Landslides, Flooding
DR-702-NY	March 28 – April 8, 1984	April 17, 1984	Flood	New York Coastal Storms, Flooding
DR-974-NY	December 10 – 14, 1992	December 21, 1992	Flood	New York Coastal Storm, High Tides, Heavy Rain, Flooding
EM-3107-NY	March 13 – 17, 1993	March 17, 1993	Snowstorm	New York Severe Blizzard
DR-1083-NY	January 6 – 12, 1996	January 12, 1996	Snowstorm	New York Blizzard
EM-3149-NY DR-1296-NY	September 16 – 18, 1999	September 18, 1999 September 19, 1999	Hurricane	New York Hurricane Floyd
EM-3155-NY	May 22 – November 1, 2000	October 11, 2000	Biological	New York Virus Threat
DR-1391-NY	September 11, 2001	September 11, 2001	Fire	New York Terrorist Attack
EM-3184-NY	February 17 – 18, 2003	March 27, 2003	Snowstorm	New York Snowstorm
EM-3186-NY	August 14 – 16, 2003	August 23, 2003	Infrastructure	New York Power Outage
DR-1534-NY	May 13 – June 17, 2004	August 3, 2004	Severe Storm	New York Severe Storms and Flooding
EM-3262-NY	August 29 – October 1, 2005	September 30, 2005	Hurricane	New York Hurricane Katrina Evacuation
DR-1692-NY	April 14 – 18, 2007	April 24, 2007	Severe Storm	Severe Storms and Inland and Coastal Flooding in New York
DR-1899-NY	March 13 – 31, 2010	April 16, 2010	Severe Storm	New York Severe Storms and Flooding
DR-1957-NY	December 26 – 27, 2010	February 18, 2011	Severe Storm	New York Severe Winter Storm and Snowstorm
EM-3328-NY DR-4020-NY	August 26 – September 5, 2011	August 26, 2011 August 31, 2011	Hurricane	Hurricane Irene in New York
EM-3351-NY DR-4085-NY	October 27 – November 8, 2012	October 28, 2012 October 30, 2012	Hurricane	Hurricane Sandy in New York
EM-3434-NY DR-4480-NY	January 20, 2020 – May 11, 2023	March 13, 2020 March 20, 2020	Biological	New York Covid-19
DR-4567-NY	August 4, 2020	October 2, 2020	Hurricane	New York Tropical Storm Isaias
EM-3565-NY	August 21 – 24, 2021	August 22, 2021	Hurricane	New York Hurricane Henri
EM-3572-NY DR-4615-NY	September 1 – 3, 2021	September 2, 2021 September 5, 2021	Hurricane	New York Remnants of Hurricane Ida
DR-4723-NY	July 9 – 10, 2023	July 22, 2023	Severe Storm	New York Severe Storms and Flooding

Source: FEMA 2023

3.3 PHYSICAL SETTING

3.3.1 Topography and Geology

Rockland County is situated in the Lower Hudson Valley, characterized by rugged terrain with steep slopes. The western part of the County features significant topographic relief, primarily attributed to the Hudson Highlands that run through Harriman and Bear Mountain State Parks. Along the southeastern portion of the County, the Palisades Ridge runs along the Hudson River, linking High Tor and Hook Mountain State Parks before turning and heading south to the southernmost tip of the county at Palisades State Park. From a high point of 1,283 feet at Rockhouse Mountain, northwest of Lake Welch in Harriman State Park, the county's elevation drops to sea level along the Hudson River (Rockland County 2011).

3.3.2 Water Resources

Rockland County's water supply comes from two sources:

- **Surface water** is water that collects on the ground or in a stream, river, lake, wetland, or ocean. Surface water is naturally replenished by precipitation and discharge from aquifers as base flow and lost through evaporation and subsurface seepage into aquifers.
- **Aquifers** are underground layers of permeable rock or other materials (gravel, sand, silt, or clay) from which groundwater can be extracted using a well.

Surface Waters

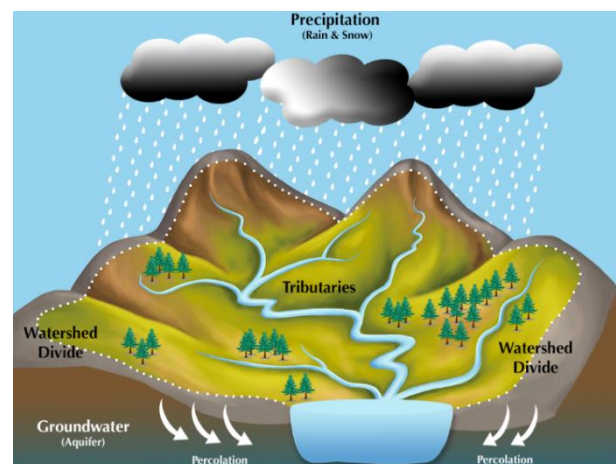
Numerous ponds, lakes, creeks, and rivers make up the waterscape of Rockland County. Major waterways in the County include the Hudson River, the Mahwah River, the Ramapo River, the Hackensack River, Cedar Pond Brook, Demarest Kill, Minisceongo Creek, Nakoma Creek, Muddy Creek, Naurausaun Brook, Pascack Brook, the Saddle River, Sparkill Creek, West Branch Hackensack River, and Willow Tree Brook (Rockland County Fire and Emergency Services 2024). The Hudson River is a tidal estuary connected to the Atlantic Ocean.

Watersheds

A watershed is the geographic land area that is drained by a river or stream (refer to Figure 3-3). In Rockland County, there are seven watershed areas, as illustrated in Figure 3-4 (Rockland County 2011):

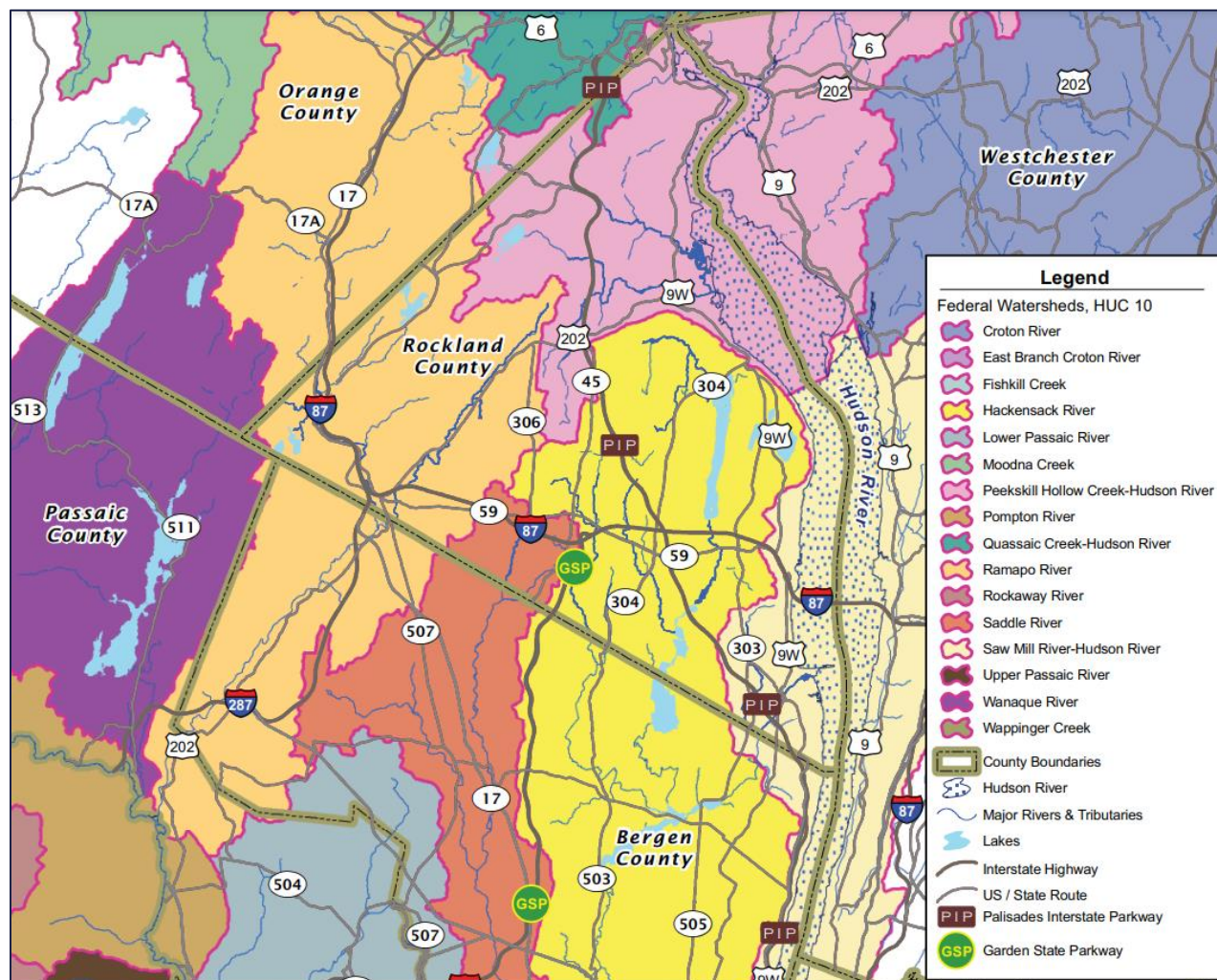
- Hackensack River
- Peekskill Hollow Creek-Hudson River
- Quassaick Creek-Hudson River
- Ramapo River
- Saddle River
- Saw Mill River-Hudson River
- Wanaque River.

Figure 3-3. Watershed Systems



Source: Hudson River Watershed Alliance 2021

Figure 3-4. Rockland County Watersheds



Source: Rockland County 2011

Aquifers

The Ramapo-Mahwah and Newark Basin aquifers are found within the County. The Ramapo-Mahwah aquifer is a highly productive stratified drift deposit located along the Ramapo and Mahwah River corridors beneath western Ramapo, including the villages of Sloatsburg and Suffern and bordering Harriman State Park. It is one of 18 principal aquifers in New York State. The Newark Basin aquifer is a fractured, sedimentary bedrock aquifer underlying southeastern Rockland County. It is another major source of public drinking water in the County. The Newark Basin stretches from Rockland County through New Jersey and Pennsylvania (Rockland County Fire and Emergency Services 2024).

3.3.3 Climate

Rockland County has a continental climate with moderate winters and summers. The County is characterized by frequent changes in the weather during spring and fall. Temperatures range from an average monthly temperature of 29 degrees Fahrenheit (°F) in January to an average monthly temperature of 74 °F in summer. The

average annual precipitation is 46 inches, distributed throughout the year. Average annual snowfall is 38 inches (FEMA 2014).

3.3.4 Land Use and Land Cover

Land use refers to the way land is developed or left in an undeveloped state. Historical land use patterns show how a community has developed over time. Zoning and related ordinances are used to guide development and largely reflect the existing and desired development patterns. Traditional zoning divides a community into various districts and permits or disallows land uses by zoning district.

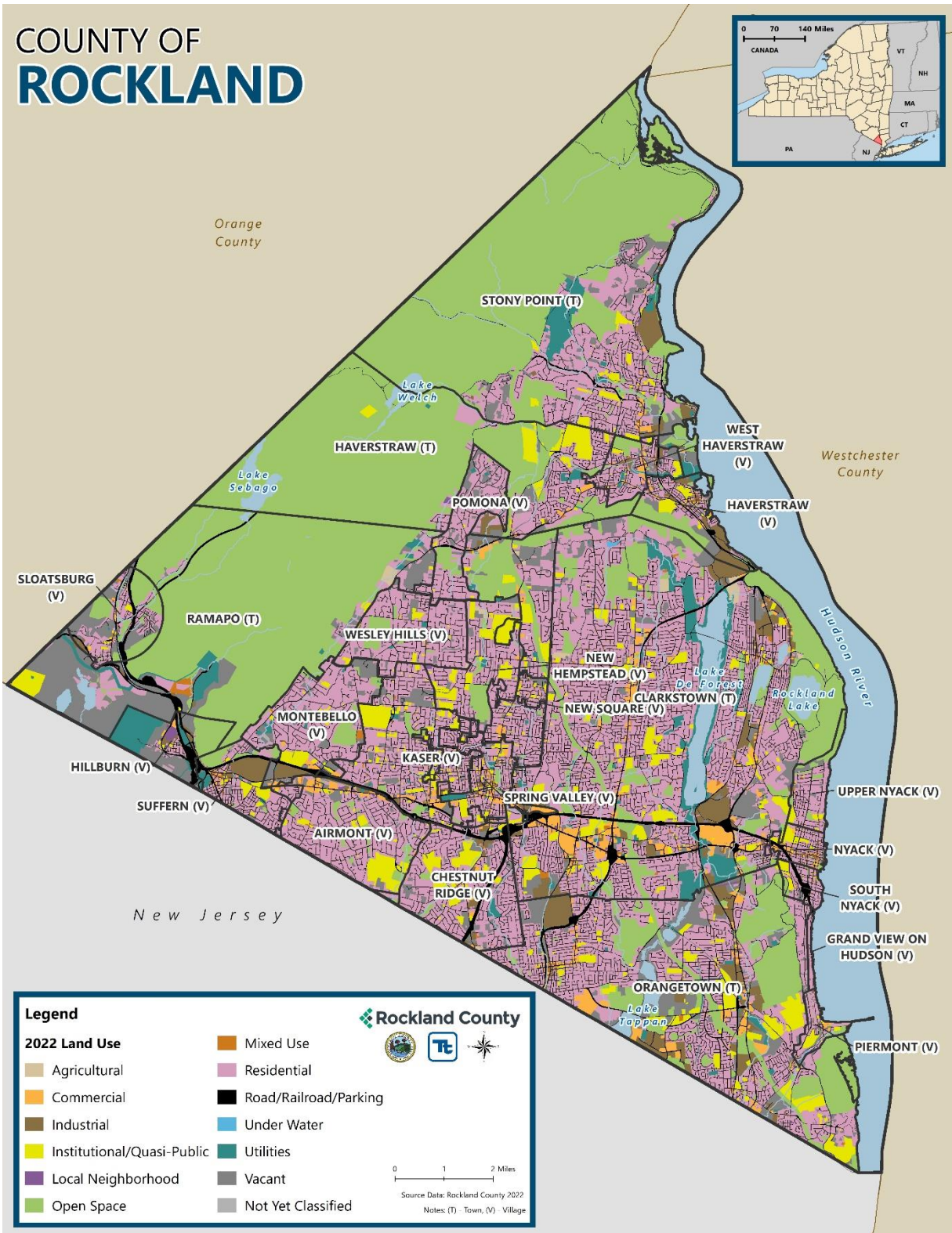
The most dominant land use in Rockland County is public park/open space (32.3 percent of the County’s area). The next highest land use is one-family residential, with 27.8 percent of the land area. Commercial and industrial land uses are found in and around the villages of the County, along Interstate 87, US-9 and US-202, and along many of the roads that run through Rockland County. Industrial uses are scattered throughout the County and include manufacturing complexes, communication facilities, hazardous materials facilities, and utilities. Table 3-2 summarizes the land use in Rockland County. Figure 3-5 shows the distribution of land use throughout the County.

Table 3-2. Land Use Summary for Rockland County

Land Use Category	Acreage	Percent of County
Agricultural	237	0.2%
General Business/Community Commercial	1,339	1.2%
Heavy Industrial	1,927	1.7%
Institutional/Quasi-Public	5,927	5.1%
Light Industrial/Warehouse	1,106	1.0%
Local Neighborhood	247	0.2%
Local Park/Open Space	3,519	3.1%
Mixed Use (Residential/Commercial)	403	0.3%
Multi-Family Residential	3,594	3.1%
Multi-Family Residential - Senior Housing	168	0.1%
Not Yet Classified	98	0.1%
Office	688	0.6%
One-Family Residential	32,079	27.8%
Private Recreation/Private Open Space	2,041	1.8%
Public Park/Open Space	37,192	32.3%
Railroad	316	0.3%
Regional Commercial	160	0.1%
Road/Commuter Parking	9,036	7.8%
Three-Family Residential	146	0.1%
Two-Family Residential	1,140	1.0%
Under Water	121	0.1%
Utilities	4,345	3.8%
Vacant	9,435	8.2%
Rockland County (Total)	115,261	100.0%

Sources: Rockland County; National Land Cover Database, MRLC 2021

Figure 3-5. Land Use Land Cover for Rockland County



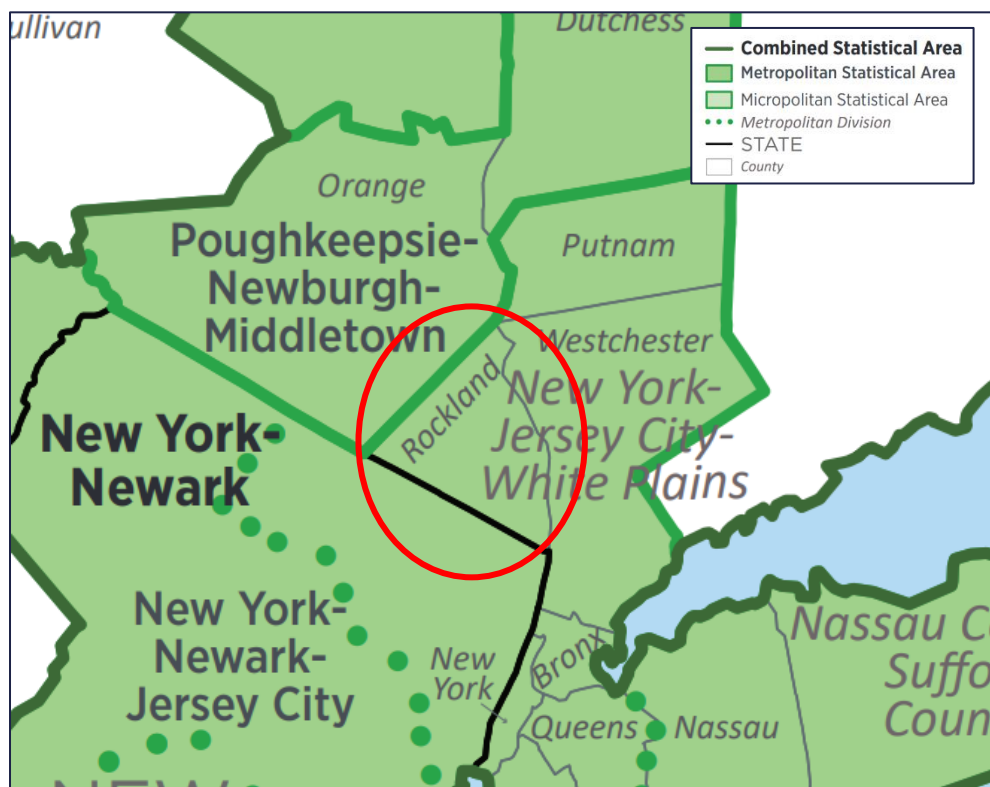
Metropolitan/Urban Area

The Census Bureau delineates urbanized area (UA) and urban cluster (UC) boundaries to encompass core census block groups or blocks that have a population density of at least 1,000 people per square mile; and surrounding census blocks that have an overall density of at least 500 people per square mile.

According to the U.S. Census, an urbanized area is a statistical geographic entity consisting of a densely settled core created from census tracts or blocks and contiguous qualifying territory that together have a population of 50,000 or more persons. An urban cluster is a statistical geographic entity consisting of a densely settled core created from census tracts or blocks and contiguous qualifying territory that together have at least 5,000 persons but fewer than 50,000 persons (US Census Bureau 2022). Rockland County has a population of over 317,000 and a population density of approximately 1,600 people per square mile, so it is considered an urban area.

Rockland County is located within the New York-Jersey City-White Plains Metropolitan Statistical Area (MSA). As of the 2020 Census, there were 12,076,970 people living in the MSA (US Census Bureau 2020). Figure 3-6 shows the location of Rockland County and the MSA.

Figure 3-6. New York-Jersey City-White Plains Metropolitan Statistical Area



Source: US Census Bureau 2021

Note: Rockland County (red oval) is in the New York-Jersey City-White Plains Metropolitan Statistical Area

3.4 POPULATION AND DEMOGRAPHICS

An understanding of the planning area population characteristics provides a foundation for assessing the impacts of natural hazards in the County. As noted in Section 4.2, modeling of the impacts of natural hazards on the population was performed using FEMA’s Hazus risk simulation model. Population information in the Hazus model used for this HMP (v6.0) includes the 2010 Decennial Census which indicates a county population of 311,687. However, more current data, according to American Community

Survey (ACS) 2021 Five-Year Estimate, approximates a county population of 336,485. Table 3-3 shows the ACS estimates for Rockland County and its jurisdictions. The information in this table is the best available population data for the HMP update. Figure 3-7 shows the distribution of population density (persons per square mile).

For this plan, the default population data available in Hazus (representing 2010 data) are used to support the analysis of displaced households and number of persons seeking shelter. Population exposure results are based on the ACS 2021 Five-Year population estimates.

3.4.1 Vulnerable Populations

The federal guidelines require that HMPs consider socially vulnerable populations. These populations can be more susceptible to hazard events based on several factors, including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Populations with a higher level of vulnerability can be more seriously affected during an emergency or disaster. Vulnerable populations have unique needs that must be considered by public officials to ensure the safety of those with a higher level of risk.

The vulnerable populations in the 2024 HMP include persons ages 65 and over, persons under 5 years of age, individuals determined to be below the Asset Limited, Income Constrained, Employed (ALICE) threshold, those with physical or mental disabilities, and non-English speakers. Identifying concentrations of vulnerable populations can assist communities in targeting preparedness, response, and mitigation actions. Table 3-3 lists the ACS 2021 Five-Year Estimate vulnerable population statistics in Rockland County by jurisdiction.

The ALICE Threshold represents the minimum income level necessary for survival for a household. Derived from the Household Survival Budget, the ALICE Threshold is rounded to the nearest American Community Survey income category and adjusted for household size and composition for each county (United for ALICE 2024).

Various Census Bureau products were used as sources for the population trends section. The Decennial Census is the official population count taken every 10 years. The American Community Survey Five-Year Estimate products were used to establish annual changes in population. American Community Survey Five-Year Estimates are used to show annual population changes but are not official population counts. The Five-Year Estimates are used because they are the most accurate form of American Community Survey with the largest sample size, which allows for greater accuracy at smaller geographic areas. The numbers provided are not official census counts, but are official estimates provided to communities so that they may have a greater understanding of population changes within their jurisdictions.

Table 3-3. Rockland County Population Statistics

Jurisdiction	2021 ACS 5-year Population Estimates	% of County Total	ACS 5-Year Population Estimates (2021)									
			Over 65		Under 5		Non-English Speaking		Disability		Below ALICE Threshold	
			Number	% total	Number	% total	Number	% total	Number	% total	Number	% total
Airmont (V)	9,964	3.0%	1,487	14.9%	660	6.6%	355	3.6%	727	7.3%	2,616	26.3%
Chestnut Ridge (V)	10,211	3.0%	1,587	15.5%	1,368	13.4%	617	6.0%	1,149	11.3%	1,957	19.2%
Clarkstown (T)	81,385	24.2%	16,757	20.6%	3,729	4.6%	4,251	5.2%	8,056	9.9%	22,733	27.9%
Grand View on Hudson (V)	241	0.1%	64	26.6%	13	5.4%	0	0.0%	16	6.6%	32	13.4%
Haverstraw (T)	14,028	4.2%	2,523	18.0%	1,093	7.8%	996	7.1%	1,228	8.8%	5,023	35.8%
Haverstraw (V)	12,292	3.7%	1,624	13.2%	882	7.2%	2,045	16.6%	1,500	12.2%	4,671	38.0%
Hillburn (V)	1,110	0.3%	161	14.5%	114	10.3%	48	4.3%	145	13.1%	362	32.6%
Kaser (V)	5,433	1.6%	174	3.2%	1,319	24.3%	1,350	24.8%	102	1.9%	1,182	21.8%
Montebello (V)	4,665	1.4%	563	12.1%	193	4.1%	165	3.5%	303	6.5%	588	12.6%
New Hempstead (V)	5,440	1.6%	816	15.0%	259	4.8%	65	1.2%	383	7.0%	439	8.1%
New Square (V)	9,433	2.8%	201	2.1%	1,523	16.1%	1,651	17.5%	319	3.4%	1,586	16.8%
Nyack (V)	7,303	2.2%	1,521	20.8%	347	4.8%	265	3.6%	862	11.8%	3,653	50.0%
Orangetown (T)	36,127	10.7%	6,912	19.1%	1,804	5.0%	1,056	2.9%	3,540	9.8%	12,603	34.9%
Piermont (V)	2,525	0.8%	539	21.3%	141	5.6%	142	5.6%	181	7.2%	1,214	48.1%
Pomona (V)	3,306	1.0%	613	18.5%	246	7.4%	116	3.5%	293	8.9%	520	15.7%
Ramapo (T)	48,846	14.5%	4,698	9.6%	7,183	14.7%	1,265	2.6%	2,424	5.0%	18,912	38.7%
Sloatsburg (V)	3,043	0.9%	513	16.9%	200	6.6%	68	2.2%	380	12.5%	1,437	47.2%
South Nyack (V)	2,803	0.8%	535	19.1%	59	2.1%	32	1.1%	371	13.2%	911	32.5%
Spring Valley (V)	32,953	9.8%	3,176	9.6%	3,730	11.3%	9,690	29.4%	2,751	8.3%	13,385	40.6%
Stony Point (T)	14,876	4.4%	2,653	17.8%	594	4.0%	265	1.8%	1,619	10.9%	4,393	29.5%
Suffern (V)	11,376	3.4%	2,316	20.4%	490	4.3%	866	7.6%	1,101	9.7%	5,449	47.9%
Upper Nyack (V)	2,355	0.7%	479	20.3%	88	3.7%	19	0.8%	161	6.8%	539	22.9%
Wesley Hills (V)	6,105	1.8%	862	14.1%	626	10.3%	0	0.0%	406	6.7%	1,008	16.5%
West Haverstraw (V)	10,665	3.2%	1,286	12.1%	944	8.9%	1,663	15.6%	991	9.3%	4,490	42.1%
Rockland County (Total)	336,485	100%	52,060	15.5%	27,605	8.2%	26,990	8.0%	29,008	8.6%	109,704	32.6%

Source: U.S. Census 2024; American Community Survey 2024

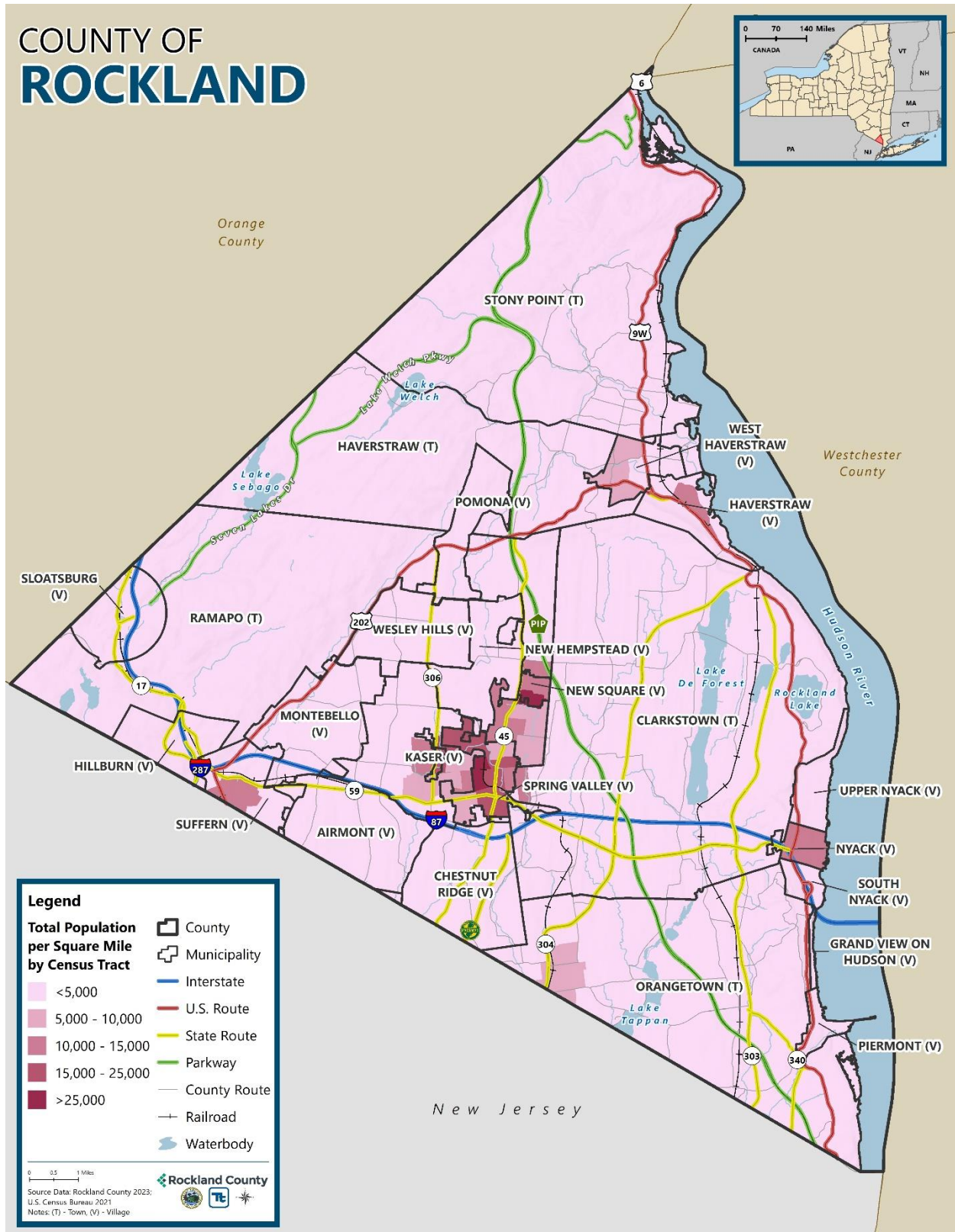
Notes: The following villages were contained with towns; the population totals were adjusted based on average population based on the count of residential structures from the general building stock data.

Village of Nyack - Part of Town of Clarkstown; Part of Town of Orangetown

Village of Pomona - Part of Town of Haverstraw; Part of Town of Ramapo

Village of Spring Valley - Part of Town of Clarkstown; Part of Town of Ramapo

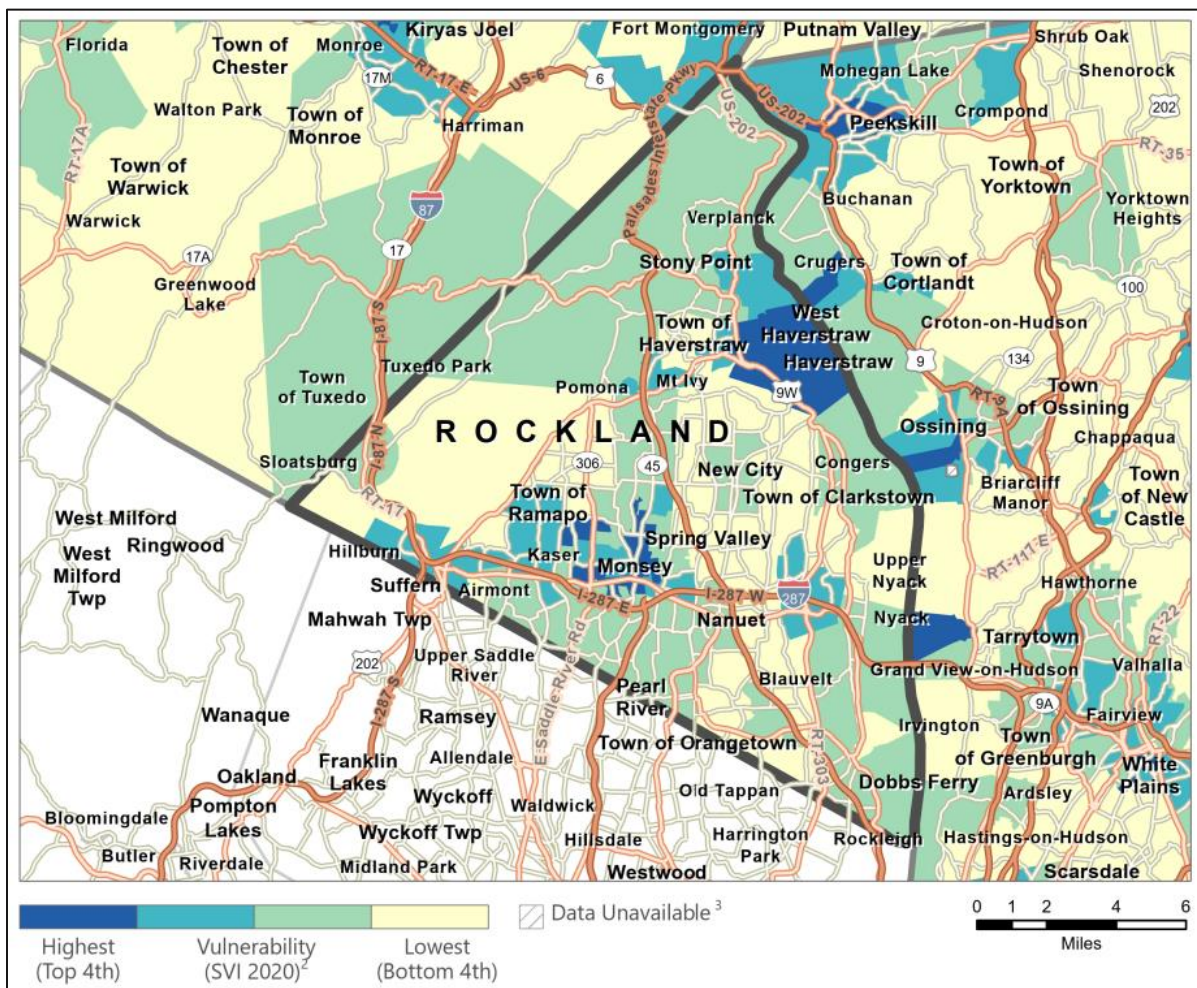
Figure 3-7. Distribution of General Population for Rockland County



Social Vulnerability Index

The Social Vulnerability Index (SVI) is a recent tool developed by the U.S. Centers for Disease Control and Prevention (CDC) to identify socially vulnerable populations. The CDC defines socially vulnerable population using factors such as poverty, lack of access to transportation, and crowded housing. These factors may weaken a community’s ability to prevent human suffering and financial loss in a disaster. The SVI uses U.S. Census data to determine the social vulnerability of every Census tract. The SVI ranks each tract on 16 social factors and groups them into four related themes. Each tract receives a separate ranking for each of the four themes, as well as an overall ranking (Agency for Toxic Substances and Disease Registry 2022). Figure 3-8 illustrates the overall social vulnerability distribution in Rockland County.

Figure 3-8. Overall Social Vulnerability in Rockland County



Source: Agency for Toxic Substances and Disease Registry 2022

Age

Children are considered more vulnerable to the impacts of hazard events because they are dependent on others to safely access resources during emergencies and may experience increased health risks from hazard exposure. Older adults are more vulnerable than other age groups before and after disasters and experience more casualties

during and after disasters. Factors include a greater prevalence of chronic conditions, cognitive impairment, medication concerns, greater dependence on assistive devices (e.g., mobility and medical equipment), need for support from caregivers and others, and likelihood of social isolation (American Red Cross 2020). The 2021 ACS reports 8.2 percent of the population of Rockland County is under the age 5 and 15.5 percent is age 65 and older (Figure 3-9 and Figure 3-10).

Income

The 2021 ACS 5-Year Estimates find that the median household income in Rockland County was \$99,707, and the per capita income was \$41,041 (US Census Bureau 2021). The U.S. Census Bureau identifies households with two adults and two children with an annual household income below \$29,678 per year as “low income” (US Census Bureau 2023). The 2021 ACS 5-Year Estimates for Rockland County indicate a total of 10.1 percent persons below the poverty level (US Census Bureau 2021).

It is noted that the spatial U.S. Census data for household income provided in Hazus includes two 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 established by the 2023 U.S. Census Bureau data. This difference is not significant for the purposes of this planning effort; therefore, for the exposure and loss estimations in the risk assessment, the U.S. Census data in Hazus is reported. Figure 3-11 illustrates the low-income population density in Rockland County.

Asset Limited, Income Constrained, Employed (ALICE)

The County’s median and per capita incomes are significantly higher than the U.S. Census Bureau’s low income designation. In recognition of this discrepancy, the Steering Committee recommended including the United Way’s Asset Limited, Income Constrained, Employed (ALICE) metric in this HMP update. An ALICE household is one that earns above the federal poverty level but cannot afford the basic cost of living in their county (United Way of New York State & United for ALICE 2023). These households often do not qualify for public assistance programs and may struggle to make ends meet. In other words, the ALICE metric is relative to a county’s economic composition (i.e., median income).

ALICE is determined by two factors: essential costs and income. Essential costs include a household’s basic needs, such as housing, childcare, food, transportation, health care, smartphone plan, and taxes. This number is compared to the U.S. Census Bureau data on county-level income. If a household’s costs exceed its income, it is said to be below the ALICE threshold. The ALICE threshold exceeds the federal poverty level, so ALICE households include these households.

In Rockland County, 27 percent of households are below the ALICE threshold (United Way of New York State & United for ALICE 2023). Compared to households meeting poverty thresholds (10 percent), this metric suggests a greater share of the County’s population could be adversely affected by hazard impacts than those meeting poverty or U.S. Census Bureau low income thresholds. Refer to Figure 3-12.

Figure 3-9. Distribution of Population Under 5 Years Old in Rockland County

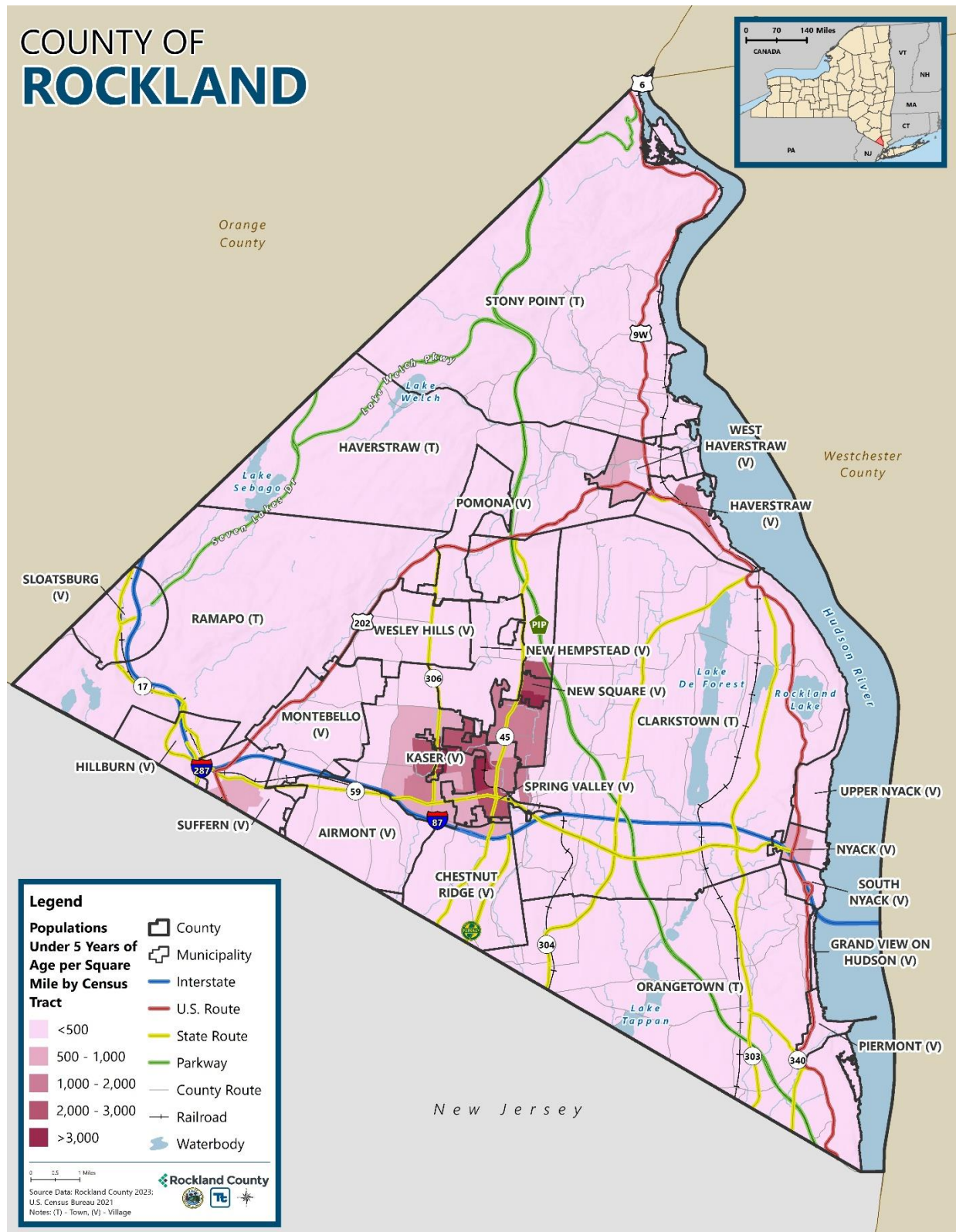


Figure 3-10. Distribution of Population Over 65 Years Old in Rockland County

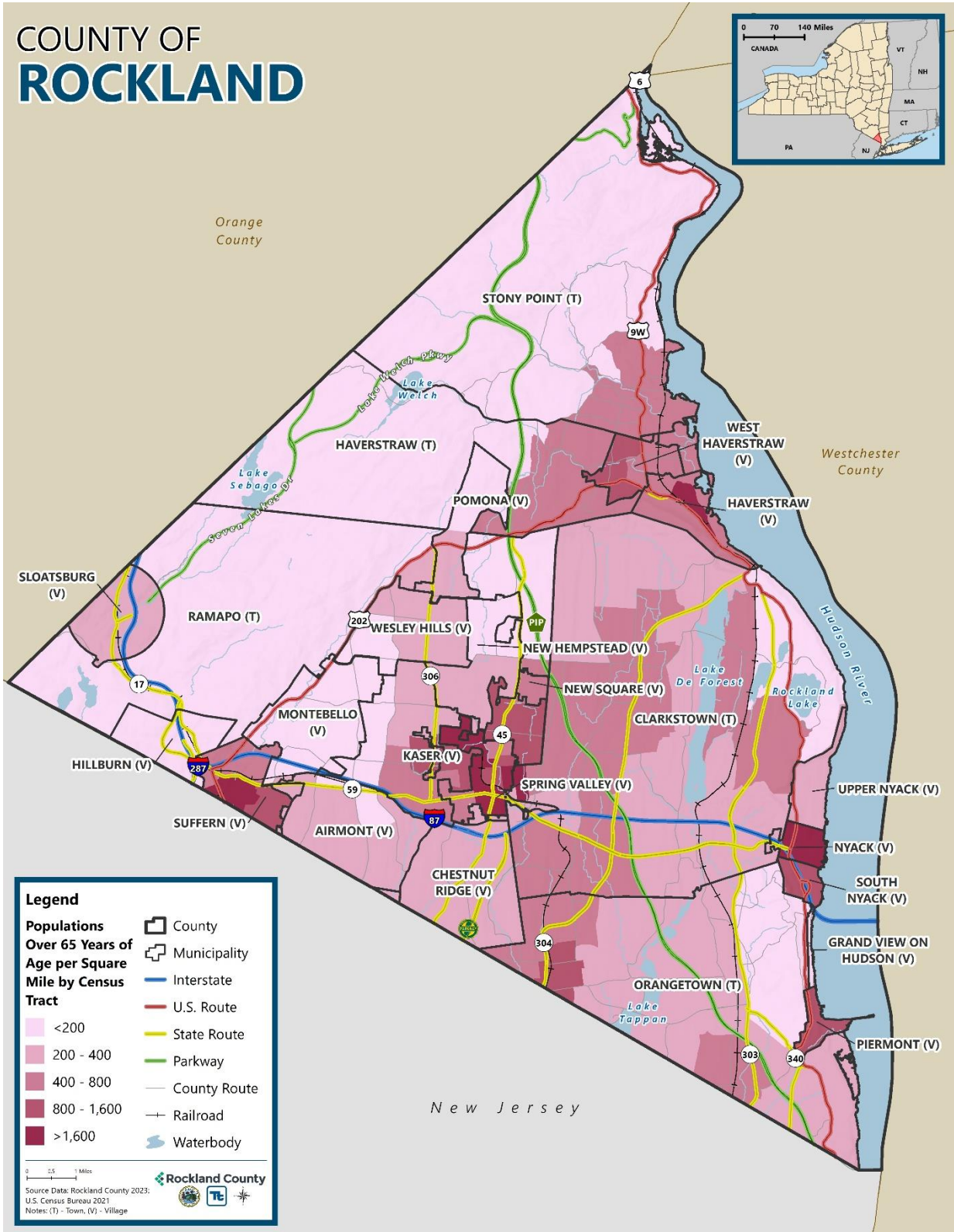


Figure 3-11. Distribution of Low-Income Population in Rockland County

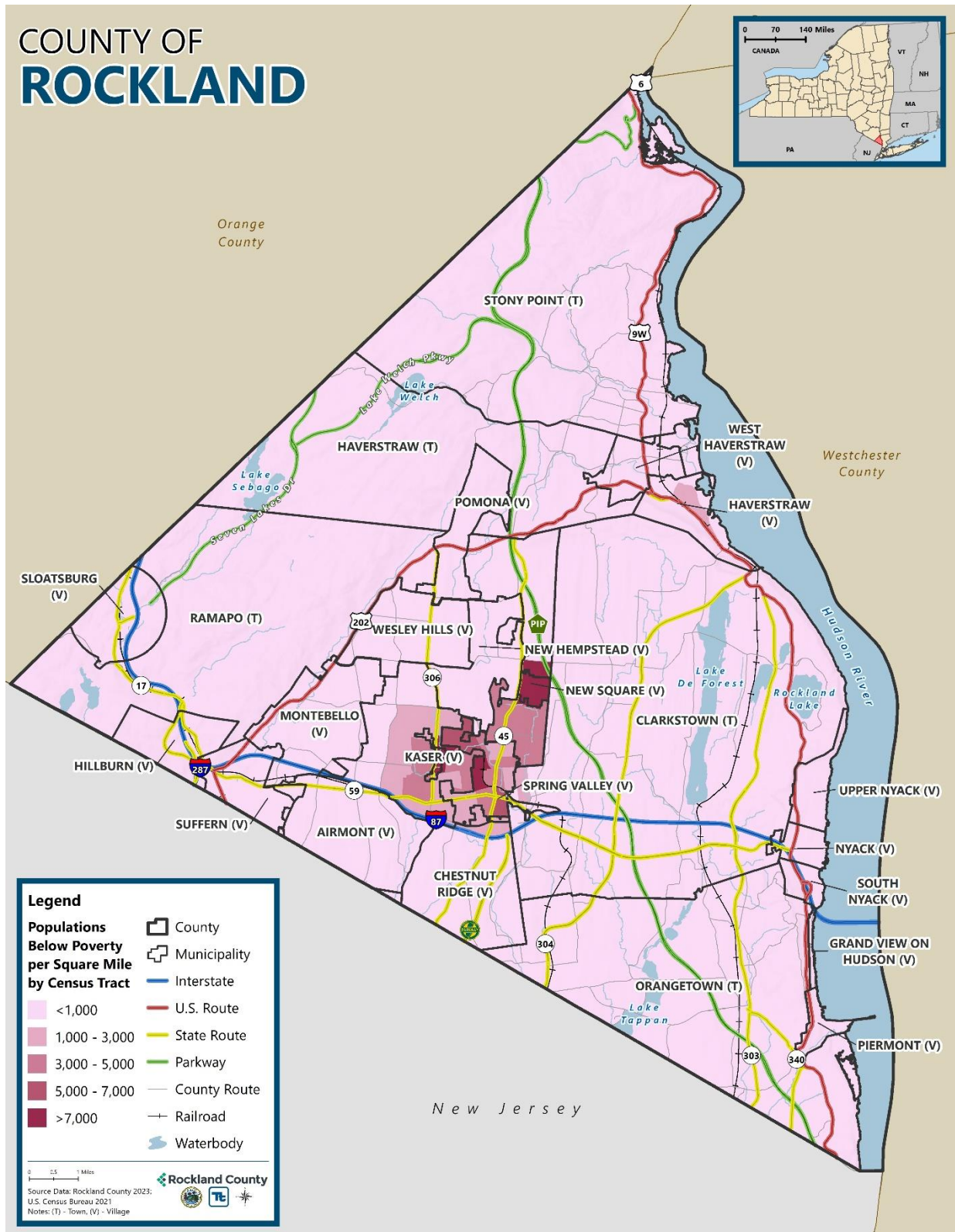
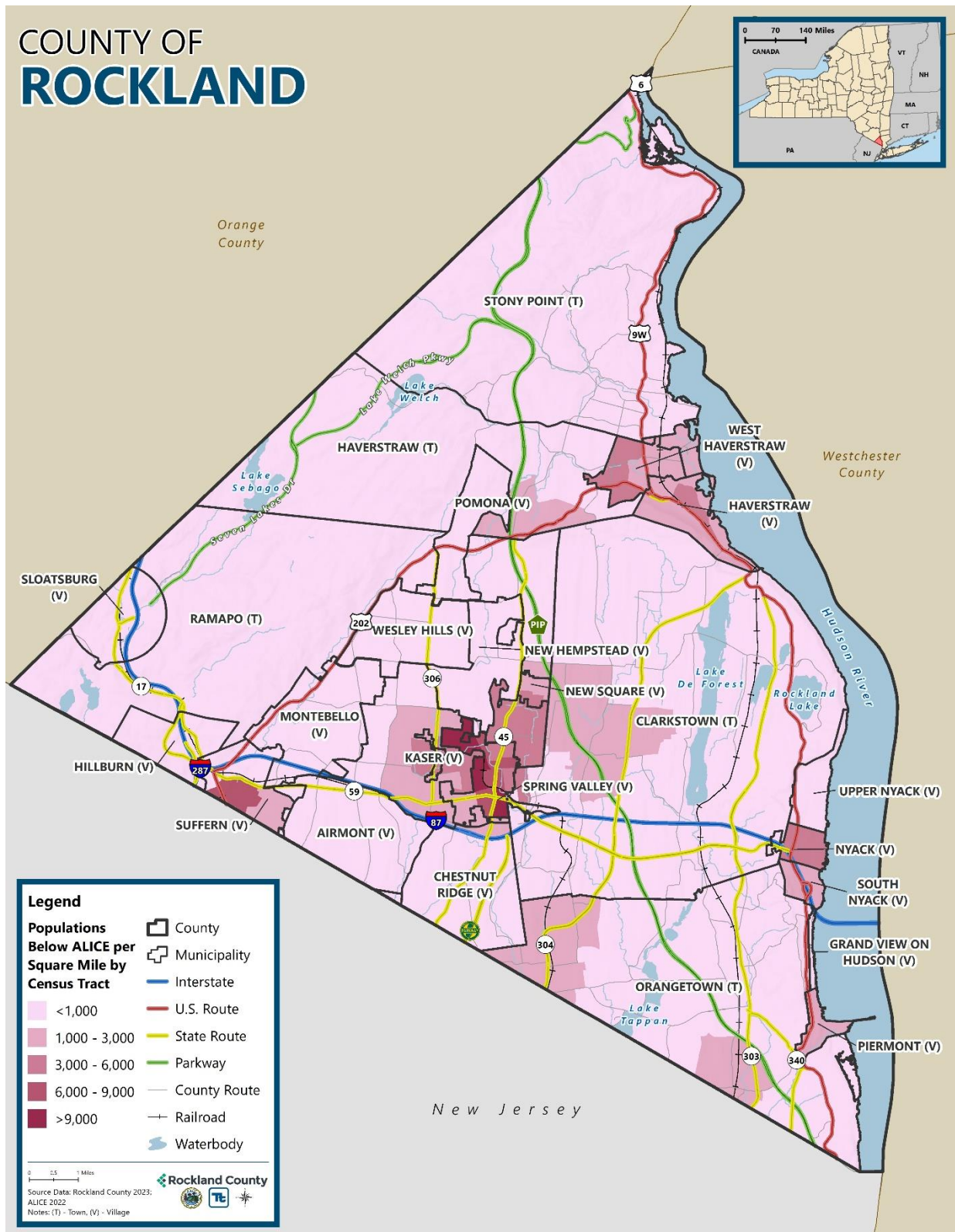


Figure 3-12. Distribution of Population Below ALICE Threshold in Rockland County



Physically or Mentally Disabled

According to the CDC, “persons with a disability include those who have physical, sensory, or cognitive impairment that might limit a major life activity” (U.S. Department of Justice 2023). 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 ACS, 8.7 percent of the County’s total population is identified as having a disability (refer to Figure 3-13).

Non-English Speakers

Individuals who are not fluent or proficient 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 (U.S. Department of Justice 2016). According to the 2021 ACS, 42.6 percent of the County’s population over the age of five speaks a language other than English at home; this is higher than the State average of 30.5 percent. Of the County’s population, 14.0 percent speak Spanish and 23 percent speak other Indo-European languages (US Census Bureau 2021) (refer to Figure 3-14).

3.4.2 Population and Demographic Trends

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.

According to the U.S. Census Bureau, the 2020 population for Rockland County was 338,329, an 8.5 percent increase from the 2010 Census population of 311,687. From 1900 to 2010, the County has seen an overall growth in population, with the exception of from 1910 to 1920. The largest increase was seen between 1960 and 1970 when the County experienced a 68.1 percent increase (93,100 persons). The smallest increase was experienced from 1980 to 1990 when the County saw only a 2.3 percent increase in population. The only decrease in population occurred from 1910 to 1920, with the County seeing a 2.8 percent decrease. Table 3-4 displays the population and change in population from 1900 to 2020 in Rockland County.

Cornell University’s Program on Applied Demographics produced population projections by county and by age and sex for New York State. The projections were completed in 2018 and are in annual intervals through 2040. The projections are based on rates of change estimated from historical data. According to this data, shown in Figure 3-15, Rockland County has a projected population increase of 8.6 percent over the next 17 years (Cornell University 2018).

Figure 3-13. Distribution of Population with a Disability in Rockland County

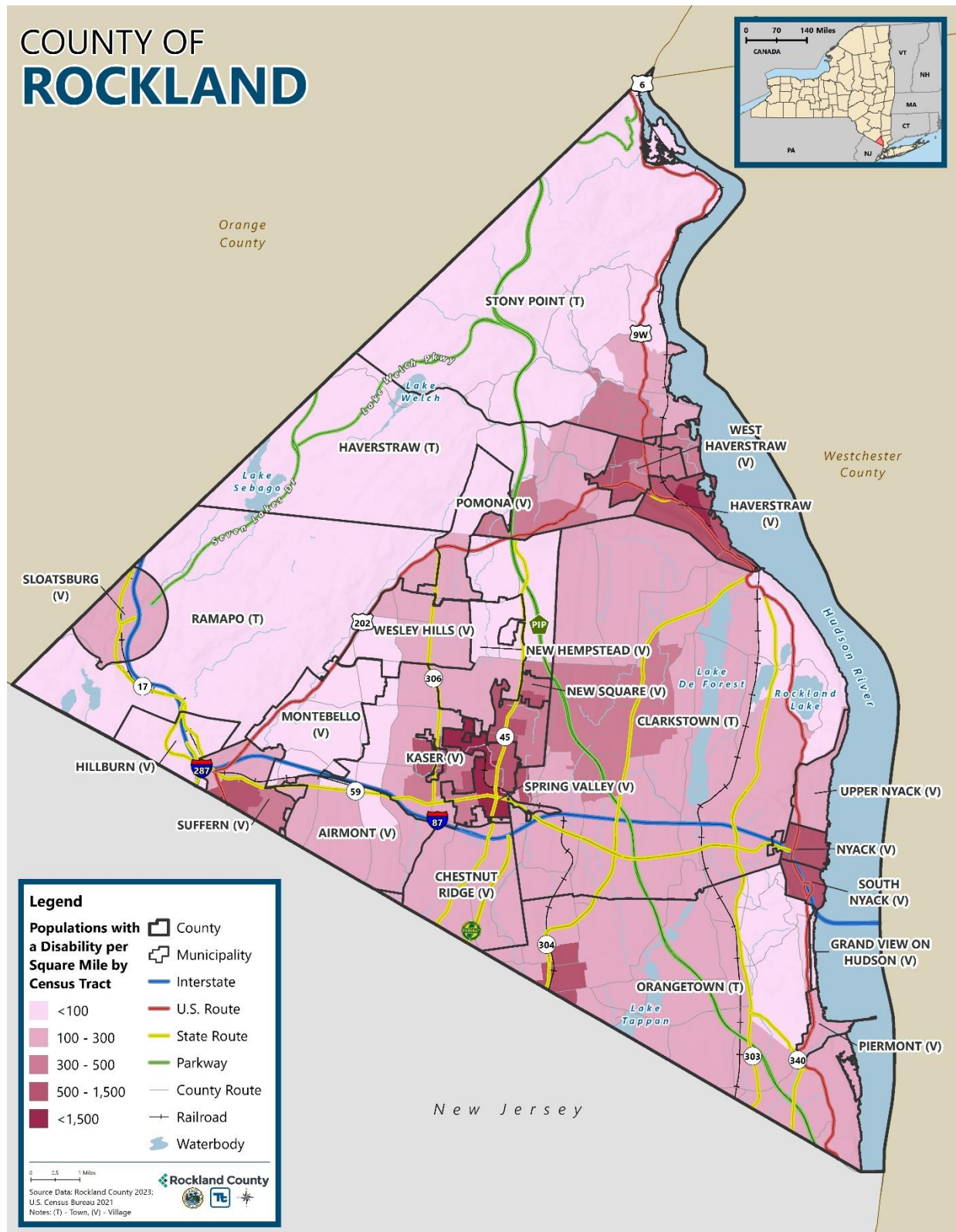


Figure 3-14. Distribution of Non-English Speaking Population in Rockland County

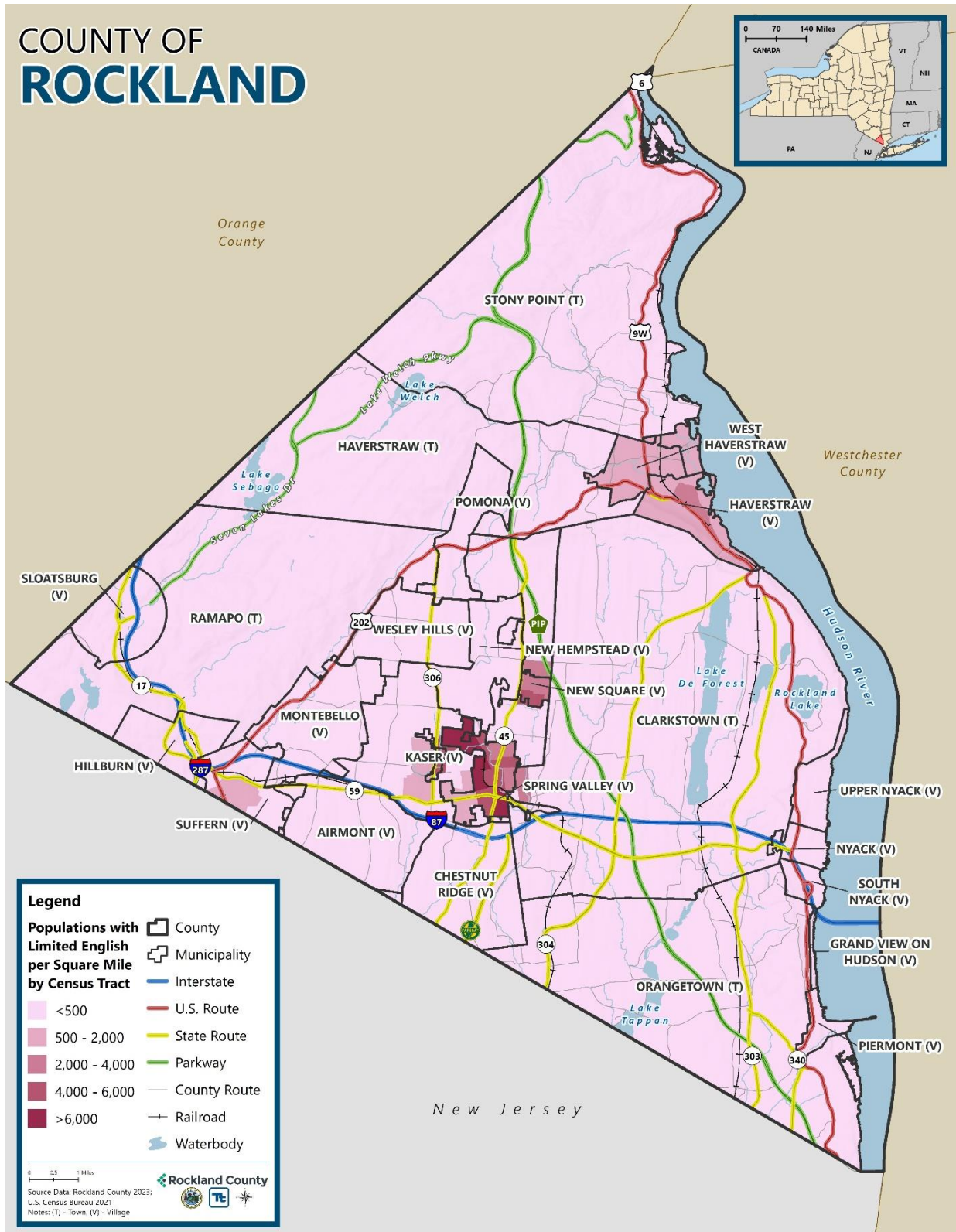


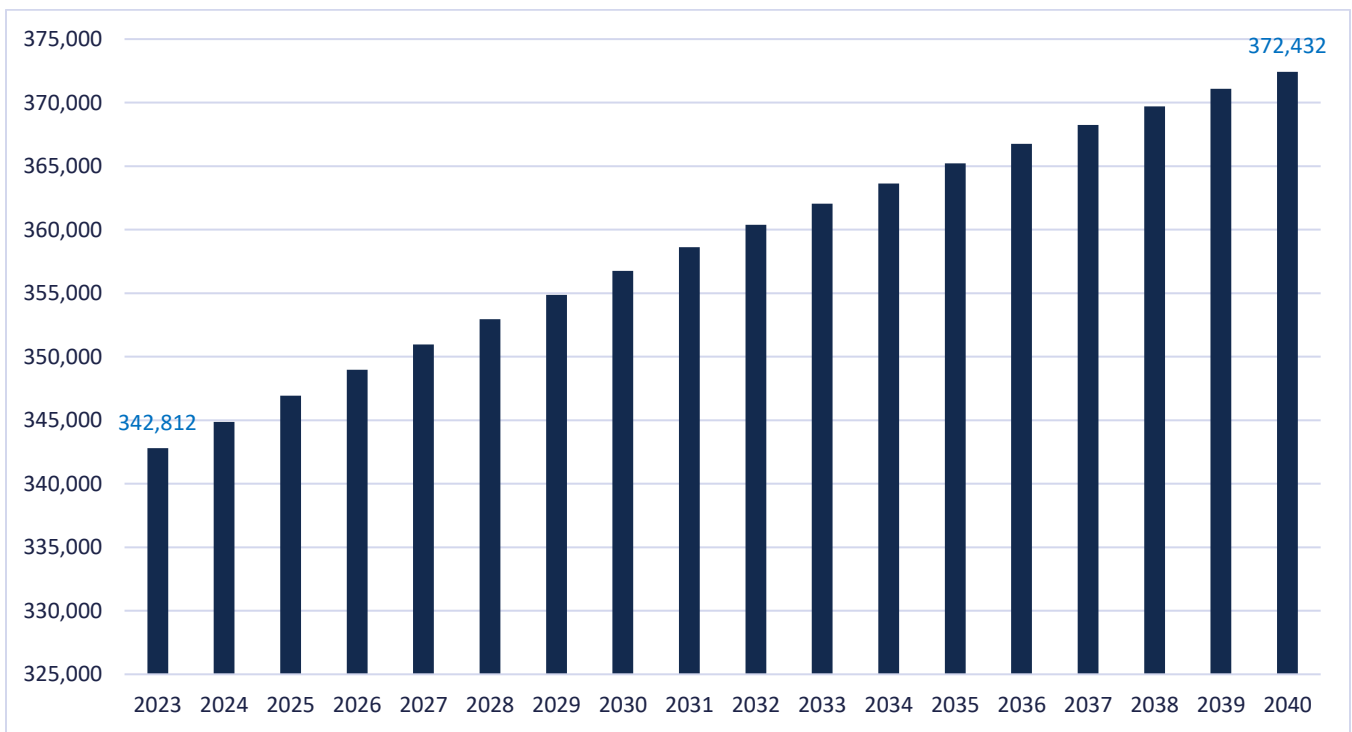
Table 3-4. Rockland County Population Trends

Year	Population	Change in Population	Population Change (%)
1900	38,298	-	-
1910	46,873	8,575	22.4%
1920	45,548	-1,325	-2.8%
1930	59,599	14,051	30.8%
1940	74,261	14,662	24.6%
1950	89,276	15,015	20.2%
1960	136,803	47,527	53.2%
1970	229,903	93,100	68.1%
1980	259,530	29,627	12.9%
1990	265,475	5,945	2.3%
2000	286,753	21,278	8.0%
2010	311,687	24,934	8.7%
2020	338,329	26,642	8.5%

Source: U.S. Census 2024

Note: Change in population and percent in population change were calculated from available data.

Figure 3-15. Rockland County Population Projections, 2023 to 2040



Source: Cornell University 2018

Table 3-5 provides population trends for the 24 municipalities of Rockland County. The Village of New Square saw the largest growth in population, a 39.4 percent increase. The Village of South Nyack saw the greatest decrease with a loss of 23.1 percent.

Table 3-5. Population Trends in Rockland County by Municipality

Jurisdiction	2010 Census	2020 Census	% Change (2010 to 2020)
Airmont (V)	8,628	10,166	17.8%
Chestnut Ridge (V)	7,916	10,505	32.7%
Clarkstown (T)	84,187	86,855	3.2%
Grand View on Hudson (V)	285	246	-13.7%
Haverstraw (T)	36,634	39,087	6.7%
Haverstraw (V)	11,910	12,323	3.5%
Hillburn (V)	951	930	-2.2%
Kaser (V)	4,724	5,491	16.2%
Montebello (V)	4,526	4,507	-0.4%
New Hempstead (V)	5,132	5,463	6.4%
New Square (V)	6,944	9,679	39.4%
Nyack (V)	6,765	7,265	7.4%
Orangetown (T)	49,212	48,655	-1.1%
Piermont (V)	2,510	2,517	0.3%
Pomona (V)	3,103	3,824	23.2%
Ramapo (T)	126,595	148,919	17.6%
Sloatsburg (V)	3,039	3,036	-0.1%
South Nyack (V)	3,510	2,699	-23.1%
Spring Valley (V)	31,347	33,066	5.5%
Stony Point (T)	15,059	14,813	-1.6%
Suffern (V)	10,723	11,441	6.7%
Upper Nyack (V)	2,063	2,015	-2.3%
Wesley Hills (V)	5,628	6,116	8.7%
West Haverstraw (V)	10,165	10,678	5.0%
Rockland County (Total)	311,687	338,329	8.5%

3.5 GENERAL BUILDING STOCK

For this update, a customized general building stock was created using building footprints and parcel data from the County, supplemented with other County-provided data and 2022 RSMeans replacement cost values for buildings and contents. Contents are valued at 50 percent of the building’s value for residential structures and 100 percent of the building’s value for non-residential facilities. The updated building inventory contains 112,485 buildings with a total building replacement value (structure and contents) of \$54.1 billion. This inventory was incorporated into Hazus. The Town of Clarkstown has the greatest number of structures, at 34,094. The Village of Kaser has the fewest structures, with 197.

Residential housing accounts for 93 percent of the buildings in the inventory (104,229 buildings) and 52 percent of the building stock replacement value (approximately \$48 billion). The 2021 ACS identifies 108,165 housing units in Rockland County, with a median value of \$528,900 for owner-occupied housing units (US Census Bureau 2021). The Census Bureau defines a housing unit as any house, apartment, mobile home, group of rooms, or single room that is intended for occupancy as separate living quarters. Commercial buildings make up 25 percent of the total building replacement value. Replacement cost values of commercial, industrial, and residential properties in Rockland County are shown in Figure 3-16 through Figure 3-18, respectively.

Figure 3-16. Replacement Cost Value of Commercial Properties in Rockland County

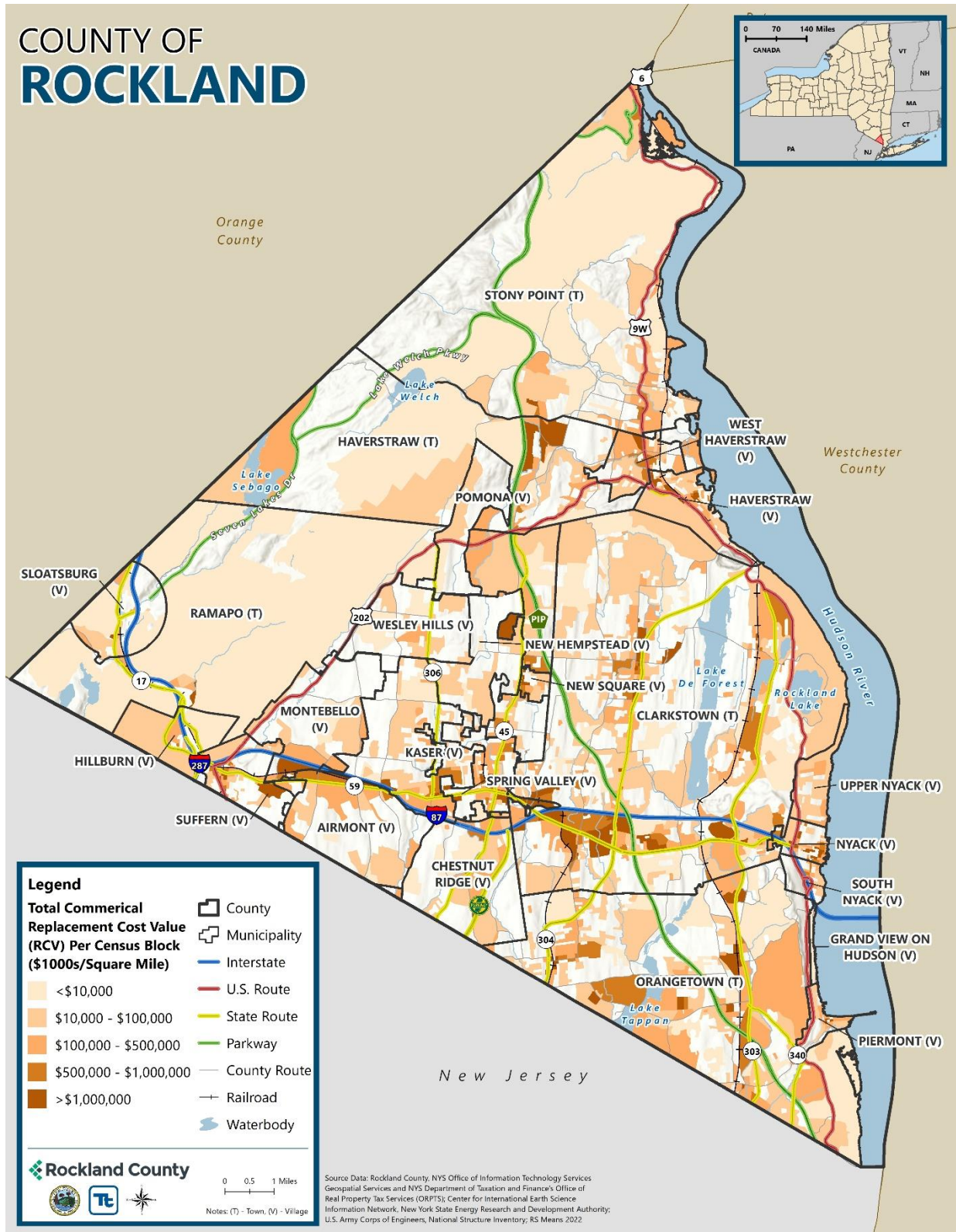


Figure 3-17. Replacement Cost Value of Industrial Properties in Rockland County

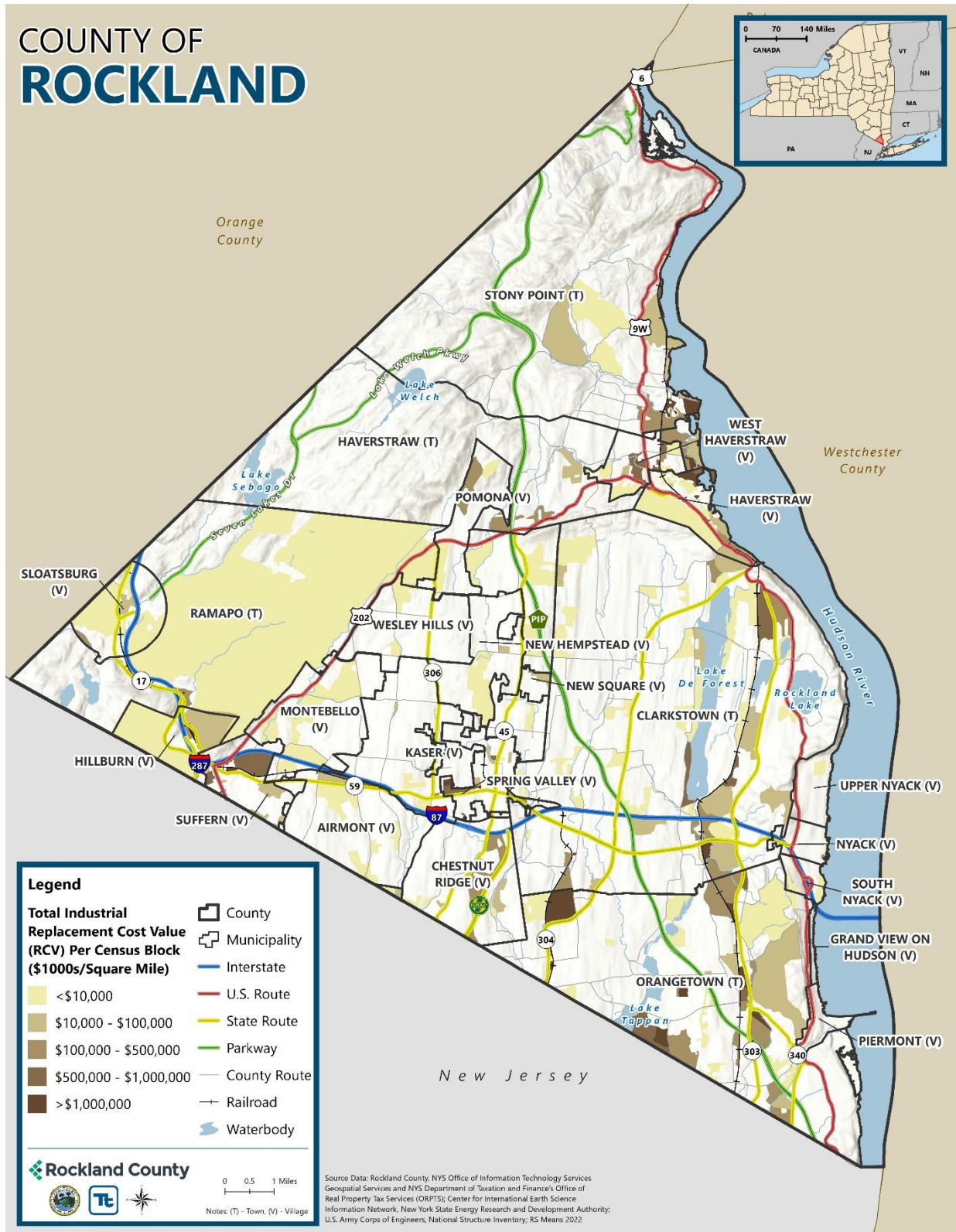
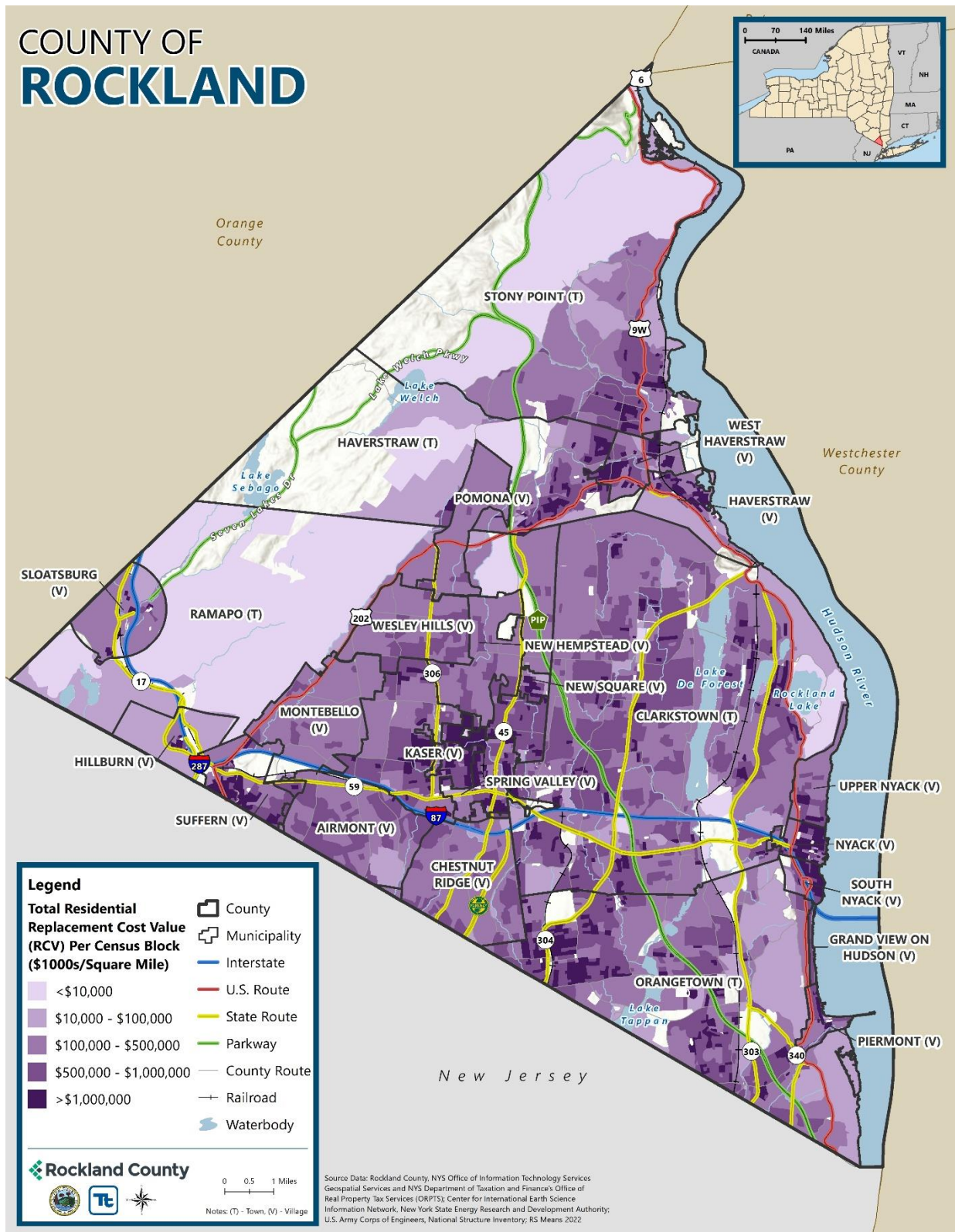


Figure 3-18. Replacement Cost Value of Residential Properties in Rockland County



3.6 DEVELOPMENT TRENDS AND NEW DEVELOPMENT

Federal guidelines for hazard mitigation require that communities consider land use trends, which can impact the need for and priority of mitigation options over time. Land use trends can also significantly impact exposure and vulnerability to various hazards. For example, significant new development in a hazard area increases the building stock and population exposed to that hazard.

The hazard profiles in this HMP provide a general overview of land use trends and types of development occurring within known hazard areas. In the jurisdictional annexes in Volume II, the County and participating municipalities have identified development that has occurred in the last five years and potential future development in the next five years, along with the development's exposure to natural hazards. An understanding of these trends can assist in planning for further development and ensuring that appropriate mitigation, planning, and preparedness measures are in place to protect human health and community lifelines. In general, development occurring in Rockland County is outside of high hazard areas (e.g., floodplains and steep slopes).

While any development increases the risk of losses due to natural hazards, such increases can be mitigated by existing federal, state, county and local regulations, policies, and programs. In New York State, land use regulatory authority is vested in towns, villages, and cities. Each municipality in Rockland County is empowered by the Municipal Home Rule Law to plan and zone within its boundaries. However, many development and preservation issues transcend local political boundaries.

All communities have planning and regulatory mechanisms in place that control and limit the increased natural hazard risk of new development and re-development. All communities have planning boards and site plan review requirements that include review and appropriate consideration of hazard areas. The County requires that all development and construction conform with the Uniform Fire Prevention and Building Code (Uniform Code). Further all Rockland County communities participate, and are in good standing, in the National Flood Insurance Program (NFIP), which by state regulation requires 2 feet of freeboard above the FEMA 1 percent annual chance base flood elevation (BFE) for new residential construction and substantial improvement, and 1 foot for all other construction types.

Certain communities have adopted ordinances to further protect against natural hazards (e.g., steep slope ordinances) and protect natural resources that provide natural mitigation benefits (e.g., wetlands and wetland buffers, stream courses and stream banks, areas of retention/detention). County and community capabilities to manage development to minimize increases in natural hazard risk are discussed in the capability assessment subsection of Section 5 and in each jurisdictional annex in Volume II. Also identified in each annex are actions the community has taken or will take to further integrate the findings and recommendations of this plan into other planning mechanisms and programs, many of which support land use and development to minimize increases in natural hazard risk.

3.7 COMMUNITY LIFELINES AND CRITICAL FACILITIES

Critical Facilities are facilities that are critical to the health and welfare of the population and that are especially important following a hazard event. As defined for this HMP, critical facilities include transportation systems, utility systems, high-potential loss facilities, hazardous material facilities, and essential facilities.

Community lifelines enable the continuous operation of critical business and government functions and are essential to human health and safety or economic security.

Critical infrastructure and facilities are those that are essential to the health and welfare of the population. These facilities are especially important after any hazard event. In 2017, FEMA created the concept of Community Lifelines. Lifelines allow for continuity of operations of critical facilities before, during, and after a disaster. Focusing on protecting lifelines, preventing and mitigating potential impacts, and building back

stronger will increase the resilience of Rockland County and its jurisdictions.

Community lifelines represent the most fundamental services in the community that, when stabilized, enable all other aspects of society. Following a disaster event, intervention is required to stabilize community lifelines. Lifelines are divided into the following categories (see Figure 3-19):

- Safety and security
- Food, hydration, shelter
- Health and medical
- Water systems
- Energy (power and fuel)
- Communications
- Transportation
- Hazardous materials

Figure 3-19. FEMA Community Lifelines



Source: FEMA 2024

A comprehensive inventory of critical facilities and lifelines in Rockland County was developed from various sources, including input from the Planning Partnership. They include critical facilities and community lifelines provided and reviewed by Rockland County as well as facilities listed in Hazus v6.0. The list includes facilities owned and/or operated by County, local, or private entities. It does not include state-owned or -leased facilities. Table 3-6 summarizes the number of community lifelines identified, by jurisdiction and lifeline category.

Table 3-6. Community Lifelines in Rockland County

Jurisdiction	Safety and Security	Food, Hydration, Shelter	Health and Medical	Water Systems	Energy	Communications	Transportation	Hazardous Materials	TOTAL
Airmont (V)	13	3	13	8	-	2	-	1	40
Chestnut Ridge (V)	8	-	11	3	-	8	-	-	30
Clarkstown (T)	70	15	51	32	-	39	2	21	230
Grand View on Hudson (V)	1	-	-	-	-	-	-	-	1
Haverstraw (T)	25	-	3	29	-	7	-	4	68
Haverstraw (V)	11	9	8	-	-	1	-	1	30
Hillburn (V)	7	-	-	2	-	2	-	1	12
Kaser (V)	1	-	-	-	-	-	-	-	1
Montebello (V)	24	1	4	5	-	3	-	-	37
New Hempstead (V)	7	-	3	-	-	1	-	1	12
New Square (V)	1	-	2	1	-	-	-	-	4
Nyack (V)	10	9	10	1	-	4	-	1	35
Orangetown (T)	43	6	28	13	-	25	1	13	129
Piermont (V)	7	1	1	-	-	1	-	-	10
Pomona (V)	1	-	-	3	-	1	-	-	5
Ramapo (T)	45	-	21	12	-	28	-	3	109
Sloatsburg (V)	9	1	2	3	-	5	1	1	22
South Nyack (V)	3	2	-	-	-	2	-	-	7
Spring Valley (V)	10	16	20	1	-	6	2	3	58
Stony Point (T)	24	5	6	27	-	10	-	3	75
Suffern (V)	10	2	5	6	-	2	2	1	28
Upper Nyack (V)	5	-	-	-	-	-	-	-	5
Wesley Hills (V)	6	-	-	1	-	4	-	1	12
West Haverstraw (V)	8	1	7	1	-	3	-	1	21
Rockland County (Total)	349	71	195	148	0	154	8	56	981

Source: Rockland County; USDHS Sara Title 3

Note: The critical facilities and community lifelines included in the 2024 HMP were provided and reviewed by Rockland County or listed in Hazus v6.0. The list includes facilities owned and/or operated by county, local, or private entities but not state-owned or -leased facilities.

3.7.1 Community Lifelines by Category

Safety and Security



Safety and security lifelines include law enforcement, security, fire services, search and rescue services, government services, and community safety (e.g., dams). For this HMP update, 349 safety and security lifelines were identified, consisting of alternative education facilities, correctional institutions, county facilities, dams, emergency operation centers, fire stations, county-owned buildings, police stations, post offices, post-secondary education facilities, primary education facilities, public works, secondary education facilities, and town/village halls. The number of each type of safety and security facility is presented in Table 3-7 and shown in Figure 3-20.

Fire protection and emergency services are provided to Rockland County through 26 all-volunteer fire departments, some of which consist of more than one company. There are 51 fire stations operating throughout the County (Rockland County Fire and Emergency Services 2024).

Figure 3-20. Safety and Security Lifelines in Rockland County

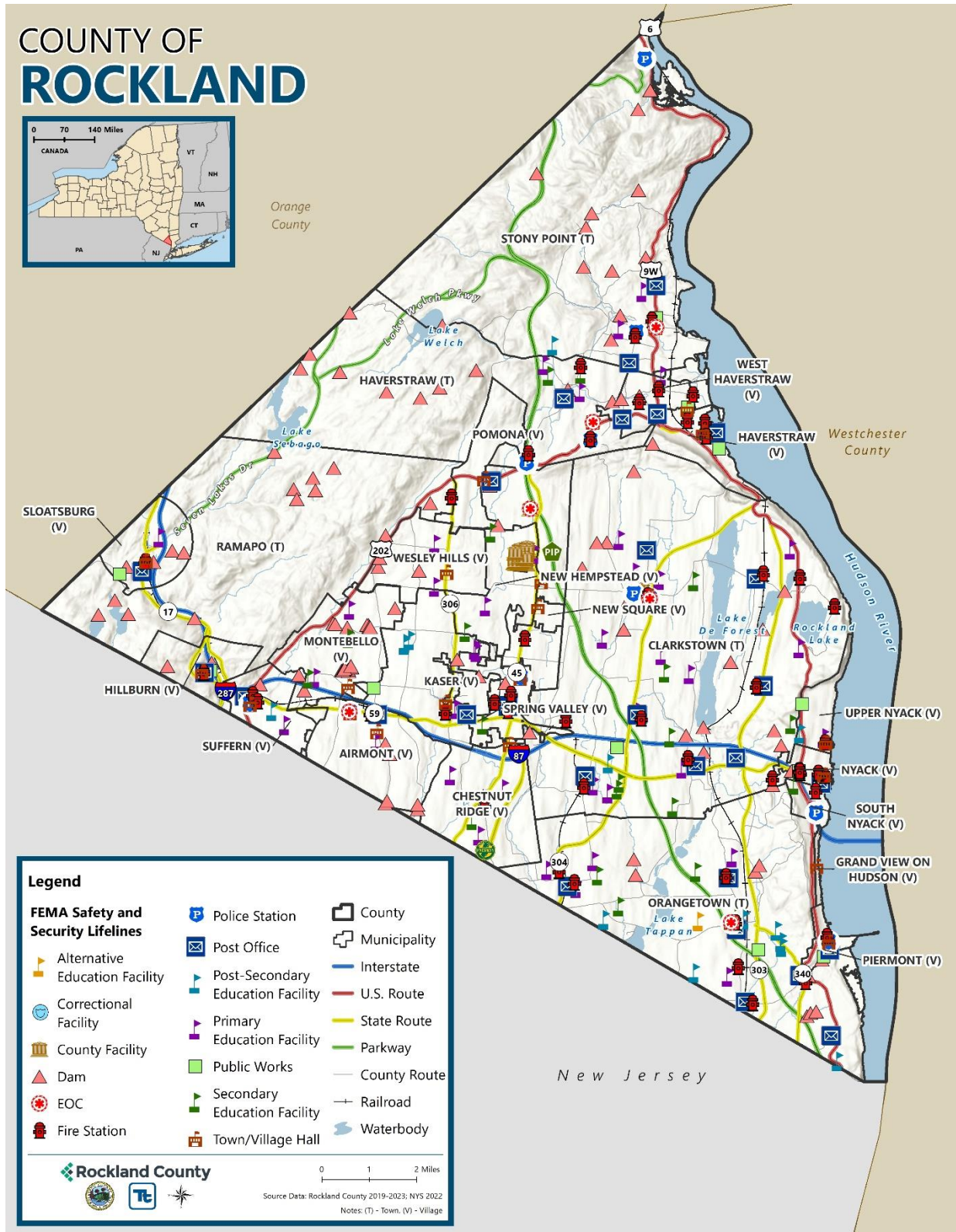


Table 3-7. Safety and Security Lifelines in Rockland County

Lifeline Type	Number of Lifelines
Alternative Education Facility	1
Correctional Facility	1
County Facility	26
Dam	107
EOC	6
Fire Station	51
Police Station	12
Post Office	28
Post-Secondary Education Facility	16
Primary Education Facility	40
Public Works	15
Secondary Education Facility	23
Town/Village Hall	23
TOTAL	349

Sources: Rockland County

The Rockland County public school system consists of eight school districts containing a total of 63 primary and secondary schools. Additionally, there are 16 post-secondary education facilities in the County, including six higher education institutions: Dominican University New York, New York University at Dominican College of Blauvelt, Salvation Army Collection for Officer Training, New York University – St. Thomas, Rockland Community College, and St. Thomas Aquinas College (NYSED 2024).

Food, Hydration, Shelter



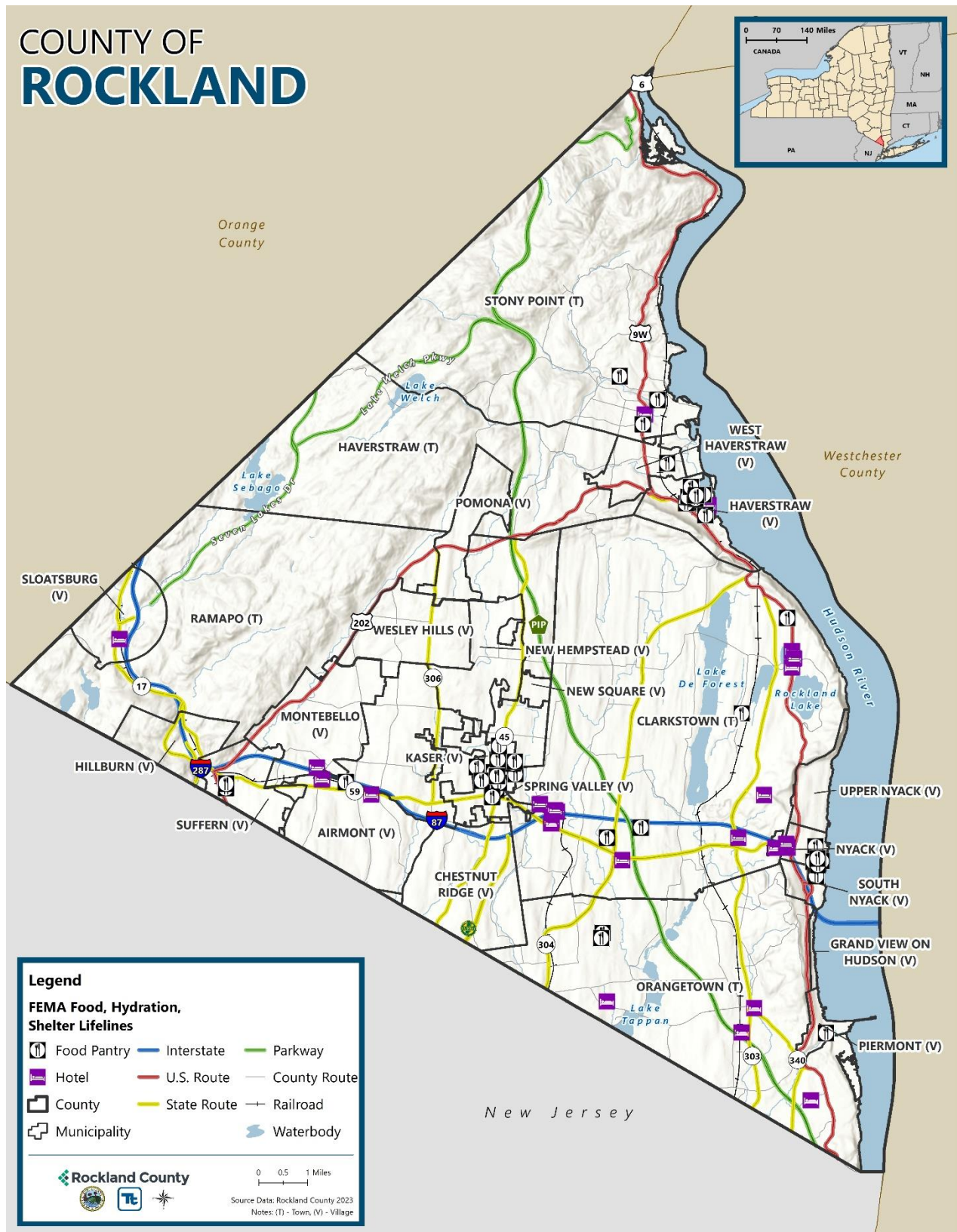
Food and hydration lifelines include facilities associated with commercial food distribution, the commercial food supply chain, food distribution programs, temporary hydration missions, the commercial water supply chain, housing, commercial facilities, animals, and agriculture. Shelter facilities includes day cares, libraries, major employers, places of worship, polling sites, and marinas. For this HMP update, the County identified food pantries and hotels to include in the plan update. This included 71 food, hydration, shelter facilities (refer to Table 3-8). Figure 3-21 shows the location of the facilities in the County. Due to the number of such lifelines across the County, they were not included in the critical facility/community lifeline total. However, these facilities provide essential services to the County before, during, and after a disaster.

Table 3-8. Food, Hydration, Shelter Lifelines in Rockland County

Lifeline Type	Number of Lifelines
Food Pantry	46
Hotel	25
TOTAL	71

Sources: Rockland County

Figure 3-21. Food, Hydration, Shelter Lifelines in Rockland County



Health and Medical



Health and medical lifelines include medical care (e.g., hospitals, pharmacies, long-term care facilities), patient movement, fatality management, public health, and medical supply chain. For this HMP update, 195 health and medical lifelines were identified, consisting of ambulance transportation providers, hospitals, pharmacies, senior care facilities, and urgent care. Table 3-9 summarizes the number of each type of lifeline in Rockland County and Figure 3-22 shows the location of the facilities.

Table 3-9. Health and Medical Lifelines in Rockland County

Lifeline Type	Number of Lifelines
Ambulance Transportation	23
Hospital	3
Pharmacy	90
Senior Care Facility	57
Urgent Care	22
TOTAL	195

Sources: Rockland County

Rockland County Emergency Medical Services (EMS), a division of the Rockland County Department of Health, is made up of 14 volunteer basic life support (BLS) and two advanced life support (ALS) agencies, an EMS coordinator, assistant EMS coordinator, and 11 deputy EMS coordinators (Rockland County Health Department 2024). Additionally, there are three hospitals in Rockland County: Good Samaritan Hospital of Suffern, Helen Hayes Hospital, and Montefiore Nyack (New York State Department of Health 2023).

Water Systems



Water system lifelines include potable water infrastructure (intake, treatment, storage, and distribution) and wastewater management (collection, storage, treatment, and discharge). For this HMP update, 148 water system lifelines were identified, consisting of wastewater treatment plants, water towers, and wells. According to New York State Department of Health’s public water supply database, there are 29 community public water systems and 41 non-community public water systems in Rockland County. Table 3-10 summarizes the number of each type of lifeline in Rockland County and Figure 3-23 shows the location of the facilities.

A **community water system** is a public water system that serves the same people year-round. Most residences including homes, apartments, and condominiums in cities, towns, and mobile home parks are served by community water systems. Examples of community water systems include municipal-owned public water supplies, public water authorities, or privately owned water suppliers such as homeowner associations, apartment complexes, and mobile home parks that maintain their own drinking water systems.

A **non-community water system** is a public water system that serves the public but does not generally serve the same people year-round. There are two types of non-community water systems: transient and non-transient. A transient non-community water system provides water in a place such as a gas station or campground where people do not remain for long periods of time. A non-transient non-community system regularly supplies water to at least 25 of the same people at least six months per year. Some examples are schools, factories, office buildings, and hospitals that have their own water systems (U.S. Environmental Protection Agency 2023).

Figure 3-22. Health and Medical Lifelines in Rockland County

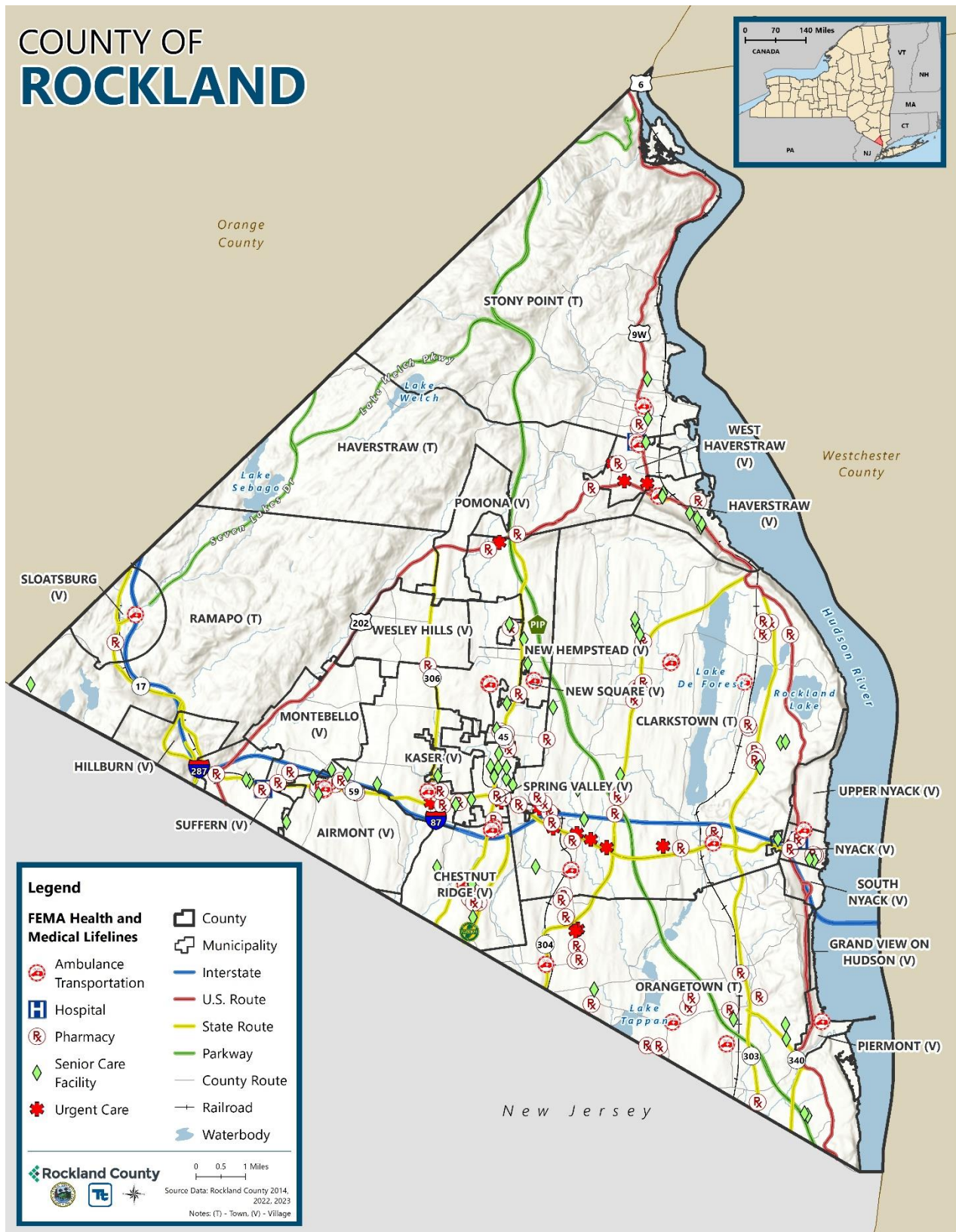


Figure 3-23. Water System Lifelines in Rockland County



Table 3-10. Water System Lifelines in Rockland County

Lifeline Type	Number of Lifelines
Wastewater Treatment Plant	10
Water Tower	5
Well	133
TOTAL	148

Sources: Rockland County

Energy



Energy lifelines include power grids and fuel facilities. For this HMP update, specific energy lifelines were not identified in Rockland County. Orange and Rockland Utilities, Inc. (O&R) provides electricity and natural gas to residents of Rockland County.

Communications



Communications lifelines include infrastructure, alerts/warnings/messages, 911 and dispatch, responder communications, and finance. Overall, 154 communication facilities were identified in Rockland County for this HMP update, consisting of cellular towers and emergency response towers. Rockland County has an extensive radio communications network that is utilized by emergency services agencies, hospitals, law enforcement, public works, transportation, and other supporting organizations. Refer to Table 3-11 for a summary of communication lifelines and Figure 3-24 illustrates the location of communication lifelines in the County.

Table 3-11. Communication Lifelines in Rockland County

Lifeline Type	Number of Lifelines
Cell Tower	141
Emergency Response Tower	13
Total	154

Sources: Rockland County

Transportation



Transportation lifelines include highways and other roadways, mass transit, railways, aviation facilities, and maritime facilities. Overall, there are eight transportation facilities identified in Rockland County for this HMP update, consisting of rail yards and train stations. Table 3-12 summarizes the types of transportation lifelines in the County, and Figure 3-25 illustrates the location of these facilities in Rockland County.

Figure 3-24. Communications Lifelines in Rockland County

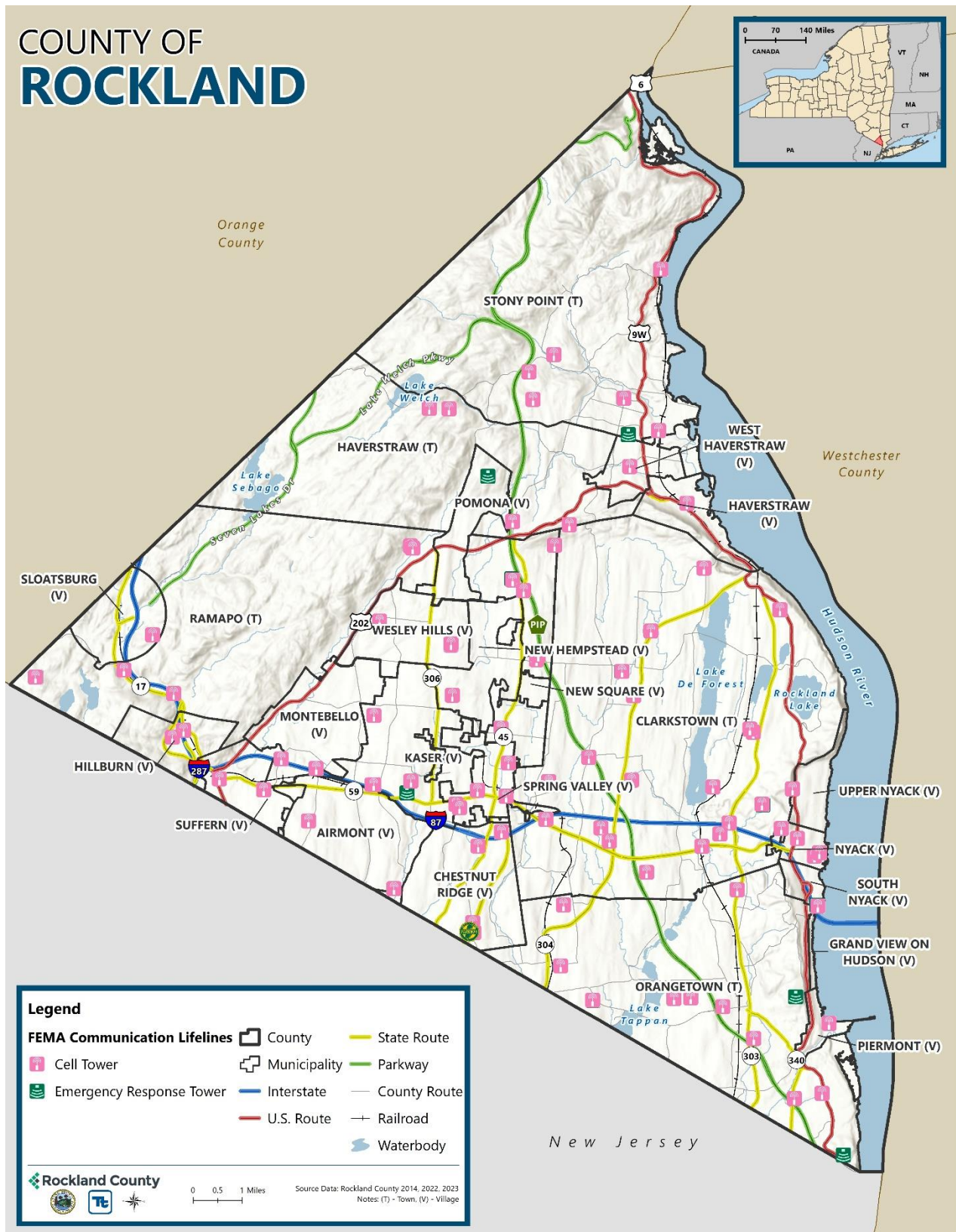


Figure 3-25. Transportation Lifelines in Rockland County

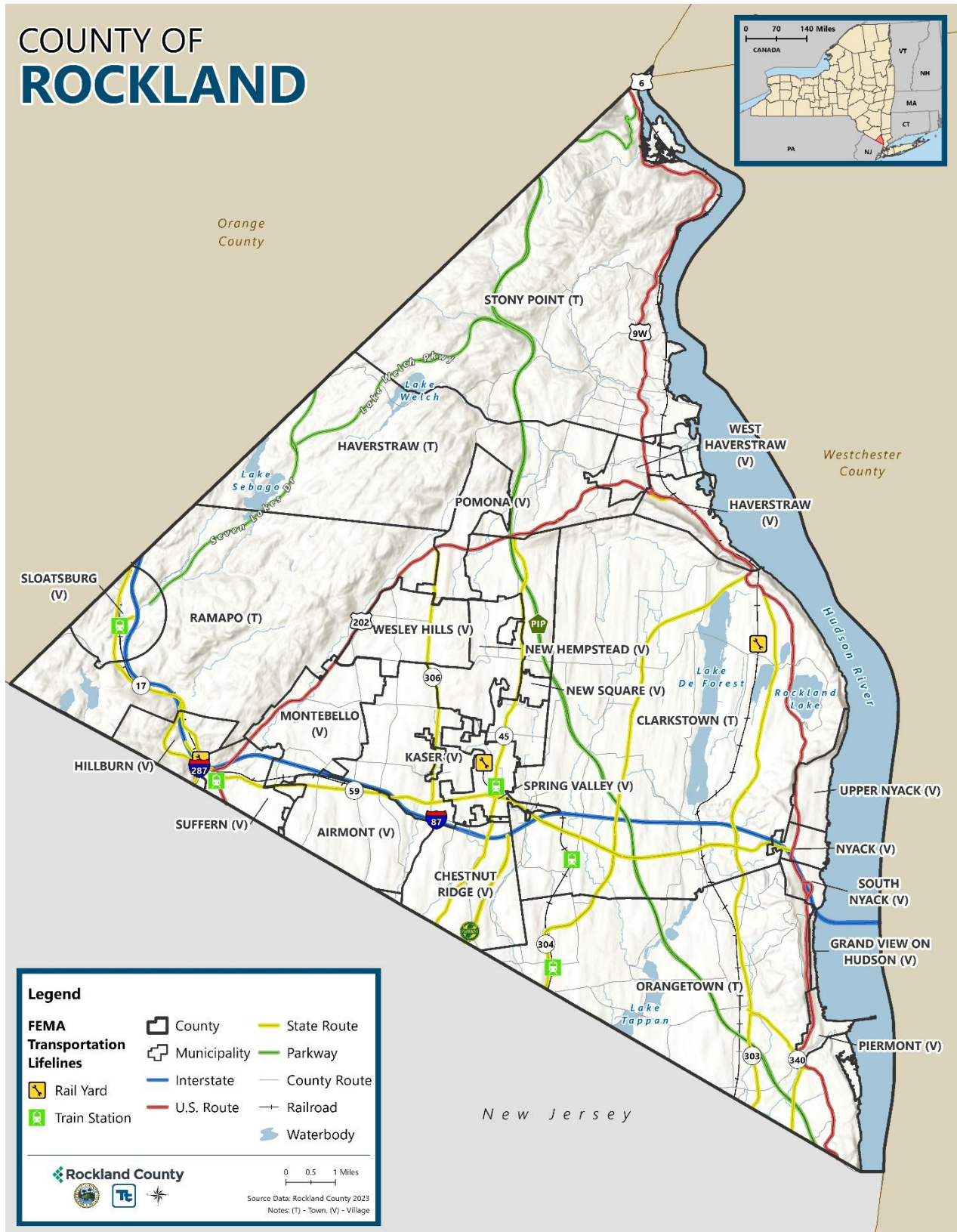


Table 3-12. Transportation Lifelines in Rockland County

Lifeline Type	Number of Lifelines
Rail Yard	3
Train Station	5
Total	8

Sources: Rockland County

Rockland County provides bus services to its residents. These services include Transport of Rockland (TOR) and Transportation Resources, Intra-county, for Physically disabled and Senior Citizens (TRIPS) Paratransit. TOR is Rockland County's local bus system of 10 routes, providing service along major corridors as well as with feeder loops within the County. TRIPS is Rockland County's paratransit bus service for residents with physical or mental disabilities or who are aged 60 or over. Other bus transit services in the County include Coach USA/Rockland Coaches, Monsey Trails, NJ Transit bus, Westchester Bee-Line, and Clarkstown Mini-Trans (Rockland County Department of Public Transportation 2024).

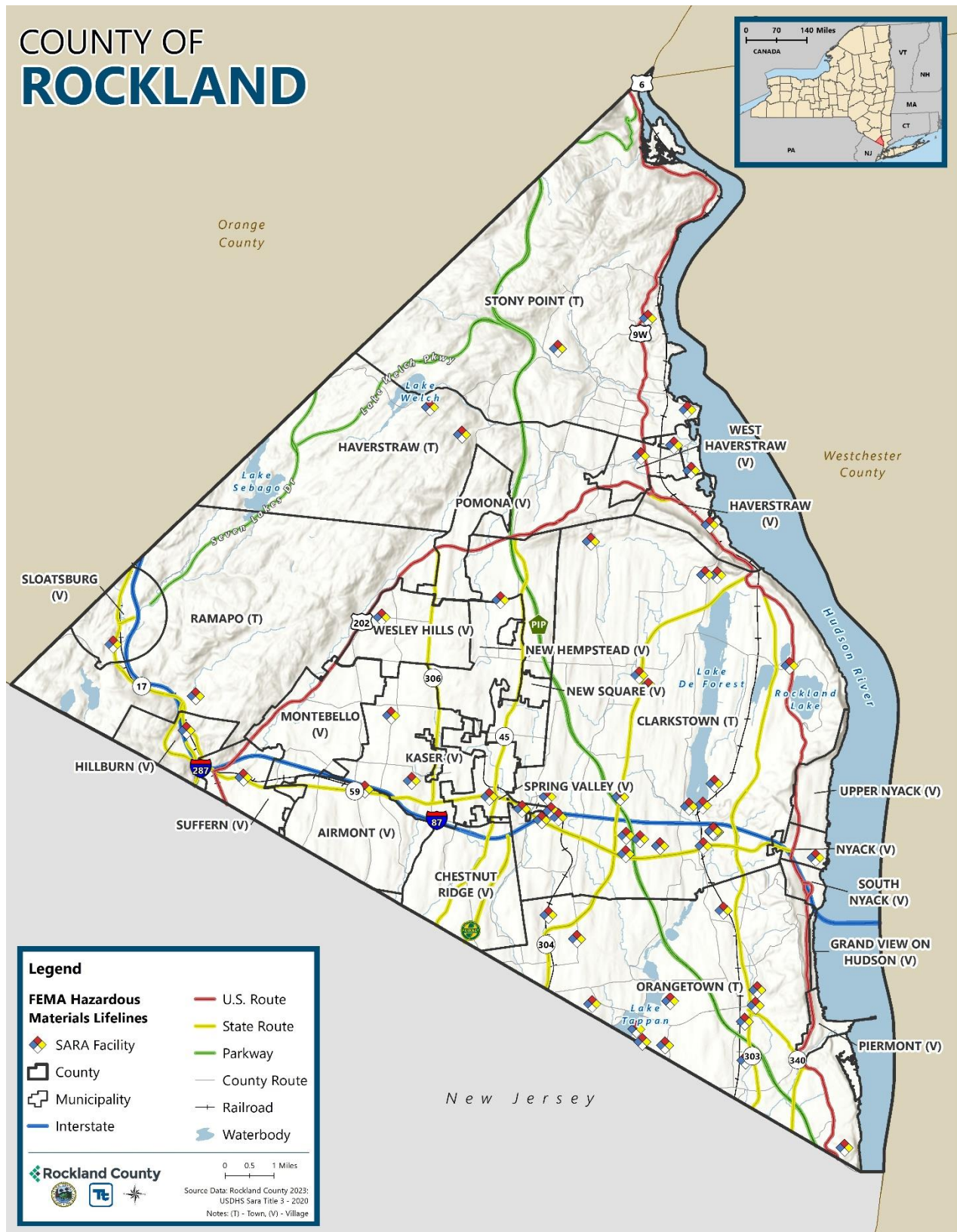
Metro-North, NJ Transit, PATH, and Amtrak all provide rail services to Rockland County residents. Metro-North provides rail service from Westchester County to Grand Central Terminal in Manhattan. The Hudson Link bus provides service from Rockland to Tarrytown Rail Station to connect with the Hudson Line and to White Plains Rail Station to connect with the Harlem Line. NJ Transit provides rail service from Rockland County under contract with Metro-North. The Main/Bergen/Port Jervis line provides service between Suffern, Sloatsburg, the Pascack Valley Line, Spring Valley, Nanuet, and Pearl River. Haverstraw-Ossining Ferry is operated by NY Waterway and travels between Haverstraw and Ossining (Westchester County) to connect with Metro-North Hudson Line train to New York City (Rockland County Department of Public Transportation 2024).

Hazardous Materials



Hazardous materials lifelines include hazardous materials, pollutants, and contaminants and the facilities that handle them. There are 56 hazardous material lifelines in Rockland County, all of which are identified as SARA (Superfund Amendments and Reauthorization Act) facilities. Figure 3-26 shows the location of hazardous material facilities in the County.

Figure 3-26. Hazardous Material Lifelines in Rockland County



SECTION 4. RISK ASSESSMENT

4.1 IDENTIFICATION OF HAZARDS OF CONCERN

To provide a strong foundation for mitigation actions considered in Section 6 (Mitigation Strategy) and Section 9 (Jurisdictional Annexes), Rockland County focused on a full range of hazards that could impact the area and then identified and ranked those hazards that presented the greatest concern. The hazard of concern identification process incorporated input from the County and participating jurisdictions; review of the New York State Hazard Mitigation Plan (NYS HMP 2019); review of the 2018 Rockland County HMP; research and local, state, and federal information on the frequency, magnitude, and costs associated with the various hazards that have previously or could feasibly impact the region; and qualitative or anecdotal information regarding natural hazards and the perceived vulnerability of the study area's assets to them.

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

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

4.1.1 Changes from 2018 Hazard Mitigation Plan

Many of the hazards of concern for the Rockland County 2024 HMP update are the same as the County's 2018 HMP. The 2024 update includes best available data throughout the plan to present an updated understanding of the County's hazard risk. The following changes were made for the 2024 HMP:

- In 2018, dam failure was included in the flood profile. For the 2024 update, dam failure is a standalone hazard of concern.
- The prior plan did not address disease outbreak as a natural hazard of concern. Beginning in March 2020, Rockland County was hit with the COVID-19 pandemic, along with the rest of the world. The impacts this outbreak had on the County led to the inclusion of disease outbreak as a hazard of concern in the 2024 HMP.

4.1.2 Hazard Groupings

For this HMP, the Steering Committee, as defined in Section 2 (Planning Process), grouped some natural hazards together, based on the similarity of hazard events, their typical concurrence, their impacts, hazard groupings in the 2019 State of New York HMP, and consideration of how hazards are grouped in FEMA guidance documents ("Understanding Your Risks, Identifying Hazards and Estimating Losses" (FEMA 386-2); "Multi-Hazard Identification and Risk Assessment – The Cornerstone of the National Mitigation Strategy").

4.1.3 Hazards of Concern for the 2024 HMP

Based on input from the County and review of all available resources, 10 hazards were identified as hazards of concern affecting Rockland County and will be assessed in the 2024 HMP, as explained in Table 4.1-1. The hazards include:



The *Dam Failure* hazard can be caused by human-caused accidents and natural disasters such as floods, earthquakes, and landslides. The *Dam Failure* hazard can be caused by human-caused/made accidents and natural disasters such as floods,



earthquakes, and landslides. Potential dam breaks are classified into either high hazard, significant hazard, and low hazard. High hazard dam breaks would most likely result in loss of life and significant property damage.

The *Disease Outbreak* hazard exists when there are more cases of a particular disease than expected in a given area, or among a specific group of people, over a particular period of time. An aggregation of cases in a given area over a particular period, regardless of the number of cases, is called a cluster. In an outbreak or epidemic, it is presumed that the cases are related to one another or that they have a common cause.



A *Drought* is a period characterized by long durations of below normal precipitation. Drought is a temporary irregularity that can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.



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 human-caused explosion.



The *Extreme Temperature* hazard includes both heat and cold events, which can have a significant impact to human health, commercial/agricultural businesses, and primary and secondary effects on infrastructure (e.g., burst pipes and power failure). What constitutes “extreme cold” or “extreme heat” can vary across different areas of the country based on what the population is accustomed to. The 2024 HMP considers the heat island effect that occurs within developed areas.



The *Flood* hazard includes riverine flooding, lakeshore, flash flooding, shallow flooding, ice jam flooding, urban drainage flooding, and dam failure flooding. Inclusion of the various 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 NYS HMP.



The *Landslide* hazard includes rock falls, rock topples, rotational slump, transitional slide, earth flows, creep, block slides, debris avalanche, and debris flows.



The *Severe Storm* hazard includes windstorms that often entail a variety of other influencing weather conditions, including thunderstorms, hail, lightning, and tornadoes. Tropical disturbances (hurricanes, tropical storms, and tropical depressions) are often identified as a type of severe storm. For this HMP update, Severe Storm includes thunderstorms, hail, lightning, tornadoes, hurricanes, and tropical storms.



The *Severe Winter Storm* hazard includes blizzards, ice storms, snowstorms, sleet, and freezing rain. Winter storms create a higher risk of car accidents, hypothermia, frostbite, carbon monoxide poisoning, and heart attacks from overexertion. Winter storms including blizzards can bring extreme cold, freezing rain, snow, ice and high winds.



The *Wildfire* hazard can be defined as any non-structural fire that occurs in the wildland. Three distinct types of wildland fires have been defined and include naturally occurring wildfire, human-caused wildfire, and prescribed fire. They may be highly destructive and become difficult to control. 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.

Table 4.1-1. Identification of Natural Hazards of Concern for Rockland County

Hazard	Is this a hazard that may occur in Rockland County?	If yes, does this hazard pose a significant threat to Rockland County?	Why was this determination made?	Source(s)
Avalanche	No	No	<ul style="list-style-type: none"> The 2019 NYS HMP identifies avalanche as a hazard of concern. The topography and climate of Rockland County does not support the occurrence of an avalanche. New York State, in general, has a very low occurrence of avalanche events based on statistics provided by National Avalanche Center – American Avalanche Association (NAC-AAA) between 1998 and 2018. Avalanche was identified as a hazard in the NYS HMP, and there have been occurrences in the state; however, there were no occurrences in Rockland County. The Steering Committee and Planning Partnership do not consider the hazard to be a significant concern. 	<ul style="list-style-type: none"> NYS Division of Homeland Security and Emergency Services (DHSES) NAC-AAA Input from Steering and Planning Committees
Coastal Hazards	No	No	<ul style="list-style-type: none"> The NYS HMP identifies coastal erosion as a hazard of concern for New York State. Erosion can impact of all the state’s coastal counties along Lake Erie and the Niagara River, Lake Ontario and the St. Lawrence River, Atlantic Ocean and Long Island Sound, Hudson River south of the federal dam in Troy, the East River, the Harlem River, the Kill van Kull and Arthur Kill, and all connecting waterbodies, bays, harbors, shallows, and wetlands. Although the Hudson River forms the eastern border of Rockland County, the geology of Rockland County does not make it susceptible to coastal erosion. The Steering Committee and Planning Partnership do not consider the hazard to be a significant concern. 	<ul style="list-style-type: none"> NYS DHSES Input from Steering Committee and Planning Partnership
Dam Failure	Yes	Yes	<ul style="list-style-type: none"> The 2019 NYS HMP does not identify dam failure as a hazard of concern, though it is included in the Flood hazard profile. The 2019 NYS HMP does not identify dam failure as a hazard of concern, though it is included in the Flood hazard profile. According to the NYS DHSES, there are 32 dams in Rockland County, 13 of which are high hazard dams. The Steering Committee and Planning Partnership has identified dam failure as a hazard of concern for Rockland County. 	<ul style="list-style-type: none"> NYS DHSES Input from Steering Committee and Planning Partnership New York State Department of Environmental Conservation (NYSDEC) NYS Geographic Information System (GIS)

Table 4.1-1. Identification of Natural Hazards of Concern for Rockland County

Hazard	Is this a hazard that may occur in Rockland County?	If yes, does this hazard pose a significant threat to Rockland County?	Why was this determination made?	Source(s)
Disease Outbreak	Yes	Yes	<ul style="list-style-type: none"> The 2019 NYS HMP does not identify disease outbreak as a hazard of concern. The 2019 NYS HMP does not identify disease outbreak as a hazard of concern. The County has been impacted by various diseases (e.g., influenza, COVID-19) in recent years. The Steering Committee and Planning Partnership has identified disease outbreak as a hazard of concern for Rockland County. 	<ul style="list-style-type: none"> NYS DHSES NYS DEC Input from Steering Committee and Planning Partnership
Drought	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identifies drought as a hazard of concern for the state. Rockland County has been impacted by several drought events that have occurred in New York State. Rockland has been impacted by water shortages as a result of drought-related events. New York State was included in one FEMA drought-related disaster declaration (DR-204), which did include Rockland County. Rockland County was included in one recent drought-related U.S. Department of Agriculture (USDA) disaster declaration (S5306) in 2022. The Steering Committee and Planning Partnership has identified drought as a hazard of concern for Rockland County. 	<ul style="list-style-type: none"> NYS DHSES FEMA USDA Input from Steering Committee and Planning Partnership National Centers for Environmental Information (NCEI) Northeast Regional Climate Center (NRCC)
Earthquake	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identified earthquake as a hazard of concern for the state. The probability of a strong earthquake occurring is moderate. New York State was included in one FEMA earthquake-related disaster declaration (DR-1415); Rockland County was not included in this declaration. From 2017 to 2023, there have been no significant earthquakes with an epicenter in Rockland County. From 2017 to 2023, there have been no significant earthquakes with an epicenter in Rockland County. Based on input from the Steering Committee and Planning Partnership, earthquake has been identified as a hazard of concern for Rockland County. 	<ul style="list-style-type: none"> NYS DHSES Input from Steering Committee and Planning Partnership U.S. Geological Survey (USGS) – Earthquake Hazards Program, Review of USGS Seismic Maps
Extreme Temperature (cold and heat)	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identifies Coldwaves and Heatwaves as hazards of concern for New York State. From 2018 and 2023, Rockland County was not included in any USDA disaster declarations related to extreme temperature. From 1954 to 2023, Rockland County was not included in any FEMA extreme temperature-related disaster declarations. The Steering Committee and Planning Partnership identified extreme temperature as a hazard of concern for Rockland County. 	<ul style="list-style-type: none"> NYS DHSES Input from Steering Committee and Planning Partnership NOAA-NCEI USDA

Table 4.1-1. Identification of Natural Hazards of Concern for Rockland County

Hazard	Is this a hazard that may occur in Rockland County?	If yes, does this hazard pose a significant threat to Rockland County?	Why was this determination made?	Source(s)
Flood (riverine, ice jam, urban flooding, and flash flooding)	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identifies flooding as a hazard of concern. The NYS HMP identifies flooding as a hazard of concern. Between 1956 and 2023, Rockland County was included in the following eight FEMA flood-related declarations: <ul style="list-style-type: none"> FEMA DR-311; September 13, 1971; New York Severe Storms, Flooding FEMA DR-338; June 23, 1972; New York Tropical Storm Agnes FEMA DR-487; October 2, 1975; New York Severe Storms, Heavy Rain, Landslides, Flooding FEMA DR-702; March 28 – April 8, 1984; New York Coastal Storms, Flooding FEMA DR-974; December 10-14, 1992; New York Coastal Storm, High Tides, Heavy Rain, Flooding FEMA DR-1534; May 13-June 17, 2004; New York Severe Storms and Flooding FEMA DR-1899; March 13-31, 2010; New York Severe Storms and Flooding FEMA DR-4723; July 9-10, 2023; New York Severe Storms and Flooding Between 2014 and 2023, Rockland County was included in one flood related USDA disaster declaration (S3747). Based on the history of flooding and its impacts on Rockland County and input from the Steering Committee and Planning Partnership, flooding has been identified as a hazard of concern for the County. 	<ul style="list-style-type: none"> NYS DHSES Input from Steering Committee and Planning Partnership FEMA NOAA-National Centers for Environmental Information (NCEI) Cold Regions Research and Engineering Laboratory (CRREL)
Landslide	Yes	Yes	<ul style="list-style-type: none"> The 2019 NYS HMP includes landslide as a hazard of concern. The 2019 NYS HMP includes landslide as a hazard of concern. Between 1954 and 2022, New York State has included in one landslide-related disaster declaration, which did include Rockland County. USGS indicates that the northern section of Rockland County has a high landslide incidence, while the remainder of the County has a low landslide incidence. Based on previous occurrences and input from the Steering Committee and Planning Partnership, the landslide hazard was identified as a hazard of concern for Rockland County. 	<ul style="list-style-type: none"> NYS DHSES Input from Steering Committee and Planning Partnership FEMA
Lightning	Yes	Yes	Please see Severe Storm Profile	

Table 4.1-1. Identification of Natural Hazards of Concern for Rockland County

Hazard	Is this a hazard that may occur in Rockland County?	If yes, does this hazard pose a significant threat to Rockland County?	Why was this determination made?	Source(s)
Severe Storm (hurricane, lightning, hail, windstorms, thunderstorms, nor'easters, hail, and tornadoes)	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identifies severe storm as a hazard of concern for New York State; however, for the state HMP, the hazards were profiled in individual sections lightning, hail, tornadoes, high winds, nor'easters and hurricanes/tropical storms. For the Rockland County HMP, the hazards were combined into one profile. Between 1954 and 2022, Rockland County was included in 21 FEMA severe storm-related declarations. Based on previous occurrences and input from the Steering Committee and Planning Partnership, severe storms are identified as a hazard of concern for Rockland County. 	<ul style="list-style-type: none"> NYS DHSES FEMA NOAA-NCEI SPC Input from Steering Committee and Planning Partnership
Severe Winter Storm (heavy snow, blizzards, ice storms)	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identifies ice storms and snowstorms as hazards of concern for New York State. According to the 2019 NYS HMP, it is calculated that Rockland County can expect one severe winter storm event each year. FEMA included Rockland County in the following three winter storm-related disaster declarations: <ul style="list-style-type: none"> FEMA EM-3107; March 13-17, 1993; New York Severe Blizzard FEMA DR-1083; January 12, 1996; New York Severe Snowstorm FEMA EM-3184; March 27, 2003; Snowstorm Based on previous occurrences and input from the Steering Committee and Planning Partnership, severe winter storms are identified as a hazard of concern for Rockland County. 	<ul style="list-style-type: none"> NYS DHSES FEMA NOAA-NCEI Input from Steering Committee and Planning Partnership
Tsunami	No	No	<ul style="list-style-type: none"> Tsunami is identified as a hazard of concern in the NYS HMP. The Steering Committee and Planning Partnership do not consider tsunami to be a hazard of concern for Rockland County as the County is not a coastal county. 	<ul style="list-style-type: none"> NYS DHSES Input from Steering Committee and Planning Partnership
Volcano	No	No	<ul style="list-style-type: none"> The NYS HMP identifies volcano as a hazard of concern. The NYS HMP identifies volcano as a hazard of concern. However, the Steering Committee and Planning Partnership do not consider volcano to be a hazard of concern for Rockland County as volcanos are not present in the County. 	<ul style="list-style-type: none"> NYS DHSES Input from Steering Committee and Planning Partnership
Wildfire	Yes	Yes	<ul style="list-style-type: none"> The NYS HMP identifies wildfire as a hazard of concern. The NYS HMP identifies wildfire as a hazard of concern. Rockland County was not included in any FEMA wildfire-related disaster declarations. Wildfires have occurred within Rockland County. Based on available data and the nature of the county, the Steering Committee and Planning Partnership identified Wildfire as a hazard of concern. 	<ul style="list-style-type: none"> NYS DHSES Input from Steering Committee and Planning Partnership FEMA

<i>CRREL</i>	<i>Cold Regions Research and Engineering Laboratory</i>
<i>DR</i>	<i>Presidential Disaster Declaration Number</i>
<i>EM</i>	<i>Presidential Disaster Emergency Number</i>
<i>FEMA</i>	<i>Federal Emergency Management Agency</i>
<i>NCEI</i>	<i>National Centers for Environmental Information</i>
<i>NRCC</i>	<i>Northeast Regional Climate Center</i>
<i>NYS DEC</i>	<i>New York State Department of Environmental Conservation</i>
<i>NYS DHSES</i>	<i>New York State Division of Homeland Security and Emergency Services</i>
<i>NYS HMP</i>	<i>New York State Hazard Mitigation Plan</i>
<i>PGA</i>	<i>Peak ground acceleration</i>
<i>SPC</i>	<i>Storm Prediction Center</i>
<i>USDA</i>	<i>U.S. Department of Agriculture</i>
<i>USGS</i>	<i>United States Geologic Survey</i>

SECTION 4. RISK ASSESSMENT

4.2 METHODOLOGY AND TOOLS

A risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from identified hazards of concern. It allows emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets. The process focuses on the following elements:

- **Hazard identification** uses all available information to determine what types of hazards may affect a jurisdiction, how often they can occur, and their potential severity.
- **Profile each hazard** aims to understand each hazard in terms of the following components:
 - Extent (i.e., severity of each hazard)
 - Location (i.e., geographic area most affected by the hazard)
 - Previous occurrences and losses
 - Impacts of climate change
 - Probability of future hazard events
- **Assess vulnerability** by identifying exposure, estimate losses, and assessing future changes that may affect vulnerability.
 - *Exposure identification* estimates 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.
 - *Vulnerability identification and loss estimation* assesses the impact of hazard events on the people, property, economy, and lands of the region, including estimates of the cost of potential damage or cost that can be avoided by mitigation.
 - *Future changes that may impact vulnerability* analyzes how demographic changes, projected development and climate change impacts can alter current exposure and vulnerability.

This section presents the Rockland County risk assessment and is outlined as follows:

- Methodology and tools used to conduct the risk assessment
- Identification of hazards of concern that impact Rockland County
- Hazards of concern profiles and vulnerability assessment
- Hazard ranking

4.2.1 Risk Assessment Tools

The following section describes the various tools used to complete the risk assessment for the Rockland County HMP update.

Mapping

National, state, and county databases were reviewed to locate available spatially based data relevant to this planning effort. Maps were produced using geographic information system (GIS) software to show the spatial

extent and location of hazards when such datasets were available. These maps are included in the hazard profile chapters of this document.

Hazus

In 1997, FEMA developed the standardized Hazards U.S. (Hazus) model to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. Hazus was later expanded into a multi-hazard methodology (Hazus-MH) with new models for estimating potential losses from hurricanes and floods.

Hazus is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, critical facility, transportation and utility lifeline, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that they can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve.
- Facilitates review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.
- Produces hazard data and loss estimates that can be used in communication with local stakeholders.
- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

Level of Detail for Evaluation

Hazus provides default data for inventory, vulnerability, and hazards; these default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- **Level 1**—All of the information needed to produce an estimate of losses is included in the software's default data. These data are derived from national databases and describe in general terms the characteristic parameters of the planning area.
- **Level 2**—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics, and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format.
- **Level 3**—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

4.2.2 Risk Assessment Approach

To address the requirements of the Disaster Mitigation Act (DMA) of 2000 and to better understand potential vulnerability and losses associated with hazards of concern, Rockland County used standardized tools, combined with local, state, and federal data and expertise to conduct the risk assessment. Three different levels of analysis

were used depending upon the data available for each hazard, which can be summarized as the following (also see Table 4.2-1):

1. **Historic Occurrences and Qualitative Analysis** includes an examination of historic impacts to understand potential impacts of future events of similar size. In addition, potential impacts and losses are discussed qualitatively using best-available data and professional judgement.
2. **Exposure Assessment** involves overlaying available spatial hazard layers, or hazards with defined extent and locations, with assets in GIS to determine which assets are in the impact area of the hazard. The analysis highlights which assets are in the hazard area and may incur future impacts.
3. **Loss Estimation** is produced by the FEMA Hazus modeling software to estimate potential losses for the following hazards: flood, earthquake, and hurricane. In addition, examinations of historical impacts and an exposure assessment are conducted for these spatially delineated hazards.

Table 4.2-1. Summary of Risk Assessment Analyses

Hazard	Population	General Building Stock	Critical Facilities	New Development
Dam/Levee Failure	E	E	E	E
Drought	Q	Q	Q	Q
Earthquake	E	E	E	E
Extreme Temperature	Q	Q	Q	Q
Flood	E, H	E, H	E, H	E
Landslide	E	E	E	E
Severe Storm	H	H	H	Q
Severe Winter Storm	Q	Q	Q	Q
Wildfire	E	E	E	E

Notes: E – Exposure analysis; H – Hazus analysis; Q – Qualitative analysis

Dam/Levee Failure

An exposure analysis was conducted for the County’s assets (population, building stock, critical facilities, historic assets, and new development) using the Dam Inundation Areas provided by Rockland County. While there are 32 dams in the County, not all had mapped inundation areas available during the HMP update. Table 4.2-2 lists the dams and shows which dam inundation areas were included in the risk assessment. In order to conduct analysis, a composite dam failure inundation area was developed for all accessible dams. Consequently, if an asset is identified as being exposed, it is located at minimum within one dam failure inundation area.

Table 4.2-2. Dams in Rockland County

Dam Name	Hazard Classification	Inundation Area Included in HMP
Breakneck Pond Dam	Low	No
Central Nyack Dam	High	Yes
Christie Brook Dam #1	Significant	Yes
Christie Brook Dike	Low	No
Congers Lake Dam	High	Yes
Doodletown Dam	Significant	Yes

Dam Name	Hazard Classification	Inundation Area Included in HMP
First Reservoir Dam	High	Yes
Garnerville Dam	High	No
Henrich Pond Dam	Significant	No
Ibm Edcenter Dam A	Significant	No
John Patrick Pond Dam	Significant	No
Lake Boyce Dam	Significant	Yes
Lake Deforest Dam	High	Yes
Lake Kanawauke Dam	High	Yes
Lake Lucille Dam	High	Yes
Lake Sebago Dam	High	Yes
Lake Suzanne Dam	High	Yes
Lake Welch Dam	High	Yes
Pine Grove Lake Dam	High	Yes
Pine Meadow Brook Dam	Low	No
Pine Meadow Lake Dam	Significant	No
Potake Lake Dam	High	No
Rockland Print CO Dam #2	Significant	No
Schwartz Estate Pond Dam 6	Significant	Yes
Second Reservoir Dam	Significant	Yes
Stony Point Dam	Significant	No
Third Reservoir Spillway and Dam	Significant	Yes
Tivoli Lake Dam	High	Yes
Tivoli Lake Spillway	Significant	No
Tomkins Cove Dam	Significant	No
Wesley Chapel Dam #1	Significant	Yes
Wesley Chapel Dam #2	Significant	Yes

Disease Outbreak

To assess the vulnerability of the County to disease outbreak and its associated impacts, a qualitative assessment was conducted. This includes historical impacts, information provided by the Steering Committee and Planning Partnership, and publicly available hazard history information.

Drought

To assess the vulnerability of the County to drought and its associated impacts, a qualitative assessment was conducted.

Earthquake

An exposure analysis was conducted for the County’s assets (population, building stock, critical facilities, historic assets, and new development) using the National Earthquake Hazards Reduction Program (NEHRP) soil data. Due to their known susceptible to ground shaking from earthquakes, NEHRP Soil Classes Type D and Type E were used to determine what assets are exposed to the soils most susceptible to seismic activity. Assets with their centroid in the hazard areas were totaled to estimate the numbers and values vulnerable to these soil types.

Extreme Temperature

To assess the vulnerability of the County to extreme temperatures and its associated impacts, a qualitative assessment was conducted. This includes historical impacts, information provided by the Steering Committee and Planning Partnership, and publicly available hazard history information.

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 National Flood Insurance Program (NFIP).

The following data were used to evaluate exposure and determine potential future losses for this plan update:

- The Rockland County FEMA Effective Digital Flood Insurance Rate Map (DFIRM) dated March 3, 2014 with the latest Letter of Map Amendment (LOMR) date of May 23, 2023.
- A depth grid was created using base-flood elevation and cross-section data from FEMA and a one-third Arc-second digital elevation models (DEM) model (highest resolution seamless DEM dataset for the U.S. with full coverage of the 48 conterminous states, Hawaii, and U.S. territories) provided by the U.S. Geological Survey (USGS); areas without flood elevation data from FEMA were generated using the FEMA flood boundaries and USGS DEM.

The effective Rockland County DFIRM effective in 2014 was used to evaluate exposure for both the 1- and 0.2-percent annual chance flood events; and determine potential future losses for the 0.2-percent annual chance flood event. The depth grid generated using the DFIRM and one-third Arc-second DEM was integrated into the Hazus riverine flood model and used to estimate potential losses for the 1-percent annual chance flood event.

To estimate exposure to the 1- and 0.2-percent annual chance flood events, the DFIRM flood boundaries were overlaid on the centroids of updated assets (population, building stock, historic assets, and critical facilities); as well as the DFIRM flood boundaries being overlaid on the polygons provided for anticipated new development. Centroids or polygons that intersected the flood boundaries were totaled to estimate the building replacement cost value (RCV) and population vulnerable to the flood inundation areas. A Level 2 Hazus riverine flood analysis was performed. Both the critical facility and building inventories were formatted to be compatible with Hazus and its Comprehensive Data Management System (CDMS). Once updated with the inventories, the Hazus riverine flood model was run to estimate potential losses in Rockland County for the 1-percent annual chance flood event. A user-defined analysis was also performed for the building stock. Buildings located within the floodplain were imported as user-defined facilities to estimate potential losses to the building stock at the structural level. Hazus calculated the estimated potential losses to the population (default 2020 U.S. Census data across dasymetric blocks), potential damages to the general building stock, and potential damages to critical facility inventories based on the depth grids generated and the default Hazus damage functions in the flood model.

Landslide

An exposure analysis was conducted for the County's assets (population, building stock, critical facilities, historic assets, and new development). Landslide susceptibility maps were used to complete the analysis. These maps describe the relative likelihood of future landsliding based solely on the intrinsic properties of a locale or site. Prior

failure (from a landslide inventory), rock or soil strength, and steepness of slope are three of the more important site factors that determine susceptibility (USGS 2023).

Severe Weather

A Hazus probabilistic analysis was performed to analyze the wind hazard losses for Rockland County for the 100- and 500-year MRP events. 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 Rockland County. Hazus contains data on historical hurricane events and wind speeds. It also includes surface roughness and vegetation (tree coverage) maps for the area. Surface roughness and vegetation data support the modeling of wind force across various types of land surfaces. Default demographic and updated building and critical facility inventories in Hazus were used for the analysis. Although damages are 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 percentage 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.

Severe Winter Weather

All of Rockland County is exposed and vulnerable to severe winter weather events. Therefore, the entire general building stock inventory in Rockland County is exposed and vulnerable to the severe winter storm 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 the severe winter storm hazard.

Historical data on structural losses to general building stock are not adequate to predict specific losses to this inventory; therefore, a percentage of the custom-building stock RCV was used to estimate damages that could result from winter storm conditions. This methodology is based on FEMA's How-to Series (FEMA 386-2), Understanding Your Risks, Identifying and Estimating Losses (FEMA 2001) and FEMA's Using HAZUS-MH for Risk Assessment (FEMA 433) (FEMA 2004).

Based on professional expertise and the information currently at hand, the projected losses for this hazard are believed to be overstated, thereby offering a cautious estimate for losses related to winter storm occurrences.

Wildfire

The wildfire urban interface, known as WUI, obtained through the SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin-Madison was used to define the wildfire hazard areas. The wildland fire hazard areas are based on the 2010 Census and 2006 National Land Cover Dataset and the Protected Areas Database. For the purposes of this risk assessment, the high-, medium- and low-density interface areas aggregated into a single interface hazard area and the high-, medium- and low-density intermix areas aggregated into a single intermix hazard area.

The defined hazard area was overlaid upon the asset data (population, building stock, critical facilities) to estimate the exposure to each hazard. To determine what assets are exposed to wildfire, available and appropriate GIS data were overlaid with the hazard area. Assets with their centroid located in the hazard area were totaled to estimate the number of assets and their replacement cost value exposed to a wildfire event.

4.2.3 Sources of Data Used in Hazus Modeling and Exposure Analysis

Rockland County assets were identified to assess potential exposure and loss associated with the hazards of concern. For the HMP update, Rockland County assessed exposure and vulnerability of the following types of assets: population, buildings, critical facilities, lifelines, infrastructure, new development, historic and cultural, and the environment. Some assets may be more vulnerable because of their physical characteristics or socio-economic uses. To protect individual privacy and the security of critical facilities, information on properties assessed is presented in aggregate, without details about specific individual personal or public properties. The following section defines each asset type and identifies the data sourced used in this risk assessment.

Building and Cost Data

A custom building stock inventory was generated using Rockland County, NYS Office of Information Technology Services Geospatial Services and NYS Department of Taxation and Finance's Office of Real Property Tax Services (ORPTS) 2022 parcel data; 2022 U.S. Army Corps of Engineers, National Structure Inventory to identify occupancy class, and 2022 Center for International Earth Science Information Network (CIESIN), New York State Energy Research and Development Authority for building footprints. Attributes provided in the associated files were used to further define each structure, such as year built, number of stories, occupancy class, and square footage. The centroid of each building footprint was used to estimate the building location. Structural and content RCV were calculated for each building using the available assessor data, the building footprint, and RSMMeans 2022 values.

A regional location factor for Rockland County was applied based on the individual building stock's zip code location - 109: Residential – 1.08/Non-Residential – 1.05

RCV is the current cost of returning an 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 estimate value of contents of a building. The occupancy classes available in Hazus were condensed into the categories of residential, commercial, industrial, agricultural, religious, governmental, and educational to facilitate analysis and presentation of results. Residential loss estimates addressed both multi-family and single-family dwellings.

Critical Facilities and Lifelines

The individual datasets used to create the critical facility inventory, which includes essential facilities, utilities, transportation features and user-defined facilities, were provided by Rockland County GIS. The development aligned with Hazus attribute standards and included determining whether the critical facility is considered a lifeline in accordance with FEMA's definition (refer to Appendix F, Critical Facilities). To protect individual privacy and the security of assets, information is presented in aggregate, without details about specific individual properties or facilities.

Critical facilities were provided by Rockland County and updated based on review by officials from each participating jurisdiction. Lifelines were identified in the critical facility inventory to align with FEMA's lifeline definition.

Population

Total population statistics from the 2021 American Community Survey (ACS) Five-Year Estimate were used to estimate the exposure and potential impacts to the County's population in place of the 2020 U.S. Census block estimates. The 2021 ACS was used because it provides information about communities every year and is considered best available data. To determine population statistics for villages and towns, village population totals were subtracted from the total town population. Population counts at the jurisdictional level were averaged among the residential structures in the county to estimate the population at the structure level. This estimate provides a more precise distribution of population across the county compared to only using the Census block or Census tract boundaries. Limitations of these analyses are recognized, and thus the results are used only to provide a general estimate for planning purposes.

Socially Vulnerable Populations

As discussed in Section 3, County Profile, research has shown that some populations are at greater risk from hazard events because of decreased resources or physical abilities. Vulnerable populations in Rockland County included in the risk assessment are children, elderly, population below the poverty level, non-English speaking individuals, and persons institutionalized with a disability. The 2021 ACS was used to determine the number of each at the county and municipal level.

However, the United Way of New York State's Asset Limited, Income Constrained, Employed (ALICE) report was used to determine the number of households and individuals earning above the federal poverty level but struggle to afford basic expenses. For the purpose of this HMP and as determined by the Steering Committee, ALICE data for Rockland County was used to determine the number of households and individuals that earn more than the federal poverty level but not enough to afford the basics (e.g., housing, child care, food, transportation, health care, and utilities) where they live. To determine this threshold, the ALICE measures use household costs and income. The Household Survival Budget calculates the cost of household essentials for each county in New York and relies on a wide range of sources for the budget items of housing, child care, food, transportation, health care, and a smartphone plan, plus taxes. For household income, the ALICE measures rely on the U.S. Census Bureau's ACS.

Household costs are compared to household income to determine if households are below the ALICE threshold. This includes both households in Poverty, with income below the FPL, and those that are ALICE, with income above the FPL but below the cost of basics. The average percent of ALICE households was calculated to determine the number of households in Rockland County that are below the ALICE threshold. It should be noted that this is a calculated average and may not fully represent the number of ALICE households in Rockland County.

FEMA's Hazus program was used to model estimated potential losses to flood and wind hazards as discussed further later in this section. Hazus contains 2020 U.S. Census block data and was used to estimate sheltering and injuries as part of the hazard analysis.

Environmental and Land Use Area

The National Land Use and Land Cover data was derived from the Multi-Resolution Land Characteristics (MRLC) Consortium. The MRLC is a consortium of federal agencies that coordinates and generates consistent and relevant land cover information at the national scale for a wide variety of environmental, land management, and modeling applications. Additionally, Rockland County provided 2022 land use information that includes more detailed categories, such as agricultural, general business/community commercial, heavy industrial, institutional/quasi-public, light industrial/warehouse, local neighborhood, local park/open space, mixed use (residential/commercial), multi-family residential, multi-family residential - senior housing, not yet classified, office, one family residential, private recreation/private open space, public park/open space, railroad, regional commercial, road/commuter parking, three family residential, two family residential, under water, utilities, and vacant.

New Development

In addition to assessing the vulnerability of the built environment, Rockland County examined anticipated new development in the next five years. New development was identified by Rockland County as anticipated in the next five years and recently developed since the last plan update in 2018. An exposure analysis was conducted in GIS to determine hazard exposure to the anticipated development sites.

Identifying these changes and integrating new development into the risk assessment provides communities information to consider when developing the mitigation strategy to reduce these vulnerabilities in the future (one tool in the Mitigation Toolbox discussed in Section 6, Mitigation Strategy). The new development is listed in Section 4, County Profile, and hazard exposure analysis results are presented in Section 9, Jurisdictional Annexes, as a table in each annex.

Data Source Summary

Table 4.2-3 summarizes the data sources used for the risk assessment for this plan.

Table 4.2-3. Risk Assessment Data Documentation

Data	Source	Date	Format
Population Data	U.S. Census Bureau, American Community Survey 5-Year Estimates	2017- 2021	Digital (GIS) format
New Development	Participating Rockland County Municipalities	2023	Digital Format
Building Inventory	Rockland County, NYS Office of Information Technology Services Geospatial Services and NYS Department of Taxation and Finance’s Office of Real Property Tax Services (ORPTS); Center for International Earth Science Information Network, New York State Energy Research and Development Authority; U.S. Army Corps of Engineers, National Structure Inventory; RS Means 2022	2022	Digital Format
Critical Facilities and Lifelines	Rockland County	2023	Digital Format
Land Use	National Land Use Cover Database; Rockland County	2019; 2022	Digital Format
Natural/Historical/Cultural Resources	U.S. National Park Service	N/A	Digital Format
NEHRP Soils	NYS DHSES	N/A	Digital Format

Data	Source	Date	Format
Dam Failure	Rockland County	2023	Digital Format
Landslide	USGS, Godt	2011	Digital Format
Wildfire Hazard Data	Radeloff et al.	2012	Digital Format
Social Vulnerability Index	Center for Disease Control	2020	Digital Format

Notes:

FEMA – Federal Emergency Management Agency

NEHRP – National Earthquake Hazard Reductions Program

NYS DHSES – New York State, Division of Homeland Security and Emergency Services

4.2.4 Limitations

Loss estimates, exposure assessments, and hazard-specific vulnerability 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 phenomenon:

- 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 municipalities
- 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 exposure and loss estimates are approximate. These results do not predict precise results and should be used to understand relative risk. Over the long term, Rockland 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 qualitatively analyzed.

4.2.5 Considerations for Mitigation and Next Steps

The following section discusses for considerations for the next plan update to enhance the vulnerability assessment.

All Hazards

- Create an updated user-defined general building stock dataset using up-to-date parcels, footprints, and RSMean values.
- Utilize updated and current demographic data.
- Utilizing assessor data, include updated occupancy class attributes in general building stock.

Extreme Temperatures

- Track extreme temperature data for injuries, deaths, shelter needs, pipe freezing, agricultural losses, and other impacts to determine distributions of most at-risk areas.

Flood

- The general building stock inventory can be updated to include attributes regarding first floor elevation and foundation type (basement, slab on grade, etc.) to enhance loss estimates.
- As more current FEMA floodplain data become available (i.e., DFIRMs), update the exposure analysis and generate a more detailed flood depth grid that can be integrated into the current Hazus version.
- 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.

Severe Storm

- 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.

Severe Winter Storm

- If available for the region, obtain average snowfall distributions to determine if various areas in the county have historically received higher snowfalls and might continue to be more susceptible to higher snowfalls and snow loads on the building stock and critical facilities and infrastructure.

Wildfire

- General building stock inventory can be updated to include attributes such as roofing material or fire detection equipment or integrate distance to fuels as another measure of vulnerability.

4.3.1 Dam Failure

Hazard Profile

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the dam failure hazard in Rockland County.

Hazard Description

A dam is an artificial barrier allowing storage of water, wastewater, or liquid-borne materials for many reasons (flood control, human water supply, irrigation, livestock water supply, energy generation, containment of mine tailings, recreation, or pollution control). Many dams fulfill a combination of these stated functions (Association of State Dam Safety Officials 2023). Dam failure is any malfunction or abnormality outside of the design that adversely affects a dam's primary function of impounding water and potentially leads to a sudden, rapid, and uncontrolled release of water (USSD 2023). The risks that are associated with dams must always be minimized and maintained properly, including safety inspections, technical review of a proposed new dam, monitoring and enforcement of dam safety criteria and emergency preparedness (NYS DEC n.d.).

Man-made dams can be classified by the type of construction material used, methods applied in construction, slope, or cross-section of the dam, how a dam resists forces of water pressure behind it, means used to control seepage, and occasionally, purpose of the dam. Materials used for construction of dams include earth, rock, tailings from mining or milling, concrete, masonry, steel, timber, miscellaneous materials (plastic or rubber), and any combination of these materials (Association of State Dam Safety Officials 2023). Dams are built for the purpose of power production, agriculture, water supply, recreation, and flood protection.

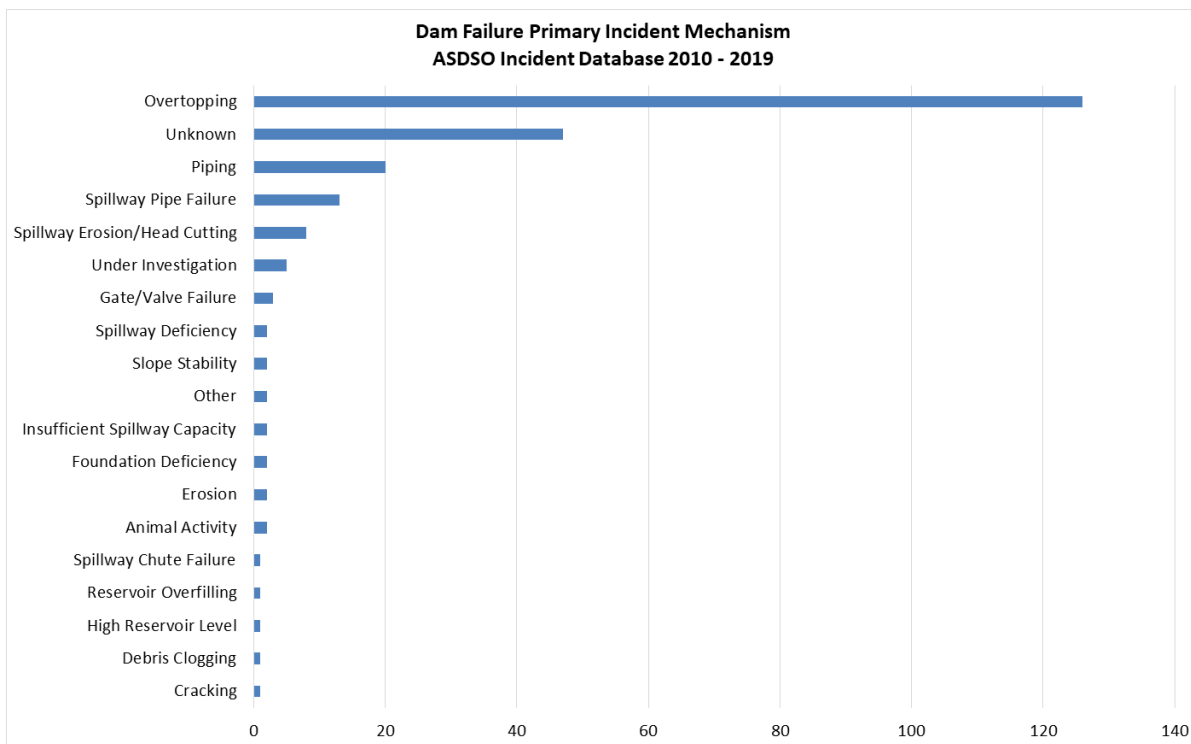
More than a third of the nation's dams are at least 50 years old. Approximately 15,000 of those dams pose a significant hazard to life and property if failure occurs. About 2,000 unsafe dams are dispersed throughout the United States in almost every state.

Dams typically fail when spillway capacity is inadequate and excess flow overtops the dam or when internal erosion (piping) through the dam or foundation occurs. Complete failure occurs if internal erosion or overtopping results in a complete structural breach, releasing a high-velocity wall of debris-filled water that rushes downstream, damaging or destroying anything in its path (FEMA 2016).

Figure 4.3.1-1 visualizes the primary causes of dam failures, nationally. Dam failures can result from one or a combination of the following (ASDSO n.d.):

- Overtopping caused by floods that exceed capacity of the dam
- Deliberate acts of sabotage
- Structural failure of materials used in dam construction
- Movement or failure of the foundation supporting the dam
- Settling and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate maintenance and upkeep

Figure 4.3.1-1. Dam Failure Causes



Source: ASDSO n.d.

Regulatory Oversight of Dams

Potential for catastrophic flooding caused by dam failures led to passage of the NDSP (Public Law 92-367). For 30 years, the NDSP has protected Americans from dam failure. NDSP is a partnership among the states, federal agencies, and other stakeholders that encourages individual and community responsibility for dam safety. Under FEMA’s leadership, state assistance funds have allowed all participating states to improve their programs through increased inspections, emergency action planning, and purchase of needed equipment. FEMA has also expanded existing training programs and initiated new training programs (FEMA 2022). Grant assistance from FEMA provides support for improvement of dam safety programs that regulate most dams in the United States (FEMA 2023).

The State of New York has a comprehensive dam safety program through which three governmental authorities regulate dam safety throughout the state:

- NYSDEC – Environmental Conservation Law (ECL) Article 15, Part 673
- FERC – 18 *Code of Federal Regulations* (CFR) 12.22-24
- USACE – EP 1110-2-13, Dam Safety Preparedness

Dam safety EAPs are formal dam failure procedures written by the dam owner/operator. EAPs are site-specific plans and relate only to the facility’s procedures to prevent/mitigate occurrence of a catastrophic dam failure. USACE is responsible for submitting an EAP for each dam it owns, operates, and maintains. EAPs for hydroelectric dams fall under the purview of FERC, and NYSDEC regulates dam safety and EAPs for all dams in New York.

New York State Department of Environmental Conservation

The New York State Department of Environmental Conservation's (NYSDEC) Dam Safety Section is responsible for safety inspection of dams, technical review of proposed dam construction or modification, monitoring of remedial work for compliance with dam safety criteria, and emergency preparedness for all dams in the state. NYSDEC is responsible for more than 100 flood control projects throughout the state, most of which were constructed by US Army Corps of Engineers (USACE) and are operated and maintained by NYSDEC (in some cases with local municipal partners) (NYSDEC 2014).

The State inspects high hazard dams every two years and moderate hazard dams every four years. To support emergency planning efforts and raise awareness among local officials and emergency managers, a copy of each inspection report is sent to the chief executive of the community in which the dam is located. Municipal officials or emergency managers from any municipality in the dam's inundation area may receive a copy of the inspection report upon request (NYSDEC 2023).

US Army Corps of Engineers Dam Safety Program

USACE is responsible for safety inspections of some federal and non-federal dams in the United States that meet size and storage limitations specified in the National Dam Safety Act, including the 80 dams identified in the USACE National Inventory of Dams (NID). USACE has inventoried dams and has surveyed each state and federal agency's capabilities, practices, and regulations regarding design, construction, operation, and maintenance of 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) has the largest dam safety program in the United States. FERC cooperates with many federal and state agencies to ensure and promote dam safety and, more recently, homeland security. 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 FERC-approved consulting engineer 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).

FERC monitors and evaluates seismic research in geographic areas where seismic activity is a concern. This information is applied to investigate and analyze structures of hydroelectric projects within these areas. FERC staff also evaluates effects of potential and actual large floods on safety of dams. FERC staff visit dams and licensed projects during and after floods, assess extents of damage, and direct any studies or remedial measures the licensee must undertake. FERC's *Engineering Guidelines for the Evaluation of Hydropower Projects* guides its engineering staff and licensees in evaluations of dam safety. The publication is frequently revised to reflect current information and methodologies (FERC 2020).

FERC requires licensees to prepare Emergency Action Plans (EAP) and conducts training sessions on developing and testing these plans. The plans outline an early warning system in the event of an actual or potential sudden release of water from a dam failure. The plans include operational procedures that may be implemented during

regulatory measures, such as reducing reservoir levels and downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that all applicable parties are informed of the proper procedures in emergencies (FERC 2020).

Location

In the State of New York, there are 400 high hazard dams and 700 moderate hazard dams that pose a threat to jurisdictions in the event of a dam failure. 32 dams are present throughout Rockland County. Most of these dams pose little risk; however, there are 13 high hazard dams. Table 4.3.1-1 is a complete list of the high hazard dams in Rockland County (NYS DHSES n.d.). Figure 4.3.1-2 shows the locations of dam inundation areas in Rockland County.

According to the NID, all dams in Rockland County are state regulated. All 13 high hazard dams eight additional dams also have EAPs. In addition, there are dams located in neighboring counties near the County border that may impact parts of the County (USACE 2023).

Table 4.3.1-1. High Hazard Dams in Rockland County (via NID)

Dam Name	Municipality	Stream	Class
First Reservoir Dam	Thiells	Horse Chock Brook	High
Lake Deforest Dam	West Nyack	Hackensack River	High
Lake Welch Dam	Willow Grove	Minisceongo Creek	High
Lake Sebago Dam	Sloatsburg	Stony Brook Creek	High
Garnerville Dam	West Haverstraw	Minisceongo Creek	High
Tivoli Dam	Sloatsburg	Ramapo River Tributary	High
Potake Lake Dam	Sloatsburg	Ramapo River Tributary	High
Lake Kanawauke Dam	New Sebago Beach	Stony Brook	High
Lake Suzanne Dam	Spring Valley	Pascack Brook	High
Lake Lucille Dam	Lake Lucille	Hackensack River	High
Central Nyack Dam	Clarkstown	Hackensack River Tributary	High
Pine Grove Lake Dam	Sloatsburg	Ramapo River Tributary	High
Congers Lake Dam	Congers	E. Branch Hackensack River	High

Source: USACE 2023

Figure 4.3.1-2. Dam Inundation in Rockland County



Extent

Dam failures 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 York has seen significant property damage including damage or loss of dams, bridges, roads, and buildings because of storm events and dam failures.

According to the NYSDEC Division of Water Bureau of Flood Protection and Dam Safety, the hazard classification of a dam is assigned according to the potential impacts of a dam failure pursuant to 6 New York Codes Rules and Regulations (NYCRR) Part 673.3 (NYSDEC date unknown) (N.Y. Comp. Codes R. & Regs. Tit. 6 § 673.3 - General provisions n.d.). Dams are classified in terms of potential for downstream damage if the dam were to fail. These hazard classifications are identified and defined below (NYS DEC n.d.):

- *Low Hazard (Class A)* is a dam located in an area where failure will damage nothing more than isolated buildings, undeveloped lands, or township or county roads; and/or will cause no significant economic loss or serious environmental damage. Failure or mis-operation would result in no probable loss of human life. Losses are principally limited to the owner’s property.
- *Intermediate Hazard (Class B)* is a dam located in an area where failure may damage isolated homes, main highways, and minor railroads; interrupt the use of relatively important public utilities; and/or cause significant economic loss or serious environmental damage. Failure or mis-operation would result in no probable loss of human life, but may cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Dams classified as intermediate hazard dams are often located in predominantly rural or agricultural areas but could be in areas with population and significant infrastructure.
- *High Hazard (Class C)* is a dam located in an area where failure may cause loss of human life, serious damage to homes, industrial or commercial buildings, important public utilities, main highways, or railroads, and/or will cause extensive economic loss. This hazard classification is for dams in which excessive economic loss (urban area including extensive community, industry, agriculture, or outstanding natural resources) would occur as a direct result of dam failure.
- *Negligible or No Hazard (Class D)* is a dam that has been breached or removed, or has failed or otherwise no longer materially impounds waters, or a dam that was planned but never constructed. These dams are defunct dams posing negligible or no hazard to downstream areas. NYSDEC may retain pertinent records regarding such dams.

Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, Rockland County was not included in any major disaster (DR) or emergency (EM) declarations for dam failure-related events (FEMA 2023). However, dam failures have occurred due to other precursor events, such as hurricanes, tropical storms, and severe storms. For declarations of events which have triggered dam failures that occurred between 2017 and 2023, refer to Table 4.3.1-2. Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

Table 4.3.1-2. FEMA Declarations for Dam Failure Precursor Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
August 21-24, 2021	Hurricane	EM-3565-NY	Yes	Countywide	New York Hurricane Henri

Sources: FEMA 2023

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2018 and 2023, Rockland County was not included in any dam failure-related agricultural disaster declarations.

Previous Events

For this 2024 HMP update, known hazard events that impacted Rockland County between January 2017 and December 2023 are discussed in Table 4.3.1-3. For events prior to 2017, refer to the 2018 Rockland County HMP.

Table 4.3.1-3. Hazard Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
August 4, 2020	Tropical Storm	N/A	N/A	Rockland County	the remnants of Tropical Storm Isaias brought high winds and heavy rain to Rockland County. High winds caused a tree to fall at the downstream edge of the Pine Grove Lake Dam crest. These conditions created a void in the embankment and a crack in the soil around the tree roots, but further examination concluded the cracking was due to earth being pulled away by the roots, not due to dam slope sliding.

Sources: ASDSO n.d.

Probability of Future Occurrences

For the 2024 HMP update, best available data was used to collect hazard event details. These details were used to calculate the probability of future occurrence of hazard events in the County. Information from the 2019 State of New York HMP, the 2018 Rockland County HMP, and FEMA were used to identify the number of events that occurred between 1999 and 2023. Table 4.3.1-4 provides the calculated probability of future dam failure events in Rockland County.

Table 4.3.1-4. Probability of Future Dam Failure Events in Rockland County

Hazard Type	Number of Occurrences Between 1999 and 2023	Percent Chance of Occurring in Any Given Year
Dam Failure	3	12.5%

Sources:

Notes: *Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act, and selected dam failure events since 1968. Due to limitations in data, not all dam failure events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.*

In Section 4.4, the identified hazards of concern for Rockland County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for dam failure in the County is considered ‘occasional’.

Climate Change Projections

Dams are designed partly based on assumptions about a river’s flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hydrograph changes, it is conceivable that the dam can lose some or its entire designed margin of safety, also known as freeboard. Loss of designed margin of safety may cause floodwaters more readily to overtop the dam or create unintended loads. Such situations could lead to a dam failure.

Warming atmospheric temperatures influence ocean temperatures. With the projected increase in temperature, it is anticipated that ocean waters will increase as well, causing ice sheets and glaciers to melt, increasing the level of the ocean’s waters. Sea level rise can impact the amount of water in the tidal Hudson River, impacting not only bordering communities, but inland communities as well. With an increase in water, the inundation area of a dam failure may increase, causing damage further than originally anticipated.

Rockland County is part of Region 2, Catskill Mountains, and the West Hudson River Valley. In Region 2, it is estimated that temperatures will increase by 3.0 °F to 5.0 °F by the 2050s and 4.0 °F to 8.0 °F by the 2080s. Precipitation totals will increase between 0 and 10 percent by the 2050s and 5 to 10 percent by the 2080s. Table 4.3.1-5 displays the projected seasonal precipitation change for ClimAID Region 2 (NYSERDA 2014). Increases in precipitation can lead to dams becoming fuller, increasing the risk of overtopping during heavy rainfall events.

Table 4.3.1-5. Projected Seasonal Precipitation Percent Change in Region 2 from Present to 2050

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: *NYSERDA 2014*

Climate change can impact stored water systems as 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 off historical events (USBR 2003). The overtopping of a dam can lead to areas downstream to become inundated with flood waters that would otherwise be safely stored.

Vulnerability Assessment

Dam failures are a hazard of concern for Rockland County because 32 dams are present across the County, 13 of which are identified as high hazard (Figure 4.3.1-2) (USACE 2023). Dam failure events are frequently triggered by other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and intensifies the risk for potential damage.

Dam failure inundation maps and downstream hazard areas are considered sensitive information and are not made available in the Rockland County Hazard Mitigation Plan. To assess the County’s risk to dam failure, an exposure analysis was conducted for the County’s assets (population, building stock, critical facilities, historic assets, and new development) using the Dam Inundation Areas provided by Rockland County. This analysis combined all available dam inundation areas to create an aggregate dam inundation area for the County. An asset is indicated as exposed if it is in at least one dam failure inundation area. Evaluated dams include Central Nyack Dam, Christie Brooke Pine Meadow Dam, Congers Lake Dam, Doodletown Dam, Lake Boyce Dam, Lake Deforest-United Water Dam, Lake Kanawauke Dam, Lake Lucille Dam, Lake Sebago Dam, Lake Suzanne Dam, Lake Tiorati Dam, Lake Welch Dam, Pine Grove Dam, Reservoir 3,2,1 Dam, Schwartz Estate Pond Dam, Skenonto Dam, and Wesley Hills Chapel Dam.

Impact on Life, Health, and Safety

The impact of dam failure on life, health, and safety depends on several factors such as the class of dam, the area being protected, the location, and the proximity of structures, infrastructure, and critical facilities to the dam. According to the State HMP, the level of impact due to a failure can be estimated using the United States Army Corps of Engineers’s (USACE) hazard potential classification system (USACE 2014). Table 4.3.1-6 outlines these hazard classifications.

Table 4.3.1-6. United States Army Corps of Engineers Hazard Potential Classification

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

Note: 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 consider 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.

Overall Population

The entire population residing within a dam failure inundation zone is considered exposed and vulnerable to an event. The potential for loss of life is affected by the capacity and number of evacuation routes available to populations living within these areas. As shown in Table 4.3.1-7, there are 5,437 persons located in the dam inundation area; the Village of Spring Valley has the greatest population in the dam inundation area with 1,689 persons.

Dam failure can displace persons in the area if flooding of structures occurs. Dam failure may mimic flood events, depending on the size of the dam reservoir and breach. Understanding potential outcomes of flooding for each dam in Rockland County would require intensive hydraulic modeling.

Table 4.3.1-7. Estimated Population Located in the Aggregate Dam Inundation Area

Jurisdiction	Total Population	Estimated Population Located in the Aggregate Dam Inundation Area	
		Number of People	Percent of Total
Airmont, Village of	9,964	0	0.0%
Chestnut Ridge, Village of	10,211	0	0.0%
Clarkstown, Town of	81,385	1,394	1.7%
Grand View on Hudson, Village of	241	0	0.0%
Haverstraw, Town of	14,028	392	2.8%
Haverstraw, Village of	12,292	417	3.4%
Hillburn, Village of	1,110	30	2.7%
Kaser, Village of	5,433	0	0.0%
Montebello, Village of	4,665	108	2.3%
New Hempstead, Village of	5,440	0	0.0%
New Square, Village of	9,433	0	0.0%
Nyack, Village of	7,303	0	0.0%
Orangetown, Town of	36,127	32	0.1%
Piermont, Village of	2,525	0	0.0%
Pomona, Village of	3,306	0	0.0%
Ramapo, Town of	48,846	245	0.5%
Sloatsburg, Village of	3,043	597	19.6%
South Nyack, Village of	2,803	0	0.0%
Spring Valley, Village of	32,953	1,689	5.1%
Stony Point, Town of	14,876	242	1.6%
Suffern, Village of	11,376	12	0.1%
Upper Nyack, Village of	2,355	0	0.0%
Wesley Hills, Village of	6,105	0	0.0%
West Haverstraw, Village of	10,665	280	2.6%
Rockland County (Total)	336,485	5,437	1.6%

Source: U.S. Census Bureau, American Community Survey 5-year Estimates 2017-2021

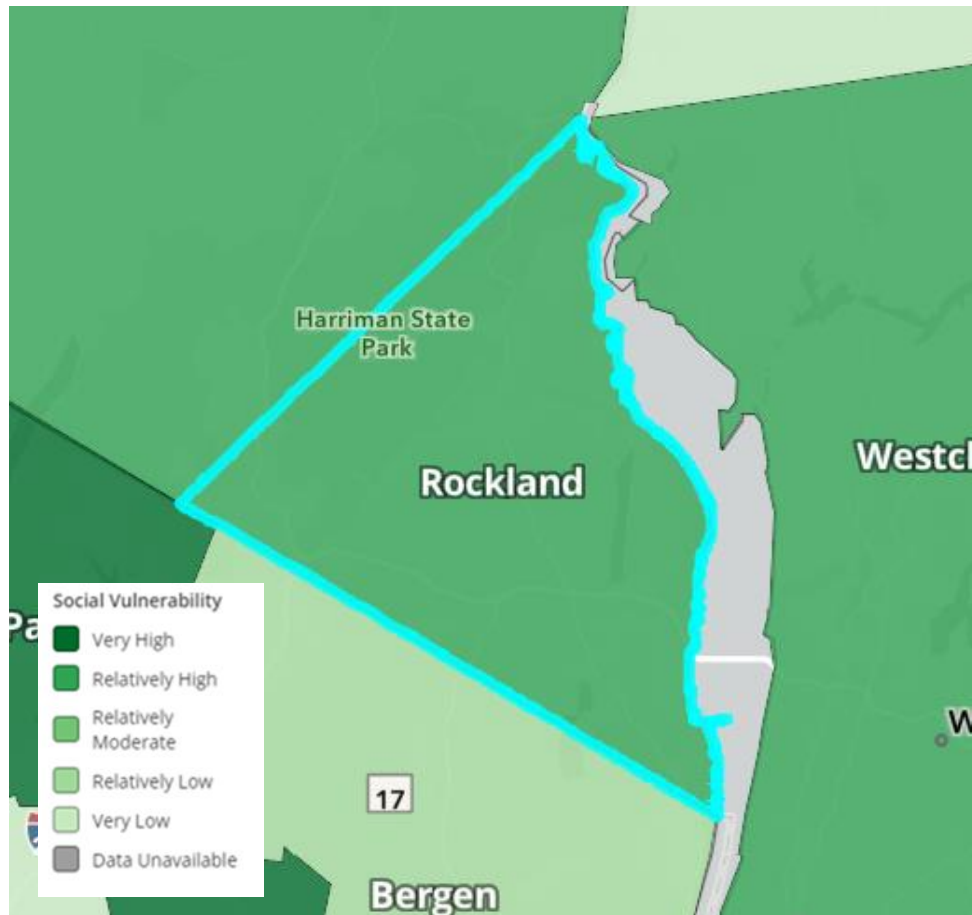
Note: Values are rounded down.

Socially Vulnerable Populations

According to Census data, there are 49,451 total persons living below the poverty level, 52,060 persons over the age of 65 years, 27,605 persons under the age of 5 years, 26,990 non-English speakers, 29,008 persons with a disability, 49,451 living in poverty, and 109,704 living below ALICE in Rockland County. These populations are more at risk during a dam failure event because economically disadvantaged populations are more likely to make the decision to evacuate based upon the net economic impact to their family, while elderly populations are likely to seek or need medical attention. The availability of medical attention may be limited due to isolation during a flood event and other difficulties in evacuating. There is often limited warning time for a dam failure event. Populations without adequate warning of the event are highly vulnerable. Individuals who may not receive adequate warning

may include those that are lack internet connection, do not speak English proficiently, and/or do not regularly use the communication tool used for warnings, like a cellphone or social media account. Figure 4.3.1-3 displays the FEMA National Risk Inventory’s Social Vulnerability Index for the County of Rockland, which is identified as ‘relatively high’.

Figure 4.3.1-3. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA n.d.

As shown in Table 4.3.1-7, there are 5,437 persons located in the dam inundation area. Table 4.3.1-8 presents the estimated socially vulnerable populations located in the aggregate dam inundation area. Of the 5,437 persons located in the dam inundation area, there are 802 persons over the age of 65 years, 435 persons under the age of 5 years, 741 non-English speakers, 518 persons with a disability, 748 living in poverty, and 1,980 living below ALICE.

Table 4.3.1-8. Estimated Vulnerable Persons Located Within the Aggregated Dam Inundation Hazard Area

Jurisdiction	Vulnerable Population						Estimated Vulnerable Persons Located Within the Aggregated Dam Inundation Hazard Area											
	Over 65	Under 5	Non-English Speaking	Disability	Poverty Level	Living Below ALICE	Over 65	Percent of Total	Under 5	Percent of Total	Non-English Speaking	Percent of Total	Disability	Percent of Total	Poverty Level	Percent of Total	Living Below ALICE	Percent of Total
Airmont, Village of	1,487	660	355	727	1,067	2,616	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Chestnut Ridge, Village of	1,587	1,368	617	1,149	1,947	1,957	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Clarkstown, Town of	16,757	3,729	4,251	8,056	3,548	22,733	287	1.7%	64	1.7%	73	1.7%	138	1.7%	61	1.7%	390	1.7%
Grand View on Hudson, Village of	64	13	0	16	13	32	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Haverstraw, Town of	2,523	1,093	996	1,228	1,414	5,023	70	2.8%	31	2.8%	28	2.8%	34	2.8%	39	2.8%	140	2.8%
Haverstraw, Village of	1,624	882	2,045	1,500	1,796	4,671	55	3.4%	30	3.4%	69	3.4%	51	3.4%	61	3.4%	159	3.4%
Hillburn, Village of	161	114	48	145	154	362	4	2.7%	3	2.7%	1	2.7%	4	2.7%	4	2.7%	10	2.7%
Kaser, Village of	174	1,319	1,350	102	3,284	1,182	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Montebello, Village of	563	193	165	303	516	588	13	2.3%	4	2.3%	4	2.3%	7	2.3%	12	2.3%	14	2.3%
New Hempstead, Village of	816	259	65	383	121	439	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
New Square, Village of	201	1,523	1,651	319	5,699	1,586	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Nyack, Village of	1,521	347	265	862	286	3,653	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Orangetown, Town of	6,912	1,804	1,056	3,540	1,626	12,603	6	0.1%	2	0.1%	1	0.1%	3	0.1%	1	0.1%	11	0.1%
Piermont, Village of	539	141	142	181	48	1,214	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pomona, Village of	613	246	116	293	111	520	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Ramapo, Town of	4,698	7,183	1,265	2,424	16,194	18,912	24	0.5%	36	0.5%	6	0.5%	12	0.5%	81	0.5%	95	0.5%
Sloatsburg, Village of	513	200	68	380	166	1,437	101	19.6%	39	19.6%	13	19.6%	74	19.6%	33	19.6%	282	19.6%
South Nyack, Village of	535	59	32	371	73	911	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Spring Valley, Village of	3,176	3,730	9,690	2,751	7,963	13,385	163	5.1%	191	5.1%	497	5.1%	141	5.1%	408	5.1%	686	5.1%
Stony Point, Town of	2,653	594	265	1,619	667	4,393	43	1.6%	10	1.6%	4	1.6%	26	1.6%	11	1.6%	71	1.6%

Jurisdiction	Vulnerable Population						Estimated Vulnerable Persons Located Within the Aggregated Dam Inundation Hazard Area											
	Over 65	Under 5	Non-English Speaking	Disability	Poverty Level	Living Below ALICE	Over 65	Percent of Total	Under 5	Percent of Total	Non-English Speaking	Percent of Total	Disability	Percent of Total	Poverty Level	Percent of Total	Living Below ALICE	Percent of Total
Suffern, Village of	2,316	490	866	1,101	706	5,449	2	0.1%	1	0.1%	1	0.1%	1	0.1%	1	0.1%	6	0.1%
Upper Nyack, Village of	479	88	19	161	170	539	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Wesley Hills, Village of	862	626	0	406	513	1,008	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
West Haverstraw, Village of	1,286	944	1,663	991	1,369	4,490	34	2.6%	25	2.6%	44	2.6%	26	2.6%	36	2.6%	118	2.6%
Rockland County (Total)	52,060	27,605	26,990	29,008	49,451	109,704	802	1.5%	435	1.6%	741	2.7%	518	1.8%	748	1.5%	1,980	1.8%

Source: U.S. Census Bureau, American Community Survey 5-year estimates 2017-2021; ALICE 2021

Note: Values are rounded down.

Impact on General Building Stock

Buildings located downstream of a dam are at risk to damages should there be a failure. Properties located closest to the dam inundation area have the greatest potential to experience the largest, most destructive surge of water. The overall impact of flooding damages caused by dam failure will vary depending on the depth of flooding and velocity of the surge.

The potential damage is the modeled loss that could occur to the exposed inventory measured by the structural and content replacement cost value. There are an estimated 1,926 buildings in the dam inundation area, representing approximately 2.7 percent of the County’s total general building stock and 2.7 percent of the County's inventory replacement cost value. The Town of Clarkstown has the greatest number of its buildings located in the dam inundation area (665 buildings or 2 percent of its total building stock). Refer to Table 4.3.1-9 for the estimated exposure of the dam inundation area by jurisdiction.

Table 4.3.1-9. Estimated Number and Total Replacement Cost Value of Structures Located in the Aggregate Dam Inundation Area

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Number and Total Replacement Cost Value of Structures Located in the Aggregate Dam Inundation Area			
			Number of Buildings	Percent of Total	Total Replacement Cost Value of Buildings	Percent of Total
Airmont, Village of	4,324	\$2,712,726,498	0	0.0%	\$0	0.0%
Chestnut Ridge, Village of	3,996	\$2,590,102,202	0	0.0%	\$0	0.0%
Clarkstown, Town of	34,094	\$22,578,694,610	665	2.0%	\$509,009,033	2.3%
Grand View on Hudson, Village of	219	\$123,746,894	0	0.0%	\$0	0.0%
Haverstraw, Town of	5,157	\$14,687,792,118	180	3.5%	\$933,991,050	6.4%
Haverstraw, Village of	2,232	\$1,373,775,543	81	3.6%	\$164,215,430	12.0%
Hillburn, Village of	499	\$340,797,550	30	6.0%	\$120,050,659	35.2%
Kaser, Village of	197	\$434,976,786	0	0.0%	\$0	0.0%
Montebello, Village of	2,002	\$1,957,771,278	45	2.2%	\$23,605,206	1.2%
New Hempstead, Village of	2,074	\$1,416,579,766	0	0.0%	\$0	0.0%
New Square, Village of	455	\$640,979,013	0	0.0%	\$0	0.0%
Nyack, Village of	1,830	\$1,930,474,072	0	0.0%	\$0	0.0%
Orangetown, Town of	18,439	\$19,240,363,073	26	0.1%	\$97,151,228	0.5%
Piermont, Village of	841	\$520,681,014	0	0.0%	\$0	0.0%
Pomona, Village of	1,437	\$947,429,629	0	0.0%	\$0	0.0%
Ramapo, Town of	9,783	\$7,401,302,608	75	0.8%	\$207,213,312	2.8%
Sloatsburg, Village of	1,776	\$780,218,848	367	20.7%	\$150,283,766	19.3%
South Nyack, Village of	1,009	\$628,994,780	0	0.0%	\$0	0.0%
Spring Valley, Village of	3,468	\$2,977,580,954	157	4.5%	\$78,915,119	2.7%
Stony Point, Town of	8,819	\$4,492,546,145	151	1.7%	\$57,462,089	1.3%
Suffern, Village of	3,110	\$2,011,976,760	44	1.4%	\$35,851,085	1.8%
Upper Nyack, Village of	1,121	\$714,087,836	0	0.0%	\$0	0.0%
Wesley Hills, Village of	2,432	\$1,597,464,375	0	0.0%	\$0	0.0%
West Haverstraw, Village of	3,171	\$1,575,031,545	105	3.3%	\$108,232,036	6.9%
Rockland County (Total)	112,485	\$93,676,093,896	1,926	1.7%	\$2,485,980,013	2.7%

Source: Rockland County, NYS Office of Information Technology Services Geospatial Services and NYS Department of Taxation and Finance’s Office of Real Property Tax Services (ORPTS) 2022; Center for International Earth Science Information Network, New York State Energy Research and Development Authority 2022; U.S. Army Corps of Engineers, National Structure Inventory 2022; RS Means 2022

Impact on Critical Facilities and Community Lifelines

Dam failures may also impact critical facilities and lifelines located in the downstream inundation zone. Consequentially, dam failure can cut evacuation routes, limit emergency access, and/or create isolation issues. Dam failure can cause severe downstream flooding and may transport large volumes of sediment and debris, depending on the magnitude of the event. Widespread damage to buildings and infrastructure affected by an event would result in large costs to repair these locations. In addition to physical damage costs, businesses can be closed while flood waters retreat, and utilities are returned to a functioning state. Further, 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.

Table 4.3.1-10 summarizes the number of community lifelines exposed to the dam inundation area. Of the 69 community lifelines located in the dam inundation area, Safety and Security has most facilities exposed (34). Refer to Section 3 (County Profile) for more information about the critical facilities and lifelines in Rockland County.

Table 4.3.1-10. Number of Lifelines Located in the Aggregate Dam Inundation Area

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines Located in the Aggregate Dam Inundation Area
Communications	154	7
Energy	0	0
Food, Water, Shelter	71	2
Hazardous Materials	56	4
Health and Medical	195	8
Safety and Security	349	34
Water Systems	8	14
Transportation	148	0
Rockland County (Total)	981	69

Impact on the Economy

Severe flooding that follows an event like a dam failure can cause extensive structural damage and withhold essential services. The cost to recover from flood damages after a surge will vary depending on the hazard risk of each dam.

Severe flooding that follows an event like a dam failure can cause extensive damage to public utilities and disruptions to delivery of services. Loss of power and communications may occur and drinking water and wastewater treatment facilities can become temporarily out of operation. Debris from surrounding buildings can accumulate should the dam mimic major flood events, such as the 1-percent annual chance flood event that is discussed in Section 4.3.6 (Flood).

Impact on the Environment

The environmental impacts of a dam failure can include significant water-quality and debris-disposal issues or severe erosion that can impact local ecosystems. Floodwaters can back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate residential and commercial buildings and the

flooded waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals may get added to flood waters. Hazardous materials may be released and distributed widely across the floodplain. Water supply and wastewater treatment facilities could be offline for weeks. After the flood waters subside, contaminated and flood-damaged building materials and contents must be properly disposed of. Contaminated sediment must be removed from buildings, yards, and properties.

The total land area in the dam inundation area is summarized in Table 4.3.1-11 by jurisdiction. Overall, the County has 4,496 acres (4.1 percent of all County land) in the dam inundation area. Of those 4,496 acres, 992 acres lie in the Town of Clarkstown, 775 acres in the Town of Ramapo, and 704 acres in the Town of Haverstraw.

Table 4.3.1-11. Total Acres of Land Area (Excluding Waterbodies) Located in the Aggregate Dam Inundation Area

Jurisdiction	Total Acres of Land Area	Total Acres of Land Area (Excluding Waterbodies) Located in the Aggregate Dam Inundation Area	
		Total Acres Located in the Dam Inundation Area	Percent of Total
Airmont, Village of	2,844	0	0.0%
Chestnut Ridge, Village of	3,109	0	0.0%
Clarkstown, Town of	23,295	992	4.3%
Grand View on Hudson, Village of	106	0	0.0%
Haverstraw, Town of	11,066	704	6.4%
Haverstraw, Village of	1,254	105	8.4%
Hillburn, Village of	1,364	253	18.5%
Kaser, Village of	103	0	0.0%
Montebello, Village of	2,704	76	2.8%
New Hempstead, Village of	1,747	0	0.0%
New Square, Village of	220	0	0.0%
Nyack, Village of	492	0	0.0%
Orangetown, Town of	13,958	343	2.5%
Piermont, Village of	411	0	0.0%
Pomona, Village of	1,488	0	0.0%
Ramapo, Town of	19,415	775	4.0%
Sloatsburg, Village of	1,564	528	33.8%
South Nyack, Village of	389	0	0.0%
Spring Valley, Village of	1,285	69	5.4%
Stony Point, Town of	17,910	409	2.3%
Suffern, Village of	1,317	84	6.4%
Upper Nyack, Village of	738	0	0.0%
Wesley Hills, Village of	2,102	0	0.0%
West Haverstraw, Village of	988	156	15.8%
Rockland County (Total)	109,869	4,496	4.1%

Source: Rockland County 2020; USGS, NHD 2023

Note: 1) Excludes areas designated as water

2) Values are rounded to the nearest whole value

Abbreviation Notes:

1) USGS: United States Geological Survey

2) NHD: National Hydrography Dataset

Cascading Impacts on Other Hazards

Dam failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential secondary hazards of dam failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat. Dam failures can occur as a result of structural failures, such as progressive erosion of an embankment or overtopping and breaching by a severe flood. Earthquakes may weaken dams. Floods caused by dam failures have caused loss of life and property damage (FEMA 2013).

Future Changes That May Impact Vulnerability

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

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Potential or Projected Development

As discussed and illustrated in Section 3 (County Profile), areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by a dam failure event if the structures are located within the flood protection area and mitigation measures are not considered. 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.

Projected Changes in Population

Rockland County has experienced an increase in its population since 2010. According to the U.S. Census Bureau, the County's population increased by approximately 8.5 percent between 2010 and 2020 (County of Rockland 2021). Cornell University's Program on Applied Demographics produced populations projections by County from 2016 to 2040. According to these projections, Rockland County is projected to have a population of 356,758 by 2030 and 372,432 by 2040 (Cornell University 2018).

As the population increases any changes in the density of population can impact the number of persons exposed to the probable maximum flood inundation hazard areas. Higher density can not only create issues for residents during evacuation of a dam failure event but can also have an effect on commuters that travel into and out of the County for work, particularly during a flood event that may impact transportation corridors, which are also major commuter roads. Refer to Section 3 (County Profile) for more information about population trends in the County.

Other Identified Conditions

Most studies project that the State of New York will see an increase in average annual precipitation. 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 dam failures. Increases in precipitation may stress the structures (NYSERDA 2014). Further, 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.

Change of Vulnerability Since 2018 HMP

Overall, the County's vulnerability has not changed, and the County will continue to be exposed and vulnerable to dam failure events, especially those located within or near downstream inundation zones. Because of the sensitive nature of the dam failure inundation zones, potential losses have not been quantified and presented in this plan. To estimate potential losses to population, buildings, critical facilities and infrastructure, dam inundation areas and depths of flooding may be used to generate depth grids. Hazus may be used to estimate potential losses for the County and participating municipalities.

4.3.2 Disease Outbreak

Hazard Profile

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the disease outbreak hazard in Rockland County.

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).

Rockland County has a history of pandemics, epidemics, and disease outbreaks. For the purposes of this hazard mitigation plan update, the following infectious diseases will be discussed in further detail: Influenza, West Nile Virus (WNV), Lyme Disease, and Coronavirus.

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 (NYSDOH 2021).

Pandemic influenza differs from seasonal influenza (or ‘the flu’) because outbreaks of seasonal flu are caused by viruses already living amongst people. Pandemic influenza is a global outbreak of a new influenza virus, which can infect people easily and spread from person to person in an efficient and sustained manner (CDC 2020). Additionally, the seasonal flu happens annually and usually peaks between December and February, whereas a pandemic influenza does not occur as regularly.

The risk of a global influenza pandemic has increased over the last several years. This type of disease can claim thousands of lives and adversely affect critical infrastructure and key resources. An influenza pandemic can reduce the health, safety, and welfare of the essential services workforce; immobilize core infrastructure and induce fiscal instability.

West Nile Virus

West Nile Virus (WNV) is the leading cause of mosquito-borne disease in the United States. It is most spread to people who are bitten by an infected mosquito. WNV is usually diagnosed during mosquito season, starting in the summer and continuing through the fall (CDC 2021). WNV was first found in the State of New York in 1999. Between 2000 and 2017 (most recent available data), 490 human cases and 37 deaths of WNV have been reported statewide (NYS DOH 2017). When WNS progresses to severe infection it is called West Nile encephalitis or meningitis, which can include headache, high fever, neck stiffness, muscle weakness, stupor, disorientation, tremors, seizures, paralysis, and coma. WNV can cause serious illness, and in some cases, death. Usually, symptoms occur from three to 14 days after being bitten by an infected mosquito (NYS DOH 2017).

Lyme Disease

Lyme disease is the most common vector-borne disease (vectors are mosquitoes, ticks, and fleas that spread pathogens) in the United States. This disease is caused when an individual is bitten by a tick carrying a specific bacterium (either *Borrelia burgdorferi* and rarely, *Borrelia mayoni*). Typical symptoms include fever, headache, fatigue, and skin rash. If left untreated, symptoms can be severe. Most cases of Lyme disease can be treated successfully with a few weeks of antibiotics. Steps to prevent Lyme disease include using insect repellent, removing ticks promptly, applying pesticides, and reducing tick habitat (CDC 2022). In New York, the commonly infected tick is the deer tick. Immature ticks become infected by feeding on infected white-footed mice and other small mammals. Deer ticks can also spread other tick-borne diseases. Anyone who is bitten by a tick carrying the bacteria can become infected (NYS DOH 2019).

Coronavirus

Coronaviruses are a type of virus. There are many different kinds, and some cause disease. Coronaviruses are 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).

Coronavirus disease (Covid-19) is an infectious 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 (WHO 2022). The Covid-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes.

Reported illnesses have ranged from mild symptoms to severe illness and death. Reported symptoms include difficulty breathing and shortness of breath, fever or chills, cough, fatigue, muscle or body aches, loss of smell or taste, sore throat, congestion, and nausea or vomiting. Emergency symptoms that require immediate medical attention include trouble breathing, persistent pain or pressure in the chest, confusion, or inability to wake or stay awake, and bluish lips or face. Symptoms may appear two to 14 days after exposure to the virus (based on the incubation period of MERS-CoV viruses) (CDC 2021).

Location

Disease outbreaks can occur without regard for location, therefore can occur throughout Rockland County.

Extent

The extent of disease outbreaks depend on the preferred habitat of the species, as well as the species' ease of movement and establishment. The magnitude of disease outbreaks ranges from nuisance to widespread. The exact size and extent of an infected population depend on how easily the illness is spread, the mode of transmission, and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in more densely populated areas. The transmission rate of infectious diseases will depend on the mode of transmission of a given illness, and whether a vaccine, cure, or treatment is available. The threat is typically intensified when the ecosystem or host species is already stressed, such as during periods of drought. The already weakened state of the ecosystem causes it to more easily be impacted by an infestation.

The severity and length of the next pandemic cannot be predicted; however, experts anticipate that its effect on the United States could be severe.

The World Health Organization (WHO) has identified the six phases of a global pandemic (World Health Organization 2009). Phases 1 to 3 and 5 to 6 have been grouped to include common action points. The WHO pandemic phases are outlined in Table 4.3.2-1 below.

New York State uses WHO classification system guidance to inform its activities during a pandemic event.

Table 4.3.2-1. 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 reassortant 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 (H2H) of an animal or human-animal influenza reassortant 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: World Health Organization 2009

Influenza

The United States Environmental Protection Agency (US EPA) has noted 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. Seasonal flu epidemics occur yearly, typically beginning at the end of October and continuing through the colder months (NYS DOH 2023).

West Nile Virus

West Nile Virus (WNV) disease is spread by the bite of a mosquito infected with the virus. Mosquitos become infected when they feed on infected birds (NYS DOH 2017). The West Nile Virus cases will increase in portions of the state during the late summer and early fall seasons. There are no vaccines to prevent or medications to treat WNV in people, and those infected rarely experience sickness or symptoms.

Lyme Disease

Most cases of Lyme disease in New York are reported from May through August, which corresponds to the peak activity period for nymphs. This suggests that the majority of Lyme disease cases are transmitted by nymphal deer

ticks. Young deer ticks, called nymphs, are active from mid-May to mid-August and are about the size of poppy seeds. Adult ticks, which are approximately the size of sesame seeds, are most active from March to mid-May and from mid-August to November. Both nymphs and adults can transmit Lyme disease. Ticks can be active any time the temperature is above freezing (NYS DOH 2023).

Coronavirus

Similar to influenza, 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.

Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, Rockland County was included in three major disaster (DR) or emergency (EM) declarations for disease outbreak-related events (FEMA 2023). For declarations that occurred between 2017 and 2023, refer to Table 4.3.2-2. Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

Table 4.3.2-2. FEMA Declarations for Disease Outbreak Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
January 20, 2020 - May 11, 2023	Pandemic: Coronavirus	EM-3434-NY	Yes	County-wide	New York Covid-19
January 20, 2020 - May 11, 2023	Pandemic: Coronavirus	DR-4480-NY	Yes	County-wide	New York Covid-19 Pandemic

Sources: FEMA 2023

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2018 and 2023, Rockland County was not included in any disease outbreak-related agricultural disaster declarations.

Previous Events

For this 2024 HMP update, known hazard events that impacted Rockland County between January 2017 and December 2023 are discussed in Table 4.3.2-3. For events prior to 2017, refer to the 2018 Rockland County HMP.

Table 4.3.2-3. Hazard Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
2017	Influenza	N/A	N/A	County-wide	666 confirmed cases of Influenza in Rockland County
2017	West Nile Virus	N/A	N/A	County-wide	1 confirmed case of West Nile Virus in Rockland County
2017	Lyme Disease	N/A	N/A	County-wide	49 confirmed cases of Lyme Disease in Rockland County
2018	Influenza	N/A	N/A	County-wide	1,487 confirmed cases of Influenza in Rockland County
2018	West Nile Virus	N/A	N/A	County-wide	1 confirmed case of West Nile Virus in Rockland County
2018	Lyme Disease	N/A	N/A	County-wide	48 confirmed cases of Lyme Disease in Rockland County
2019	Influenza	N/A	N/A	County-wide	1,912 confirmed cases of Influenza in Rockland County
2019	West Nile Virus	N/A	N/A	County-wide	1 confirmed case of West Nile Virus in Rockland County
2019	Lyme Disease	N/A	N/A	County-wide	48 confirmed cases of Lyme Disease in Rockland County
2020	Influenza	N/A	N/A	County-wide	1,961 confirmed cases of Influenza in Rockland County
2020	West Nile Virus	N/A	N/A	County-wide	1 confirmed case of West Nile Virus in Rockland County
2020	Lyme Disease	N/A	N/A	County-wide	54 confirmed cases of Lyme Disease in Rockland County
2020	Coronavirus	DR-4480-NY, EM-3434-NY	Yes	County-wide	Rockland County has reported 27,510 positive cases of Covid-19 and 587 deaths.
2021	Influenza	N/A	N/A	County-wide	1,985 confirmed cases of Influenza in Rockland County
2021	West Nile Virus	N/A	N/A	County-wide	1 confirmed case of West Nile Virus in Rockland County
2021	Lyme Disease	N/A	N/A	County-wide	51 confirmed cases of Lyme Disease in Rockland County
2021	Coronavirus	DR-4480-NY, EM-3434-NY	Yes	County-wide	Rockland County has reported 39,055 positive cases of Covid-19 and 219 deaths.
2022	Influenza	N/A	N/A	County-wide	12,114 confirmed cases of Influenza in Rockland County
2022	West Nile Virus	N/A	N/A	County-wide	1 confirmed case of West Nile Virus in Rockland County
2022	Lyme Disease	N/A	N/A	County-wide	201 confirmed cases of Lyme Disease in Rockland County
2022	Coronavirus	DR-4480-NY, EM-3434-NY	Yes	County-wide	Rockland County has reported 49,262 positive cases of Covid-19 and 115 deaths.
2023 ^a	Influenza	N/A	N/A	County-wide	3,974 confirmed cases of Influenza in Rockland County
2023 ^b	West Nile Virus	N/A	N/A	County-wide	0 confirmed cases of West Nile Virus in Rockland County
2023 ^c	Lyme Disease	N/A	N/A	County-wide	201 confirmed cases of Lyme Disease in Rockland County
2023 ^d	Coronavirus	DR-4480-NY, EM-3434-NY	Yes	County-wide	Rockland County has reported 5,489 positive cases of Covid-19 and 29 deaths.

Sources: Sources: CDC 2023; NYSDOH 2023; CDC 2022; NYS DOH 2023

Note: Lyme Disease incidences for 2022 and 2023 were unable to be identified

- a As of September 14, 2023*
 - b As of September 14, 2023*
 - c As of September 14, 2023*
 - d As of July 23, 2023*
-

Probability of Future Occurrences

For the 2024 HMP update, best available data was used to collect hazard event details. These details were used to calculate the probability of future occurrence of hazard events in the County. Information from the Centers for Disease Control and Prevention, New York State Department of Health, the 2019 State of New York HMP, the 2018 Rockland County HMP, and FEMA were used to identify the number of events that occurred between 2017 and 2023. Table 4.3.2-4 provides the calculated probability of future disease outbreak events in Rockland County.

Table 4.3.2-4. Probability of Future Disease Outbreak Events in Rockland County

Hazard Type	Number of Occurrences Between 2017 and 2023	Percent Chance of Occurring in Any Given Year
Disease Outbreak	25	100 percent

Sources: CDC 2023; NYSDOH 2023; CDC 2022; NYS DOH 2023

Notes: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act, and selected disease outbreak events since 1968. Due to limitations in data, not all disease outbreak events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

In Section 4.4, the identified hazards of concern for Rockland County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for disease outbreak in the County is considered ‘frequent’.

In Rockland County, the probability for a future disease outbreak event is dependent on several factors. One factor that influences the spread of disease is population density. Populations that live close to one another are more likely to spread diseases, depending on how they are transmitted. As population density increases in the County, so too will the probability of a disease outbreak event to occur. When there is a significant change in a circulating strain of a virus, more of the population is susceptible and the strain could rapidly spread from person to person.

Another key factor in the likelihood of future events is how well-prepared Rockland County is to respond to a disease outbreak. Instances of WNV have been generally decreasing throughout the northeast United States due to planning and eradication efforts. Disease-carrying ticks will continue to inhabit Rockland County and the threat of Lyme disease and other tick-borne diseases will continue. Like mosquitoes, there are eradication efforts in place to control the tick population and new methods of control are being developed (Steere, Coburn and Glickstein 2004). Therefore, based on all available information and available data regarding mosquito and tick populations, it is anticipated that mosquito- and tick-borne diseases will continue to be a threat to Rockland County. However, vaccines are currently being developed for Lyme Disease, which may assist in slowing the contraction rates (CDC 2022).

Climate Change Projections

Some scientists anticipate an increase in WNV and other mosquito-borne diseases due to changing climate conditions creating suitable habitats for disease carriers (CDC 2013). Warmer temperatures and changing rainfall patterns provide an environment where mosquitos can remain active longer, greatly increasing the risk for animals and humans. Lyme disease could also expand throughout the United States as temperatures warm, allowing ticks to move into new areas of the country. The climate changes can also allow tropical and subtropical insects to move from regions where diseases thrive into new places (NRDC 2015).

An increase in temperature and humidity may also lead to a larger number of influenza outbreaks. Studies have shown that warmer winters led to an increase in influenza cases. During warm winters, fewer people contract influenza which causes a large number in population to remain vulnerable into the next season. This causes an early and strong occurrence of the virus (Towers, et al. 2013). Temperatures in the State of New York are warming, with an average rate of warming over the past century of 0.25° F per decade. Average annual temperatures are projected to increase across the State by 2 to 3.4 °F by the 2020s, 4.1 to 6.8 °F by the 2050s, and 5.3 to 10.1 °F by the 2080s (NYSERDA 2014). In Rockland County, it is estimated that temperatures will increase by 3.0 °F to 5.0 °F by the 2050s and 4.0 °F to 8.0 °F by the 2080s (baseline of 48.0 °F, mid-range projection) (NYSERDA 2014).

Sitting water can be a breeding ground for mosquitos, which spread diseases. Precipitation totals will increase between 0 and 10 percent by the 2050s and 0 to 15 percent by the 2080s (baseline of 48.0 inches, mid-range projection). Table 4.3.2-5 displays the projected seasonal precipitation change for the Region 2 (NYSERDA 2014).

Table 4.3.2-5. Projected Seasonal Precipitation Change in Region 2, 2050s (% change)

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: NYSEDA 2014

The relationship between climate change and increase in infectious diseases is difficult to predict with certainty, but there are scientific linkages between the two. Increased rainfall and heavy rainfalls increase the chances of standing water where mosquitos breed. As flooding events increase in the County owing to climate change, water-borne and vector-borne diseases (particularly those associated with mosquitos) may similarly increase owing to the prevalence of standing water over long periods (National Geographic 2022).

The notion that rising temperatures will increase the number of ticks and mosquitoes that can transmit diseases such as Lyme disease and WNV among humans (rather than just shift their range) has been the subject of debate over the past decade. Some believe that climate change may affect the spread of disease, while others are not convinced. However, many researchers point out that climate is not the only force at work in increasing the spread of infectious diseases into the future (Jordan 2019). However, a warming climate is likely to increase the length of the insect season, increasing the potential rates of transmission of insect borne disease.

Vulnerability Assessment

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

Impact on Life, Health, and Safety

The entire population of Rockland County is vulnerable to disease outbreak. 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. Further, the elderly and immunocompromised individuals may have increased vulnerability to becoming infected or experience exacerbated impacts depending upon the disease.

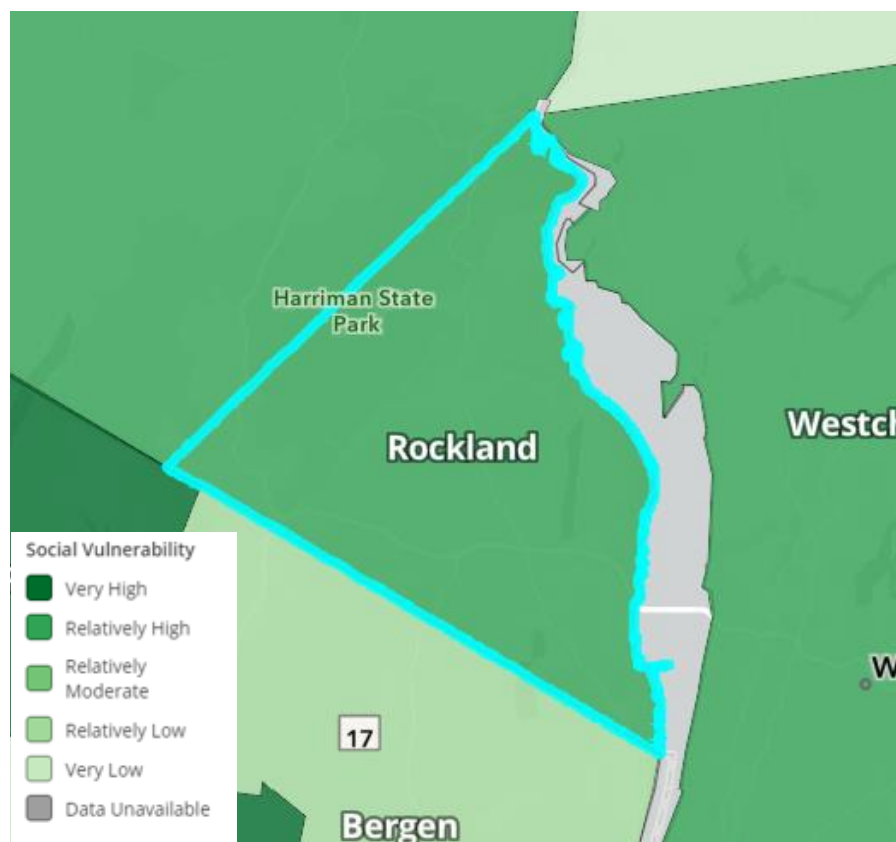
Overall Population

The entire population of Rockland County (336,485) is vulnerable to the disease outbreak hazard. Due to a lack of quantifiable loss information, a qualitative assessment was conducted to evaluate the assets exposed to this hazard and the potential impacts associated with this hazard.

Socially Vulnerable Population

Most recently with Covid-19, the Centers for Disease Control and Prevention have indicated that persons over 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 2021). According to the 2021 ACS, there are 52,060 (15.5 percent of the County's total population) persons over 65 and 49,451 (14.7 percent of the County's total population) persons living in poverty in Rockland County. For the purpose of this HMP and as determined by the Steering Committee, ALICE data for Rockland County was used to determine the number of households and individuals that earn more than the federal poverty level but not enough to afford the basics (e.g., housing, childcare, food, transportation, health care, and utilities) where they live. According to the ALICE data, there are 109,704 persons (32.6 percent of the County's total population) living below the ALICE threshold (\$48,048 annually for a single adult) for Rockland County. Figure 4.3.2-1 displays the FEMA National Risk Inventory's Social Vulnerability Index for the County of Rockland, which is identified as 'relatively high'.

Figure 4.3.2-1. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA n.d.

Impact on General Building Stock

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

Impact on Critical Facilities and Community Lifelines

A pandemic or disease outbreak will not be directly impact the actual structures of County and municipal buildings, critical facilities, and infrastructure. However, the effect of worker absenteeism will impact local government services.

The most significant impact on critical facilities would be the increased service demands, such as hospitalization and emergency room visit that would take place because of the outbreak. This would create a greater demand on these critical facilities, their staff, and resources. The healthcare system will be severely taxed, if not overwhelmed, from the large number of illnesses and complications from influenza requiring hospitalization and critical care. Ventilators will be the most critical shortage if a respiratory outbreak were to occur (Homeland Security Council 2006).

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

Impact on the Economy

The impact disease outbreaks have on the economy in estimated dollar losses is difficult to measure. Costs associated with the activities and programs implemented to conduct surveillance and address disease outbreaks have not been quantified in available documentation. Instead, activities and programs have been implemented by the County and State to address this hazard.

The Covid-19 pandemic had significant economic impacts across the State of New York, including Rockland County. Over the course of two months, nearly 2 million jobs as businesses were forced to close, disrupting the economy at the state, county, and local levels. Rockland County saw a 2.7 percent decrease in sales tax collection between 2019 and 2020, from \$232.2 million (2019) to \$225.9 million (2020) (Office of the New York State Comptroller 2021). As a result, Rockland County received \$63.18 million in funding through the American Rescue Plan Act of 2021 that went towards mental health services, food security initiatives, support for businesses and frontline workers, and affordable housing (Rockland County Executive 2021).

Impact on the Environment

Disease outbreaks may have an impact on the environment if the outbreaks are caused by invasive species. Invasive species tend to be competitive with native species and their habitat. One study has shown that invasive mosquitos such as the Asian tiger mosquito, a common invasive mosquito found in New Jersey, have “desiccation-resistant eggs,” which means that they have enhanced survival in inhospitable environments (Juliano and Lounibos 2005). This species is considered a competitive predator and will prey on other species of mosquitos and a range of insects disrupting the natural food chain. Invasive species of mosquitos can be the major transmitters of disease like Zika, dengue, and yellow fever (CDC 2020).

Secondary impacts from mitigating disease outbreaks could also have an impact on the environment. Pesticides used to control disease carrying insects like mosquitos have been reviewed by the EPA and United States Department of Health. If these sprays are applied in large concentrations, they could potentially leach into waterways and harm nearby terrestrial species. New York State Department of Environmental Conservation's (NYSDEC) Bureau of Pest Management's pesticide laws, regulations and policies ensure that pesticides are used and sold in compliance with the Environmental Conservation Law (NYSDEC 2014).

Future Changes That May Impact Vulnerability

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

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Potential or Project Development

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

Projected Changes in Population

Rockland County has experienced an increase in its population since 2010. According to the U.S. Census Bureau, the County's population increased by approximately 8.5 percent between 2010 and 2020 (County of Rockland 2021). Cornell University's Program on Applied Demographics projects Rockland County will have a population of 356,758 by 2030 and 372,432 by 2040 (Cornell University 2018).

An increase in population will expose more people to the pandemic hazard as residents move into area and the population exposed increases. Population density changes when households move throughout the County could influence the number of persons exposed to disease outbreaks. Higher density jurisdictions are not only at risk of greater exposure to disease outbreak, but density may also reduce available basic services provided by critical facilities such as hospitals and emergency facilities for persons that are not affected by a disease.

Other Identified Conditions

As discussed earlier in this section, the relationship between climate change and increased infectious diseases is difficult to predict with certainty, however there may be linkages between the two. Changes in the environment may create a more livable habitat for vectors carrying disease as suggested by the CDC (CDC 2021). Localized changes in climate and human interaction may also be a factor in the spread of disease.

The relationship between infectious diseases occurrence and climate change is difficult to predict with certainty. However, there may be linkages between the two. Changes in the environment may create a more livable habitat for vectors carrying disease as suggested by the Centers for Disease Control and Prevention (CDC n.d.). Localized changes in climate and human interaction may also be a factor in the spread of disease. For example, in the wake

of significant flooding events, prolonged and intense precipitation often provides breeding grounds for mosquitos that necessitate mosquito control measures.

The relationship between climate change and infectious diseases is not universally agreed upon. Climate change may affect the spread of disease, while others are not convinced. However, research indicates that the only force at work in increasing the spread of infectious diseases into the future. 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 (Harmon 2010).

Change of Vulnerability Since 2018 HMP

Disease outbreak was not included as a hazard of concern in the 2018 HMP. However, with an increase in population it can be assumed that the vulnerability to disease outbreak events has slightly increased since 2018.

4.3.3 Drought

Hazard Profile

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the drought hazard in Rockland County.

Hazard Description

A drought is a period of unusually constant dry weather that persists long enough to cause deficiencies in water supply (surface or underground) that can last a short period or for many years. Droughts are slow-onset hazards, but, over time, they can severely affect crops, municipal water supplies, recreational resources, and wildlife. If drought conditions extend over several years, the direct and indirect economic impacts can be significant. High temperatures, high winds, and low humidity can worsen drought conditions and make areas more susceptible to wildfire. In addition, human actions and demands for water resources can accelerate drought-related impacts (MitigateNY 2018).

Droughts can be categorized as one or more of the following four types (National Drought Mitigation Center 2023):

- **Meteorological** drought is a measure of departure of precipitation from normal. It is defined solely on the relative degree of dryness. Due to climatic differences, what might be considered a drought in one location of the country may not be a drought in another location.
- **Agricultural** drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential 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. Agricultural drought is defined in terms of soil moisture deficiencies relative to water demands of plant life, primarily crops.
- **Hydrological** drought is associated with the effects of periods of precipitation shortfalls (including snowfall) on surface or subsurface water supply. It occurs when these water supplies are below normal. It is related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- **Socioeconomic** drought is associated with the supply and demand of an economic good with elements of meteorological, hydrological, and agricultural drought. This differs from the aforementioned because its occurrence depends on current economic trends of supply and demand to identify or classify droughts. Socioeconomic drought occurs when the demand for an economic good exceeds supply because of a weather-related shortfall in water supply.

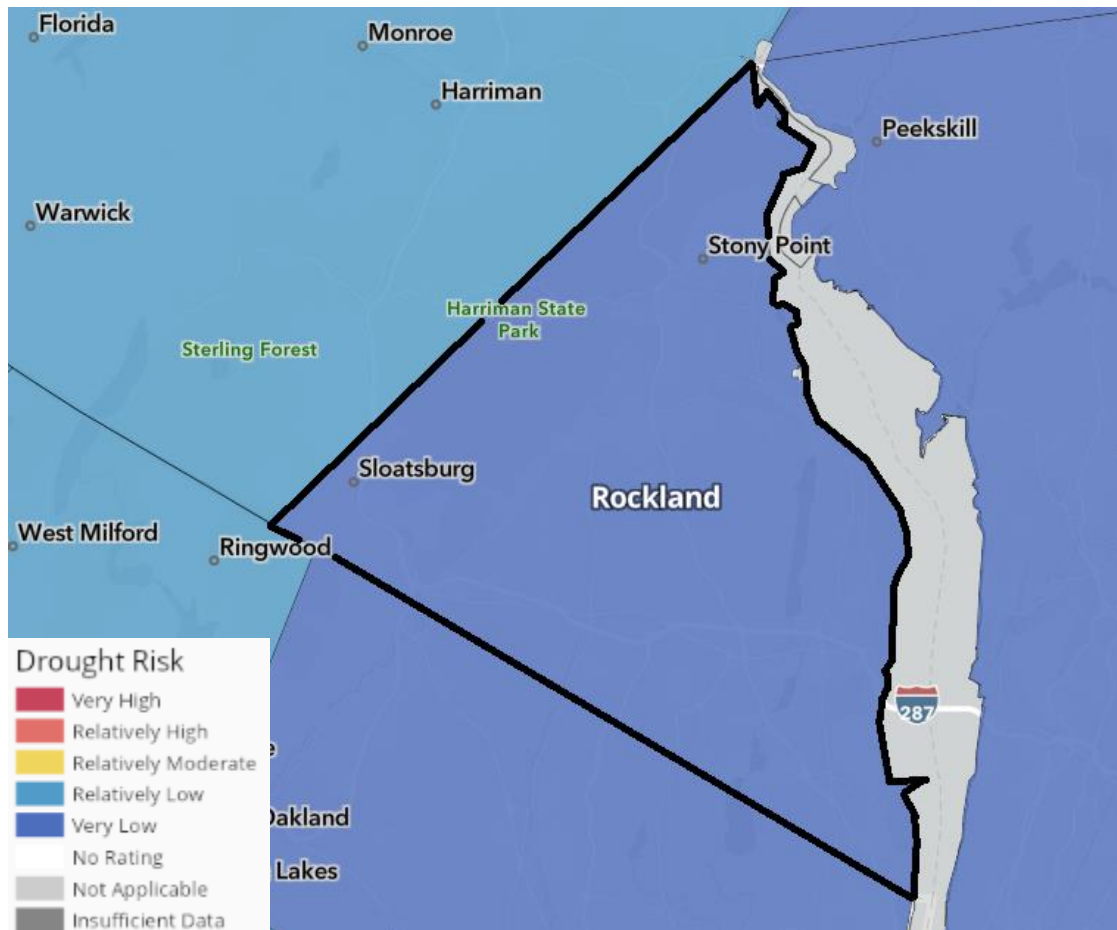
Location

Droughts can occur in all parts of the United States and any time of the year. Drier regions are more susceptible to long-term or extreme drought conditions, while other areas tend to be more susceptible to short-term, less severe droughts. Variations in the precipitation amounts can lead to periods of dry weather and drought. In the

State of New York, average precipitation amounts range from 60 inches in the Catskills to 28 inches in the Lake Champlain Valley (NYSDEC 2023).

Figure 4.3.3-1 and Figure 4.3.3-2 show the Drought Risk Index for Rockland County on the county and census tract scales, respectively. This index helps to understand the susceptibility of the County to drought. According to the National Risk Index, on the county scale, the County has a very low risk to drought; on the census tract scale, much of the County has no rating, however, some census tracks range from a very low risk to a relatively low risk (FEMA 2019).

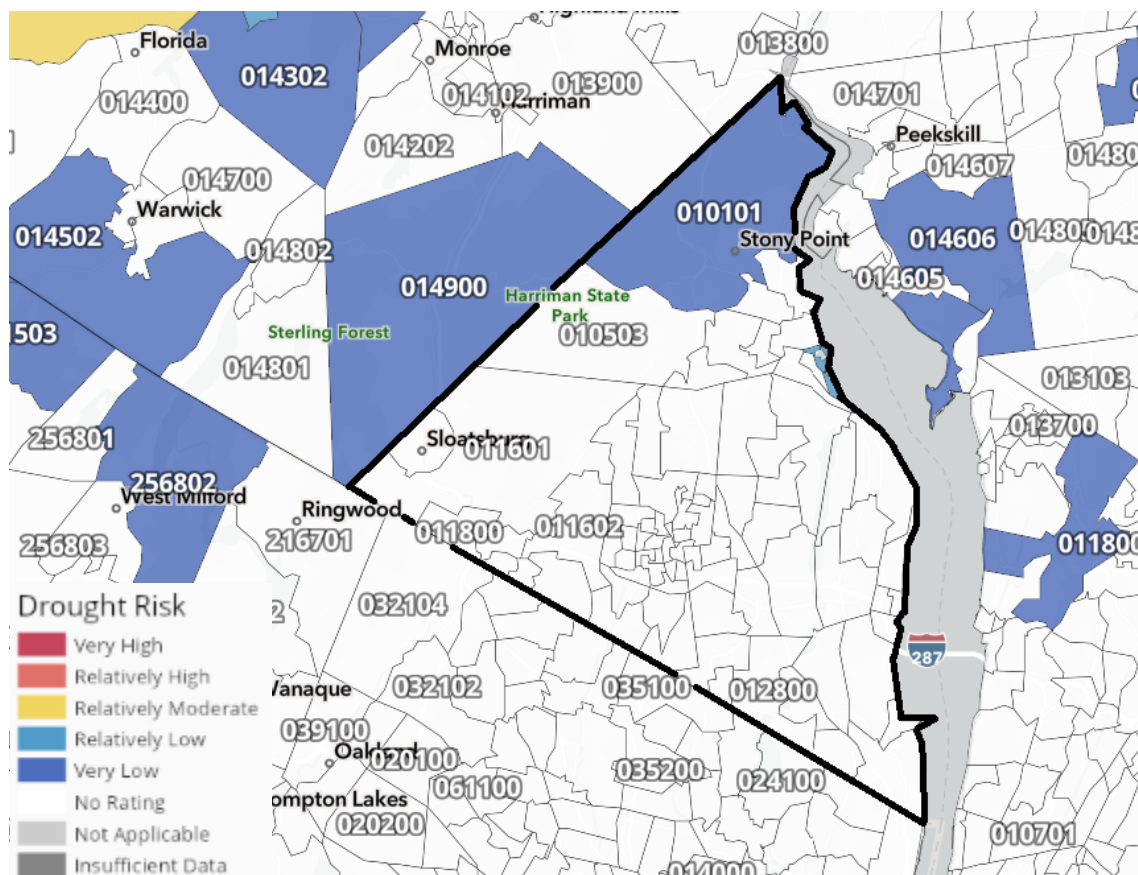
Figure 4.3.3-1. National Risk Index, Drought Risk Index Score Using the County Scale



Source: FEMA 2019

Note: Rockland is outlined in a bolded black border.

Figure 4.3.3-2. National Risk Index, Drought Index Score Using the Census Tract Scale



Source: FEMA 2019

Note: Rockland is outlined in a bolded black border.

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 (USDA 2023).

The New York State Department of Environmental Conservation (NYSDEC) has divided the State into nine drought management regions based on drainage basins and county lines. NYSDEC monitors precipitation, lake and reservoir levels, stream flow, and groundwater level at least monthly in each region and more frequently during periods of drought. NYSDEC and the New York State Drought Management Task Force use this data to assign each region one of the following four drought stages (NYSDEC 2023):

- **Normal** is considered the standard moisture soil levels found throughout the State.
- **Drought Watch** is the first stage of drought. This stage is declared by the NYSDEC and is intended to give advance notice of a developing drought. As this stage, the public is urged to conserve water. Public water purveyors and industries are urged to update and begin to implement individual drought contingency plans.
- **Drought Warning** is the second stage of drought. This stage is also declared by the NYSDEC and is a notice of impending and imminent severe drought conditions. A warning declaration includes stepping up public

awareness and increasing voluntary conservation. Public water supply purveyors and industries are urged to continue to implement local drought contingency plans. Federal, state, and local water resources agencies are notified to prepare for emergency response measures.

- **Drought Emergency** is the third stage of drought. This stage is declared by the NYSDHSES, based upon recommendation of the New York State Drought Management Task Force. It is a notice of existing severe and persistent drought conditions. An emergency declaration is a notice for local water resources agencies to mandate conservation and implement other emergency response measures. A continuing and worsening drought emergency may result in the the State governor declaring a drought disaster. It is a notice of the most severe and persistent drought conditions. At this stage, a significant proportion of communities in the impacted area may lack the capabilities to respond to a drought of this scale.

The State of New York uses two primary methodologies to determine the various drought stages. The Palmer Drought Severity Index (PDSI) is a commonly used drought indicator and is primarily based on soil conditions. These are typically the first indicators that a moisture deficit is present. These values range from negative five to positive five, where positive values indicate wetter conditions and negative values represent drier conditions (NYSDEC 2023).

The second methodology used by the State was developed by the NYSDEC and is referred to as the State Drought Index (SDI). The SDI evaluates drought conditions on a more comprehensive basis by measuring whether numerous indicators reach dire thresholds. The data collected is compared against critical threshold values to show a normal or changeable drought condition. The indicators are weighted on a regional basis to reflect the unique circumstances of each drought management region (NYSDEC 2023). It is through this SDI that New York State determines if various regions are experiencing the various levels of drought conditions detailed above.

The State of New York also tracks the Standardized Precipitation Evapotranspiration Index (SPEI) as an additional drought measurement tool. The SPEI, along with the PDSI, can be used to evaluate the levels of soil moisture and forecast potential impacts to agriculture within the State (NYSDEC 2023).

The PDSI and SPEI are monitored to help the State understand potential impacts of drought on agricultural conditions (NYSDEC 2023). For more information on the potential agricultural and environmental impacts of drought on Rockland County, refer to the Vulnerability Assessment later in this section.

Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, Rockland County was included in one major disaster (DR) or emergency (EM) declaration for drought-related events (FEMA 2023). There were no declarations that occurred between 2017 and 2023 for drought-related events. Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2017 and 2023, Rockland County was included in one drought-related agricultural disaster declarations. For declarations that occurred between 2017 and 2023, refer to Table 4.3.3-1.

Table 4.3.3-1. USDA Declarations for Drought Events in Rockland County (2017 to 2023)

Event Date	Event Type	USDA Declaration Number	Description
August 9, 2022	Drought	USDA S5306	Serious, widespread drought conditions affected the entire tri-state area, leading to mandatory water restrictions. Rockland County declared a Stage II Water Emergency due to drought. This event was caused by unprecedented flow levels in the Ramapo River that limited the use of a nearby reservoir, which is a significant source of water for Rockland County.

Sources: USDA 2023; NBC 2022

Previous Events

For this 2024 HMP update, known hazard events that impacted Rockland County between January 2017 and December 2023 are discussed in Table 4.3.3-2. For events prior to 2017, refer to the 2018 Rockland County HMP.

Table 4.3.3-2. Hazard Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
August 9, 2022	Drought	USDA S5306	Yes	Countywide	Serious, widespread drought conditions affected the entire tri-state area, leading to mandatory water restrictions. Rockland County declared a Stage II Water Emergency due to drought. This event was caused by unprecedented flow levels in the Ramapo River that limited the use of a nearby reservoir, which is a significant source of water for Rockland County.

Sources: USDA 2023; NBC 2022

Probability of Future Occurrences

For the 2024 HMP update, best available data was used to collect hazard event details. These details were used to calculate the probability of future occurrence of hazard events in the County. Information from the Drought Impact Reporter, the 2019 State of New York HMP, the 2018 Rockland County HMP, and FEMA were used to identify the number of events that occurred between 2010 and 2023. Table 4.3.3-3 provides the calculated probability of future drought events in Rockland County.

Table 4.3.3-3. Probability of Future Drought Events in Rockland County

Hazard Type	Number of Occurrences Between 2010 and 2023	Percent Chance of Occurring in Any Given Year
Drought	15	100 percent

Sources: Drought Impact Reporter 2023

Notes: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act, and selected drought events since 1968. Due to limitations in data, not all drought events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

In Section 4.4, the identified hazards of concern for Rockland County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for drought in the County is considered ‘occasional’.

Climate Change Projections

In New York, there is an expectation that droughts – specifically seasonal summer ones – could become more common because of climate change. By the end of the century, late-summer short-duration droughts may increase in the New York metropolitan region. It is less clear what impacts climate change will have on longer term “multi-year” droughts in the New York region, but climate change is likely to make at least some droughts more common. Climate change increases the potential for drought events, can make drought conditions more severe and lengthier, and accelerates the water cycle leading to secondary impacts such as drier soils, melting of polar ice, and increases occurrence of extreme weather events (World Economic Forum 2022). Since 1970, average annual temperatures in the State have increased by 0.6°F per decade (NYSERDA 2014).

The West Hudson River Valley, encompassing Rockland County, is expected to experience average temperatures increases 3.1°F to 6.9°F by the 2050s and 4.0°F to 10.7°F by the 2080s (baseline of 50.0°F). Precipitation totals will increase between 1 percent and 14 percent by the 2050s and 2 percent to 18 percent by the 2080s (baseline of 46.0 inches). Table 4.3.3-4 displays the projected seasonal precipitation change for the Catskill Mountains and West Hudson River Valley ClimAID Region (NYSERDA 2014).

Table 4.3.3-4. Projected Seasonal Precipitation Percent Change in Region 2 from Present to 2050s

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: NYSEDA 2014

In the West Hudson River Valley region, the number of days per year with maximum temperatures over 90 to 95° Fahrenheit and the total number of heat waves per year are expected to increase into the 2080s (NYSERDA 2014). These increases in temperature have the potential to worsen drought conditions, elevating the risk for adverse impacts for the County.

Table 4.3.3-5. Changes in Extreme Events in Region 2 – Heat Waves and Drought Conditions

Event Type	# Days Per Year	Baseline	2020s	2050s	2080s
Heat Waves	Number of Days per year with maximum temperature exceeding: minimum, (central range), and maximum				
	90°F	12 days	13 (14 to 24) 34	16 (22 to 40) 53	21 (28 to 65) 75
	Number of heat waves per year	2 events	2 (2 to 3) 5	2 (3 to 5) 7	3 (4 to 9) 10
	Average duration	4 days	4 (4 to 5) 5	5 (5 to 5) 6	5 (5 to 6) 8

Source: NYSEDA 2014

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. The following discusses Rockland County’s vulnerability, in a qualitative nature, to the drought hazard.

Impact on Life, Health, and Safety

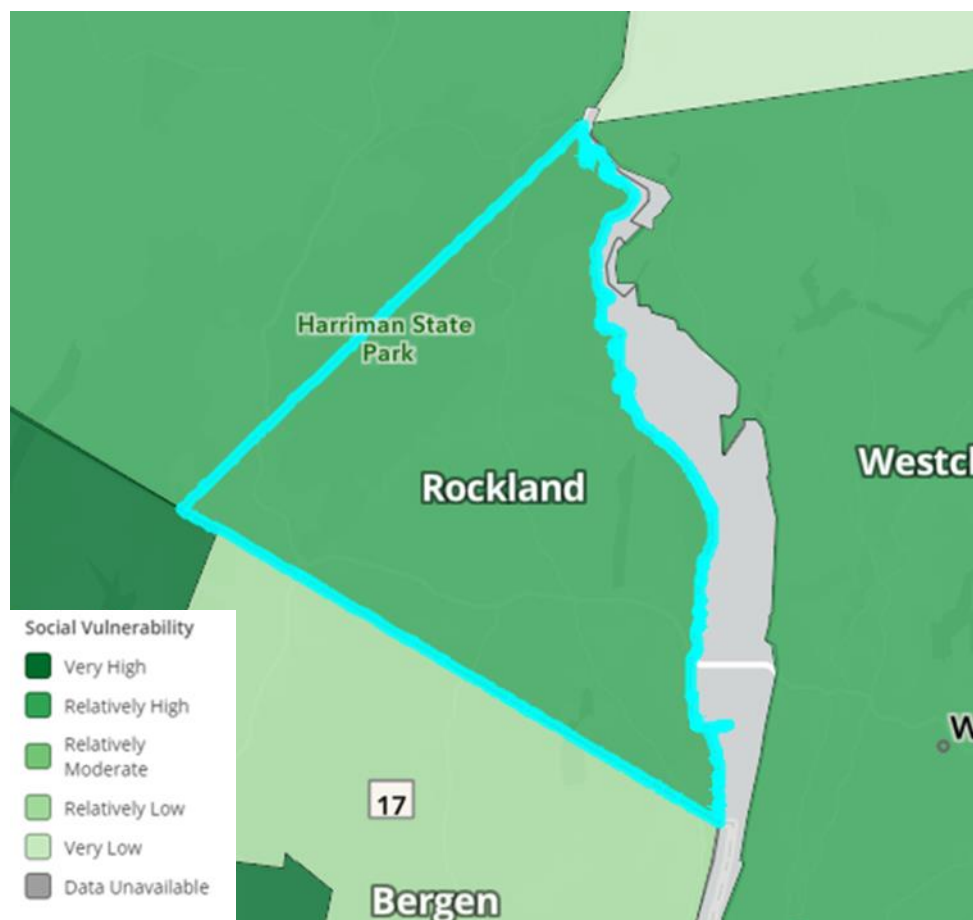
The entire population of Rockland County (461,860) is exposed to this hazard. Drought conditions can affect people’s health and safety, including health problems related to low water flows and poor water quality, and health problems related to dust. Droughts also can lead to loss of human life (NDMC 2013). Other possible impacts

on health from drought include increased recreational risks; effects on air quality; diminished living conditions related to energy, air quality, and sanitation and hygiene; compromised food and nutrition; and increased incidence of illness and disease. Health implications of drought are numerous. Some drought-related health effects are short-term while others can be long-term (CDC 2012).

Socially Vulnerable Population

Socially vulnerable populations are most susceptible to drought events based on several factors, including their physical and financial ability to react or respond during a drought. Vulnerable populations include homeless persons, elderly (over 65 years old), low income or linguistically isolated populations, people with life-threatening illnesses, and residents that may have limited access to water as is. The population over the age of 65 is also more vulnerable. They may require extra water supplies or need assistance to obtain water and are more likely to seek or need medical attention. According to the 2021 ACS, there are 49,451 total persons living below the poverty level, 52,060 persons over the age of 65 years, 27,605 persons under the age of five years, 26,990 non-English speakers, 29,008 persons with a disability, 49,451 living in poverty, and 109,704 living below ALICE in Rockland County. Figure 4.3.3-3 displays the FEMA National Risk Inventory's Social Vulnerability Index for Rockland County, which is identified as 'relatively high'.

Figure 4.3.3-3. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA n.d.

Impact on General Building Stock

A drought event is not expected to directly affect any structures. However, droughts contribute to conditions conducive to wildfires and reduce fire-fighting capabilities. Risk to life and property is greatest within those areas where forested areas adjoin urbanized areas (high-density residential, commercial, and industrial) or wildland urban interface (WUI).

Impact on Critical Facilities and Community Lifelines

Drought events generally do not impact buildings; however, droughts have the potential to impact agriculture-related facilities and critical facilities that are associated with water supplies such as potable water used with fire-fighting services.

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 stream flows are lowest.

Impact on the Economy

Drought can produce a range of impacts that span many economic sectors and can reach beyond an area experiencing physical drought. As previously discussed, water withdrawals are not only used for potable water but for use in the commercial/industrial/mining sectors and power generation.

One impact of drought is its impact on water supply. When drought conditions persist with little to no relief, water restrictions may be put into place by local or state governments. These restrictions may include placing limitations on when or how frequent lawns can be watered, car washing services, or any other recreational/commercial outdoor use of water supplies. In exceptional drought conditions, watering of lawns may not be an option (NC State University 2013).

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 within another area could impact the food supply and price of food for residents within the county.

Impact on the Environment

Drought can impact the environment because it can trigger wildfires, increase insect infestations, and exacerbate the spread of disease (NOAA 2000). Droughts will also 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 availability to sustain growth. As a result, these types of habitats can be negatively impacted after long periods of dryness.

Future Changes That May Impact Vulnerability

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

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Potential or Projected Development

Section 3 identifies areas targeted for future growth and development across the County. Any areas of growth located in the County could be susceptible to drought. Specific areas of recent and new development are indicated in tabular form and/or on the hazard maps included in Volume II, Section 9 (Annexes) of this plan.

Projected Changes in Population

Rockland County has experienced an increase in its population since 2010. According to the U.S. Census Bureau, the County's population increased by approximately 8.5 percent between 2010 and 2020 (County of Rockland 2021). Cornell University's Program on Applied Demographics projects Rockland County will have a population of 356,758 by 2030 and 372,432 by 2040 (Cornell University 2018). Changes in the density of the population can impact the number of persons exposed to drought and the draw upon water resources.

Other Identified Conditions

As mentioned previously, studies indicate that the State of New York is expected to observe a rise in average annual temperatures. Furthermore, there is a projected increase in the occurrence of droughts, which could impact the availability of water supplies and place added strain on the population and their access to clean drinking water. A decrease in water supply, or an increase in demand for water, may heighten the County's susceptibility to structural fires and wildfires. Consequently, it may be necessary for critical water-related service sectors to modify their management strategies and proactively allocate resources to adapt to forthcoming shifts.

Change of Vulnerability Since 2018 HMP

The total population across the County has increased since the last plan. This increase can place a greater stress on the water supply during a drought event.

4.3.4 Earthquake

Hazard Profile

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the earthquake hazard in Rockland County.

Hazard Description

An earthquake is a shaking of the Earth's surface by energy waves emitted by slow moving tectonic plates overcoming friction with one another underneath the Earth's surface, a volcanic eruption, or by a manmade explosion (FEMA 2023). 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. In the process of breaking, vibrations called “seismic waves” are generated. These waves travel outward from the source of the earthquake at varying speeds. Most earthquakes occur at the boundaries where the Earth’s tectonic plates meet (faults), whereas less than 10 percent occur within plate interiors.

Faults or Fault Lines

A fault (also known as a fault line) is a fracture or zone of fractures between two blocks of rock. Faults allow the blocks to move relative to each other. This movement may occur rapidly, in the form of an earthquake - or may occur slowly, in the form of creep (USGS 2023). 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.

Tectonic Plates

The State of New York is in an area where the rarer plate interior-related earthquakes occur. As plates continue to move and plate boundaries shift over time, weakened boundary regions become part of the interiors of the plates. These zones of weakness within the continents can cause earthquakes in response to stresses that originate at the edges of the plate or in the deeper crust (USGS 2016). As mentioned above, seismic waves are produced when some form of energy stored in Earth’s crust is suddenly released. This is usually when rock masses straining against one another suddenly fracture and slip.

Certain saturated soft soil can take on the characteristics of a fluid when shaken by an earthquake, resulting in a state called liquefaction. Amplified shaking also results in areas of “soft soils” which includes fill, loose sand, waterfront, and lakebed clays.

Seismic Zones

The term “Seismic Zone” is used to describe an area where earthquakes tend to focus. Seismic Zones slightly differ from “Seismic Hazard Zones” in that Seismic Hazard Zones describe areas with a particular level of hazard due to earthquakes (USGS n.d.). The U.S. Geological Survey (USGS) creates Seismic Hazard Maps that reflect these Seismic Zones and Seismic Hazard Zone data across the United States.

According to the U.S. Geological Survey (USGS) Earthquake Hazards Program, an earthquake hazard is any disruption associated with an earthquake that affects residents’ normal activities. The program defines seven different types of earthquake hazards (USGS n.d.) (CRMP 2021):

- **Surface faulting** is when a displacement reaches the Earth's surface during a slip along a fault. Commonly occurs with shallow earthquakes, which are those with an epicenter less than 20 kilometers.
- **Ground motion (shaking):** The movement of the Earth's surface from earthquakes or explosions. Ground motion or shaking is produced by waves that are generated by a sudden slip on a fault or sudden pressure at the explosive source and travel through the Earth and along its surface.
- **Landslide:** A movement of surface material down a slope.
- **Liquefaction:** A process by which water-saturated sediment temporarily loses strength and acts as a fluid, like the wet sand near the water at the beach. Earthquake shaking can cause this effect. Liquefaction susceptibility is determined by the geological history, depositional setting, and topographic position of the soil (USGS n.d.). Liquefaction effects may occur along the shorelines of the ocean, rivers, and lakes and they can also happen in low-lying areas away from water bodies in locations where the ground water is near the earth's surface.
- **Tectonic Deformation:** A change in the original shape of a material caused by stress and strain.
- **Tsunami:** A sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major sub-marine slides, or exploding volcanic islands.
- **Seiche:** The sloshing of a closed body of water, such as a lake or bay, from earthquake shaking (NOAA 2023).

Location

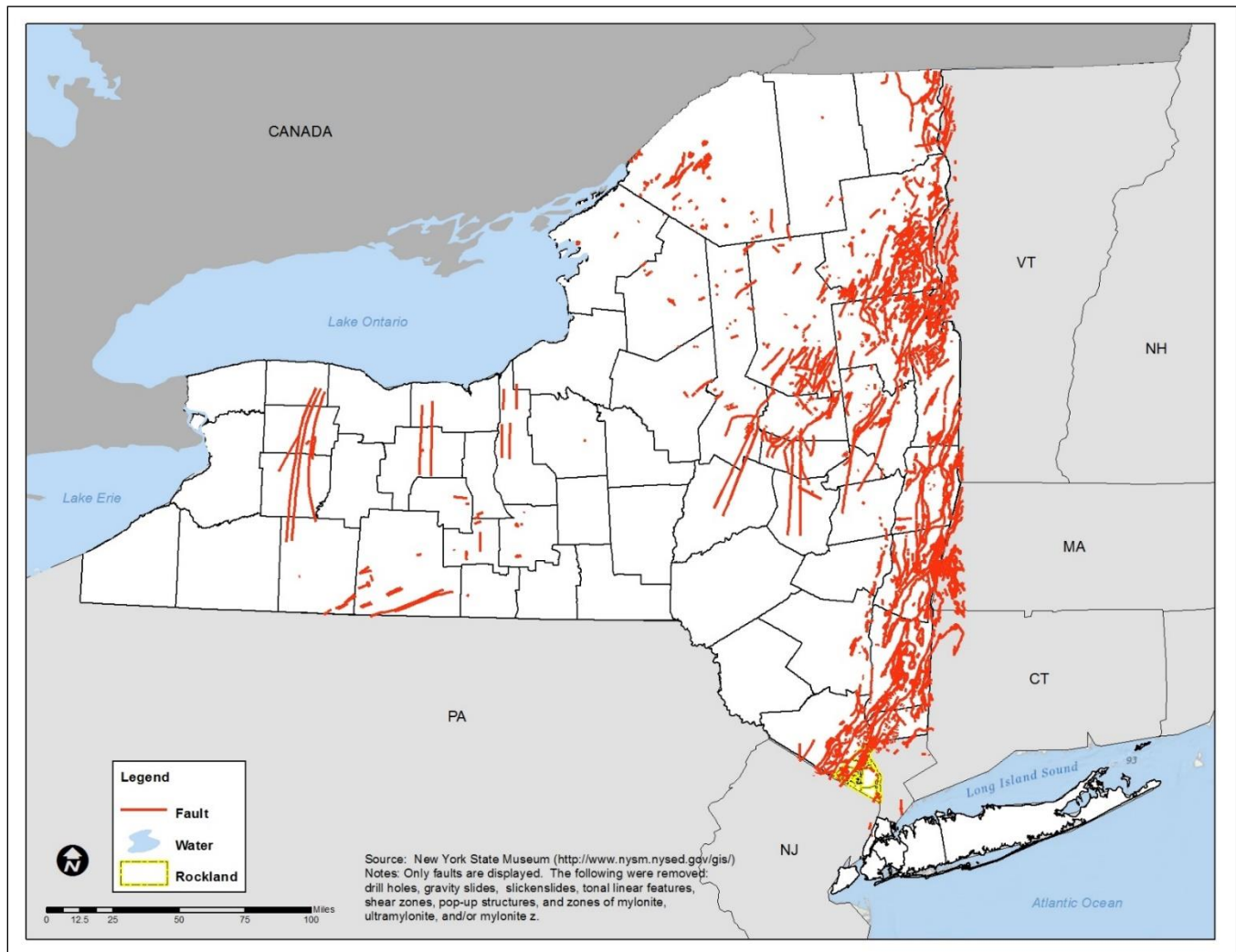
Though less common than other hazards (such as hurricanes or floods), earthquakes can occur throughout the State of New York and the Northeast (MitigateNY 2018). Rockland County has not been identified as an area with increased risk of earthquake events and according to multiple sources, Rockland County faces a low risk of earthquake events (ThinkHazard 2023). Rockland County is not located near any major or especially active fault lines, contributing to the low threat posed by earthquakes. Despite this low earthquake risk, several fault lines run through Rockland County and the surrounding area, as illustrated in Figure 4.3.4-1. No significant geological or topographical features of the County play a role in affecting local earthquake vulnerability.

The Ramapo Seismic Zone is one of the major known fault features that runs from eastern Pennsylvania to the mid-Hudson Valley. This system contains numerous smaller faults that include the 125th Street Fault in Manhattan, the Dyckman Street Fault, the Mosholu Parkway fault, and the Dobbs Ferry fault. The Lamont-Doherty Earth Observatory found evidence of an active seismic zone running at least 25 miles from Stamford, Connecticut to the Hudson Valley's Town of Peekskill (Westchester County), known as the Stamford-Peekskill line. Small clusters of earthquake events are found along the length of the line and to its immediate southwest. Just north of the line, there are no recorded earthquakes. The Stamford-Peekskill line runs parallel to the other faults beginning at 125th Street and researchers believe this fault is in the same family capable of producing at least a magnitude 6.0 earthquake. This fault also intersects the Ramapo seismic zone (USGS 2008).

The Ramapo Fault Line spans more than 185 miles in New York, New Jersey and Pennsylvania. It is one of the best-known fault zones in the mid-Atlantic region. The Ramapo Fault Line crosses the northern and western edge of Rockland County, running approximately parallel to its boundary with Orange County (Guglielmo 2010).

Figure 4.3.4-1 shows the location of the Ramapo and 125th Street fault lines and earthquakes that have occurred in the area.

Figure 4.3.4-1. Faults in Rockland County

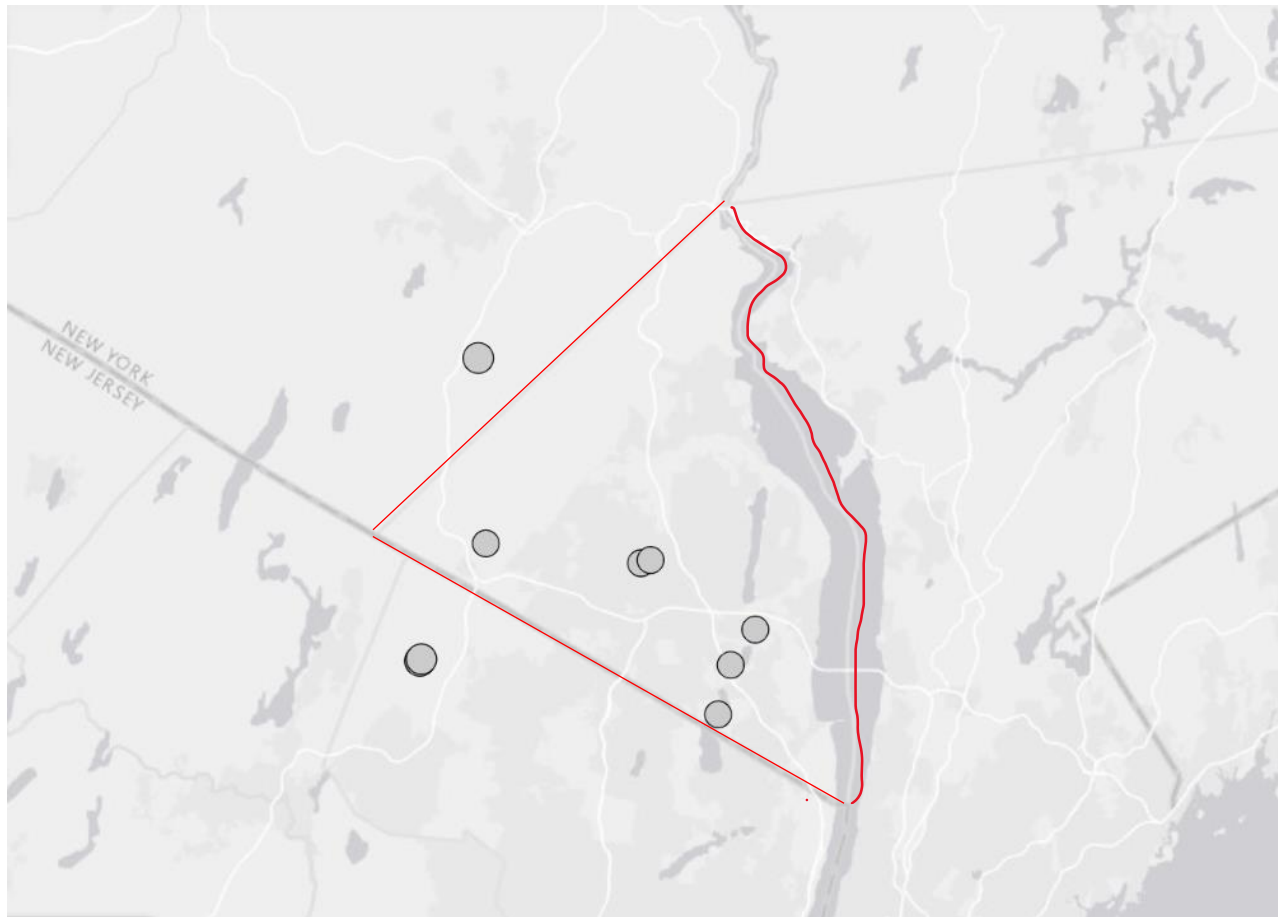


Source: New York State Museum 2023
 Note: Rockland County is outlined in yellow.

Figure 4.3.4-2 illustrates historic earthquake epicenters across the southeast region of the State and northern New Jersey between 1950 and 2023. According to this figure, there have been six earthquakes with epicenters in Rockland County (2005, two in 2006, 2018, and two in 2019).

Earthquake epicenters are not the only place at risk to damage during an event. Depending on the scale and type, earthquakes can affect areas far away from their epicenters. Some earthquakes originating outside of the State have had impacts in Rockland County. For details regarding these events between 2017 and 2023, refer to Figure 4.3.4-2.

Figure 4.3.4-2. Earthquake Epicenters in the Rockland County, 1950-2023



Source: USGS 2023

Note: Rockland County is outlined in red.

Figure 4.3.4-3 and Figure 4.3.4-4 show the Earthquake Risk Index for Rockland County on the county and census tract scales, respectively. This index helps to understand the susceptibility of the County to earthquakes. According to the National Risk Index, on the county scale, the County has a relatively low risk to earthquakes; on the census tract scale, the County ranges from a very low risk to a relatively low risk (FEMA 2019).

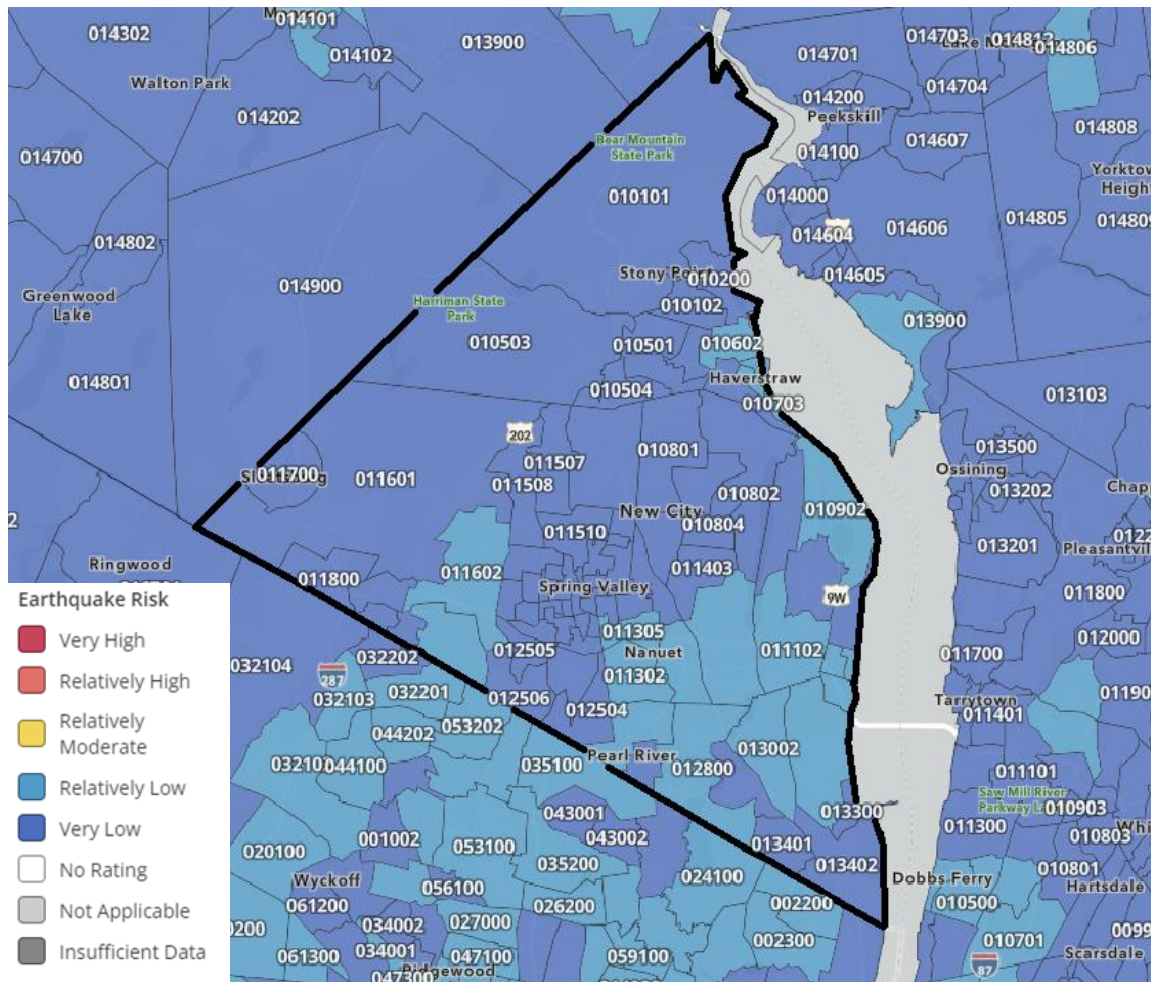
Figure 4.3.4-3. National Risk Index, Earthquake Risk Index Score Using the County Scale



Source: FEMA 2019

Note: Rockland is outlined in a bolded black border.

Figure 4.3.4-4. National Risk Index, Earthquake Index Score Using the Census Tract Scale



Source: FEMA 2019

Note: Rockland is outlined in a bolded black border.

Extent

An earthquake’s magnitude and intensity are used to describe the size and severity of the event. Magnitude describes the size at the focus of an earthquake. Intensity describes the overall severity of shaking felt during the event. The earthquake’s magnitude is a measure of the energy released at the source of the earthquake.

Magnitude is expressed by ratings on the Richter scale and/or the moment magnitude scale (MMS). The Richter Scale conveys the shaking felt by an event but does not measure damage (USGS 2023). Table 4.3.4-1. Richter Magnitude Scale presents the Richter scale magnitudes. The Richter Scale is no longer commonly used but is often referred to when discussed past events.

Table 4.3.4-1. Richter Magnitude Scale

Richter Magnitude	Earthquake Effects
2.5 or less	Usually not felt, but can be recorded by seismograph
2.5 or 5.4	Often felt, but causes only minor damage
5.5 or 6.0	Slight damage to buildings and other structures
6.1 or 6.9	May cause a lot of damage in very populated areas
7.0 or 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake, can totally destroy communities near the epicenter

Source: Michigan Tech 2023

The MMS has replaced the Richter Scale as a common measure of earthquake severity. The moment magnitude provides an estimate of earthquake size that is valid over the complete range of magnitudes, a characteristic that was lacking in other magnitude scales. For very large earthquakes, moment magnitude gives the most reliable estimate of earthquake size. Moment is a physical quantity proportional to the slip on the fault multiplied by the area of the fault surface that slips; it is related to the total energy released in the earthquake. The moment can be estimated from seismograms (and also from geodetic measurements). The moment is then converted into a number similar to other earthquake magnitudes by a standard formula. The result is called the moment magnitude (USGS n.d.).

Earthquake intensity is based on the observed effects of ground shaking on people, buildings, and natural features, and varies across affected locations. The Modified Mercalli (MMI) scale expresses how strong a shock was felt at a particular location in values. Table 4.3.4-2 summarizes earthquake intensity as expressed by the Modified Mercalli scale.

Peak ground elevation (PGA) measures how hard the earth shakes, or accelerates, in a given geographic area. PGA is expressed as a percent acceleration force of gravity (%g). For example, 10%g PGA means that the ground is accelerating at a rate that is 10% that of gravity (USGS 2019). Damage levels experienced in an earthquake vary with the intensity of ground shaking and with the seismic capacity of structures, as noted in Table 4.3.4-3.

Table 4.3.4-2. Modified Mercalli Intensity Scale

Mercalli Intensity	Shaking	Description
I	Not Felt	Not felt except by a very few under especially favorable conditions.
II	Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.

Mercalli Intensity	Shaking	Description
IX	Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Source: USGS 2023

Table 4.3.4-3. Damage Levels Experienced in Earthquakes (PGA)

Ground Motion Percentage	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.
< 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: USGS 2005

Note: %g: Peak Ground Acceleration (PGA)

Table 4.3.4-4. Modified Mercalli Intensity and PGA Equivalents

Modified Mercalli Intensity	Acceleration (%g) (PGA)	Perceived Shaking	Potential Damage
I	< .17	Not Felt	None
II	.17 – 1.4	Weak	None
III	.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	>124	Extreme	Very Heavy

Source: Freeman 2004

Note: PGA: Peak Ground Acceleration

Table 4.3.4-4 describes the MMI scale alongside PGA equivalents to provide a more holistic picture of earthquake extent as it relates to ground acceleration. Building construction, type of structure, building materials, and other factors will play a role in determining the extent of earthquake damage within the planning area.

The USGS updated the National Seismic Hazard Maps in 2022, which superseded the 2014 maps. New seismic, geologic, and geodetic information on earthquake rates and associated ground shaking were incorporated into these revised maps under the National Seismic Hazard Model. The 2022 map represents the best available data

as determined by the USGS. According to the data, Rockland County has a PGA between 3%g and 5%g (USGS 2014).

The New York State Geological Survey conducted seismic shear-wave tests of the State’s surficial geology (glacial deposits). Surficial materials are those at or near Earth’s surface and in the case of New York State, these come in the form of sediment (such as rock, soil, gravel, etc.) that are deposited by glaciers (UC Davis n.d.). Based on these test results, the surficial geologic materials of the State of New York were categorized according to the National Earthquake Hazard Reduction Program’s (NEHRP) Soil Site Classifications (Table 4.3.4-5). The NEHRP developed five soil classifications defined by their shear-wave velocity that impact the severity of an earthquake. The soil classification system ranges from A to E, as noted in Table 4.3.4-5, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses. Class E soils include water-saturated mud and artificial fill. The strongest amplification of shaking due is expected for this soil type. Seismic waves travel faster through hard rock than through softer rock and sediments. As the waves pass from harder to softer rocks, the waves slow down and their amplitude increases. Shaking tends to be stronger at locations with softer surface layers where seismic waves move more slowly. Ground motion above an unconsolidated landfill or soft soils can be more than 10 times stronger than at neighboring locations on rock for small ground motions (FEMA 2016).

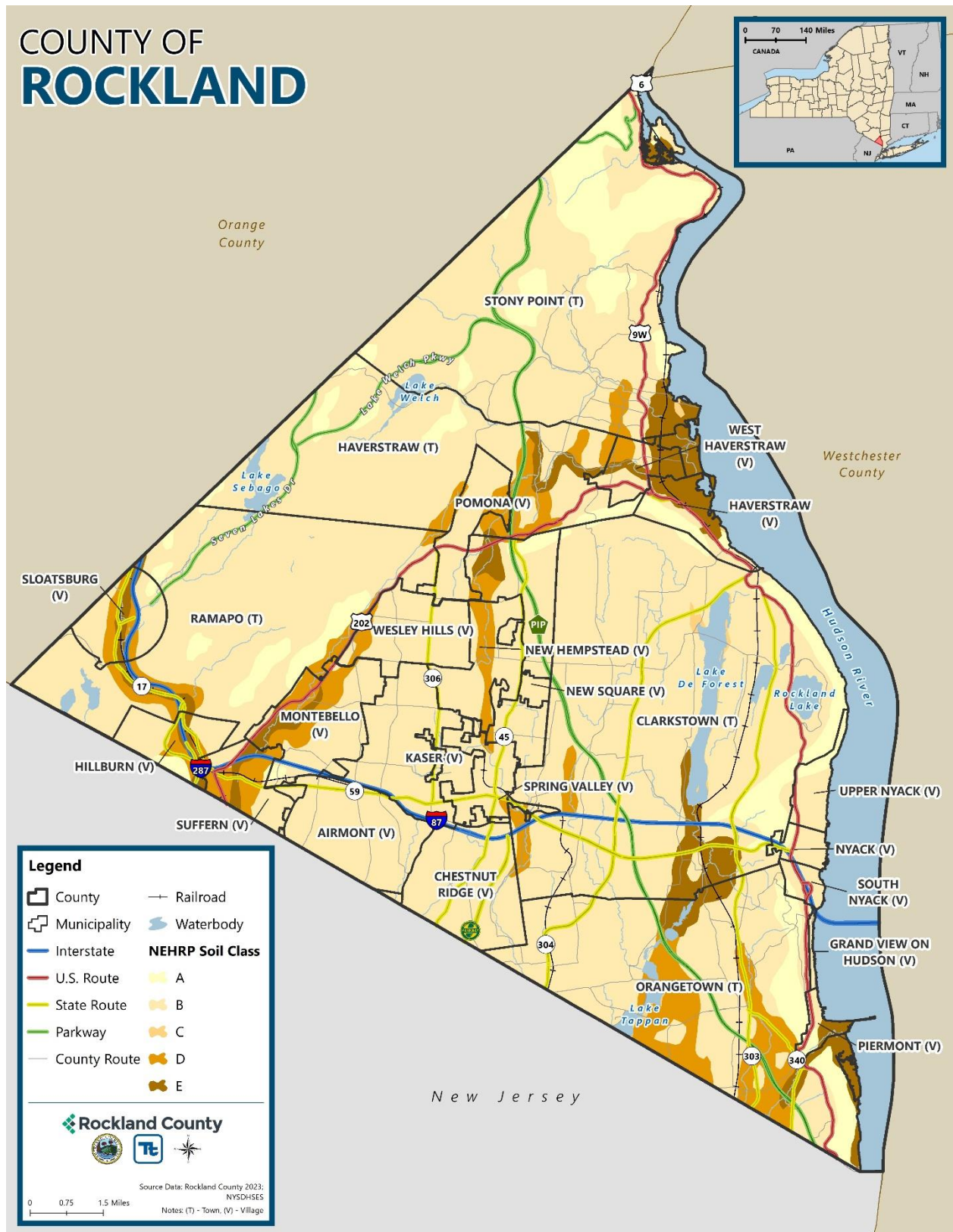
Table 4.3.4-5. NEHRP Soil Classifications

Soil Classification	Description
A	Hard Rock
B	Rock
C	Very dense soil and soft rock
D	Stiff soils
E	Soft soils

Source: FEMA 2016

Figure 4.3.4-5 illustrates the NEHRP soils located throughout Rockland County. The data was available from the NYS DHSES. The available NEHRP soils information is incorporated into the Hazus earthquake model for the risk assessment (discussed in further detail later in this section). According to this figure, Rockland County is predominately underlain by Type B soils.

Figure 4.3.4-5. NEHRP Soils in Rockland County



Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, Rockland County was not included in any major disaster (DR) or emergency (EM) declarations for earthquake-related events (FEMA 2023). For other earthquake events that occurred between 2017 and 2023, refer to Table 4.3.4-6.

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2018 and 2023, Rockland County was not included in any earthquake-related agricultural disaster declarations.

Previous Events

For this 2024 HMP update, known hazard events that impacted Rockland County between January 2017 and December 2023 are discussed in Table 4.3.4-6. For events prior to 2017, refer to the 2018 Rockland County HMP.

Table 4.3.4-6. Hazard Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
November 4, 2019	Earthquake	N/A	N/A	Hillcrest, New York	A magnitude 1.6 earthquake was recorded in Hillcrest, New York. No damages or injuries were reported in this incident.
December 25, 2019	Earthquake	N/A	N/A	Near the New York Thruway in West Nyack, New York	A 1.1 magnitude earthquake was recorded on the Hackensack River near the New York Thruway. The depth of this earthquake was 1.9 miles, and no damage or injuries were reported.
May 25, 2018	Earthquake	N/A	N/A	Hillcrest, New York	A magnitude 1.8 earthquake was recorded in Hillcrest, New York. No damages or injuries were reported an only very weak shaking was experienced by residents.

Sources: USGS 2023

Probability of Future Occurrences

The State of New York intersects with fault lines, but none of which are considered seismically active. Still, earthquake events can impact the region. While the probability of a strong earthquake occurring is moderate, the risk is heightened because of the interdependencies of critical infrastructure systems and the age of New York’s built environment (MitigateNY 2018). Rockland County could experience indirect impacts from earthquakes that may affect the general building stock, local economy and may induce secondary hazards such ignite fires and cause utility failure.

For the 2024 HMP update, best available data was used to collect hazard event details. These details were used to calculate the probability of future occurrence of hazard events in the County. Information from NOAA, FEMA, and USGS were used to identify the number of events that occurred between 1954 and 2023. Table 4.3.4-7 provides the calculated probability of future earthquake events in Rockland County.

Table 4.3.4-7. Probability of Future Earthquake Events in Rockland County

Hazard Type	Number of Occurrences Between 1954 and 2023	Percent Chance of Occurring in Any Given Year
Earthquake	11	15.71%

Sources: FEMA 2023; FEMA 2023; NOAA 2023; USGS 2023

Notes: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act, and selected earthquake events since 1968. Due to limitations in data, not all earthquake events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

In Section 4.4, the identified hazards of concern for Rockland County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for earthquake in the County is considered ‘rare’

Climate Change Projections

The impacts of global climate change on earthquake probability are still being studied, but earthquakes are known to be affected by climate to some extent. 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. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could experience liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts. Rockland County is expected to experience extreme rises in temperature, increases in precipitation, and increases in sea level rise (NYSERDA 2014). It is unknown how the changing climate in the State of New York and across the country may affect the severity or impacts of earthquake events.

Fracking is another consideration regarding earthquakes. While the State of New York has a low risk of an earthquake event, its neighboring state, the Commonwealth of Pennsylvania, reported its first fracking-related quake in April 2016. Although the State of New York is not participating in fracking activities, it is unclear how to measure the risk of induced earthquake activity due to proximity of activity in surrounding states. Coupled with climate change impacts, the County could potentially face elevated risks related to earthquakes.

Vulnerability Assessment

To assess Rockland County’s risk to the earthquake hazard, an exposure analysis was conducted for the County’s assets (population, building stock, critical facilities, historic assets, and new development) using the NEHRP soil data. Assets with their centroid areas containing NEHRP Soil Classes Type D and Type E, which are the most susceptible soil type to seismic activity, were totaled to estimate the County’s vulnerability to earthquakes.

Impact on Life, Health, and Safety

The degree to which Rockland County residents are affected by potential earthquakes depends on many factors including the age and type of construction people live in, the soil type homes are located on, and the intensity of the earthquake. Whether directly or indirectly impacted, residents could be faced with business closures, road closures that could isolate populations, and loss of function of critical facilities and utilities.

Overall Population

Overall, risk to public safety and loss of life from an earthquake in the County is minimal for low magnitude events. However, there is a higher risk to public safety for those inside buildings due to structural damage or people walking below building ornamentalations and chimneys that may be shaken loose and fall because of an earthquake. Table 4.3.4-8 presents the estimated population located within the NEHRP Soils Class D and E Hazard Areas. As shown, there are 56,116 persons located within the NEHRP Soils Class D and E Hazard Areas; the Village of Haverstraw has the greatest population in the dam inundation area with 10,160 persons (82.7 percent of total population exposed).

Table 4.3.4-8. Estimated Population Located Within the NEHRP Soils Class D and E Hazard Areas

Jurisdiction	Total Population	Estimated Population Located Within the NEHRP Soils Class D and E Hazard Areas	
		Population	Percent of Total
Airmont, Village of	9,964	0	0.0%
Chestnut Ridge, Village of	10,211	75	0.7%
Clarkstown, Town of	81,385	3,173	3.9%
Grand View on Hudson, Village of	241	0	0.0%
Haverstraw, Town of	14,028	7,232	51.6%
Haverstraw, Village of	12,292	10,160	82.7%
Hillburn, Village of	1,110	838	75.5%
Kaser, Village of	5,433	0	0.0%
Montebello, Village of	4,665	2,426	52.0%
New Hempstead, Village of	5,440	1,131	20.8%
New Square, Village of	9,433	0	0.0%
Nyack, Village of	7,303	0	0.0%
Orangetown, Town of	36,127	7,119	19.7%
Piermont, Village of	2,525	958	37.9%
Pomona, Village of	3,306	585	17.7%
Ramapo, Town of	48,846	1,799	3.7%
Sloatsburg, Village of	3,043	1,866	61.3%
South Nyack, Village of	2,803	0	0.0%
Spring Valley, Village of	32,953	1,994	6.1%
Stony Point, Town of	14,876	2,572	17.3%
Suffern, Village of	11,376	8,367	73.5%
Upper Nyack, Village of	2,355	0	0.0%
Wesley Hills, Village of	6,105	356	5.8%
West Haverstraw, Village of	10,665	5,465	51.2%
Rockland County (Total)	336,485	56,116	16.7%

Source: U.S. Census Bureau, American Community Survey 5-year estimates 2017-2021; NYSDHSES

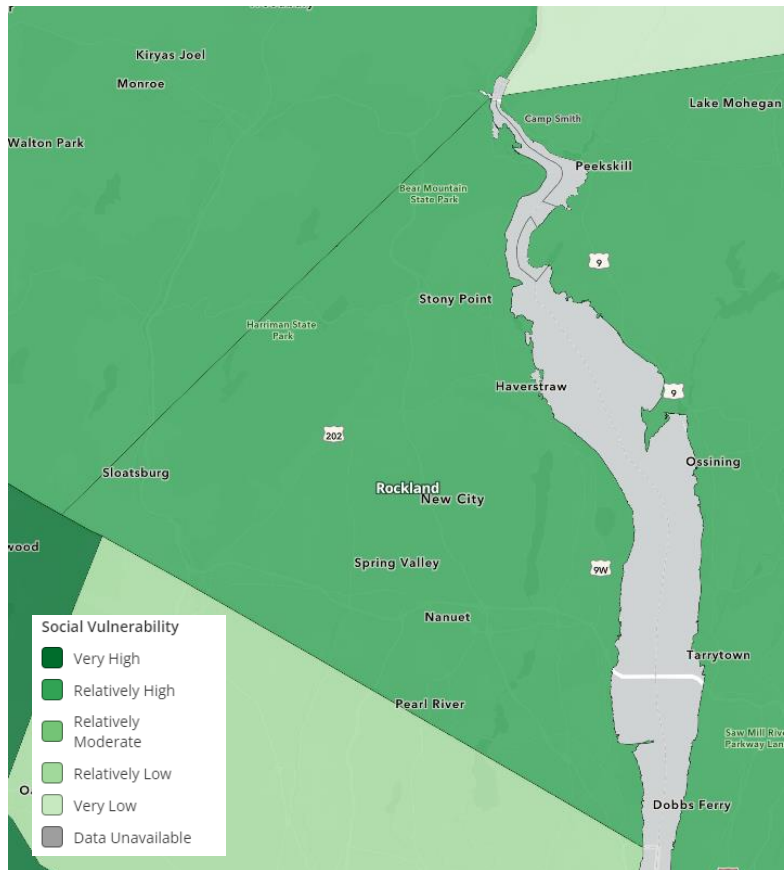
Notes: Values are rounded down

Socially Vulnerable Population

Populations considered most vulnerable to earthquake events are those located in/near the built environment, particularly those near unreinforced masonry construction. Of these most vulnerable populations, socially vulnerable populations, including the elderly (persons over age 65) and individuals living below the poverty threshold, are most susceptible. Factors leading to this higher susceptibility include decreased mobility and

financial ability to react or respond during a hazard, and the location and construction quality of their housing. Refer to Table 4.3.4-9 for details on the total number of vulnerable persons living in areas of Class D and E soils. Figure 4.3.4-6 shows the social vulnerability index for the earthquake hazard, based on FEMA’s National Risk Index.

Figure 4.3.4-6. FEMA Social Vulnerability Index for Earthquake



Source: FEMA n.d.

Table 4.3.4-9. Estimated Vulnerable Persons Located Within the NEHRP Soils Class D and E Hazard Areas

Jurisdiction	Estimated Vulnerable Persons Located Within the NEHRP Soils Class D and E Hazard Areas											
	Over 65	Percent of Total	Under 5	Percent of Total	Non-English Speaking	Percent of Total	Disability	Percent of Total	Poverty Level	Percent of Total	Living Below ALICE	Percent of Total
Airmont, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Chestnut Ridge, Village of	11	0.7%	10	0.7%	4	0.6%	8	0.7%	14	0.7%	14	0.7%
Clarkstown, Town of	653	3.9%	145	3.9%	165	3.9%	314	3.9%	138	3.9%	886	3.9%
Grand View on Hudson, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Haverstraw, Town of	1,300	51.5%	563	51.5%	513	51.5%	633	51.5%	729	51.6%	2,589	51.5%
Haverstraw, Village of	1,342	82.6%	729	82.7%	1,690	82.6%	1,239	82.6%	1,484	82.6%	3,861	82.7%
Hillburn, Village of	121	75.2%	86	75.4%	36	75.0%	109	75.2%	116	75.3%	273	75.5%
Kaser, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Montebello, Village of	292	51.9%	100	51.8%	85	51.5%	157	51.8%	268	51.9%	305	51.9%
New Hempstead, Village of	169	20.7%	53	20.5%	13	20.0%	79	20.6%	25	20.7%	91	20.7%
New Square, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Nyack, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Orangetown, Town of	1,362	19.7%	355	19.7%	208	19.7%	697	19.7%	320	19.7%	2,483	19.7%
Piermont, Village of	204	37.8%	53	37.6%	53	37.3%	68	37.6%	18	37.5%	460	37.9%
Pomona, Village of	108	17.6%	43	17.5%	20	17.2%	51	17.4%	19	17.1%	92	17.7%
Ramapo, Town of	173	3.7%	264	3.7%	46	3.6%	89	3.7%	596	3.7%	696	3.7%
Sloatsburg, Village of	314	61.2%	122	61.0%	41	60.3%	233	61.3%	101	60.8%	881	61.3%
South Nyack, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Spring Valley, Village of	192	6.0%	225	6.0%	586	6.0%	166	6.0%	481	6.0%	810	6.1%
Stony Point, Town of	458	17.3%	102	17.2%	45	17.0%	279	17.2%	115	17.2%	759	17.3%
Suffern, Village of	1,703	73.5%	360	73.5%	636	73.4%	809	73.5%	519	73.5%	4,007	73.5%
Upper Nyack, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Wesley Hills, Village of	50	5.8%	36	5.8%	0	0.0%	23	5.7%	29	5.7%	58	5.8%
West Haverstraw, Village of	659	51.2%	483	51.2%	852	51.2%	507	51.2%	701	51.2%	2,300	51.2%
Rockland County (Total)	9,111	17.5%	3,729	13.5%	4,993	18.5%	5,461	18.8%	5,673	11.5%	20,565	18.7%

Source: U.S. Census Bureau, American Community Survey 5-year estimates 2017-2021; NYSDHSES

Notes: Values are Rounded Down

Impact on General Building Stock

Buildings located in areas of Class D or Class E soils are more susceptible to earthquake impacts. The potential damage is the modeled loss that could occur to the exposed inventory measured by the structural and content replacement cost value. There are an estimated 19,585 buildings within the NEHRP Soils Class D and E Hazard Areas, representing approximately 23.3 percent of the County’s total general building stock inventory replacement cost value. The Town of Orangetown has the greatest number of its buildings located in areas of Class D and E soils (3,952 buildings or 21.4 percent of its total building stock). Refer to Table 4.3.4-10 for the estimated exposure of the dam inundation area by jurisdiction.

Table 4.3.4-10. Estimated Number and Total Replacement Cost Value of Structures Located in the NEHRP Soils Class D and E Hazard Areas

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Number and Total Replacement Cost Value of Structures Located in the NEHRP Soils Class D and E Hazard Areas			
			Number of Buildings in the NEHRP Soils Class D and E Hazard Areas	Percent of Total	Total Replacement Cost Value of Buildings Located in the NEHRP Soils Class D and E Hazard Areas	Percent of Total
Airmont, Village of	4,324	\$2,712,726,498	0	0.0%	\$0	0.0%
Chestnut Ridge, Village of	3,996	\$2,590,102,202	28	0.7%	\$13,598,906	0.5%
Clarkstown, Town of	34,094	\$22,578,694,610	1,399	4.1%	\$1,051,050,770	4.7%
Grand View on Hudson, Village of	219	\$123,746,894	0	0.0%	\$0	0.0%
Haverstraw, Town of	5,157	\$14,687,792,118	2,587	50.2%	\$9,200,052,872	62.6%
Haverstraw, Village of	2,232	\$1,373,775,543	1,787	80.1%	\$1,109,936,463	80.8%
Hillburn, Village of	499	\$340,797,550	379	76.0%	\$281,044,131	82.5%
Kaser, Village of	197	\$434,976,786	0	0.0%	\$0	0.0%
Montebello, Village of	2,002	\$1,957,771,278	1,014	50.6%	\$647,441,315	33.1%
New Hempstead, Village of	2,074	\$1,416,579,766	477	23.0%	\$324,216,662	22.9%
New Square, Village of	455	\$640,979,013	0	0.0%	\$0	0.0%
Nyack, Village of	1,830	\$1,930,474,072	0	0.0%	\$0	0.0%
Orangetown, Town of	18,439	\$19,240,363,073	3,952	21.4%	\$4,599,187,535	23.9%
Piermont, Village of	841	\$520,681,014	334	39.7%	\$215,999,239	41.5%
Pomona, Village of	1,437	\$947,429,629	258	18.0%	\$233,536,228	24.6%
Ramapo, Town of	9,783	\$7,401,302,608	403	4.1%	\$467,333,659	6.3%
Sloatsburg, Village of	1,776	\$780,218,848	1,113	62.7%	\$486,241,784	62.3%
South Nyack, Village of	1,009	\$628,994,780	0	0.0%	\$0	0.0%
Spring Valley, Village of	3,468	\$2,977,580,954	229	6.6%	\$241,728,972	8.1%
Stony Point, Town of	8,819	\$4,492,546,145	1,534	17.4%	\$771,098,825	17.2%
Suffern, Village of	3,110	\$2,011,976,760	2,314	74.4%	\$1,281,373,559	63.7%
Upper Nyack, Village of	1,121	\$714,087,836	0	0.0%	\$0	0.0%
Wesley Hills, Village of	2,432	\$1,597,464,375	143	5.9%	\$98,594,574	6.2%
West Haverstraw, Village of	3,171	\$1,575,031,545	1,634	51.5%	\$833,370,298	52.9%
Rockland County (Total)	112,485	\$93,676,093,896	19,585	17.4%	\$21,855,805,791	23.3%

Source: Rockland County, NYS Office of Information Technology Services Geospatial Services and NYS Department of Taxation and Finance’s Office of Real Property Tax Services (ORPTS) 2022; Center for International Earth Science Information Network, New York State Energy Research and Development Authority 2022; U.S. Army Corps of Engineers, National Structure Inventory 2022; RS Means 2022; NYSDHSES

National maps of earthquake shaking hazards have been produced since 1948, providing crucial information for the development and maintenance of seismic design requirements in building codes, insurance policies,

earthquake loss assessments, retrofitting prioritization, and land use planning in the United States. These maps are continuously updated by scientists to incorporate new insights and data. Structures constructed in compliance with modern seismic design standards, such as buildings, bridges, highways, and utilities, are better equipped to endure earthquakes with minimal damage and disruption. Professional engineering organizations review the latest studies to update seismic-risk maps and design standards in building codes (USGS 2008).

Impact on Critical Facilities and Community Lifelines

Critical facilities and community lifelines located in areas of Class D or Class E soils are more susceptible to earthquake impacts. Table 4.3.4-11 summarizes the number of community lifelines exposed to the earthquake hazard. In total, 216 lifelines (22 percent of the total number of lifelines) are vulnerable to earthquakes. Of the 216 community lifelines located in the earthquake hazard area, Safety and Security has the majority of facilities (73 or 33.8 percent of lifelines exposed). Refer to subsection “Critical Facilities and Lifelines” in Section 3 (County Profile) of this HMP for a complete inventory of critical facilities in Rockland County.

Table 4.3.4-11. Number of Lifelines Located in the NEHRP Soils Class D and E Hazard Areas

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines Located in the NEHRP Soils Class D and E Hazard Areas	Percent of Lifelines Exposed
Communications	154	32	14.8%
Energy	0	0	0%
Food, Water, Shelter	71	16	7.4%
Hazardous Material	56	18	8.3%
Health and Medical	195	30	13.9%
Safety and Security	349	73	33.8%
Transportation	8	3	1.4%
Water Systems	148	44	20.4%
Rockland County (Total)	981	216	100%

Impact on the Economy

Earthquakes also have impacts on the economy, including loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair/replacement of buildings. Hazus estimates building-related economic losses, including income losses (wage, rental, relocation, and capital-related losses) and capital stock losses (structural, non-structural, content, and inventory losses).

This analysis did not include damage estimates for individual roadway segments and railroad tracks, but it is assumed these features would sustain damage due to ground failure, resulting in interruptions of regional transportation and of distribution of materials.

Earthquake events can also significantly affect bridges, many of which provide the only access to certain neighborhoods. Because softer soils generally follow floodplain boundaries, bridges that cross watercourses should be considered vulnerable. Another key factor in degree of vulnerability is age of facilities and infrastructure, which correlates with building standards in place at times of construction.

Impact on the Environment

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 is one of the major seismic components to earthquakes that can create wide ruptures in the ground. Ruptures can have a direct impact on the landscape and natural environment because it can disconnect habitats for miles isolating animal species or tear 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 rather than a solid increasing risk of localized flooding and deposition or accumulation of silt (USGS n.d.).

Future Changes That May Impact Vulnerability

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

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Potential or Projected Development

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

Projected Changes in Population

Rockland County has experienced an increase in its population since 2010. According to the U.S. Census Bureau, the County's population increased by approximately 8.5 percent between 2010 and 2020 (County of Rockland 2021). Cornell University's Program on Applied Demographics project Rockland County will have a population of 356,758 by 2030 and 372,432 by 2040 (Cornell University 2018).

Persons that move into older buildings may increase their overall vulnerability to earthquakes. As noted earlier, if moving into new construction, current building codes require seismic provisions that should render new construction less vulnerable to seismic impacts.

Other Identified Conditions

Because the impacts of climate change on earthquakes are not well understood, a change in the County's vulnerability as the climate continues to change is difficult to determine. However, climate change has the potential to magnify secondary impacts of earthquakes. As a result of the climate change projections discussed

above, County's assets located on 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.

Change of Vulnerability Since 2018 HMP

Overall, the entire County remains vulnerable to earthquakes. For the 2024 HMP, the building inventory was updated using RS Means 2022 values, which is more current and reflects replacement cost versus the building stock improvement values reported in the 2018 HMP. Additional building stock updates include updates to the critical facility inventory provided by Rockland County. Updated hazard areas were used as well; since the 2018 HMP, an updated version of Hazus-MH was released. This updated model includes longer historical records to pull from to generate probabilistic events.

4.3.5 Extreme Temperature

Hazard Profile

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the extreme temperature hazard in Rockland County.

Hazard Description

Extreme temperature includes both heat and cold events, which can adversely affect human health and the economy, as well as cause primary and secondary effects on infrastructure (such as burst pipes and power failure). What constitutes “extreme cold” or “extreme heat” can vary across different areas of the country, based on the typical climate and seasonal patterns.

Extreme Cold

Extreme cold events occur when temperatures drop well below normal in an area. For example, near-freezing temperatures are considered “extreme cold” in regions relatively unaccustomed to winter weather. Conversely, “extreme cold” might be used to describe temperatures below 0° F in regions that are subjected to temperatures below freezing on more of a regular basis.

For the purposes of this HMP, extreme cold temperatures refer to when the ambient air temperature drops to approximately 0 degrees Fahrenheit (°F) or below (NWS n.d.). Prolonged exposure to extreme cold temperatures can cause frostbite or hypothermia and become life-threatening. These conditions are described as the following:

- **Frostbite** is damage to body tissue caused by extreme cold. A wind chill of negative 20°F will cause frostbite in just 30 minutes. Frostbite can cause a loss of feeling and a white or pale appearance in extremities.
- **Hypothermia** is a condition brought on when the body temperature drops to less than 95°F, and it can be deadly. Warning signs of hypothermia include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness, and apparent exhaustion.

Extreme 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). Infants and the elderly are most susceptible to the effects of extreme changes in temperatures and are particularly at risk, but anyone can be affected (CDC 2012).

In the State of New York, extreme cold days are defined to reflect the State's regional climate variations. Extreme cold days in the State are individual days with minimum temperatures at or below 32° F or individual days with minimum temperatures at or below 0°F (NYSERDA 2014).

Extreme Heat

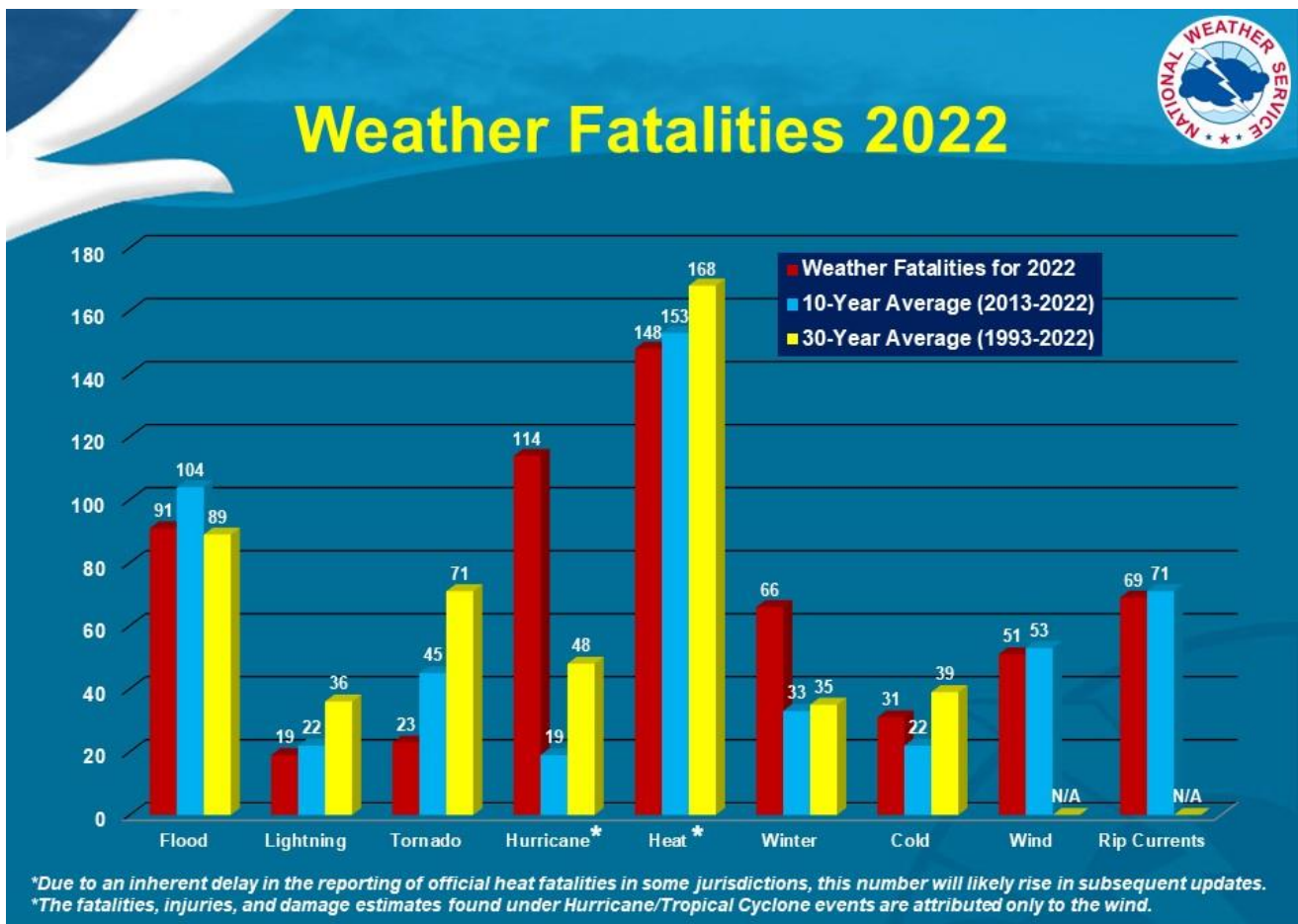
Extreme heat is defined as temperatures that are at least 10 degrees above the average high temperature for a region and that last for several weeks (CDC 2012). Humid or muggy conditions occur when a high atmospheric pressure effectively forms a dome near the ground that traps hazy, damp air. A heat wave is a period of abnormally hot and humid weather. A heat wave will typically last two or more days (NOAA 2009).

Extreme hot days in the State of New York are defined as individual days with maximum temperatures at or above 90°F or 95°F. Heat waves are defined as three consecutive days with maximum temperatures above 90°F (NYSERDA 2014).

Depending on severity, duration, and location, extreme heat events can trigger secondary hazards including, but not limited to, dust storms, droughts, wildfires, water shortages, and power outages. These secondary hazards could result in broad and far-reaching impacts throughout an entire region. Impacts could include significant loss of life and illness; economic costs in transportation, agriculture, production, energy, and infrastructure; and losses of ecosystems, wildlife habitats, and water resources (NYS DHSES 2019).

Extreme heat is the number one weather-related cause of death in the nation. On average, nearly 150 people die each year from excessive heat in the US (NWS 2021). Figure 4.3.5-1 shows the number of weather fatalities based on a 10-year average and a 30-year average. Extreme heat caused the highest average of weather-related fatalities between 1993 and 2022 (NWS 2021).

Figure 4.3.5-1. Average Number of Weather-Related Fatalities in the U.S.



Source: NWS 2021

Location

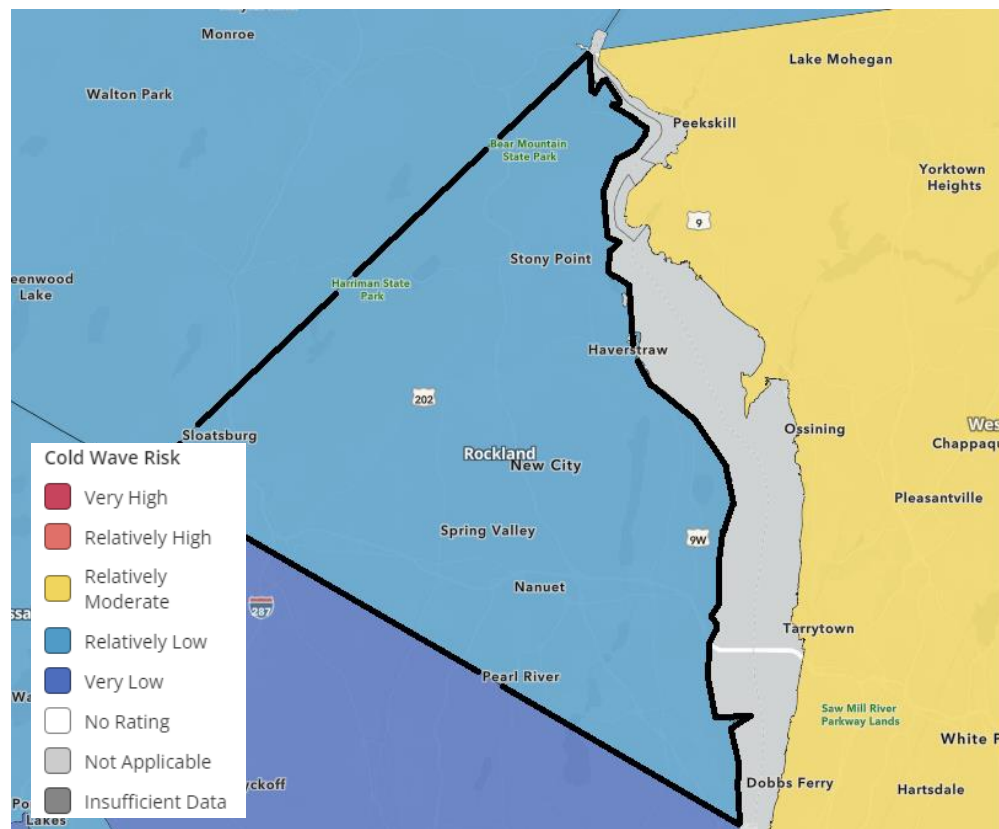
Rockland County is susceptible to both extreme cold and extreme heat temperature events. Extreme temperatures are a function of varying land elevation, topography, and proximity to water bodies, among other factors.

Extreme Cold

Extreme cold temperatures occur throughout most of the winter season and generally accompany most winter storm events throughout the state. Extensive periods of extreme cold result when great high-pressure systems move into and through the eastern US. Combined with the presence of Arctic air masses, high atmospheric pressure can cause extreme cold conditions to over the State of New York. These conditions typically manifest when arctic air masses under high atmospheric pressure move southward from central Canada or the Hudson Bay, making the State’s location in the northeast highly susceptible to extreme cold (NYS DHSES 2019, Cornell University n.d.).

Figure 4.3.5-2 and Figure 4.3.5-3 show the Cold Wave, or cold temperatures, Risk Index for Rockland County on the county and census tract scales, respectively. This index helps to understand the susceptibility of the County to cold temperatures. According to the National Risk Index, on the county scale, the County has a relatively low risk to cold temperatures; on the census tract scale, the County ranges from a very low risk to a relatively low risk (FEMA 2019).

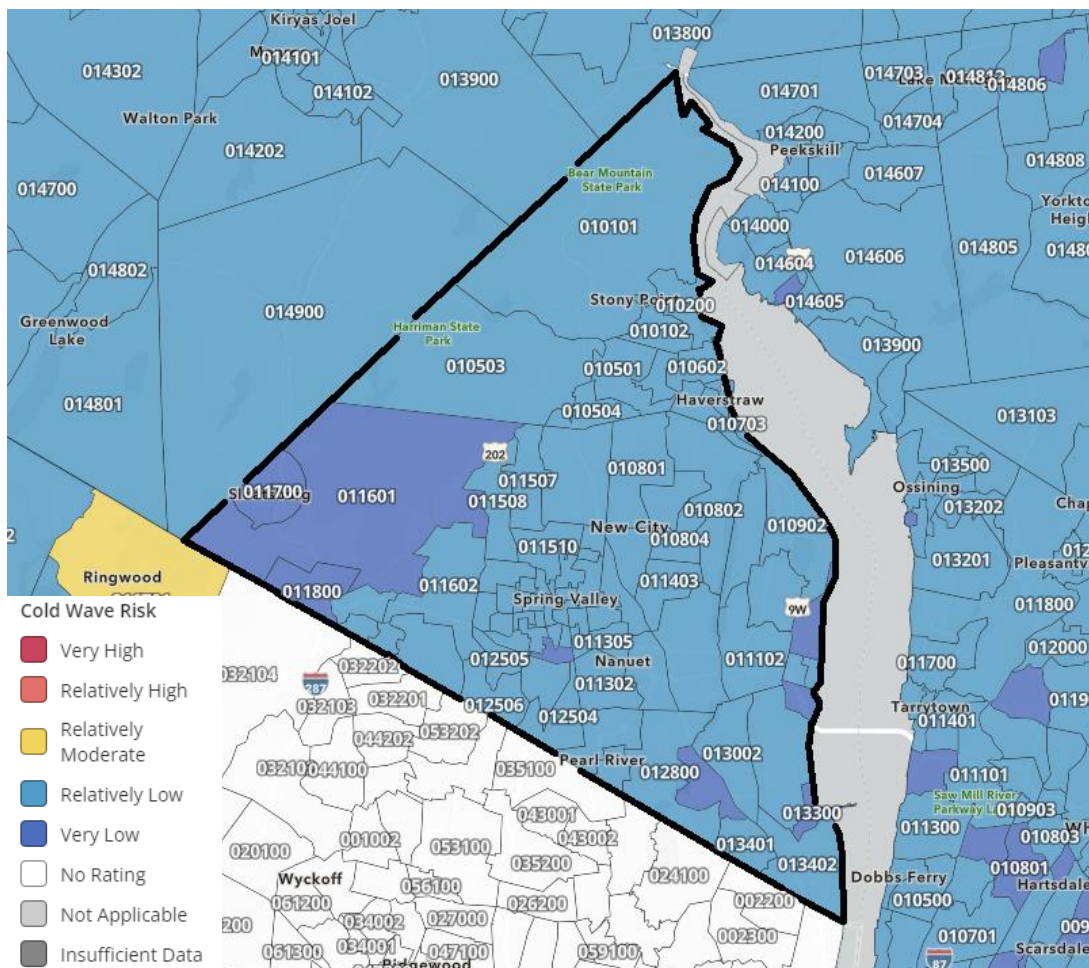
Figure 4.3.5-2. National Risk Index, Cold Wave Risk Index Score Using the County Scale



Source: FEMA 2019

Note: Rockland is outlined in a boldened black border.

Figure 4.3.5-3. National Risk Index, Cold Wave Index Score Using the Census Tract Scale



Source: FEMA 2019

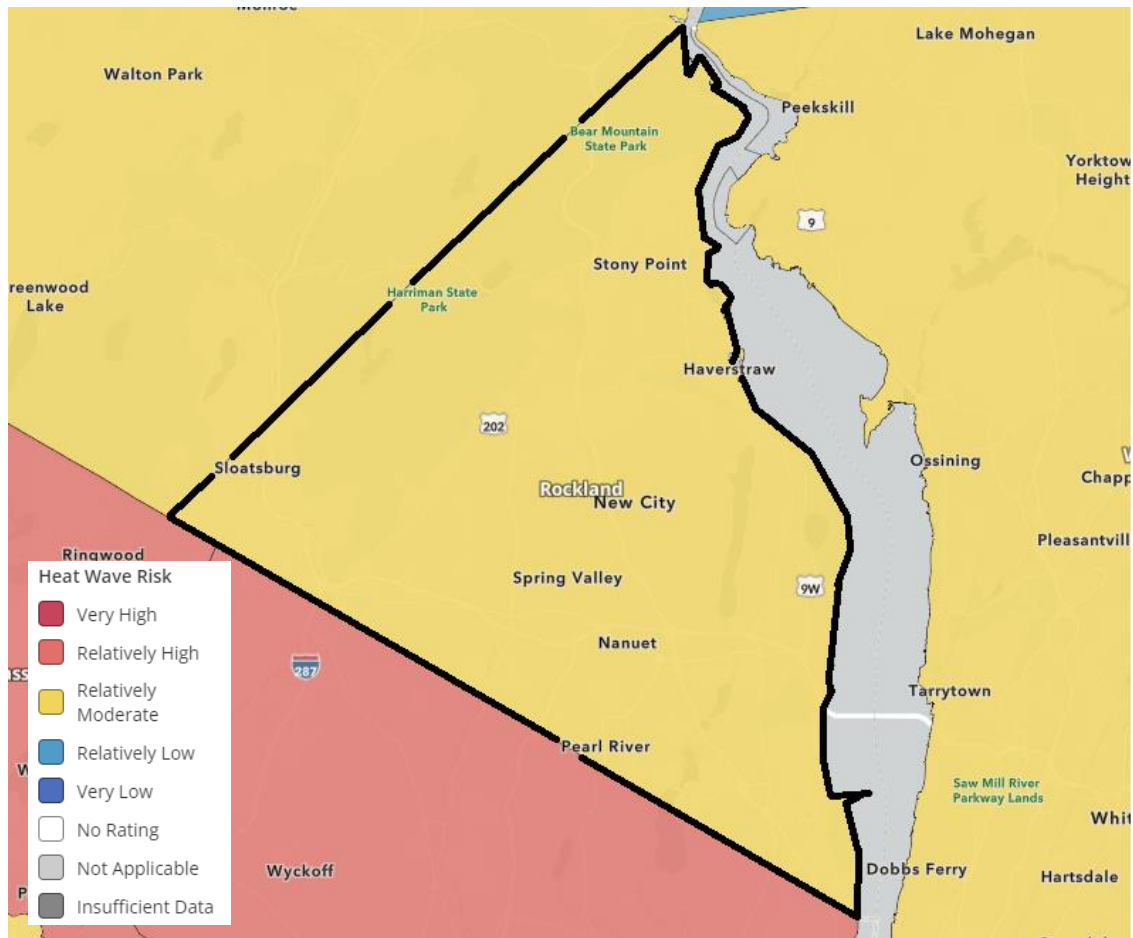
Note: Rockland is outlined in a bolded black border.

Extreme Heat

Extreme heat can occur anywhere. These 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 of their built environment holds the heat) (NYS DHSES 2019).

Figure 4.3.5-4 and Figure 4.3.5-5 show the Heat Wave Risk Index for Rockland County on the county and census tract scales, respectively. This index helps to understand the susceptibility of the County to extreme heat. According to the National Risk Index, on the county scale, the County has a relatively moderate risk to extreme heat; on the census tract scale, the County ranges from a relatively low risk to a relatively moderate risk (FEMA 2019).

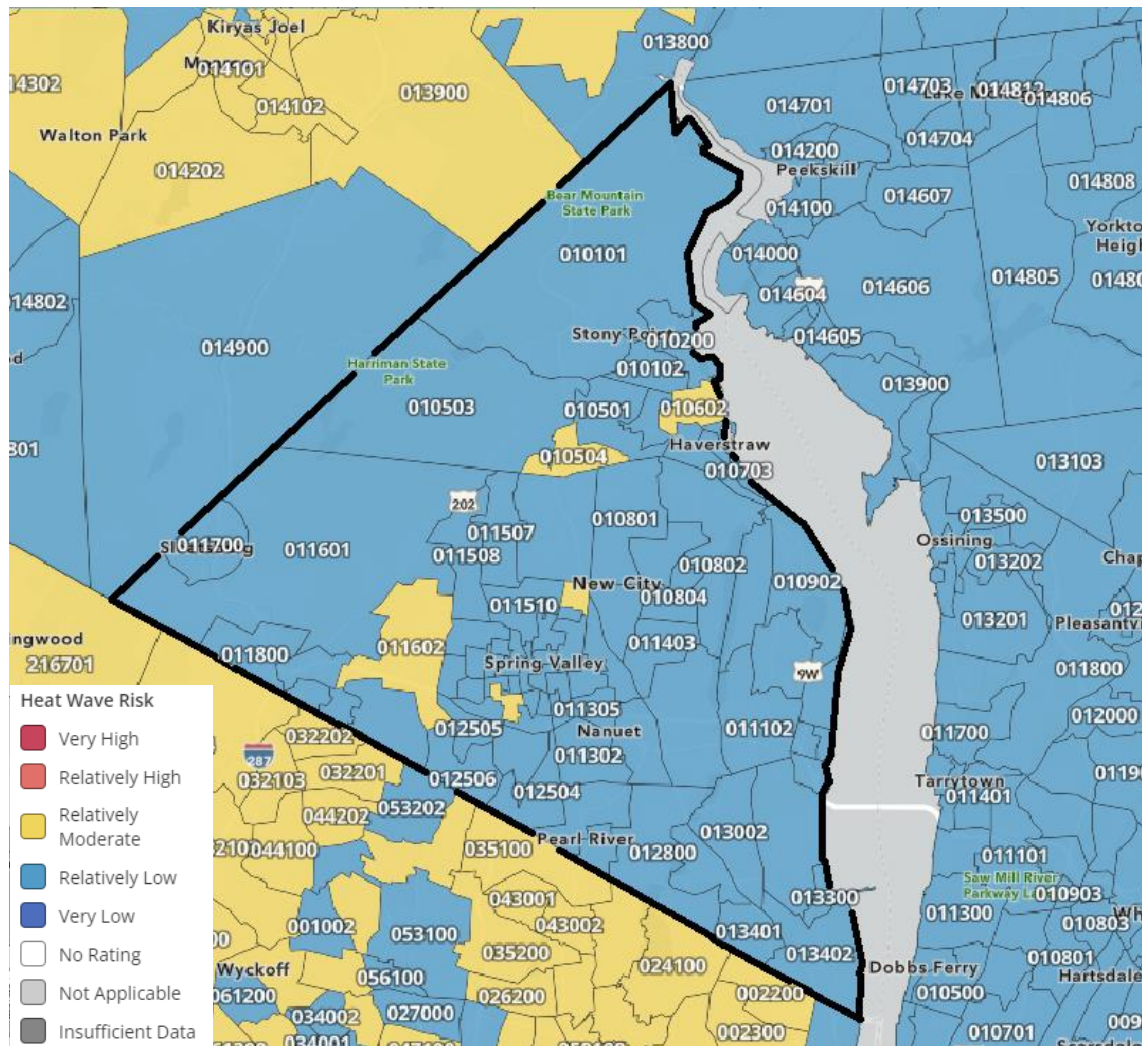
Figure 4.3.5-4. National Risk Index, Heat Wave Risk Index Score Using the County Scale



Source: FEMA 2019

Note: Rockland is outlined in a boldened black border.

Figure 4.3.5-5. National Risk Index, Heat Wave Index Score Using the Census Tract Scale



Source: FEMA 2019

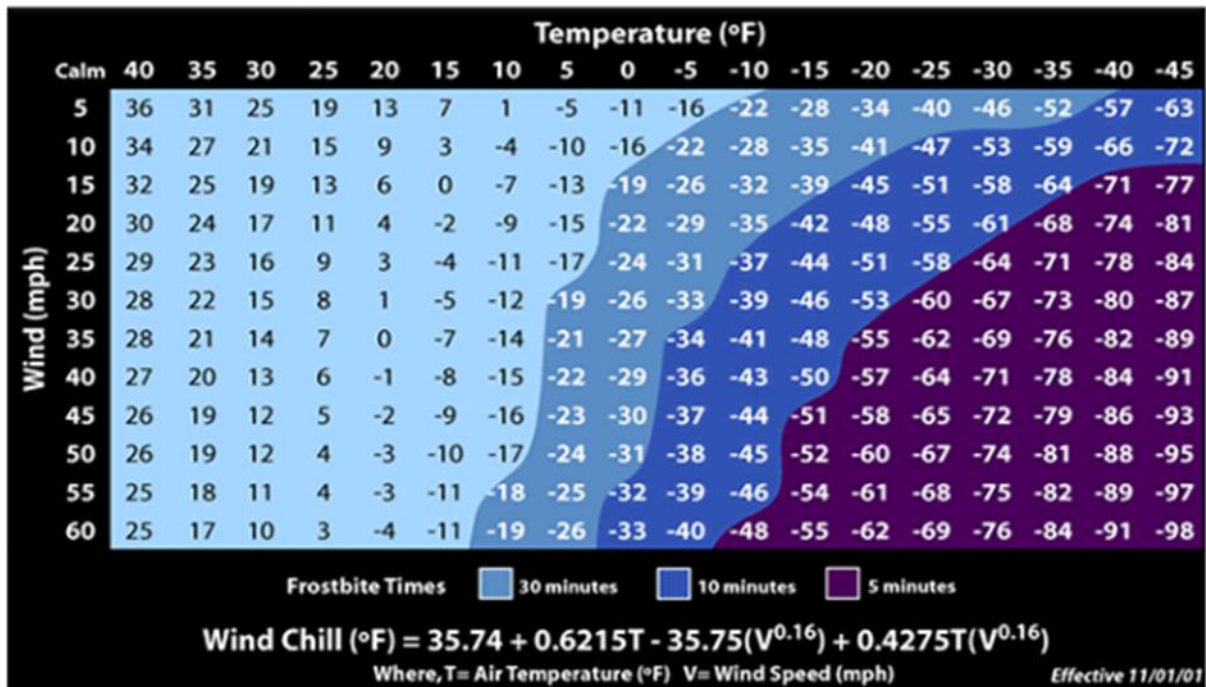
Note: Rockland is outlined in a boldened black border.

Extent

Extreme Cold

The extent (severity or magnitude) of extreme cold temperatures is generally measured through the Wind Chill Temperature (WCT) Index. Wind Chill is a term used to describe what the air temperature feels like to the human skin due to the combination of cold temperatures and winds blowing on exposed skin. In simple terms, the colder the air temperature and the higher the wind speeds the colder it will feel on your skin if you're outside (NOAA n.d.). The index approximates the dangers from wind chill. The WCT is presented in Figure 4.3.5-6.

Figure 4.3.5-6. Wind Chill Index

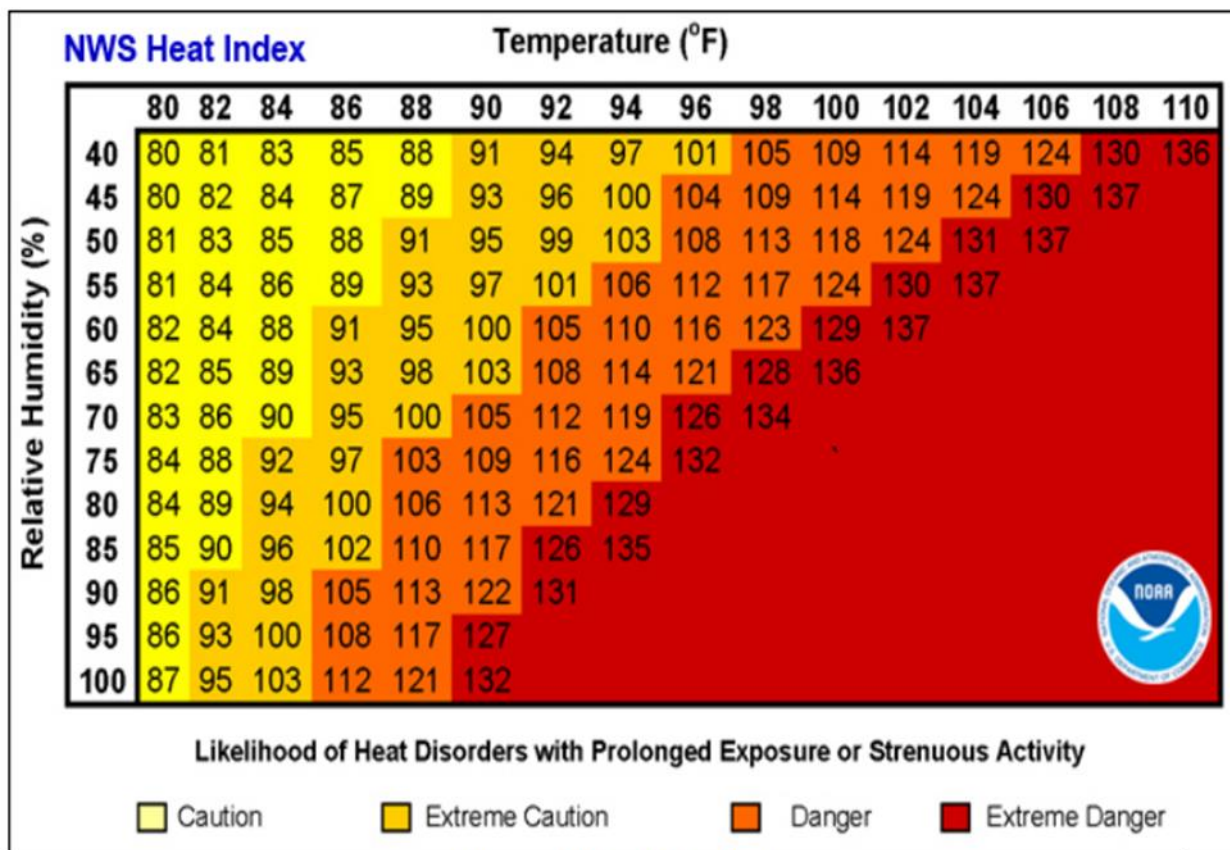


Source: NWS 2001

Extreme Heat

The extent of extreme heat temperatures is generally measured through the Heat Index, identified in Figure 4.3.5-7. Created by the National Weather Service (NWS), the Heat Index measures apparent air temperature as it increases with the relative humidity. The temperature and relative humidity are needed to determine the Heat Index. Once both values have been identified, the Heat Index is the corresponding number of both values (as seen in Figure 4.3.5-7). This index provides a measure of how temperatures feel; however, the values are devised for shady, light wind conditions. Figure 4.3.5-7 shows the heat index value for shaded areas. Exposure to full sun can increase the index by up to 15°F (NYS DHSES n.d.).

Figure 4.3.5-7. NWS Heat Index



Source: NWS

The NWS provides alerts when Heat Indices approach hazardous levels. Table 4.3.5-1 explains these alerts. In the event of an extreme heat advisory, the NWS issues special weather statements, including who is most at risk, safety rules for reducing risk, and the extent of the hazard and Heat Index values. Additionally, the NWS includes heat index values in weather forecasts and also provides assistance to the state and local health officials in preparing Civil Emergency Messages during severe heat waves (NYSDHSES n.d.).

Table 4.3.5-1. National Weather Service Alerts

Alert	Criteria
Heat Advisory	Issued 12 hours of the onset of the following conditions: maximum daytime heat index values are to reach between 100°F to 104°F for at least 2 consecutive hours
Excessive Heat Watch	Issued when conditions are favorable for excessive heat in the next 24 to 72 hours
Excessive Heat Warning	Issued within 12 hours of the onset of the following conditions: maximum heat index temperature is expected to be 105°F or higher for at least 2 days and nighttime air temperatures will not drop below 75°F

Source: NYSDHSES n.d.

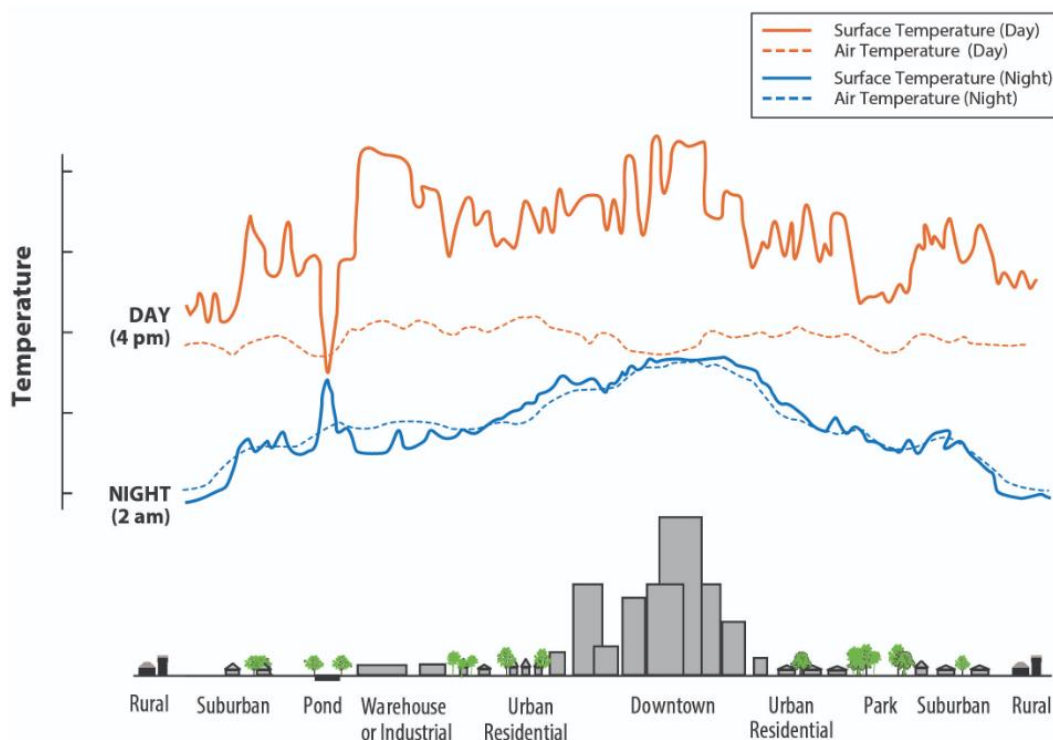
Urbanized areas face elevated risks during an extreme heat event, compared to rural and suburban areas. When natural areas are developed, open land and vegetation is replaced with buildings, roads, and other infrastructure which absorb more solar radiation than the natural land. Additionally, surfaces that were once permeable and moist are now impermeable and dry. These changes cause urban areas to become warmer than the surrounding

areas. This forms an ‘island’ of higher temperatures (EPA 2023). Rockland County is a suburban county, located in the New York City Metropolitan Area which means the County is heavily impacted by heat islands.

A heat island refers to built-up areas that are hotter than nearby outlying areas. The annual mean air temperature of a city with more than 1 million people can be between 1.8 °F and 5.4°F warmer than surrounding areas. In the evening, the difference in air temperatures can be as high as 22°F. Heat islands occur on the earth’s surface and in the atmosphere. On a hot, sunny day, the sun can heat dry, exposed urban surfaces to temperatures 50°F to 90°F hotter than the air. Heat islands can affect communities by increasing peak energy demand during the summer, thereby escalating air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and death, and rates of water quality degradation (EPA 2023).

Figure 4.3.5-8 below illustrates an urban heat island profile. The graphic demonstrates that heat islands are typically most intense over dense urban areas and are less prevalent in vegetated areas (EAP 2023).

Figure 4.3.5-8. Urban Heat Island Profile



Source: EPA 2023

Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, Rockland County was not included in any major disaster (DR) or emergency (EM) declarations for extreme temperature-related events (FEMA 2023).

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are

contiguous to a designated county. Between 2018 and 2023, Rockland County was not included in any extreme temperature-related agricultural disaster declarations.

Previous Events

For this 2024 HMP update, there were no documented incidents of extreme temperature events in Rockland between 2017 and 2023. For events prior to 2017, refer to the 2018 Rockland County HMP.

Probability of Future Occurrences

For the 2024 HMP update, best available data was used to collect hazard event details. These details were used to calculate the probability of future occurrence of hazard events in the County. Information from the NCEI database, the 2019 State of New York HMP, the 2018 Rockland County HMP, and FEMA were used to identify the number of events that occurred since the last HMP. However, temperature recordings at the various weather stations in the County have data recorded between 1990 and 2017. While these counts do not include data after 2017, it can be expected that Rockland County has a 100 percent chance of extreme heat and cold events to occur each year. Table 4.3.5-2 provides the calculated probability of future extreme temperature events in Rockland County.

Table 4.3.5-2. Probability of Future Extreme Temperature Events in Rockland County

Hazard Type	Number of Occurrences Between 1990 and 2017	Percent Chance of Occurring in Any Given Year
# days with maximum temperature $\geq 90^{\circ}\text{F}$	73	100%
# days with minimum temperature $\leq 0^{\circ}\text{F}$	167	100%
Total	140	100%

Sources: NOAA 2023

Notes: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act and selected extreme temperature events since 1968. Due to limitations in data, not all extreme temperature events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

In Section 4.4, the identified hazards of concern for Rockland County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for extreme temperature in the County is considered ‘frequent’.

Climate Change Projections

Climate change affects the State of New York’s residents and resources. As the effects of climate change worsen, extreme temperature impacts will likely worsen as well. The impacts related to increasing temperatures and sea level rise are already causing complications in the state.

The State is experiencing warming temperatures, with an average rate of warming over the past century of 0.25° F per decade. Average annual temperatures are projected to increase across New York State by 2 to 3.4 °F by the 2020s, 4.1 to 6.8 °F by the 2050s, and 5.3 to 10.1 °F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the state (NYSERDA 2011/2014).

The region encompassing Rockland County, which includes the Catskill Mountains and the West Hudson River Valley, is expected to experience temperature increases of 4.2 to 6.1°F by the 2050s and 5.4 to 9.6°F by the 2080s

(baseline of 50.0°F, middle range projection). The increase in temperatures will impact the frequency and severity of extreme heat events.

Precipitation totals are estimated to increase between three to eleven percent by the 2050s and six to fourteen percent by the 2080s (baseline of 46.0 inches, middle range projection). Table 4.3.5-3 displays the projected seasonal precipitation change for the region for 2050 (NYSERDA 2011/2014). The winter season is projected to have a precipitation increase of up to 15 percent. These predicted changes will alter water resources which could lead to water shortages during extreme heat events. Extreme events are also projected to increase, as illustrated in Table 4.3.5-3 below (NYSERDA 2014).

Table 4.3.5-3. Extreme Event Projections for the Catskill Mountains and West Hudson River Valley

Event Type (2050s)	Low Estimate (10 th Percentile)	Middle Range (25 th to 75 th Percentile)	High Estimate (90 th Percentile)
Days over 90 °F (8 days)	24	31 to 47	56
# Of Heat Waves (0.7 heat waves)	3	4 to 6	8
Duration of Heat Wave (4 days)	5	5 to 6	6
Days below 32 °F (133 days)	79	86 to 100	108
Days over 1" Rainfall (5 days)	12	13 to 14	15
Days over 2" Rainfall (0.6 days)	2	2 to 3	3

Source: NYSERDA 2014

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the extreme temperature hazard, all of Rockland County has been identified as the hazard area. Therefore, all assets in the County (population, structures, critical facilities, and lifelines), as described in the County Profile (Section 4), are vulnerable to the extreme temperature hazard.

Impact on Life, Health, and Safety

Extreme temperature events have potential health impacts including injury and death. More mild winters resulting from a warming climate can reduce illness and injuries associated with extreme cold temperatures and reallocate them to extreme heat events. The entire population of Rockland County (461,860) is exposed to the extreme temperature hazard.

Several health hazards are related to extreme cold temperatures and include wind chill, frostbite, and hypothermia, which are defined as the following:

- *Wind chill* is not the actual temperature but rather how wind and cold feel on exposed skin. As the wind increases, heat is carried away from the body at an accelerated rate, driving down the body temperature.
- *Frostbite* is damage to body tissue caused by extreme cold. A wind chill of negative 20°F will cause frostbite in just 30 minutes. Frostbite can cause a loss of feeling and a white or pale appearance in extremities.
- *Hypothermia* is a condition brought on when the body temperature drops to less than 95°F, and it can be deadly. Warning signs of hypothermia include uncontrollable shivering, memory loss, disorientation, incoherence, slurred speech, drowsiness, and apparent exhaustion (NWS 2022).

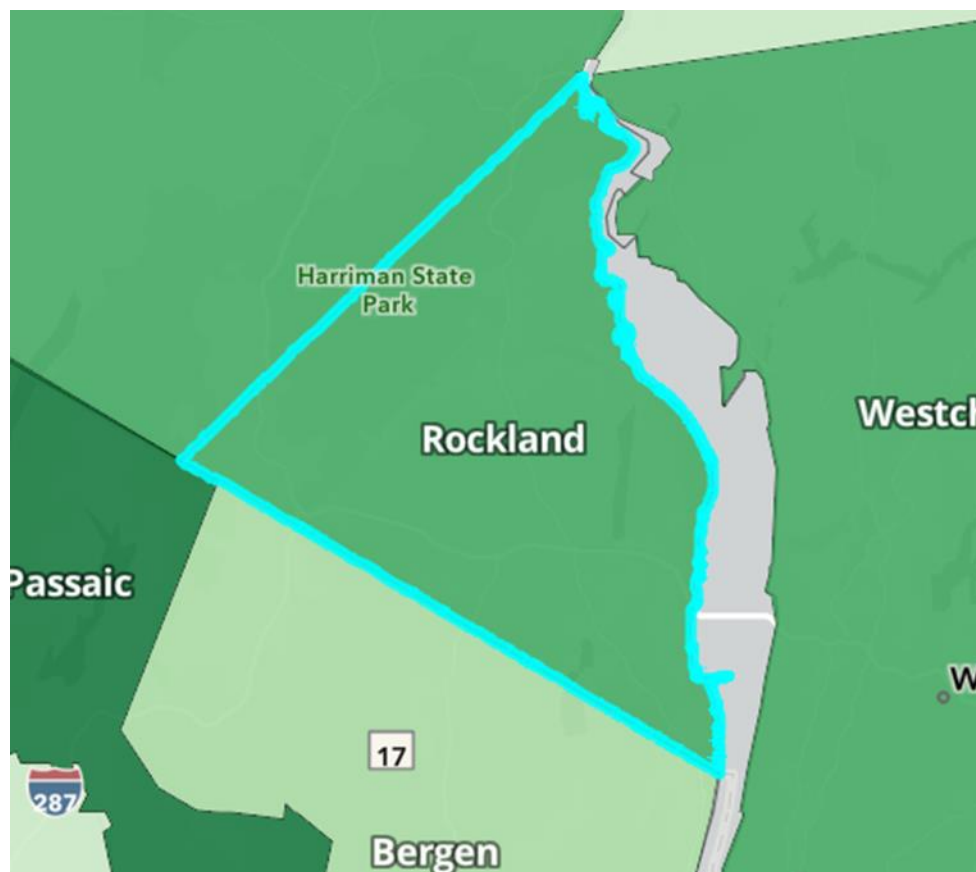
Several health hazards are related to extreme heat temperatures and include heat exhaustion and heat stroke, which are defined as the following:

- *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: the body's temperature rises rapidly, the sweating mechanism fails, and the body is unable to cool down. When heat stroke occurs, the body temperature can rise to 106°F or higher within 10 to 15 minutes. Heat stroke can cause permanent disability or death if the person does not receive emergency treatment (CDC 2022).

Social Vulnerability

According to the CDC, populations most at risk to extreme cold and heat events include the following groups: the elderly, who are less able to withstand temperatures extremes due to their age, health conditions, and limited mobility to access shelters; infants and children up to four 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; and the general public who may overexert during work or exercise during extreme heat events or experience hypothermia during extreme cold events (CDC 2022, CDC 2005). Refer to Figure 4.3.5-9 for the social vulnerability index for the natural hazard.

Figure 4.3.5-9. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA n.d.

Impact on General Building Stock

All the building stock in the County is exposed to the extreme temperature hazard. Refer to Section 3 (County Profile), which summarizes the building inventory in Rockland County. Extreme heat generally does not impact buildings; however, elevated summer temperatures increase the energy demand for cooling. Losses can be associated with the overheating of heating, ventilation, and air conditioning (HVAC) systems. Extreme cold temperature events can damage buildings through freezing/bursting pipes and freeze/thaw cycles, as well as increasing vulnerability to home fires. Additionally, manufactured homes (mobile homes) and antiquated or poorly constructed facilities can have inadequate capabilities to withstand extreme temperatures.

Impact on Critical Facilities and Community Lifelines

Similar to the general building stock, all critical facilities in the County are exposed to the extreme temperature hazard; however, direct impacts are expected to be minimal. Impacts to critical facilities are the same as were described for general building stock. Additionally, it is essential that critical facilities remain operational during natural hazard events. Extreme heat events can sometimes cause short periods of utility failures, commonly referred to as “brown outs,” created by increased usage from air conditioners, appliances, and similar equipment. Similarly, heavy snowfall and ice storms, associated with extreme cold temperature events, can interrupt power as well. Backup power is recommended for critical facilities and infrastructure. Additionally, designating and developing emergency cooling or heating facilities can also enhance the resilience and safety of communities.

Impact on the Economy

Extreme temperature events also have impacts on the economy, including loss of business function and damage and loss of inventory. Business owners may be faced with increased financial burdens due to unexpected repairs caused to the building (pipes bursting), higher than normal utility bills, or business interruption caused by power failure (loss of electricity and telecommunications). The agricultural industry is most at risk in terms of economic impact and damage caused by extreme temperature events. Extreme heat events can result in drought and dry conditions and directly affect livestock and crop production.

Impact on the Environment

Extreme temperature events can have a major impact on the environment. For example, freezing and warming weather patterns create changes in natural processes. An excess amount of snowfall and earlier warming periods may affect natural processes such as flow within water resources (USGS 2020). Extreme heat events can have particularly negative impacts on aquatic systems, contributing to fish kills, aquatic plant die offs, and increased likelihood of harmful algal blooms. These extreme temperature events can also affect the surrounding ecosystems which can destroy food webs and deplete resources in the environment.

Future Changes That May Impact Vulnerability

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

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Potential or Projected Development

The ability of new development to withstand extreme temperature impacts can be enhanced through land use practices 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. Transformation of pervious surfaces (including vegetation) to impervious surfaces causes an island of higher temperatures. Specific areas of recent and new development are indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 (Jurisdictional Annexes) of this plan.

Projected Changes in Population

Rockland County has experienced an increase in its population since 2010. According to the U.S. Census Bureau, the County's population increased by approximately 8.5 percent between 2010 and 2020 (County of Rockland 2021). Cornell University's Program on Applied Demographics projects Rockland County will have a population of 356,758 by 2030 and 372,432 by 2040 (Cornell University 2018).

Population change is not expected to have a measurable effect on the overall vulnerability of the County's population over time. However, drastic increases less densely populated areas of the County may require utility system upgrades to keep up with demands (e.g., water, electric) during extreme temperature events to prevent increased stresses on these systems. Additionally, by increasing development, green space preservation will need to continue to be a priority to mitigate increased heat islands. Refer to Section 3 (County Profile) for a detailed discussion on population changes.

Other Identified Conditions

The State of New York is expected to see an increase in average annual temperatures and precipitation. As the climate warms, extreme cold events may decrease in frequency, but will become more severe, while extreme heat events may increase and become more severe. The shifts in temperatures could also result in hotter extreme heat events. With increased temperatures, vulnerable populations could face increased susceptibility to extreme heat and associated illnesses, such as heatstroke and cardiovascular and kidney disease. Additionally, as temperatures rise, more buildings, facilities, and infrastructure systems may exceed their ability to cope with the heat. Thus, building efficiency and upgrading heating and cooling technology/HVAC will become an increasingly important issue for businesses and homeowners over the coming years.

Change of Vulnerability Since 2018 HMP

Overall, the entire County remains vulnerable to extreme temperatures. As existing development and infrastructure continue to age, they can be at increased risk to failed utility systems (e.g., HVAC) if they are not properly maintained. Similarly, an increase in the elderly population in the County increases the share of residents particularly susceptible to this hazard.

4.3.6 Flood

Hazard Profile

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the flood hazard in Rockland County.

Hazard Description

Flooding occurs when water overflows onto land that is normally dry. They can happen during heavy rains, rapid snow melt, or when dams or levees break (NOAA National Severe Storms Laboratory 2023). Floods are one of the most frequent and costly natural disasters in the United States and the State of New York.

The flood-related hazards most likely to impact Rockland County are riverine (inland) flooding, flash flooding, ice jam flooding, stormwater/urban flooding due to insufficient drainage during heavy rain events, and flooding as a result of a dam or levee break. Dam and levee failure are discussed in Section 4.3.1 (Dam and Levee Failure).

Riverine Flooding

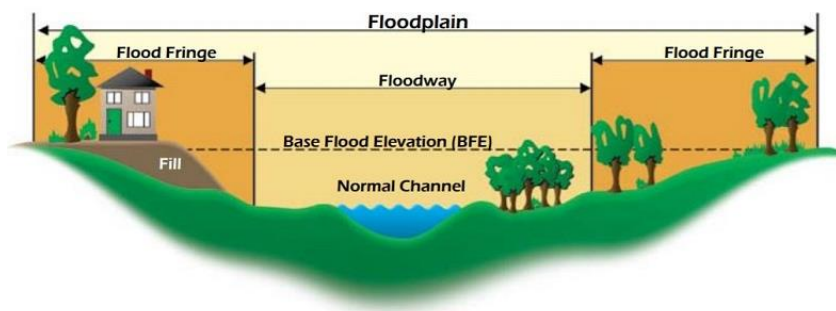
Riverine flooding, or fluvial flooding, is when streams and rivers exceed the capacity of their natural or constructed channels to accommodate water flow and water overflows the banks, spilling out into adjacent low-lying, dry land. This occurs when the flow of a river exceeds the bank sides and causes damage or obstruction to a nearby floodplain. Riverine flooding can turn into a flash flood if the river is at or above its flood stage and if the soil is saturated (FEMA 2019).

A floodplain is defined as 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. In Rockland County, floodplains line the rivers, streams, and lakes of the County. The boundaries of the floodplains are altered as a result of changes in land use, the amount of impervious surface, placement of obstructing structures in floodways, changes in precipitation and runoff patterns, improvements in technology for measuring topographic features, and utilization of different hydrologic modeling techniques.

Flash Flooding

Flash floods occur when heavy or excessive precipitation falls in a short period of time, generally less than 6 hours. Flash floods are usually characterized by raging torrents after heavy rains that rip through riverbeds, urban streets, or mountain canyons sweeping everything before them. They can occur within minutes or a few hours of excessive rainfall. They can also occur even if no rain has fallen, for instance after a levee or dam has failed, or after a sudden release of water by a debris or ice jam (NWS 2009).

Figure 4.3.6-1. Characteristics of a Floodplain



Source: FEMA 2022

Stormwater/Urban Flooding

Heavy precipitation may produce stormwater/urban flooding in areas other than delineated floodplains or along recognizable channels. If local conditions cannot accommodate intense precipitation through a combination of infiltration and drainage capacity, water may accumulate. During winter and spring, frozen ground and snow accumulations may contribute to inadequate drainage and localized ponding. Flooding issues of this nature generally occur in areas with flat gradients and generally increase 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 (FEMA 2007).

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

Figure 4.3.6-2. Stormwater/Urban Flooding in Rockland County



Note: Stormwater/urban flooding in Rockland County following a December 18, 2023 period of heavy rains.

Figure 4.3.6-3. Stormwater/Urban Flooding in Rockland County



Note: Stormwater/urban flooding in Rockland County following a December 18, 2023 period of heavy rains.

Heavy rainfall that overwhelms a developed area’s stormwater infrastructure causing flooding is commonly referred to as urban flooding. Urban flooding can be worsened by aging and inadequate infrastructure and over development of land. The growing number of extreme rainfall events that produce intense precipitation are resulting in increased urban flooding (Center for Disaster Resilience 2016). While riverine and lakeshore flooding is mapped and studied by FEMA, urban flooding is not.

Urban flooding is the flooding of streets, underpasses, low lying areas, or storm drains (NWS 2009). Urban development and inadequate drainage systems can increase precipitation runoff, elevating the risk for flooding. Drainage systems remove surface water by channeling water away from developed areas as quickly as possible to prevent localized flooding on streets and other urban areas. 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 (T. Harris 2008).

Ice Jam Flooding

An ice jam occurs when pieces of floating ice are carried with a stream's current and accumulate behind any obstruction to the stream flow. Obstructions may include river bends, mouths of tributaries, points where the river slope decreases, as well as dams and bridges. The water held back by this obstruction can cause flooding upstream, and if the obstruction suddenly breaks, flash flooding can occur as well (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. Ice jams and resulting floods can occur throughout the year: fall freeze-up from the formation of frazil ice; mid-winter periods when stream channels freeze solid, forming anchor ice; and spring breakup when rising water levels from snowmelt or rainfall break existing ice cover into pieces that accumulate at bridges or other types of obstructions (FEMA 2018).

Location

The FEMA Special Flood Hazard Area (SFHA) establishes the area that has flood insurance and floodplain management requirements (FEMA 2020). SFHA are defined as the area that will be inundated by the flood event having a 1-percent chance of being equaled to or exceeded in any given year. It should be noted that areas outside of the SFHA can be subject to flooding of different types or magnitudes. Flooding outside of the SFHA area may include stormwater/urban flooding and flash flooding.

Flooding can occur anywhere in Rockland County; however, areas in and around floodplains and those areas impacted by stormwater issues are more susceptible to flooding. In Rockland County, floodplains line the rivers and streams of the County. The boundaries of the floodplains are altered as a result of changes in land use, the amount of impervious surface, placement of obstructing structures in floodways, changes in precipitation and runoff patterns, improvements in technology for measuring topographic features, and utilization of different hydrologic modeling techniques. Figure 4.3.6-6 visualizes the

FEMA designated flood hazard area for Rockland County. The total land area in the floodplain, exclusive of waterbodies, is summarized in Table 4.3.6-1. Refer to Section 9 for a map of each jurisdiction depicting the floodplains.

Table 4.3.6-1. Number of Acres Rockland County Is Exposed to 1-Percent and 0.2-Percent Annual Chance Flood

Jurisdiction	Total Acres of Land Area	Total Acres of Land Area (Excluding Waterbodies) Located in the Flood Hazard Areas			
		Total Acres Located in the 1-Percent Annual Chance Flood Event	Percent of Total	Total Acres Located in the 0.2-Percent Annual Chance Flood Event	Percent of Total
Airmont (V)	2,844	60	2.1%	73	2.6%
Chestnut Ridge (V)	3,109	93	3.0%	114	3.7%
Clarkstown (T)	23,295	1,023	4.4%	1,261	5.4%
Grand View-on-Hudson (V)	106	2	1.9%	106	100.0%
Haverstraw (T)	11,066	210	1.9%	319	2.9%
Haverstraw (V)	1,254	43	3.4%	58	4.6%
Hillburn (V)	1,364	65	4.8%	92	6.7%
Kaser (V)	103	2	1.9%	3	2.9%
Montebello (V)	2,704	259	9.6%	314	11.6%
New Hempstead (V)	1,747	65	3.7%	68	3.9%
New Square (V)	220	2	0.9%	3	1.4%
Nyack (V)	492	3	0.6%	22	4.5%

Jurisdiction	Total Acres of Land Area	Total Acres of Land Area (Excluding Waterbodies) Located in the Flood Hazard Areas			
		Total Acres Located in the 1-Percent Annual Chance Flood Event	Percent of Total	Total Acres Located in the 0.2-Percent Annual Chance Flood Event	Percent of Total
Orangetown (T)	13,958	894	6.4%	1,169	8.4%
Piermont (V)	411	83	20.2%	169	41.1%
Pomona (V)	1,488	61	4.1%	62	4.2%
Ramapo (T)	19,415	569	2.9%	623	3.2%
Sloatsburg (V)	1,564	166	10.6%	196	12.5%
Spring Valley (V)	389	1	0.3%	197	50.6%
Stony Point (T)	1,285	76	5.9%	88	6.8%
Suffern (V)	17,910	592	3.3%	621	3.5%
Upper Nyack (V)	1,317	106	8.0%	144	10.9%
Wesley Hills (V)	738	2	0.3%	4	0.5%
West Haverstraw (V)	2,102	40	1.9%	52	2.5%
Rockland County (Total)	988	39	3.9%	55	5.6%

Source: Rockland County 2020; USGS, NHD 2023; FEMA

Note:

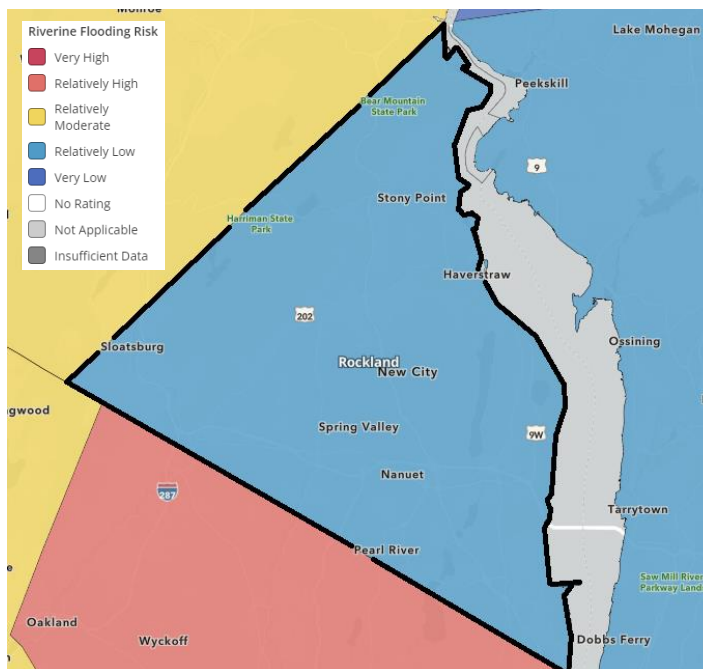
- 1) Excludes areas designated as water
- 2) Values are rounded to the nearest whole value

Riverine Flooding

Riverine flooding is most severe around major creeks and riverbeds, including the Antrim Creek, Hackensack River, Hudson River, Montebello Creek, Pascack Brook, Ramapo River, Saddle River East and West Branches, and Stony Brook. According to the County’s FIS Report, flooding can occur in Rockland County during any season of the year, but most likely occurs from rainfall associated with hurricanes, tropical storms, and nor’easters (FEMA 2014).

Figure 4.3.6-4 and Figure 4.3.6-5 show the Riverine Flooding Risk Index for Rockland County on the county and census tract scales, respectively. This index helps to understand the susceptibility of the County to riverine flooding. According to the National Risk Index, on the county scale, the County has a relatively low risk to riverine flooding; on the census tract scale, portions of the County has no rating, however, most census tracks range from a very low risk to a relatively moderate risk (FEMA 2019).

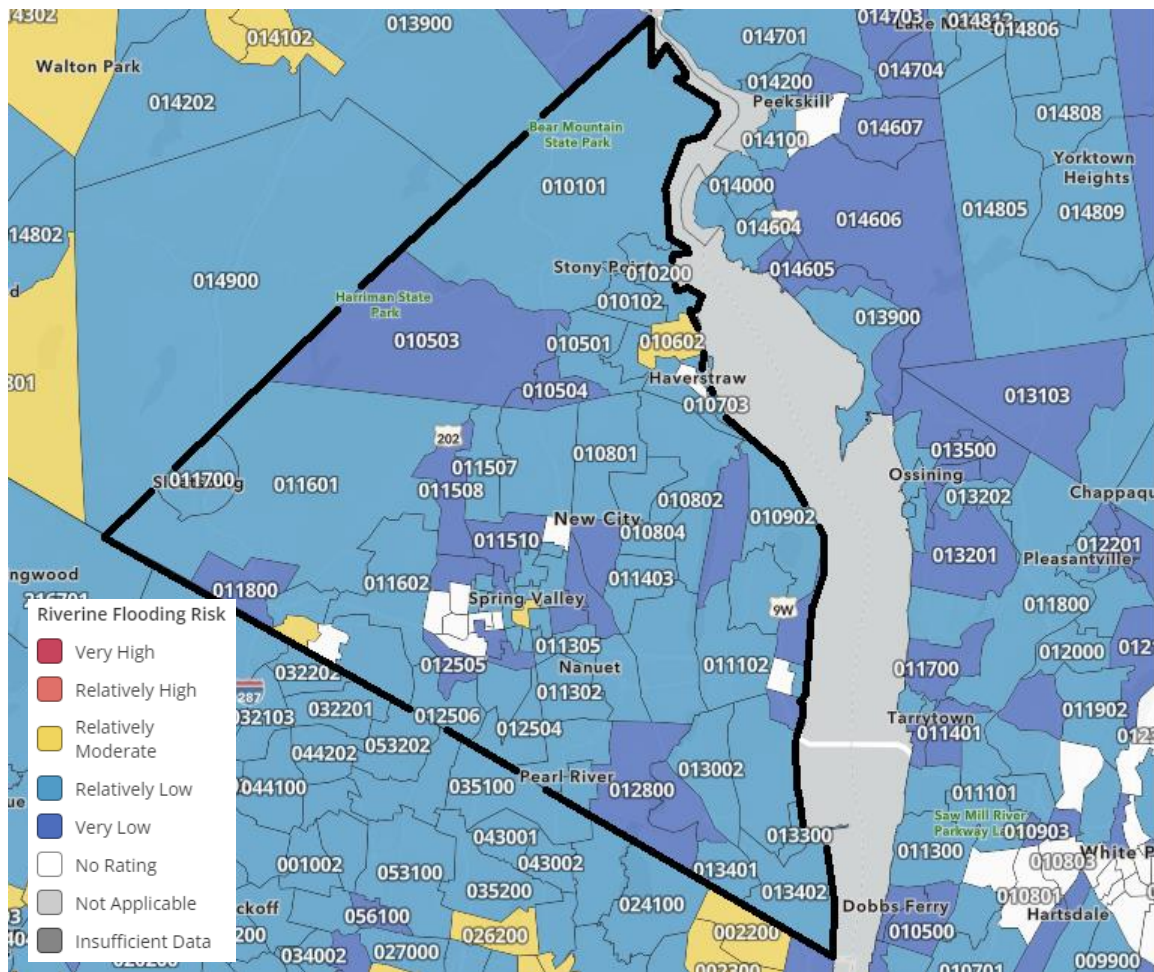
Figure 4.3.6-4. National Risk Index, Riverine Flooding Risk Index Score Using the County Scale



Source: FEMA 2023

Notes: Rockland County is outlined in bold, black lines.

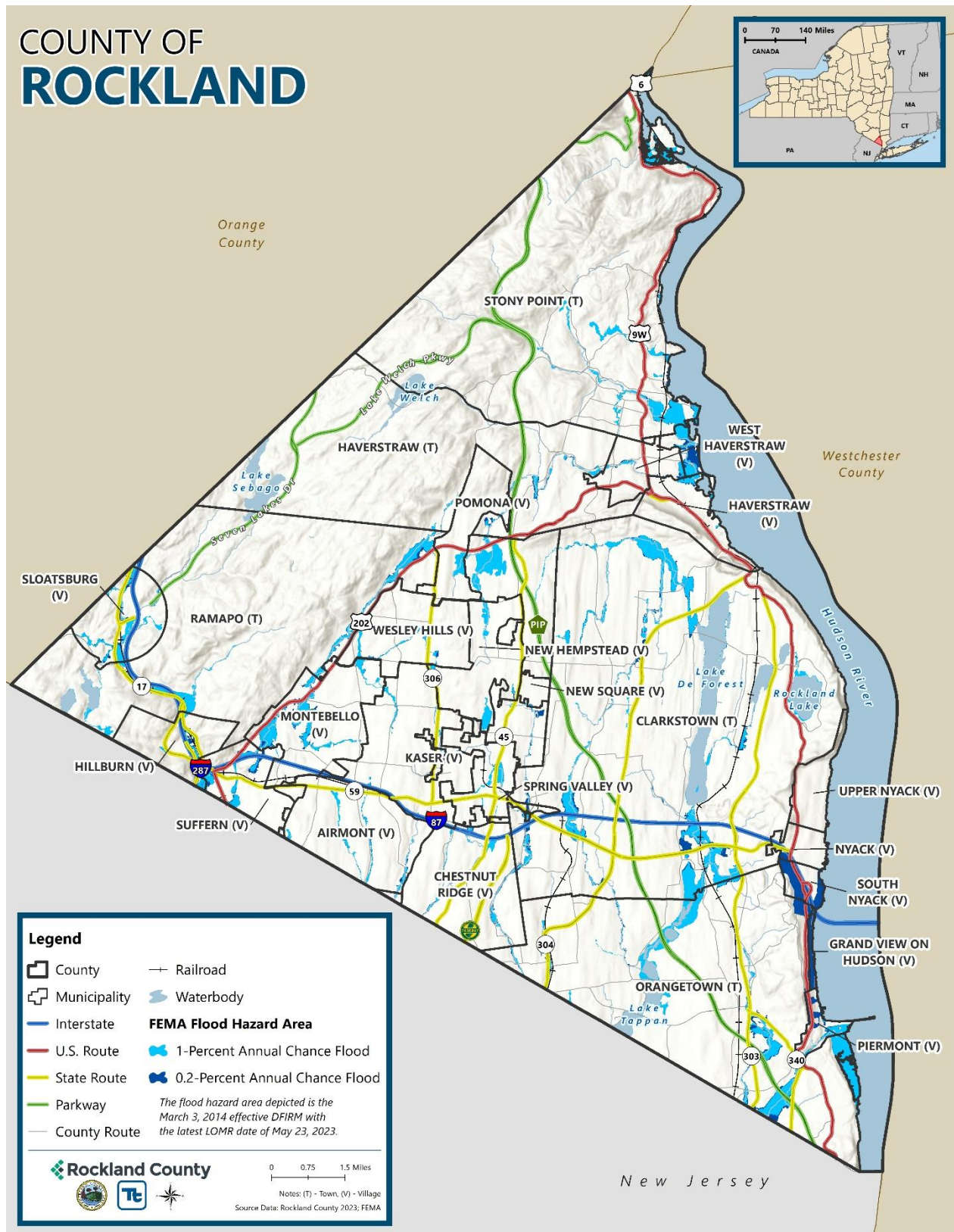
Figure 4.3.6-5. National Risk Index, Riverine Flooding Risk Index Score Using the Census Tract Scale



Source: FEMA 2023

Notes: Rockland County is outlined in bold, black lines.

Figure 4.3.6-6. FEMA Flood Hazard Areas in Rockland County



Flash Flooding

Flash flooding can occur throughout the State of New York. However, the distinctive flash flood event characterized by fast moving water and damaging impacts requires a steep topography. While Rockland County could undergo flash floods (and has, in the past), the County is at a lower risk than other parts of the State for this type of flood event (NYS DHSES 2019).

Stormwater/Urban Flooding

Stormwater/urban flooding is not mapped by the State or FEMA but is most likely to occur in highly developed areas with high percentages of impervious coverage that contribute to high rates of runoff.

Ice Jam Flooding

Ice jams are common in the northeast United States, including the State of New York. According to the US Army Corps of Engineers (USACE), the State ranks second in the nation for total number of ice jam events, with over 1,600 incidents documented between 1780 and 2022. Areas of the State that include characteristics lending to ice jam flooding, such as waterbodies with a quick increase in water levels and high flow velocities, are the northern counties of the Finger Lakes region and far western New York, the Mohawk Valley of central and eastern NYS, and the North Country (NYS DHSES 2019).

The Ice Jam Database, maintained by the Ice Engineering Group at the USACE Cold Regions Research and Engineering Laboratory (CRREL), currently consists of over 19,000 records from across the nation. According to the USACE-CRREL, Rockland County underwent or may have been impacted by 2 historic ice jam incidents between 1780 and 2022, though no events have occurred since 1994 (USACE 2022). Ice jams have formed along the Ramapo River in Suffern (1994) and the Stony Brook in Sloatsburg (1961).

Extent

The strength or magnitude of a flood varies based meteorological, environmental, and geological factors, including latitude, altitude, topography, and atmospheric conditions. Flood is also affected by seasonal variation, storm characteristics, warning time, speed of onset, and duration. Most floods are preceded by a warning period that allows emergency managers to communicate the need to prepare for the event. A flood may last from minutes to days (O'Connor, Grant and Costa 2002).

Warnings issued through official sources, such as the NWS and the Storm Prediction Center, provide the most reliable and timely preparedness

Figure 4.3.6-7. NWS Flood Advisories



Source: NWS 2023

Figure 4.3.6-8. NWS Flash Flood Advisories



Source: NWS 2023

information, but the exact flood location and depth depends on the amount, duration, and location of rainfall. Many floods, especially flash floods, occur outside of FEMA-designated flood zones.

In the case of riverine flood hazard, once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat:

- Minor Flooding - minimal or no property damage, but possibly some public threat or

inconvenience.

- Moderate Flooding - some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations (NOAA 2021).

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. The size of rivers and streams in an area and infiltration rates are significant factors. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration rates decrease and any more water that accumulates must flow as runoff (T. Harris 2001).

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1-percent chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

The extent of flooding associated with a 1-percent annual probability of occurrence (the base flood or 100-year flood) is used by the NFIP as the standard for floodplain management and to determine the need for flood insurance, as well as the regulatory flood boundary by many agencies. Also referred to as the Special Flood Hazard Area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the water elevation resulting from a given discharge level, which is one of the most important factors used in estimating flood damage. A structure located within a SFHA shown on an NFIP map has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage.

The term “500-year flood” is the flood that has a 0.2-percent chance of being equaled or exceeded each year. The 500-year flood could occur more than once in a relatively short period of time. Statistically, the 0.2-percent (500-year) flood has a 6-percent chance of occurring during a 30-year period of time, the length of many mortgages. The 500-year floodplain is referred to as Zone X500 for insurance purposes on FIRMs. Base flood elevations or depths are not shown within this zone and insurance purchase is not required in this zone (FEMA 2022).

Flood Gages

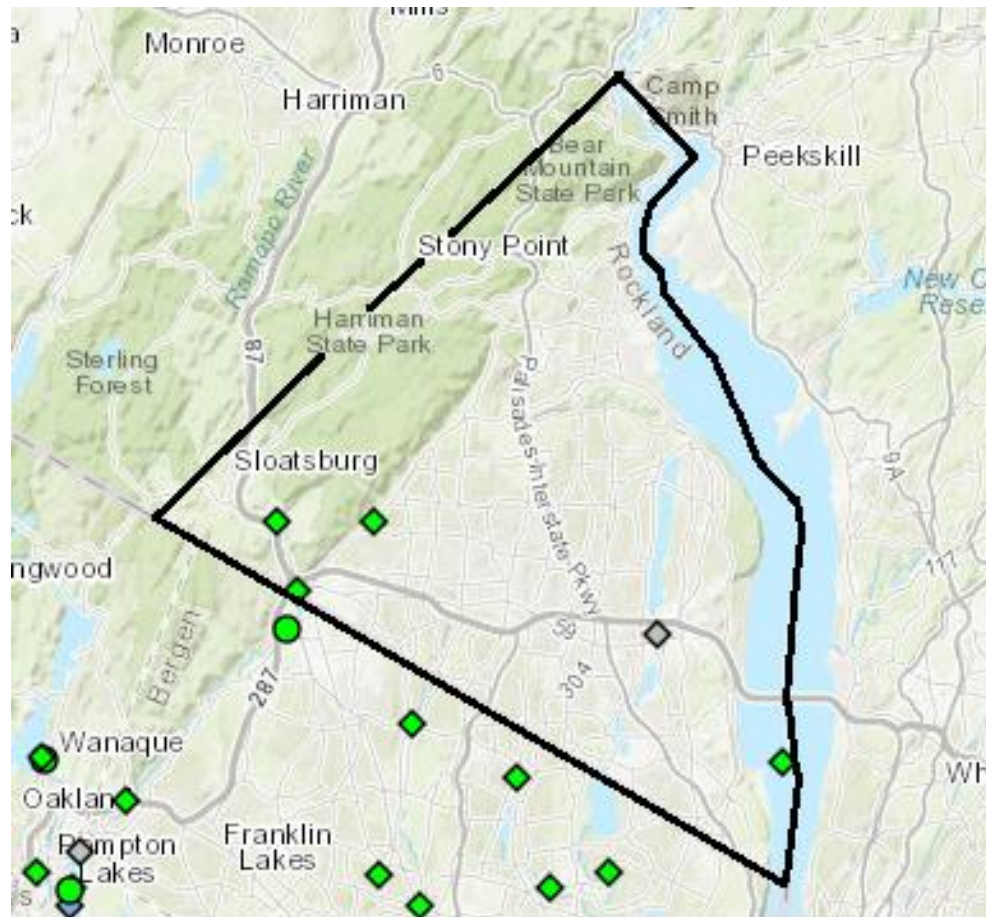
The US Geological Survey (USGS) National Water Information System (NWIS) collects surface water data from more than 850,000 stations across the country. The time-series data describes stream levels, streamflow (discharge), reservoir and lake levels, surface water quality, and rainfall. The data is collected by automatic recorders and manual field measurements at the gage locations. USGS uses stream gages to determine the severity of flood at different points along a body of water. There are numerous gages in Rockland County, in addition to others just outside of the County’s boundary, that provide critical flood data for waterways affecting the County. There are five stream gages in the County. Table 4.3.6-2 provides details about the stream gages in the County. Figure 4.3.6-9 shows the location of the gages in the County.

Table 4.3.6-2. Flood Gages in Rockland County

Gage Site Number	Site Name	Action Stage (ft)	Flood Stage (ft)	Moderate Flood Stage (ft)	Major Flood Stage (ft)	Historic Crest
01387400	Ramapo River at Ramapo	9	10	12	14	N/A
01387420	Ramapo River at Suffern	14.8	15.2	16.5	17.5	N/A
01387450	Mahwah River at Suffern	4.5	5	7	10.5	N/A
01376800	Hackensack River at West Nyack	N/A	6	8	10	N/A
01376269	Hudson River at Piermont	6.3	6.4	7.4	8.4	N/A

Source: USGS 2023; NWS 2023
 N/A Not available/not recorded

Figure 4.3.6-9. Stream Gages in Rockland County



Source: NWS 2023

Note: Rockland County is outlined with a black border

Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, Rockland County was included in eight major disaster (DR) or emergency (EM) declarations for flood-related events (FEMA 2023). For declarations that occurred between 2017 and 2023, Rockland County has not been included in any flood-related declarations. Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2014 and 2023, Rockland County was included in one flood-related agricultural disaster declarations. For declarations that occurred between 2014 and 2023, refer to Table 4.3.6-3. For declarations that occurred between 2017 and 2023, refer to Table 4.3.6-3.

Table 4.3.6-3. USDA Declarations for Flood Events in Rockland County (2014 to 2023)

Event Date	Event Type	USDA Declaration Number	Description
April 1 – July 8, 2014	Flood	S3747	Excessive Rain, Flash Flooding, Flooding, High Winds, and Hail

Sources: USDA 2023

Previous Events

For this 2024 HMP update, known hazard events that impacted Rockland County between January 2017 and December 2023 are discussed in Table 4.3.6-4. For events prior to 2017, refer to the 2018 Rockland County HMP.

Table 4.3.6-4. Hazard Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
January 12, 2018	Flood	N/A	N/A	Tallman	Rain and continued snow melt resulted in river flooding along the Mahwah River near Suffern. After an average of 5 to 9 inches of snow the week before, rainfall totals across the region ranged from 1 to 3 inches. The Mahwah River near Suffern New York exceeded its flood stage of 4 feet and crested at a height of 4.42 feet.
April 16-17, 2018	Flood, Flash Flood	N/A	N/A	Spring Valley, Tallman	Heavy rainfall resulted in flash flooding across the region. Rainfall totals ranged from 1.5 to 3.5 inches across much the Lower Hudson Valley, with much of the rain falling in a 3 to 4-hour period. South Pascack Road was closed in Nanuet due to flooding of the Pascack Brook. A vehicle was partially submerged at the intersection of South Pascack Road and Forman Drive in Spring Valley due to flooding. The Mahwah River at Suffern rose above its flood stage of 4 feet, cresting at a height of 5.51 feet.
October 2, 2018	Flash Flood	N/A	N/A	Grassy Point	Multiple rounds of showers and thunderstorms developed and moved through the region. With wet conditions from recent rainfall, these showers and storms resulted in isolated flash flooding. Rainfall totals ranged from 1 to 3 inches. Heavy rain caused a small mudslide that blocked the intersection of East Main Street and Ba Mar Drive in Stony Point. The road had to be repaired by highway crews.
July 11, 2019	Flash Flood	N/A	N/A	Viola	Showers and thunderstorms developed, resulting in a several hour period of heavy rain. Rainfall totals ranged from 0.75 to 1.5 inches. College Road was impassable due to flooding in front of Rockland Community College in Viola.
June 8, 2021	Flash Flood	N/A	N/A	Piermont	Thunderstorms and showers developed, resulting in several reports of flash flooding. Rainfall amounts varied across the area, ranging from 1 to almost 3 inches. Widespread flooding was reported on Route 303 in Orangeburg with multiple occupied vehicles under water and fire department rescue units on scene performing water rescues.

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
July 2, 2021	Flash Flood	N/A	N/A	Piermont	Showers and thunderstorms slowly moved through the County, resulting in flash flooding. Rainfall amounts ranged from around 1 to 1.5 inches. NY 303 was closed due to flooding between Spruce Street and Orangeburg Road in Orangeburg.
August 22, 2021	Flash Flood	N/A	N/A	Germonds, Spring Valley, Central Nyack	Rainfall from Tropical Storm Henri resulted in widespread flash flooding across the Lower Hudson Valley. Rainfall totals ranged from 2 to 5 inches. North Main Street in Hillcrest and West Clarkstown Road in New City were closed due to flooding. The ramp from Route 303 to westbound Route 59 in Central Nyack was closed due to flooding with a car stranded.
September 1, 2021	Flash Flood	N/A	N/A	Monsey, Tallman Bear Mountain, Bardonia	Extremely heavy rainfall associated with the remnants of Hurricane Ida produced rainfall totals ranging from 5 to 8 inches across much of the region. Ultimately 17 people died because of the flash flooding, including 13 in New York City and four in the Lower Hudson Valley. Elaine Place in Monsey was closed due to flooding. Flash flooding resulted in an estimated \$3,126,485 in damages across Rockland County. This estimate is based on FEMA grant money awarded under the Individuals and Household Program, which includes funds for both housing assistance and other needs. Severe flooding was occurring on the Palisades Parkway between North Middletown Road (Exit 10) and New Hempstead Road (Exit 11) in New City. The Mahwah River near Suffern rose above its minor flood stage of 5.0 feet, then surpassed its moderate flood stage (7 feet) and crested at a height of 7.06 feet.
October 25, 2021	Flash Flood	N/A	N/A	Monsey Heights	Thunderstorms dropped 1 to 3 of rain over a several hour period. Total rainfall amounts of 2-4 were observed. All lanes were closed on Chestnut Ridge Road due to flooding caused by heavy rain.
April 7, 2022	Flood	N/A	N/A	Spring Valley, Suffern, Germonds, Pearl River, Central Nyack	Moderate to heavy rain produced 2 to 3 inches of rain over the Lower Hudson Valley. This resulted in river and poor drainage flooding. A car was submerged in floodwater on South Pascack Road. A residence filled with water on Route 59. Nine feet of water was reported in a basement on Hickory Street. There was a water rescue of an occupant from a vehicle stuck in floodwaters on Grotke Rd. Route 59 east and westbound had all lanes closed due to flooding between Rt 303 and Palisades Center Drive. Flooding conditions were reported at Pearl River High School.
December 23, 2022	Flash Flood	N/A	N/A	Viola	Heavy rainfall resulted in a widespread 1.5 to 3 inches of rainfall with localized areas of flash flooding and river flooding. Two lanes blocked on NY 306 due to flooding.

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
July 9, 2023	Flash Flood	FEMA-DR-4723	Yes	Tallman, Bear Mountain, Cedar Flats, Stony Point	A storm stalled overtop Rockland County, producing multiple rounds of torrential rainfall and heavy thunderstorms; rainfall rates reached 2-3 inches per hour at times. There were parts of the area that receive anywhere from 3-5 inches of rain in a several hour period with some spots seeing upwards of 8 inches. This allowed for the issuance of a localized Flash Flood Emergency for portion of the Lower Hudson Valley. Water rescues took place on Spook Rock Road and Joy Road. Flooding and a debris spill has closed 9W on Seven Lakes Drive. Flooding closed Palisades Interstate parkway at Gate Hill Road in both directions. Several roads were washed out near Cedar Brook.
September 29, 2023	Flash Flood	N/A	N/A	Viola	Persistent heavy rain developed, falling over the same areas for more than 12-18 hours. While the rainfall rates were generally 1 inch per hour or less, the persistence in the heavier rainfall resulted in a widespread total of 4-6 inches of rain. There were some brief periods of time where rainfall rates peaked at near 2 inches per hour. This resulted in widespread flash flooding. DOT reports flooding and road closure on NY 306 both directions at Edison Court.
December 18, 2023	Flash Flood, Flood	N/A	N/A	Countywide	An overnight storm caused significant damage in Rockland County. The Fire & Emergency Services Department reported flooding and trees down on several roadways including the Palisades Interstate Parkway (PIP), near the Palisades Mall, along Route 59 by Pascack Road near the Nanuet/Spring Valley border, and Long Mountain Circle which had reports of multiple vehicles stuck in water.

Sources: NOAA 2023

Probability of Future Occurrences

For the 2024 HMP update, best available data was used to collect hazard event details. These details were used to calculate the probability of future occurrence of hazard events in the County. Information from USACE, NOAA, and FEMA were used to identify the number of events that occurred between 1961 and 2023. Table 4.3.6-5 provides the calculated probability of future flood events in Rockland County.

Table 4.3.6-5. Probability of Future Flood Events in Rockland County

Hazard Type	Number of Occurrences Between 1961 and 2023	Percent Chance of Occurring in Any Given Year
Flash Flood	52	79.02%
Flood	35	54.84%
Ice Jam	2	0.03%
Stormwater/Urban Flood	N/A	N/A
Total	89	100%

Sources: USACE 2022; NOAA 2023; FEMA 2023

Notes: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act, and selected flood events since 1968. Due to limitations in data, not all flood events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

In Section 4.4, the identified hazards of concern for Rockland County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for flood in the County is considered ‘frequent’.

Climate Change Projections

Climate change affects the State of New York’s residents and resources. As the effects of climate change worsen, flooding impacts are expected to worsen as well.

The region encompassing Rockland County, which includes the Catskill Mountains and the West Hudson River Valley is expected to experience temperatures increases of 3.0 °F to 5.0 °F by the 2050s and 4.0 °F to 8.0 °F by the 2080s. Precipitation totals will increase up to 10 percent by the 2050s and 5 to 10 percent by the 2080s. Table 4.3.6-6 displays the projected seasonal precipitation change (NYSERDA 2014).

The projected increase in precipitation is expected to fall as heavy downpours. Downpours are very likely to increase in frequency and intensity, a change which has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways, and transportation hubs; and increase delays and hazards related to extreme weather events (NYSERDA 2014). Less frequent rainfall during the summer months may impact the potable water availability. A secondary impact of flooding which could occur due to climate change includes impacts from increasing water temperatures in rivers and streams which will affect aquatic health and reduce the capacity of streams to assimilate effluent wastewater treatment plants (NYSERDA 2014).

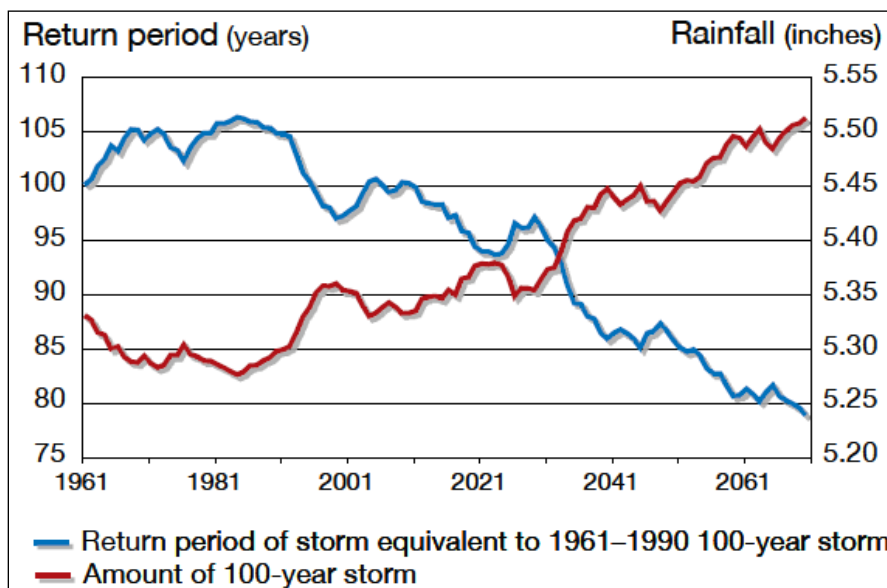
Table 4.3.6-6. Projected Seasonal Precipitation Change in the Catskill Mountains and West Hudson River Valley, 2050s (% change)

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: *NYSERDA 2014*

Figure 4.3.6-10 displays the projected rainfall and frequency of extreme storms in the State of New York. The amount of rainfall in a 100-year event is projected to increase, while the number of years between such storms (return period) is projected to decrease, meaning extreme storms will become more severe and more frequent in Rockland County (NYSERDA 2014).

Figure 4.3.6-10. Projected Rainfall and Frequency of Extreme Storms



Source: NYSERDA 2014

Warming atmospheric temperatures influence ocean temperatures. With the projected increase in temperature, it is anticipated that ocean waters will increase as well, causing ice sheets and glaciers to melt, increasing the level of the ocean’s waters. Sea level rise will lead to more frequent and extensive flooding from severe storms, particularly heavy rains in Rockland County. Rising sea levels can impact the severity of coastal and tidal flooding, such as that of the Hudson River, as floodwaters will reach farther in land than previously seen. This will not only raise impacts seen in communities along the tidal Hudson River, but also result in impacts to inland communities as well. These inland communities who rarely experience flooding in the tributaries of the Hudson River may not be equipped to mitigate and respond to such hazards.

In 2024, the New York State Department of Environmental Conservation (NYSDEC) proposed an amendment to new Part 490 of Title 6 of New York Codes, Rules, and Regulations (6 NYCRR), “Projected Sea-level Rise” (Part 490). The amendment does not impose any compliance obligations or mandates on local governments or other entities. However, the proposed amendment establishes up-to-date science-based projections for future sea level rise for multiple scenarios modeled for the New York State Climate Impacts Assessment. The proposed projections for the region encompassing Rockland County are shown in **TABLE REFERENCE**.

TABLE REFERENCE: 6 NYCRR Part 490 Sea Level Rise Projections for the Lower Hudson-New York City Region

Time Interval	Low Projection	Low-Medium Projection	Medium Projection	High-Medium Projection	High Projection	Rapid Ice Melt Scenario
2030s	6 inches	7 inches	9 inches	11 inches	13 inches	N/A
2050s	12 inches	14 inches	16 inches	19 inches	23 inches	N/A
2080s	21 inches	25 inches	30 inches	39 inches	45 inches	83 inches
2100	25 inches	30 inches	36 inches	50 inches	65 inches	114 inches
2150	38 inches	47 inches	59 inches	89 inches	177 inches	N/A

Source: NYSDEC 2024

Vulnerability Assessment

To assess Rockland County’s risk to the flood hazard, a spatial analysis was conducted using the FEMA Risk Map effective 2023. The 1-percent annual chance flood event was further examined to estimate potential loss using the FEMA Hazus model. These results are summarized below. Refer to Section 4.2 (Methodology and Tools) for additional details on the methodology used to assess flood risk.

Impact on Life, Health, and Safety

The impact of flooding on life, health, and safety depends on several factors, including the severity of the event and whether adequate warning time is provided to residents. The total number of injuries and casualties resulting from flooding is generally limited based on advance weather forecasting, blockades, and warnings. More likely, persons could become displaced from their homes or may seek shelter due to the impacts of a flood event. 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.

To estimate population exposure to the 1-percent and 0.2-percent annual chance flood events, the DFIRM flood boundaries were used. Based on the spatial analysis, there are an estimated 3,567 residents living in the 1-percent annual chance floodplain, or 1.1 percent of the County’s total population. The Village of Suffern has the greatest number of residents living in the floodplain, with approximately 602 residents living in the 1-percent annual chance floodplain. Based on the same analysis, there are an estimated 8,401 residents living in the 0.2-percent annual chance floodplain, or 2.5 percent of the County’s total population. The Town of Clarkstown has the greatest number of residents living in the floodplain, with approximately 1,218 residents living in the 0.2-percent annual chance floodplain. Table 4.3.6-7 summarizes the population exposed to the flood hazard by jurisdiction.

Table 4.3.6-7. Estimated Population Exposed to the 1-percent and 0.2-percent Annual Chance Flood Event Hazard Area

Jurisdiction	Total Population (Decennial Population 2020)	Estimated Population Located in the Flood Hazard Area			
		Number of Persons Located in the 1-percent Annual Chance Flood Event Hazard Area	Percent of Total	Number of Persons Located in the 0.2-percent Annual Chance Flood Event Hazard Area	Percent of Total
Airmont, Village of	9,964	48	0.5%	61	0.6%
Chestnut Ridge, Village of	10,211	46	0.5%	67	0.7%
Clarkstown, Town of	81,385	547	0.7%	1,218	1.5%
Grand View on Hudson, Village of	241	6	2.5%	240	99.6%
Haverstraw, Town of	14,028	18	0.1%	46	0.3%
Haverstraw, Village of	12,292	6	0.0%	64	0.5%
Hillburn, Village of	1,110	15	1.4%	17	1.5%
Kaser, Village of	5,433	33	0.6%	99	1.8%
Montebello, Village of	4,665	212	4.5%	325	7.0%
New Hempstead, Village of	5,440	28	0.5%	42	0.8%
New Square, Village of	9,433	94	1.0%	141	1.5%
Nyack, Village of	7,303	8	0.1%	327	4.5%
Orangetown, Town of	36,127	197	0.5%	818	2.3%
Piermont, Village of	2,525	278	11.0%	977	38.7%

Jurisdiction	Total Population (Decennial Population 2020)	Estimated Population Located in the Flood Hazard Area			
		Number of Persons Located in the 1-percent Annual Chance Flood Event Hazard Area	Percent of Total	Number of Persons Located in the 0.2-percent Annual Chance Flood Event Hazard Area	Percent of Total
Pomona, Village of	3,306	39	1.2%	39	1.2%
Ramapo, Town of	48,846	298	0.6%	532	1.1%
Sloatsburg, Village of	3,043	84	2.8%	199	6.5%
South Nyack, Village of	2,803	5	0.2%	1,137	40.6%
Spring Valley, Village of	32,953	588	1.8%	708	2.1%
Stony Point, Town of	14,876	378	2.5%	468	3.1%
Suffern, Village of	11,376	602	5.3%	792	7.0%
Upper Nyack, Village of	2,355	2	0.1%	2	0.1%
Wesley Hills, Village of	6,105	7	0.1%	18	0.3%
West Haverstraw, Village of	10,665	28	0.3%	64	0.6%
Rockland County (Total)	336,485	3,567	1.1%	8,401	2.5%

Source: U.S. Census Bureau, American Community Survey 5-Year Estimates 2017-2021; FEMA 2023

In addition, displaced populations were estimated for the 1-percent annual chance flood event. It is important to note that the impacts to the households in the FEMA flood hazard area are assessed using the riverine flood model in Hazus. Using 2021 ACS data, Hazus estimates 5,570 would be displaced as a result of a 1-percent annual chance flood event and 2,048 people may seek short-term sheltering. These statistics, by jurisdiction, are presented in Table 4.3.6-8.

Table 4.3.6-8. Estimated Population Seeking Short-Term Shelter from the 1-percent Annual Chance Flood Event

Jurisdiction	Total Population (American Community Survey 2021)	1-Percent Annual Chance Flood Event	
		Displaced Population	Persons Seeking Short-Term Sheltering
Airmont, Village of	9,964	75	42
Chestnut Ridge, Village of	10,211	74	38
Clarkstown, Town of	81,385	1,054	339
Grand View on Hudson, Village of	241	5	0
Haverstraw, Town of	14,028	47	23
Haverstraw, Village of	12,292	145	60
Hillburn, Village of	1,110	11	7
Kaser, Village of	5,433	72	72
Montebello, Village of	4,665	182	20
New Hempstead, Village of	5,440	40	3
New Square, Village of	9,433	74	73
Nyack, Village of	7,303	29	17
Orangetown, Town of	36,127	324	62
Piermont, Village of	2,525	225	10
Pomona, Village of	3,306	29	10
Ramapo, Town of	48,846	579	292
Sloatsburg, Village of	3,043	160	44
South Nyack, Village of	2,803	3	3
Spring Valley, Village of	32,953	1,535	713
Stony Point, Town of	14,876	221	53

Jurisdiction	Total Population (American Community Survey 2021)	1-Percent Annual Chance Flood Event	
		Displaced Population	Persons Seeking Short-Term Sheltering
Suffern, Village of	11,376	497	76
Upper Nyack, Village of	2,355	3	3
Wesley Hills, Village of	6,105	14	7
West Haverstraw, Village of	10,665	172	81
Rockland County (Total)	336,485	5,570	2,048

Source: U.S. Census Bureau, American Community Survey 5-Year Estimates 2017-2021; FEMA 2023

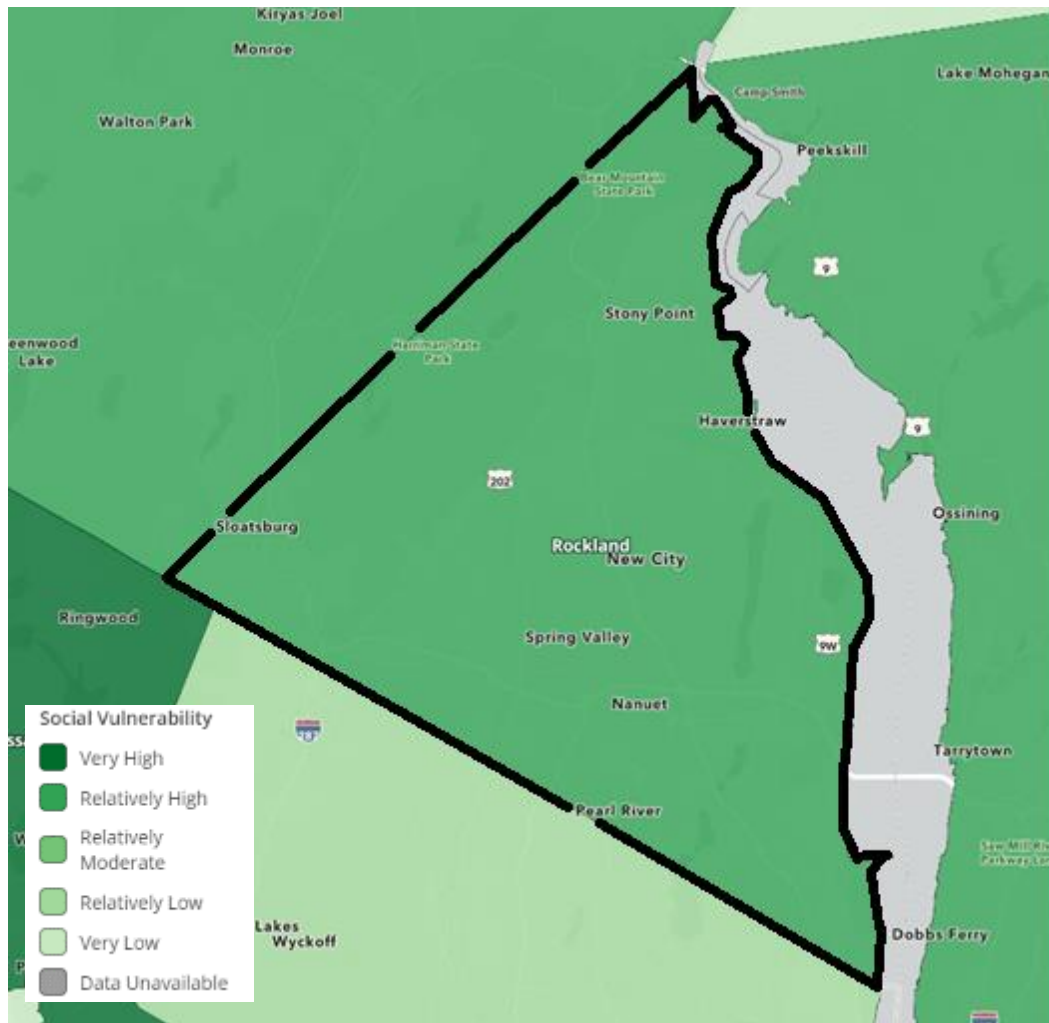
Socially Vulnerable Population

Social vulnerability is defined as the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood. Social vulnerability considers the social, economic, demographic, and housing characteristics of a community that influence its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards.

Socially vulnerable populations are most susceptible to flood events based on several factors, including their physical and financial ability to react or respond during a flood. Vulnerable populations include homeless persons, elderly (over 65 years old), low income or linguistically isolated populations, people with life-threatening illnesses, and residents that may struggle to evacuate. The population over the age of 65 is also more vulnerable. They may require extra time to evacuate or need assistance to evacuate and are more likely to seek or need medical attention.

Table 4.3.6-9 presents the estimated socially vulnerable populations located in the 1-percent annual chance flood hazard area. Of the 3,567 persons located in the 1-percent annual chance flood hazard area, there are 560 persons over the age of 65 years, 250 persons under the age of five years, 321 non-English speakers, 297 persons with a disability, and 454 living in poverty. For the purpose of this HMP and as determined by the Steering Committee, ALICE data for Rockland County was used to determine the number of households and individuals that earn more than the federal poverty level but not enough to afford the basics (e.g., housing, childcare, food, transportation, health care, and utilities) where they live. According to the ALICE data, there are 1,251 persons (1.1 percent of the County’s total population) living below the ALICE threshold (\$48,048 annually for a single adult) within the 1-percent annual chance flood hazard area. Refer to Figure 4.3.6-11 for a map indicating the social vulnerability index for riverine flooding in Rockland County.

Figure 4.3.6-11. FEMA Social Vulnerability Index for Riverine Flooding



Source: FEMA n.d.

Table 4.3.6-9. Estimated Vulnerable Persons Located Within the 1-Percent Annual Chance Flood Hazard Area

Jurisdiction	Estimated Vulnerable Persons Located Within the 1-Percent Flood Hazard Area											
	Over 65	Percent of Total	Under 5	Percent of Total	Non-English Speaking	Percent of Total	Disability	Percent of Total	Poverty Level	Percent of Total	Living Below ALICE	Percent of Total
Airmont, Village of	7	0.5%	3	0.5%	1	0.3%	3	0.4%	5	0.5%	12	0.5%
Chestnut Ridge, Village of	7	0.4%	6	0.4%	2	0.3%	5	0.4%	8	0.4%	8	0.4%
Clarkstown, Town of	112	0.7%	25	0.7%	28	0.7%	54	0.7%	23	0.6%	152	0.7%
Grand View on Hudson, Village of	1	1.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Haverstraw, Town of	3	0.1%	1	0.1%	1	0.1%	1	0.1%	1	0.1%	6	0.1%
Haverstraw, Village of	0	0.0%	0	0.0%	1	0.0%	0	0.0%	0	0.0%	2	0.0%
Hillburn, Village of	2	1.2%	1	0.9%	0	0.0%	1	0.7%	2	1.3%	4	1.1%
Kaser, Village of	1	0.6%	8	0.6%	8	0.6%	0	0.0%	20	0.6%	7	0.6%
Montebello, Village of	25	4.4%	8	4.1%	7	4.2%	13	4.3%	23	4.5%	26	4.4%
New Hempstead, Village of	4	0.5%	1	0.4%	0	0.0%	1	0.3%	0	0.0%	2	0.5%
New Square, Village of	2	1.0%	15	1.0%	16	1.0%	3	0.9%	57	1.0%	15	0.9%
Nyack, Village of	1	0.1%	0	0.0%	0	0.0%	1	0.1%	0	0.0%	4	0.1%
Orangetown, Town of	37	0.5%	9	0.5%	5	0.5%	19	0.5%	8	0.5%	68	0.5%
Piermont, Village of	59	10.9%	15	10.6%	15	10.6%	19	10.5%	5	10.4%	133	11.0%
Pomona, Village of	7	1.1%	2	0.8%	1	0.9%	3	1.0%	1	0.9%	6	1.2%
Ramapo, Town of	28	0.6%	43	0.6%	7	0.6%	14	0.6%	99	0.6%	115	0.6%
Sloatsburg, Village of	14	2.7%	5	2.5%	1	1.5%	10	2.6%	4	2.4%	39	2.7%
South Nyack, Village of	1	0.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.1%
Spring Valley, Village of	56	1.8%	66	1.8%	173	1.8%	49	1.8%	142	1.8%	239	1.8%
Stony Point, Town of	67	2.5%	15	2.5%	6	2.3%	41	2.5%	16	2.4%	111	2.5%
Suffern, Village of	122	5.3%	25	5.1%	45	5.2%	58	5.3%	37	5.2%	288	5.3%
Upper Nyack, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Wesley Hills, Village of	1	0.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.1%
West Haverstraw, Village of	3	0.2%	2	0.2%	4	0.2%	2	0.2%	3	0.2%	12	0.3%
Rockland County (Total)	560	1.1%	250	0.9%	321	1.2%	297	1.0%	454	0.9%	1,251	1.1%

Source: U.S. Census Bureau, American Community Survey 5-Year Estimates 2017-2021; Poverty Populations: ALICE 2021; FEMA 2023

Impact on General Building Stock

After considering the population exposed and potentially vulnerable to the flood hazard, the built environment was evaluated. Exposure includes those buildings located in the flood hazard areas. Potential damage is the modeled loss that could occur to the exposed inventory, including structural and content replacement cost values.

Table 4.3.6-10 and Table 4.3.6-11 summarize the number of structures located in the 1-percent and 0.2-percent annual chance flood events by jurisdiction. In summary, there are 1,448 buildings (1.3 percent of the total building stock) located in the 1-percent annual chance flood hazard area with an estimated \$1.3 billion of replacement cost value (e.g., building and content replacement costs). There are 3,409 buildings (3 percent of the total building stock) located in the 0.2-percent annual chance flood hazard area with an estimated \$2.7 billion of replacement cost value.

Table 4.3.6-12 provides the estimated building stock potential loss, by occupancy class, to the 1-percent annual chance flood event. Estimated losses for all occupancies is \$588 million, of which \$227 million is residential properties, \$162 million is commercial properties, and \$198 million is other occupancies.

Table 4.3.6-10. Estimated Building Stock Located in the 1-Percent Annual Chance Flood Hazard Area

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Building Stock Located in the Flood Hazard Area			
			Number of Buildings Located in the 1-Percent Annual Chance Flood Event Hazard Area	Percent of Total	Total Replacement Cost of Buildings in the 1-Percent Annual Chance Flood Event Hazard Area	Percent of Total
Airmont, Village of	4,324	\$2,712,726,498	25	0.6%	\$9,685,487	0.4%
Chestnut Ridge, Village of	3,996	\$2,590,102,202	20	0.5%	\$13,263,840	0.5%
Clarkstown, Town of	34,094	\$22,578,694,610	270	0.8%	\$299,184,405	1.3%
Grand View on Hudson, Village of	219	\$123,746,894	7	3.2%	\$5,415,049	4.4%
Haverstraw, Town of	5,157	\$14,687,792,118	34	0.7%	\$79,984,088	0.5%
Haverstraw, Village of	2,232	\$1,373,775,543	8	0.4%	\$135,998,296	9.9%
Hillburn, Village of	499	\$340,797,550	6	1.2%	\$1,928,934	0.6%
Kaser, Village of	197	\$434,976,786	1	0.5%	\$826,942	0.2%
Montebello, Village of	2,002	\$1,957,771,278	97	4.8%	\$47,927,094	2.4%
New Hempstead, Village of	2,074	\$1,416,579,766	22	1.1%	\$14,953,982	1.1%
New Square, Village of	455	\$640,979,013	4	0.9%	\$2,540,868	0.4%
Nyack, Village of	1,830	\$1,930,474,072	2	0.1%	\$490,461	0.0%
Orangetown, Town of	18,439	\$19,240,363,073	156	0.8%	\$123,958,932	0.6%
Piermont, Village of	841	\$520,681,014	97	11.5%	\$36,190,492	7.0%
Pomona, Village of	1,437	\$947,429,629	17	1.2%	\$7,897,582	0.8%
Ramapo, Town of	9,783	\$7,401,302,608	74	0.8%	\$174,763,227	2.4%
Sloatsburg, Village of	1,776	\$780,218,848	54	3.0%	\$20,168,393	2.6%
South Nyack, Village of	1,009	\$628,994,780	2	0.2%	\$705,215	0.1%
Spring Valley, Village of	3,468	\$2,977,580,954	92	2.7%	\$94,304,345	3.2%
Stony Point, Town of	8,819	\$4,492,546,145	256	2.9%	\$95,601,135	2.1%
Suffern, Village of	3,110	\$2,011,976,760	184	5.9%	\$62,437,520	3.1%
Upper Nyack, Village of	1,121	\$714,087,836	1	0.1%	\$598,545	0.1%
Wesley Hills, Village of	2,432	\$1,597,464,375	3	0.1%	\$1,412,252	0.1%
West Haverstraw, Village of	3,171	\$1,575,031,545	16	0.5%	\$76,676,435	4.9%
Rockland County (Total)	112,485	\$93,676,093,896	1,448	1.3%	\$1,306,913,522	1.4%

Source: Rockland County, NYS Office of Information Technology Services Geospatial Services and NYS Department of Taxation and Finance’s Office of Real Property Tax Services (ORPTS) 2022; Center for International Earth Science Information Network, New York State Energy Research and Development Authority 2022; U.S. Army Corps of Engineers, National Structure Inventory 2022; RS Means 2022; FEMA 2023

Table 4.3.6-11. Estimated Building Stock Located in the 0.2-Percent Annual Chance Flood Hazard Area

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Building Stock Located in the Flood Hazard Area			
			Number of Buildings Located in the 0.2-Percent Annual Chance Flood Event Hazard Area	Percent of Total	Total Replacement Cost of Buildings in the 0.2-Percent Annual Chance Flood Event Hazard Area	Percent of Total
Airmont, Village of	4,324	\$2,712,726,498	31	0.7%	\$16,812,928	0.6%
Chestnut Ridge, Village of	3,996	\$2,590,102,202	28	0.7%	\$17,297,182	0.7%
Clarkstown, Town of	34,094	\$22,578,694,610	577	1.7%	\$497,689,163	2.2%
Grand View on Hudson, Village of	219	\$123,746,894	219	100.0%	\$123,746,894	100.0%
Haverstraw, Town of	5,157	\$14,687,792,118	49	1.0%	\$109,132,872	0.7%
Haverstraw, Village of	2,232	\$1,373,775,543	20	0.9%	\$142,011,756	10.3%
Hillburn, Village of	499	\$340,797,550	15	3.0%	\$37,790,358	11.1%
Kaser, Village of	197	\$434,976,786	3	1.5%	\$1,371,444	0.3%
Montebello, Village of	2,002	\$1,957,771,278	144	7.2%	\$81,510,816	4.2%
New Hempstead, Village of	2,074	\$1,416,579,766	27	1.3%	\$17,417,053	1.2%
New Square, Village of	455	\$640,979,013	6	1.3%	\$4,220,601	0.7%
Nyack, Village of	1,830	\$1,930,474,072	75	4.1%	\$24,650,111	1.3%
Orangetown, Town of	18,439	\$19,240,363,073	479	2.6%	\$443,858,952	2.3%
Piermont, Village of	841	\$520,681,014	327	38.9%	\$150,356,167	28.9%
Pomona, Village of	1,437	\$947,429,629	17	1.2%	\$7,897,582	0.8%
Ramapo, Town of	9,783	\$7,401,302,608	119	1.2%	\$195,841,233	2.6%
Sloatsburg, Village of	1,776	\$780,218,848	129	7.3%	\$54,375,688	7.0%
South Nyack, Village of	1,009	\$628,994,780	421	41.7%	\$363,140,571	57.7%
Spring Valley, Village of	3,468	\$2,977,580,954	112	3.2%	\$127,304,257	4.3%
Stony Point, Town of	8,819	\$4,492,546,145	322	3.7%	\$122,246,188	2.7%
Suffern, Village of	3,110	\$2,011,976,760	248	8.0%	\$96,988,984	4.8%
Upper Nyack, Village of	1,121	\$714,087,836	2	0.2%	\$9,586,136	1.3%
Wesley Hills, Village of	2,432	\$1,597,464,375	7	0.3%	\$3,746,093	0.2%
West Haverstraw, Village of	3,171	\$1,575,031,545	32	1.0%	\$93,886,277	6.0%
Rockland County (Total)	112,485	\$93,676,093,896	3,409	3.0%	\$2,742,879,304	2.9%

Source: Rockland County, NYS Office of Information Technology Services Geospatial Services and NYS Department of Taxation and Finance’s Office of Real Property Tax Services (ORPTS) 2022; Center for International Earth Science Information Network, New York State Energy Research and Development Authority 2022; U.S. Army Corps of Engineers, National Structure Inventory 2022; RS Means 2022; FEMA 2023

Table 4.3.6-12. Estimated Building Stock Potential Loss by Occupancy to the 1-Percent Annual Chance Flood Event

Jurisdiction	Estimated Loss for All Occupancies	Estimated Loss for Residential Properties	Estimated Loss for Commercial Properties	Estimated Loss for All Other Occupancies
Airmont, Village of	\$6,784,907	\$4,963,412	\$127,848	\$1,693,647
Chestnut Ridge, Village of	\$4,607,962	\$4,124,964	\$0	\$482,998
Clarkstown, Town of	\$187,797,524	\$55,646,740	\$107,408,782	\$24,742,002
Grand View on Hudson, Village of	\$1,436,434	\$511,303	\$0	\$925,131
Haverstraw, Town of	\$25,327,966	\$1,928,281	\$2,617,980	\$20,781,705
Haverstraw, Village of	\$46,288,163	\$9,270	\$0	\$46,278,893
Hillburn, Village of	\$967,273	\$967,273	\$0	\$0
Kaser, Village of	\$534,756	\$534,756	\$0	\$0
Montebello, Village of	\$32,560,791	\$28,337,700	\$99,520	\$4,123,571
New Hempstead, Village of	\$2,095,430	\$1,659,506	\$0	\$435,925
New Square, Village of	\$2,328,357	\$2,328,357	\$0	\$0
Nyack, Village of	\$200,505	\$200,505	\$0	\$0
Orangetown, Town of	\$55,127,155	\$13,378,141	\$18,370,317	\$23,378,697
Piermont, Village of	\$5,708,587	\$5,045,283	\$663,304	\$0
Pomona, Village of	\$388,495	\$388,495	\$0	\$0
Ramapo, Town of	\$20,347,226	\$17,683,113	\$2,464,570	\$199,544
Sloatsburg, Village of	\$14,464,415	\$10,377,627	\$3,673,818	\$412,969
South Nyack, Village of	\$104,607	\$104,607	\$0	\$0
Spring Valley, Village of	\$44,434,225	\$23,690,842	\$13,094,767	\$7,648,617
Stony Point, Town of	\$41,300,866	\$24,029,536	\$5,541,257	\$11,730,072
Suffern, Village of	\$44,639,151	\$28,921,630	\$7,496,155	\$8,221,365
Upper Nyack, Village of	\$261,365	\$261,365	\$0	\$0
Wesley Hills, Village of	\$1,689,861	\$1,689,861	\$0	\$0
West Haverstraw, Village of	\$49,537,328	\$1,207,697	\$965,101	\$47,364,529
Rockland County (Total)	\$588,933,347	\$227,990,261	\$162,523,421	\$198,419,666

Source: Hazus v6.0

Note: These values are rounded to the nearest dollar/whole value.

NFIP Statistics

Participating in the NFIP is voluntary and to join, a community must complete an application; adopt a resolution of intent to participate and cooperate with FEMA; and adopt and submit a floodplain management ordinance that meets or exceeds the minimum NFIP criteria, and the ordinance must also adopt any FIRM or FHBM for the community. By participating, communities agree to adopt and implement local floodplain management regulations that protect lives and reduce risk from future flooding. In return, the federal government makes flood insurance available to property owners throughout the community (FEMA 2020) (FEMA 2022). Table 4.3.6-13 summarizes the NFIP community statistics for Rockland County. All 24 municipalities participate in the NFIP.

Table 4.3.6-13. NFIP Community Statistics for Rockland County

Community Name	Community Identification Number	Participates in the NFIP?
Airmont, Village of	360140	Yes
Chestnut Ridge, Village of	361615	Yes
Clarkstown, Town of	360679	Yes
Grand View on Hudson, Village of	360680	Yes
Haverstraw, Town of	360681	Yes
Haverstraw, Village of	360682	Yes
Hillburn, Village of	360683	Yes
Kaser, Village of	365376	Yes
Montebello, Village of	361617	Yes
New Hempstead, Village of	361618	Yes
New Square, Village of	360684	Yes
Nyack, Village of	360685	Yes
Orangetown, Town of	360686	Yes
Piermont, Village of	360687	Yes
Pomona, Village of	360688	Yes
Ramapo, Town of	365340	Yes
Sloatsburg, Village of	360690	Yes
South Nyack, Village of	360691	Yes
Spring Valley, Village of	365344	Yes
Stony Point, Town of	360693	Yes
Suffern, Village of	360694	Yes
Upper Nyack, Village of	360695	Yes
Wesley Hills, Village of	361616	Yes
West Haverstraw, Village of	360696	Yes

Source: FEMA 2022

Table 4.3.6-14 summarizes NFIP policies, claims, and repetitive loss statistics for Rockland County. Locations of the properties with policies, claims, and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that differences (and variations in those differences) were possible between listed longitude and latitude coordinates of properties and actual locations of property addresses—namely, that indications of some locations were more accurate than others.

Table 4.3.6-14. NFIP Policies, Claims, and Repetitive Loss Statistics

Jurisdiction	Number of Policies	Total Paid Policies	Number of Claims	Total Paid Claims	NFIP		FMA	
					RL Properties	SRL Properties	RL Properties	SRL Properties
Airmont, Village of	2	\$1,131	2	\$17,742	0	0	0	0
Chestnut Ridge, Village of	17	\$10,226	13	\$184,281	1	0	0	0
Clarkstown, Town of	322	\$245,945	941	\$9,346,749	99	16	1	18
Grand View on Hudson, Village of	20	\$17,296	46	\$1,296,282	4	1	0	0
Haverstraw, Town of	17	\$13,136	55	\$390,221	4	0	0	0
Haverstraw, Village of	13	\$80,105	7	\$7,768	0	0	0	0
Hillburn, Village of	3	\$4,425	33	\$1,222,574	2	1	0	1
Kaser, Village of	2	\$1,076	0	\$0	0	0	0	0

Jurisdiction	Number of Policies	Total Paid Policies	Number of Claims	Total Paid Claims	NFIP		FMA	
					RL Properties	SRL Properties	RL Properties	SRL Properties
Montebello, Village of	35	\$46,521	55	\$1,404,227	6	0	1	0
New Hempstead, Village of	9	\$7,860	6	\$44,138	1	0	0	0
New Square, Village of	0	\$0	9	\$27,452	1	0	0	0
Nyack, Village of	22	\$34,915	85	\$2,497,954	9	2	0	2
Orangetown, Town of	115	\$123,854	362	\$5,668,545	33	5	3	5
Piermont, Village of	97	\$118,937	131	\$4,725,881	15	3	2	3
Pomona, Village of	14	\$10,950	29	\$97,455	3	0	0	0
Ramapo, Town of	44	\$60,266	422	\$1,972,984	40	0	0	0
Sloatsburg, Village of	25	\$36,980	58	\$595,914	8	1	1	1
South Nyack, Village of	10	\$10,094	27	\$559,165	3	1	0	1
Spring Valley, Village of	29	\$43,417	254	\$1,469,991	29	4	0	4
Stony Point, Town of	56	\$62,159	97	\$3,170,230	4	0	2	0
Suffern, Village of	62	\$118,237	432	\$4,914,588	29	3	0	4
Upper Nyack, Village of	13	\$12,887	13	\$227,317	1	1	1	1
Wesley Hills, Village of	12	\$6,938	7	\$90,283	0	0	0	0
West Haverstraw, Village of	23	\$57,780	29	\$3,917,935	0	0	0	0
Rockland County (Total)	962	\$1,125,135	3,113	\$43,849,675	292	38	11	40

Source: FEMA 2023

Notes: Data current as of December 2023

RL count may include properties also identified as SRL

Table 4.3.6-15. Occupancy Class of Repetitive Loss (NFIP) Structures in Rockland County

Jurisdiction	NFIP										FMA									
	RL					SRL					RL				SRL					
	2-4 Family	Other Residential	Single Family	Other Non-Residential	Business Non-Residential	2-4 Family	Other Residential	Single Family	Other Non-Residential	Business Non-Residential	2-4 Family	Other Residential	Single Family	Other Non-Residential	Business Non-Residential	2-4 Family	Other Residential	Single Family	Other Non-Residential	Business Non-Residential
Airmont, Village of	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chestnut Ridge, Village of	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clarkstown, Town of	2	1	90	5	1	14	0	0	1	1	0	0	1	0	0	0	0	14	3	1
Grand View on Hudson, Village of	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Haverstraw, Town of	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haverstraw, Village of	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hillburn, Village of	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Kaser, Village of	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Montebello, Village of	0	0	6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
New Hempstead, Village of	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Square, Village of	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nyack, Village of	1	3	3	1	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1

Jurisdiction	NFIP										FMA									
	RL					SRL					RL				SRL					
	2-4 Family	Other Residential	Single Family	Other Non-Residential	Business Non-Residential	2-4 Family	Other Residential	Single Family	Other Non-Residential	Business Non-Residential	2-4 Family	Other Residential	Single Family	Other Non-Residential	Business Non-Residential	2-4 Family	Other Residential	Single Family	Other Non-Residential	Business Non-Residential
Orangetown, Town of	1	0	31	1	0	4	0	0	1	0	0	0	3	0	0	0	0	4	1	0
Piermont, Village of	4	0	11	0	0	3	0	0	0	0	1	0	1	0	0	0	0	3	0	0
Pomona, Village of	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ramapo, Town of	1	1	35	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sloatsburg, Village of	0	0	7	1	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0
South Nyack, Village of	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Spring Valley, Village of	0	3	26	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Stony Point, Town of	0	0	4	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Suffern, Village of	0	0	27	2	0	3	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Upper Nyack, Village of	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0
Wesley Hills, Village of	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
West Haverstraw, Village of	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rockland County (Total)	11	8	257	14	2	33	0	0	3	2	1	0	10	0	0	0	0	34	5	2

Source: NFIP 2023

Note: RL count may include properties also identified as SRL

Impact on Critical Facilities and Community Lifelines

Critical services during and after a flood event may not be available 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 get to 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 or the surge of water from a dam failure event. Loss of these utilities could create additional isolation issues for the inundation zones (refer to Section 4.3.1 Dam Failure).

Major roadways that may be impacted by the 1- and 0.2-percent annual chance flood events include Route 202, Route 17, portions of Route 303 and Route 340, and other various state and county roads. There are several issues associated with transportation routes flooding, including isolation caused by bridges being washed out or blocked by floods or debris, health problems caused by water and sewer systems that are flooded or backed up, drinking water contamination caused by floodwaters carrying pollutants in water supplies, and localized urban flooding caused by culverts blocked with debris.

Community lifeline exposure to the 1-percent and 0.2-percent annual chance flood hazard event boundary was examined. In addition, Hazus was used to estimate the flood loss potential to community lifelines located in the FEMA mapped floodplains. Table 4.3.6-16 summarizes the number of community lifelines exposed to the 1-percent and 0.2-percent flood inundation areas by jurisdiction. Of the 82 community lifelines located in the 1-percent annual chance flood event boundary, Safety and Security has the majority of facilities (59). Out of the 98 community lifelines located in the 0.2-percent annual chance flood event boundary, Safety and Security has the

majority of facilities (67). Refer to Section 3 (County Profile) for more information about the critical facilities and lifelines in Rockland County.

In cases where short-term functionality is impacted by flooding, other facilities of neighboring municipalities may need to increase support response functions during a disaster event. Mitigation planning should consider means to reduce flood impacts to critical facilities and ensure sufficient emergency and school services remain when a significant event occurs.

Table 4.3.6-16. Number of Lifeline Critical Facilities Located in the Annual Chance Flood Hazard Area

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines Located in the 1-Percent Annual Chance Flood Event Hazard Area	Number of Lifelines Located in the 0.2-Percent Annual Chance Flood Event Hazard Area
Communications	154	6	8
Energy	0	0	0
Food, Water, Shelter	71	0	0
Hazardous Materials	56	1	1
Health and Medical	195	2	6
Safety and Security	349	59	67
Transportation	8	0	0
Water Systems	148	14	16
Rockland County (Total)	981	82	98

Table 4.3.6-17. Critical Facilities and Lifeline Facilities Located in the 1-Percent Annual Chance Flood Event Hazard Area by Jurisdiction

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Located in the 1-Percent Annual Chance Flood Event Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Airmont, Village of	61	40	8	13.1%	8	20.0%
Chestnut Ridge, Village of	46	30	1	2.2%	1	3.3%
Clarkstown, Town of	406	230	17	4.2%	14	6.1%
Grand View on Hudson, Village of	1	1	0	0.0%	0	0.0%
Haverstraw, Town of	96	68	4	4.2%	4	5.9%
Haverstraw, Village of	65	30	0	0.0%	0	0.0%
Hillburn, Village of	20	12	2	10.0%	2	16.7%
Kaser, Village of	18	1	0	0.0%	0	0.0%
Montebello, Village of	47	37	11	23.4%	11	29.7%
New Hempstead, Village of	30	12	0	0.0%	0	0.0%
New Square, Village of	19	4	0	0.0%	0	0.0%
Nyack, Village of	64	35	1	1.6%	0	0.0%
Orangetown, Town of	243	129	3	1.2%	3	2.3%
Piermont, Village of	23	10	5	21.7%	3	30.0%
Pomona, Village of	8	5	0	0.0%	0	0.0%
Ramapo, Town of	219	109	10	4.6%	10	9.2%

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Located in the 1-Percent Annual Chance Flood Event Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Sloatsburg, Village of	32	22	6	18.8%	5	22.7%
South Nyack, Village of	13	7	0	0.0%	0	0.0%
Spring Valley, Village of	119	58	6	5.0%	3	5.2%
Stony Point, Town of	108	75	9	8.3%	6	8.0%
Suffern, Village of	42	28	6	14.3%	6	21.4%
Upper Nyack, Village of	11	5	0	0.0%	0	0.0%
Wesley Hills, Village of	22	12	3	13.6%	3	25.0%
West Haverstraw, Village of	40	21	3	7.5%	3	14.3%
Rockland County (Total)	1,753	981	95	5.4%	82	8.4%

Source: Rockland County 2023; FEMA 2023; NYSDHSES; USGS, Godt; Radeloff et al

Impact on the Economy

Flood events can significantly impact the local and regional economy. This includes but is not limited to general building stock damages and associated tax loss, impacts to utilities and infrastructure, business interruption, impacts on tourism, and impacts on the tax base to Rockland County. In areas that are directly flooded, renovations of commercial and industrial buildings may be necessary, disrupting associated services. Refer to the ‘Impact on General Building Stock’ subsection earlier which discusses direct impacts to buildings in Rockland County. Other economic components such as loss of facility use, functional downtime and socio-economic factors are less measurable with a high degree of certainty.

Flooding can cause extensive damage to public utilities and 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. Table 4.3.6-18 discusses building-related economic losses due to the 1-percent annual chance flood event. In areas that are directly flooded, renovations of commercial and industrial buildings may be necessary, disrupting associated services. The Impact on General Building Stock subsection above discusses replacement cost value for buildings located in flood zones.

Table 4.3.6-18. Building-Related Economic Loss Estimates from the 1-Percent Annual Chance Flood Event

Total Business Interruption Loss					
Flood Hazard	Inventory Loss	Relocation Loss	Wage Loss	Rental Loss	Income Loss
1-Percent Annual Chance Flood Event	\$37,760,000	\$63,140,000	\$150,180,000	\$32,400,000	\$80,210,000

Source: Hazus v6.0

Debris management may also be a large expense after a flood event. Hazus estimates the amount of debris generated from the 1-percent annual chance event. The model breaks down debris into three categories: (1) finishes (dry wall, insulation, etc.); (2) structural (wood, brick, etc.) and (3) foundations (concrete slab and block, rebar, etc.). The distinction is made because of the different types of equipment needed to handle the debris. Table 4.3.6-19 summarizes the Hazus v6 countywide debris estimates for the 1-percent annual chance flood event. This table only estimates structural debris generated by flooding and 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. Overall, Hazus estimates that there will be 67,320 tons of debris generated during the 1-percent annual chance flood event in Rockland County.

Table 4.3.6-19. Estimated Debris Generated from the 1-Percent Annual Chance Flood Event

Jurisdiction	1-Percent Annual Chance Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Airmont, Village of	3,938	668	1,949	1,321
Chestnut Ridge, Village of	1,763	305	800	659
Clarkstown, Town of	14,069	2,824	6,382	4,863
Grand View on Hudson, Village of	312	87	138	87
Haverstraw, Town of	1,021	226	456	339
Haverstraw, Village of	182	104	48	30
Hillburn, Village of	431	68	194	169
Kaser, Village of	349	108	88	153
Montebello, Village of	6,095	1,188	2,685	2,222
New Hempstead, Village of	225	67	83	74
New Square, Village of	92	28	25	39
Nyack, Village of	174	68	65	41
Orangetown, Town of	5,107	1,214	2,437	1,456
Piermont, Village of	1,455	673	479	303
Pomona, Village of	82	19	35	29
Ramapo, Town of	4,357	867	1,828	1,662
Sloatsburg, Village of	4,634	867	2,037	1,730
South Nyack, Village of	106	30	47	29
Spring Valley, Village of	6,347	1,426	2,442	2,478
Stony Point, Town of	3,306	1,086	1,165	1,054
Suffern, Village of	10,868	2,071	4,689	4,108
Upper Nyack, Village of	182	57	77	49
Wesley Hills, Village of	694	121	323	250
West Haverstraw, Village of	1,532	212	745	576
Rockland County (Total)	67,320	14,383	29,216	23,721

Source: Hazus v6.0

Note: These values are rounded to the nearest whole value.

Impact on the Environment

As Rockland County and its jurisdictions evolve with changes in population and density, flood events may increase in frequency and/or severity as land use changes, more structures are built, and impervious surfaces expand. Furthermore, flood extents for the 1-percent annual chance flood event will continue to evolve alongside natural occurrences such as climate change and/or severe weather events. These flood events will inevitably impact Rockland County’s natural and local environment.

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 residential and commercial buildings and 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. Water supply and wastewater treatment facilities could

be offline for weeks. After the 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 is likely; such erosion can negatively impact local ecosystems.

Flood events will inevitably impact Rockland County’s natural and local environment. Severe flooding not only influences the habitat of these natural land areas, but it can also be disruptive to species that reside in these natural habitats. Table 4.3.6-20 lists the number of acres exposed to the 1- and 0.2-percent annual chance flood hazard areas.

Table 4.3.6-20. Land Acreage in Rockland County Located in the 1% and 0.2% Flood Extents

Jurisdiction	Total Acres of Land Area	Total Acres of Land Area (Excluding Waterbodies) Located in the Flood Hazard Areas			
		Total Acres Located in the 1-Percent Annual Chance Flood Event	Percent of Total	Total Acres Located in the 0.2-Percent Annual Chance Flood Event	Percent of Total
Airmont, Village of	2,844	60	2.1%	73	2.6%
Chestnut Ridge, Village of	3,109	93	3.0%	114	3.7%
Clarkstown, Town of	23,295	1,023	4.4%	1,261	5.4%
Grand View on Hudson, Village of	106	2	1.9%	106	100.0%
Haverstraw, Town of	11,066	210	1.9%	319	2.9%
Haverstraw, Village of	1,254	43	3.4%	58	4.6%
Hillburn, Village of	1,364	65	4.8%	92	6.7%
Kaser, Village of	103	2	1.9%	3	2.9%
Montebello, Village of	2,704	259	9.6%	314	11.6%
New Hempstead, Village of	1,747	65	3.7%	68	3.9%
New Square, Village of	220	2	0.9%	3	1.4%
Nyack, Village of	492	3	0.6%	22	4.5%
Orangetown, Town of	13,958	894	6.4%	1,169	8.4%
Piermont, Village of	411	83	20.2%	169	41.1%
Pomona, Village of	1,488	61	4.1%	62	4.2%
Ramapo, Town of	19,415	569	2.9%	623	3.2%
Sloatsburg, Village of	1,564	166	10.6%	196	12.5%
South Nyack, Village of	389	1	0.3%	197	50.6%
Spring Valley, Village of	1,285	76	5.9%	88	6.8%
Stony Point, Town of	17,910	592	3.3%	621	3.5%
Suffern, Village of	1,317	106	8.0%	144	10.9%
Upper Nyack, Village of	738	2	0.3%	4	0.5%
Wesley Hills, Village of	2,102	40	1.9%	52	2.5%
West Haverstraw, Village of	988	39	3.9%	55	5.6%
Rockland County (Total)	109,869	4,456	4.1%	5,813	5.3%

Source: Rockland County 2020; USGS, NHD 2023; FEMA

Notes:

- 1) Excludes areas designated as water
- 2) Values are rounded to the nearest whole value

Cascading Impacts on Other Hazards

Cascading impacts may also include exposure to pathogens such as mold. 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 those with already compromised immune systems such as infants, children, the elderly and pregnant women. The degree of impact will vary and is not strictly measurable. Mold spores can grow in as short a period as 24 to 48 hours in wet and damaged areas of buildings that have not been properly cleaned. Very small mold spores can easily be inhaled, creating the potential for allergic reactions, asthma episodes, and other respiratory problems. Buildings should be properly cleaned and dried out to safely prevent mold growth (CDC 2020).

Molds and mildews are not the only public health risk associated with flooding. Floodwaters 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 also include (FEMA 2022):

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

Current loss estimation models such as Hazus are not equipped to measure public health impacts. The best level of mitigation for these impacts is to be aware that they can occur, educate the public on prevention, and be prepared to deal with these vulnerabilities in responding to flood events.

Floods of any type have the potential to impact water and power utilities which may impact public and private use, as well as cause disruption to critical infrastructure. Flooding's harmful effects on the water supply include any of the following (Andrew 2021):

- *Water Supply Contamination:* Excess floodwater can contaminate private drinking water sources, such as wells and springs. Floodwater picks up debris, increasing the number of bacteria, sewage, and other industrial waste and chemicals into the water source or leaky pipes. Excess water also makes it more difficult for water treatment plants to treat the water efficiently and effectively. If there is a contamination at any step of the water flow process, this puts consumers at risk of exposure to dangerous toxins that could result in serious harm, such as wound infections, skin rashes, gastrointestinal illnesses, and tetanus; in extreme cases, death may occur.
- *Disruption to Clean Drinking and Cooking Water:* In the event of only having access to contaminated water, consumers are unable to cook or clean in their home the water is certified as safe. Depending on the severity of the flood and the storm, this could take days, weeks, months and in some cases even years. Without access to clean drinking and cooking water, consumers ultimately become reliant on bottled water. In impoverished communities, this reality is even more detrimental because those affected may not have the economic means to stock up on bottled water. Moreover, in a flood, retail locations are often inaccessible and/or low on water supply.

Floodwaters can also cause damage to power utilities. Flooded buildings may have the utilities disrupted if the service panel, generator, meter, or other equipment are not elevated above the flood protection 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 the transformer is impacted.

Future Changes That May Impact Vulnerability

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

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Potential or Projected Development

Section 3 (County Profile) identifies areas targeted for future growth and development across the County. Any areas of growth located in the special flood hazard area could be potentially impacted by flooding. Areas outside of the special flood hazard can also be impacted by urban flooding and less frequent and more severe flooding events. Specific areas of recent and new development are indicated in tabular form and/or on the hazard maps included in Volume II, Section 9 (Jurisdictional Annexes) of this plan.

Projected Changes in Population

Rockland County has experienced an increase in its population since 2010. According to the U.S. Census Bureau, the County's population increased by approximately 8.5 percent between 2010 and 2020 (County of Rockland 2021). Cornell University's Program on Applied projects Rockland County will have a population of 356,758 by 2030 and 372,432 by 2040 (Cornell University 2018). Changes in the density of population can increase the number of persons exposed to flooding. As areas continue to be cleared for new development and run-off persists, the population in the County will remain exposed to this hazard. Refer to Section 3 (County Profile), which includes a discussion on population trends for the County.

Other Identified Conditions

As discussed above, most studies project that the County will see an increase in average annual temperatures and precipitation. Increased severe storm and heavy rainfall events are likely to increase the occurrence and severity of flooding in Rockland County. It is anticipated that the County will continue to experience direct and indirect impacts of flooding events annually that may induce secondary hazards such as infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents, and inconveniences.

Change of Vulnerability Since 2018 HMP

Rockland County remains vulnerable to the flood hazard. However, there are several differences between the exposure estimates of this plan update and the results reported in the 2018 HMP. Updated population statistics and building stock was used in the current risk assessment. Further, exposure for both the population and critical facilities was analyzed. These updated datasets provide a more accurate exposure analysis to the flood hazard.

4.3.7 Landslide

Hazard Profile

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the landslide hazard in Rockland County.

Hazard Description

According to the U.S. Geological Survey (USGS), the term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Gravity acting on an over-steepened slope is the primary reason for a landslide, but there are other contributing factors that include the following (USGS n.d.):

- Erosion by rivers, glaciers, or ocean waves create over steepened slopes
- Rock and soil slopes are weakened through saturation by snowmelt or heavy rains
- Earthquakes create stresses that make weak slopes fail
- Earthquakes of magnitude 4.0 and greater have been known to trigger landslides
- Volcanic eruptions produce loose ash deposits, heavy rain, and debris flows
- Excess weight from accumulation of rain or snow, stockpiling of rock or ore, from waste piles, or from man-made structures may stress weak slopes to failure and other structures

Areas generally prone to landslide hazards include previous landslide areas, bases of steep slopes, bases of drainage channels, developed hillsides, and areas recently burned by forest and brush fires (NYS DHSES n.d.). Landslide materials may be composed of natural rock, soil, artificial fill, or a combination of these materials. These events can transpire quickly with little to no warning. Depending on the location of a landslide, they can pose significant risks to health, safety, transportation, as well as other services. Annually, landslides in the U.S. cause approximately \$1 billion in damages and between 25 and 50 fatalities (USGS n.d.).

Landslides may be triggered by both natural and human-caused changes in the environment. Natural causes can include heavy rain, rapid snow melt, steepening of slopes caused by erosion, earthquakes, and changes in groundwater levels. Human activities that contribute to slope failure include altering the natural slope gradient, steepening slopes by construction, increasing soil water content, and removing vegetation cover. Warning signs for landslide activity include the following (USGS n.d.):

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavement, or sidewalk
- Soil moving away from foundations
- Ancillary structures, such as decks and patios, tilting and moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls, or fences
- Offset fence lines
- Sunken or down dropped roadbeds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity

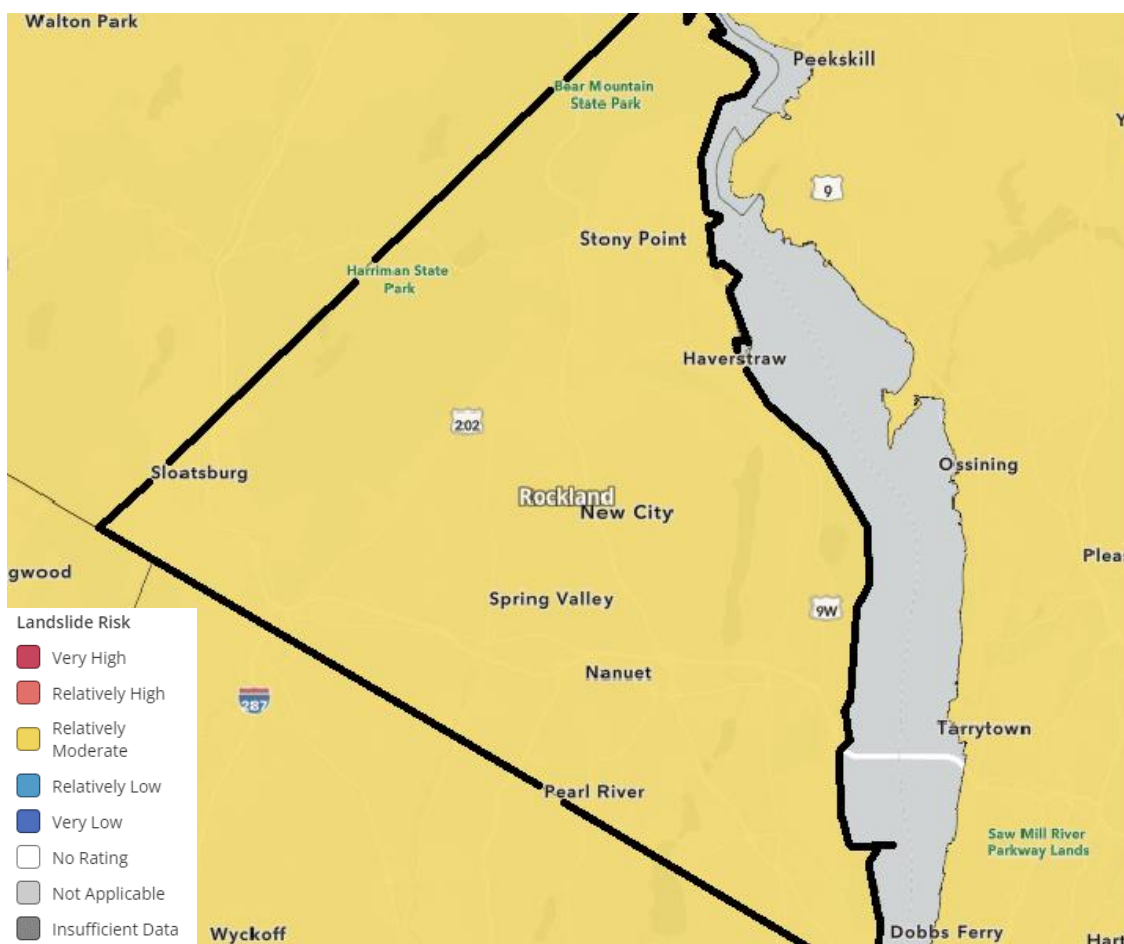
- Sudden increase in creek water levels while rain is still falling or just recently ended
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together

Location

Variables that contribute to the overall extent of potential landslide activity include soil properties, topographic position and slope, and historical incidence. Predicting a landslide is difficult, even under ideal conditions. As a result, the landslide hazard is often represented by an area’s landslide incidence and/or susceptibility.

Figure 4.3.7-1 and Figure 4.3.7-2 show the Wildfire Risk Index for Rockland County on the county and census tract scales, respectively. This index helps to understand the susceptibility of the County to landslides. According to the National Risk Index, on the county scale, the County has a relatively moderate risk to landslides; on the census tract scale, portions of the County ranges from a very low risk to a relatively moderate risk, with the area of Spring Valley having no rating (FEMA 2019).

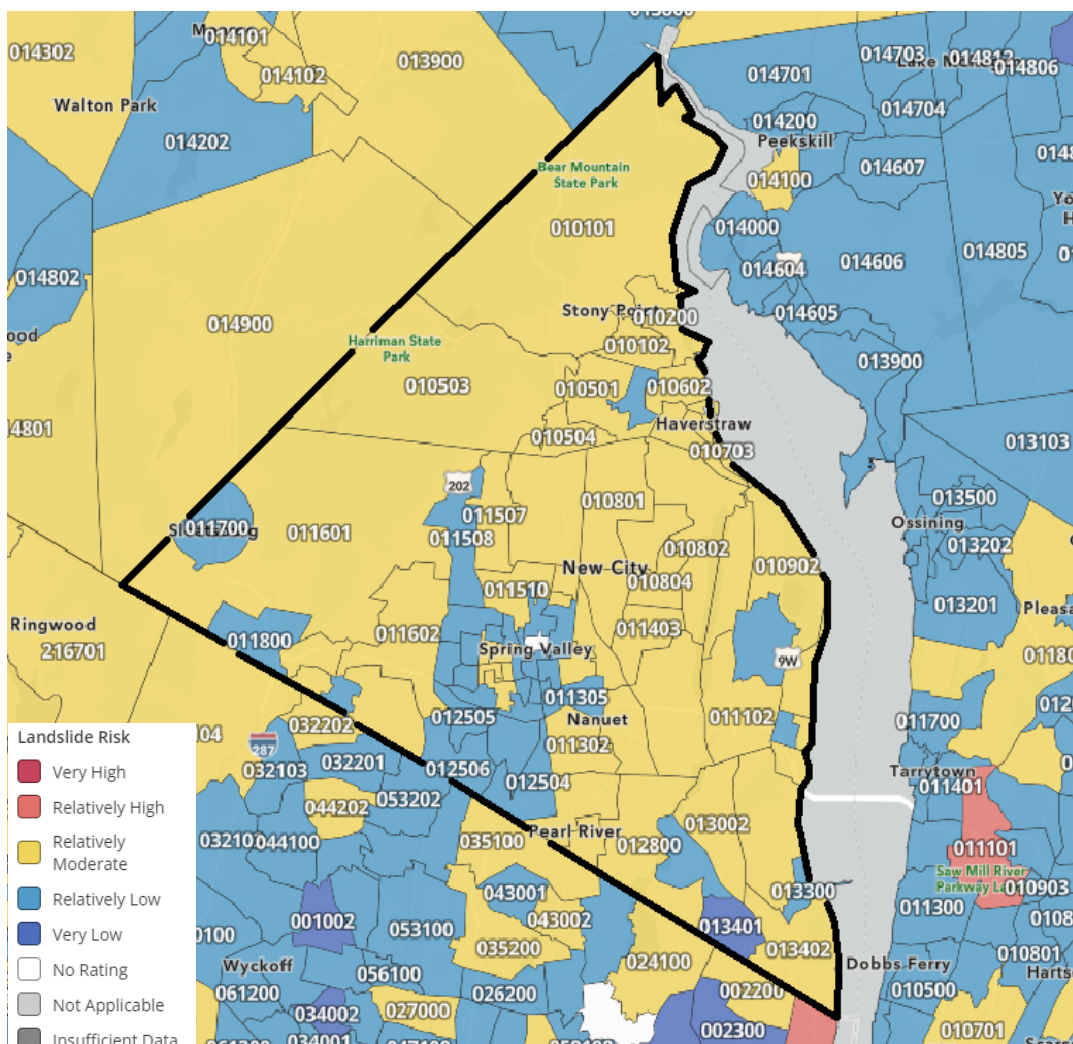
Figure 4.3.7-1. National Risk Index, Landslide Risk Index Score Using the County Scale



Source: FEMA 2019

Note: Rockland is outlined in a boldened black border.

Figure 4.3.7-2. National Risk Index, Landslide Index Score Using the Census Tract Scale



Source: FEMA 2019

Note: Rockland is outlined in a bolded black border.

Landslide incidence is the number of landslides that have occurred in a geographic area (DOROTHY H. RADBRUCH-HALL 1982). Refer to Table 4.3.7-1 for the degrees of landslide incidence.

Table 4.3.7-1. Degrees of Landslide Incidence and Susceptibility

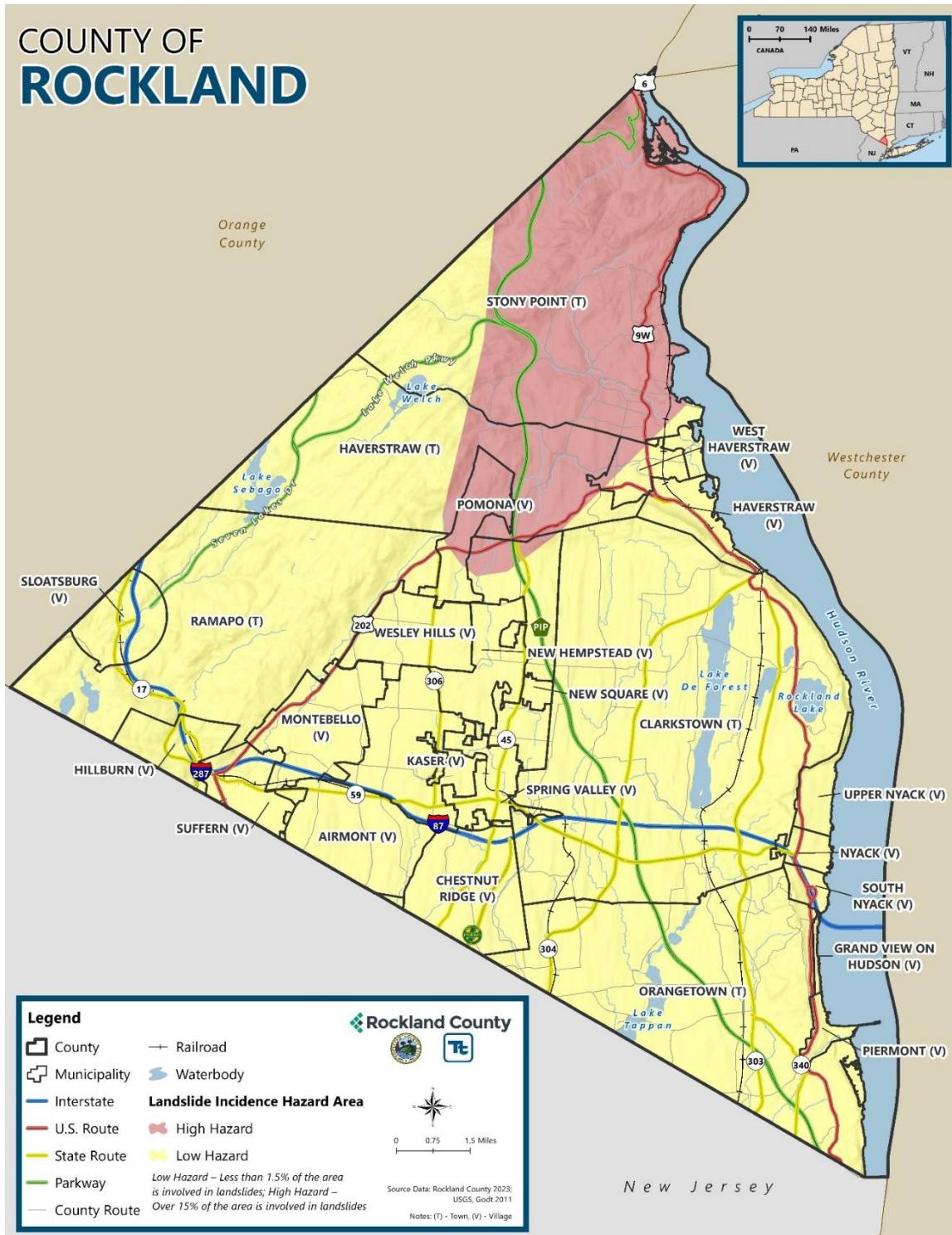
Degree of Incidence	Degree of Susceptibility	Total Area of Landslide(%)
High Incidence	High Susceptibility	15%
Medium Incidence	Medium Susceptibility	1.5% to 15%
Low Incidence	Low Susceptibility	< 1.5%

Source: Dorothy H. Rudbruch-Hall, 1982.

Landslide susceptibility is defined as the probable degree of response of geologic formations 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.

Landslide susceptibility only identifies areas potentially affected and does not imply a time frame when a landslide might occur. High, medium, and low susceptibility are delimited by the same percentages used for classifying the incidence of land sliding (refer to Table 4.3.7-1). Refer to Figure 4.3.7-3 below for the landslide susceptibility of Rockland County.

Figure 4.3.7-3. Landslide Susceptibility of Rockland County

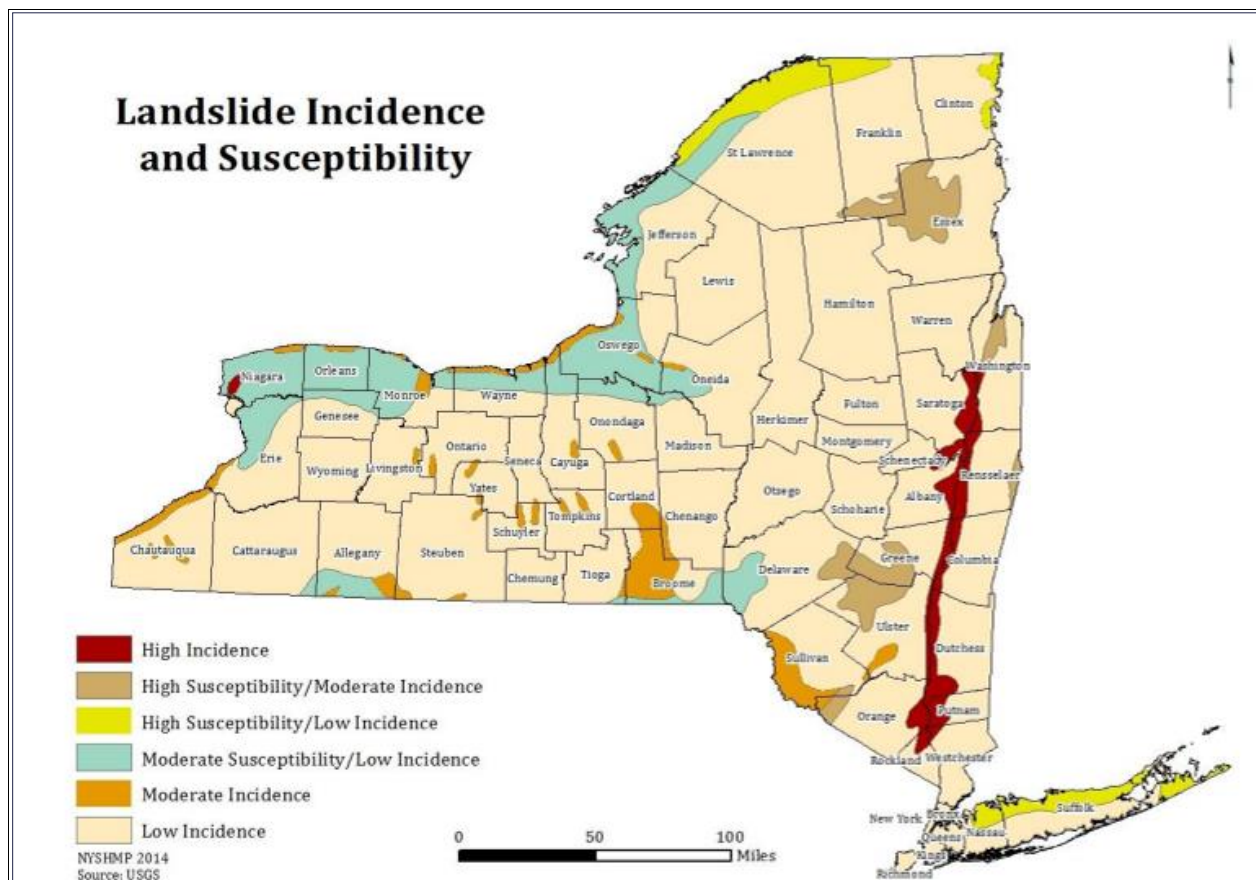


Extent

The potential for landslides exists across the entire State and the entire northeast region of the US. Scientific and historical data for the State of New York indicates that some areas of the State have a substantial landslide risk. It is estimated that 80% of the State has a low susceptibility to the landslide hazard. In general, the highest potential for landslides can be found along major rivers and lake valleys that were formerly occupied by glacial lakes resulting in glacial lake deposits and usually associated with steeper slopes (for example, the Hudson and Mohawk River Valleys). Some natural variables, such as soil properties, topographic position and slope, and historical incidence, all contribute to determining the overall risk of landslide activity in any particular area (NYS 2019).

As illustrated in Figure 4.3.7-4, the northern section of Rockland County has a high incidence of landslide events. This area has steep slopes, resulting in bed rock topples and soil slides (also known as debris slides). The remainder of the County has a low landslide incidence, but landslides are a concern for some jurisdictions. In the Town of Ramapo, there are areas of steep slopes along Route 202. In the Town of Stony Point, there are steeply sloped areas along Route 9W heading north (Rockland County 2011). The Village of Upper Nyack and sections of the Town of Orangetown (formerly the incorporated Village of South Nyack) have identified concerns about landslides due to development on steeply sloped areas (Rockland County 2018).

Figure 4.3.7-4. Landslide Susceptibility in New York State



Source: NYS DHSES 2014

Note: According to this figure, the northern portion of the county is located within the high incidence area for landslide susceptibility while the remainder of the county has a low incidence.

Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, New York State was included in one landslide major disaster (DR) declaration on October 2, 1975 (DR-487-NY). The event was classified as a severe storm, heavy rain, landslide, and flooding. Generally, these declarations cover a wide region of the State, but not all counties are included in every declaration. NYS HMP and other sources indicate that Rockland County was declared as a disaster or emergency area as part of this landslide declaration (FEMA 2023). For declarations that occurred between 2017 and 2023, specific information regarding any landslide events was not identified. Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2018 and 2023, Rockland County was not included in any landslide-related agricultural disaster declarations.

Previous Events

There are not many recorded events of landslide events occurring in Rockland County. However, this does not mean that landslide events have not and do not occur regularly in the area. There is insufficient data and reporting capabilities for landslide-related hazards at this time.

Probability of Future Occurrences

For the 2024 HMP update, best available data was used to collect hazard event details. These details were used to calculate the probability of future occurrence of hazard events in the County. Information from NOAA-NCEI, the 2019 State of New York HMP, the 2018 Rockland County HMP, and FEMA were used to identify the number of events that occurred between 1954 and 2023. Table 4.3.7-2 provides the calculated probability of future landslide events in Rockland County.

Table 4.3.7-2. Probability of Future Landslide Events in Rockland County

Hazard Type	Number of Occurrences Between 1954 and 2023	Percent Chance of Occurring in Any Given Year
Landslides	0	0 percent

Sources: NOAA-NCEI 2024, FEMA 2024, State of New York 2019

Notes: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act, and selected landslide events since 1968. Due to limitations in data, not all landslide events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

In Section 4.4, the identified hazards of concern for Rockland County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for landslide in the County is considered ‘rare.’

Future landslides certainly will occur in the State of New York, but severity of these landslides cannot be determined. Additionally, because documentation on landslides in Rockland County is sparse, predicting the extent of future landslides in the County is difficult.

According to the New York State Geological Survey (NYSGS) Landslide Inventory Study to estimate probability of future landslides (based on documented historical occurrences), NYS can expect on average approximately two major landslides each year; a greater number of smaller but still significant slides, slumps, or flows each year; and at least one landslide causing a fatality once every 12 years.

Climate Change Projections

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Refer to Table 4.3.7-3 for ClimAID Region 2 seasonal precipitation percent changes. Increase in global temperature could also affect the snowpack and its ability to hold and store water. Thus, resulting in an increase in the occurrence and duration of droughts, which would increase the probability of wildfire, leading to the reduction in vegetation growth that helps to support steep slopes. All these factors would increase the probability for landslide occurrences.

The West Hudson River Valley, encompassing Rockland County, is expected to experience average temperatures increases 3.1°F to 6.9°F by the 2050s and 4.0°F to 10.7°F by the 2080s (baseline of 50.0°F). Precipitation totals will increase between 1 percent and 14 percent by the 2050s and 2 percent to 18 percent by the 2080s (baseline of 46.0 inches). Table 4.3.7-3 displays the projected seasonal precipitation change for the Catskill Mountains and West Hudson River Valley ClimAID Region (NYSERDA 2014).

Table 4.3.7-3. Projected Seasonal Precipitation Percent Change in Region 2 from Present to 2050s

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: NYSERDA 2014

Vulnerability Assessment

To assess Rockland County’s risk to the landslide hazard, an exposure analysis was conducted for the County’s assets (population, building stock, critical facilities, historic assets, and new development) using the USGS’s Landslide Incidence and Susceptibility data, which approximates areas that are vulnerable to this hazard. For the purposes of this plan, the Vulnerability Assessment define high landslide incidence hazard area as areas with over 15 percent of the area is involved in landsliding.

Impact on Life, Health, and Safety

Generally, a landslide event is an isolated incidence and impacts the populations within the immediate area of the incident. Specifically, the population located downslope of high landslide incidence hazard areas are particularly vulnerable. In addition to causing damages to residential buildings and displacing residents, landslide events can block off or damage major roadways and inhibit travel for emergency responders or populations trying to evacuate the area.

Table 4.3.7-4 summarizes the estimated population exposed to the landslide hazard by municipality. Based on the analysis, an estimated 32,842 residents, or 9.8 percent of the County’s population, are in the landslide hazard area. Overall, the Town of Stony Point has the greatest number of individuals located in high landslide incidence hazard area (14,761 persons).

Table 4.3.7-4. Estimated Population Located in the High Landslide Incidence Hazard Area

Jurisdiction	Total Population	Estimated Population in High Landslide Incidence Hazard Area	
		Number of Persons	Percent of Total
Airmont, Village of	9,964	0	0.0%
Chestnut Ridge, Village of	10,211	0	0.0%
Clarkstown, Town of	81,385	0	0.0%
Grand View on Hudson, Village of	241	0	0.0%
Haverstraw, Town of	14,028	12,936	92.2%
Haverstraw, Village of	12,292	0	0.0%
Hillburn, Village of	1,110	0	0.0%
Kaser, Village of	5,433	0	0.0%
Montebello, Village of	4,665	0	0.0%
New Hempstead, Village of	5,440	0	0.0%
New Square, Village of	9,433	0	0.0%
Nyack, Village of	7,303	0	0.0%
Orangetown, Town of	36,127	0	0.0%
Piermont, Village of	2,525	0	0.0%
Pomona, Village of	3,306	2,157	65.2%
Ramapo, Town of	48,846	608	1.2%
Sloatsburg, Village of	3,043	0	0.0%
South Nyack, Village of	2,803	0	0.0%
Spring Valley, Village of	32,953	0	0.0%
Stony Point, Town of	14,876	14,761	99.2%
Suffern, Village of	11,376	0	0.0%
Upper Nyack, Village of	2,355	0	0.0%
Wesley Hills, Village of	6,105	0	0.0%
West Haverstraw, Village of	10,665	2,380	22.3%
Rockland County (Total)	336,485	32,842	9.8%

Source: U.S. Census Bureau, American Community Survey 5-Year Estimates 2017-2021; USGS, Godt 2011
 Notes: Values are rounded down.

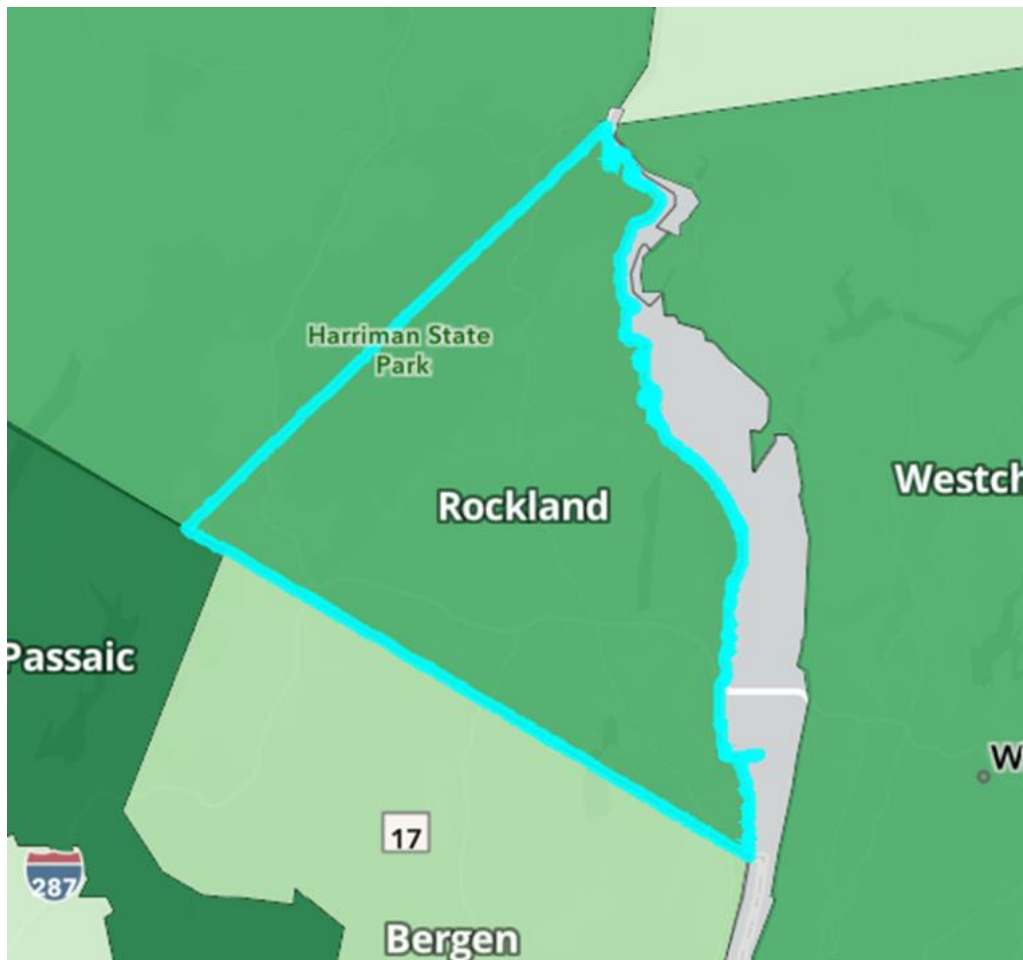
Socially Vulnerable Population

According to the 2017 to 2021 American Community Survey, there are 49,451 total persons living below the poverty level, 52,060 persons over the age of 65 years, 27,605 persons under the age of five years, 26,990 non-English speakers, 29,008 persons with a disability, 49,451 living in poverty, and 109,704 living below the Asset Limited, Income Constrained, Employed (ALICE) threshold in Rockland County.

Economically disadvantaged populations, including those living below the poverty and ALICE thresholds, are more vulnerable to landslides because they are likely to evaluate their risk and make decisions to evacuate based on net economic impacts on their families. The population over age 65 and those living with a disability is also more vulnerable because they are more likely to seek or need medical attention that may not be available due to isolation during a landslide event, and they may have more difficulty evacuating. Similarly, those under five may be more vulnerable because they are dependent on others for essential needs and mobility. Individuals that are

not proficient in English may be unable to interpret emergency warning messages to evacuate or providing resources to protect or mitigate damage to themselves and/or their property.

Figure 4.3.7-5. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA n.d.

As shown in Table 4.3.7-4, there are 32,842 persons located in high landslide incidence hazard area. Table 4.3.7-5 presents the estimated socially vulnerable populations located in high landslide incidence hazard area. Of the 32,842 persons located in high landslide incidence hazard area, there are 5,702 persons over the age of 65 years, 2,055 persons under the age of five years, 1,641 non-English speakers, 3,180 persons with a disability, 2,542 living in poverty, and 10,567 living below ALICE.

Table 4.3.7-5. Estimated Vulnerable Persons Located Within the High Landslide Incidence Hazard Area

Jurisdiction	Estimated Vulnerable Persons Located Within the High Landslide Incidence Hazard Area											
	Over 65	Percent of Total	Under 5	Percent of Total	Non-English Speaking	Percent of Total	Disability	Percent of Total	Poverty Level	Percent of Total	Living Below ALICE	Percent of Total
Airmont, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Chestnut Ridge, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Clarkstown, Town of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Grand View on Hudson, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Haverstraw, Town of	2,326	92.2%	1,007	92.1%	918	92.2%	1,132	92.2%	1,303	92.1%	4,632	92.2%
Haverstraw, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Hillburn, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Kaser, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Montebello, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
New Hempstead, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
New Square, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Nyack, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Orangetown, Town of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Piermont, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pomona, Village of	399	65.1%	160	65.0%	75	64.7%	191	65.2%	72	64.9%	339	65.2%
Ramapo, Town of	58	1.2%	89	1.2%	15	1.2%	30	1.2%	201	1.2%	235	1.2%
Sloatsburg, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
South Nyack, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Spring Valley, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Stony Point, Town of	2,632	99.2%	589	99.2%	262	98.9%	1,606	99.2%	661	99.1%	4,359	99.2%
Suffern, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Upper Nyack, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Wesley Hills, Village of	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
West Haverstraw, Village of	287	22.3%	210	22.2%	371	22.3%	221	22.3%	305	22.3%	1,002	22.3%
Rockland County (Total)	5,702	11.0%	2,055	7.4%	1,641	6.1%	3,180	11.0%	2,542	5.1%	10,567	9.6%

Source: U.S. Census Bureau, American Community Survey 5-year estimates 2017-2021; ALICE 2021; USGS, Godt 2011
 Notes: Values are rounded down.

Impact on General Building Stock

The potential damage is the modeled loss that could occur to the exposed inventory measured by the structural and content replacement cost value. There are an estimated 14,996 buildings in high landslide incidence hazard area, representing approximately 20.8 percent of the County’s total general building stock inventory replacement cost value. The Town of Stony Point has the greatest number of its buildings located in high landslide incidence hazard area (8,680 buildings or 98.4 percent of its total building stock). Refer to Table 4.3.7-6 for the estimated exposure of high landslide incidence hazard area by jurisdiction.

Table 4.3.7-6. Estimated Buildings Located in the High Landslide Incidence Hazard Area

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Buildings Located in the High Landslide Incidence Hazard Area			
			Number of Buildings	Percent of Total	Total Replacement Cost Value of Buildings	Percent of Total
Airmont, Village of	4,324	\$2,712,726,498	0	0.0%	\$0	0.0%
Chestnut Ridge, Village of	3,996	\$2,590,102,202	0	0.0%	\$0	0.0%
Clarkstown, Town of	34,094	\$22,578,694,610	0	0.0%	\$0	0.0%
Grand View on Hudson, Village of	219	\$123,746,894	0	0.0%	\$0	0.0%
Haverstraw, Town of	5,157	\$14,687,792,118	4,495	87.2%	\$14,113,465,466	96.1%
Haverstraw, Village of	2,232	\$1,373,775,543	0	0.0%	\$0	0.0%
Hillburn, Village of	499	\$340,797,550	0	0.0%	\$0	0.0%
Kaser, Village of	197	\$434,976,786	0	0.0%	\$0	0.0%
Montebello, Village of	2,002	\$1,957,771,278	0	0.0%	\$0	0.0%
New Hempstead, Village of	2,074	\$1,416,579,766	0	0.0%	\$0	0.0%
New Square, Village of	455	\$640,979,013	0	0.0%	\$0	0.0%
Nyack, Village of	1,830	\$1,930,474,072	0	0.0%	\$0	0.0%
Orangetown, Town of	18,439	\$19,240,363,073	0	0.0%	\$0	0.0%
Piermont, Village of	841	\$520,681,014	0	0.0%	\$0	0.0%
Pomona, Village of	1,437	\$947,429,629	942	65.6%	\$580,444,466	61.3%
Ramapo, Town of	9,783	\$7,401,302,608	178	1.8%	\$213,477,407	2.9%
Sloatsburg, Village of	1,776	\$780,218,848	0	0.0%	\$0	0.0%
South Nyack, Village of	1,009	\$628,994,780	0	0.0%	\$0	0.0%
Spring Valley, Village of	3,468	\$2,977,580,954	0	0.0%	\$0	0.0%
Stony Point, Town of	8,819	\$4,492,546,145	8,680	98.4%	\$4,203,793,357	93.6%
Suffern, Village of	3,110	\$2,011,976,760	0	0.0%	\$0	0.0%
Upper Nyack, Village of	1,121	\$714,087,836	0	0.0%	\$0	0.0%
Wesley Hills, Village of	2,432	\$1,597,464,375	0	0.0%	\$0	0.0%
West Haverstraw, Village of	3,171	\$1,575,031,545	701	22.1%	\$400,473,726	25.4%
Rockland County (Total)	112,485	\$93,676,093,896	14,996	13.3%	\$19,511,654,422	20.8%

Source: Rockland County, NYS Office of Information Technology Services Geospatial Services and NYS Department of Taxation and Finance’s Office of Real Property Tax Services (ORPTS) 2022; Center for International Earth Science Information Network, New York State Energy Research and Development Authority 2022; U.S. Army Corps of Engineers, National Structure Inventory 2022; RS Means 2022; USGS, Godt 2011

Impact on Critical Facilities and Community Lifelines

Landslides have the potential to cause significant physical damage to critical facilities and community lifelines that may interrupt key services and resources in the region.

Landslides can cause significant damage to buildings and the supply chains that provide health and medical, public safety and security, and food, water, and shelter services. If these facilities and lifelines are not functional during or after an emergency, the County may experience cascading impacts, like additional injuries or health issues or prolonged economic impacts, if a significant number of displaced individuals cannot access temporary or transitional housing.

Access to major roads is crucial to life-safety after a disaster event and to response and recovery operations. Landslides can block egress and ingress on roads and bridge, causing isolation for neighborhoods, traffic problems, and delays for public and private transportation. This can result in economic losses for businesses. Mass movements can knock out bridge abutments or significantly weaken the soil supporting them, making them hazardous for use. Similar to roads, rail lines are important for response and recovery operations after a disaster. Landslides can block travel along the rail lines, which would become especially troublesome, because it would not be as easy to detour a rail line as it is on 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.

Additionally, 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. Power and communication failures due to landslides can create problems for vulnerable populations and businesses. For example, for individuals that rely on medical equipment, a prolonged power outage can present serious health risks or complications. Similarly, water systems can become dammed or contaminated by landslide materials.

Table 4.3.7-7 summarizes the number of community lifelines exposed to high landslide incidence hazard area. Of the 128 community lifelines located in high landslide incidence hazard area, Water Systems has the majority of facilities (51). Refer to Section 3 (County Profile) for more information about the critical facilities and lifelines in Rockland County.

Table 4.3.7-7. Estimated Critical Facilities Located in the High Landslide Incidence Hazard Area

FEMA Lifeline Category	Number of Lifelines	Estimated Critical Facilities Located in the High Landslide Incidence Hazard Area
Communications	154	12
Energy	0	0
Food, Water, Shelter	71	5
Hazardous Material	56	3
Health and Medical	195	15
Safety and Security	349	42
Transportation	8	0
Water Systems	148	51
Rockland County (Total)	981	128

Impact on the Economy

The impact of a landslide on the economy and estimated dollar losses are difficult to measure. As stated earlier, landslides can impose direct and indirect impacts on society. Direct costs include the actual damage sustained by buildings, property, and infrastructure. Indirect costs, such as clean-up costs, business interruption, loss of tax revenues, reduced property values, and loss of productivity are difficult to measure. Additionally, landslides threaten transportation corridors, fuel and energy conduits, and communication lines.

Impact on the Environment

A landslide event alters the landscape. In addition to changes in topography, vegetation and wildlife habitats may be damaged or destroyed. Soil and sediment runoff will accumulate downslope, potentially blocking waterways and roadways and impacting quality of streams and other water bodies. Additional environmental impacts include loss of forest productivity.

Furthermore, soil and sediment runoff can accumulate downslope potentially blocking waterways and roadways and impacting quality of streams and other water bodies. Mudflows that erode into downstream waterways can threaten the life of freshwater species (USGS 2020). The impacts of eroded landscape can travel for miles downstream into adjacent waterways and create issues for surrounding watersheds.

Future Changes That May Impact Vulnerability

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

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Potential or Projected 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 located in areas with moderate landslide incidence or susceptibility could be potentially impacted by the landslide hazard. Please refer to the specific areas of development indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 of this plan.

Projected Changes in Population

Rockland County has experienced an increase in its population since 2010. According to the U.S. Census Bureau, the County's population increased by approximately 8.5 percent between 2010 and 2020 (County of Rockland 2021). Cornell University's Program on Applied Demographics projects Rockland County will have a population of 356,758 by 2030 and 372,432 by 2040 (Cornell University 2018).

Other Identified Conditions

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.

Change of Vulnerability Since 2018 HMP

For this HMP Update, the risk for the County's population, building stock, and critical facilities was assessed, and, overall, the County's landslide vulnerability has remained unchanged.

4.3.8 Severe Storm

Hazard Profile

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the severe storm hazard in Rockland County.

Hazard Description

For the purpose of this 2024 plan update and as deemed appropriated by the Rockland County Steering and Planning Committees, the severe storm hazard includes hail, high winds, thunderstorms, tornadoes, Nor'easters, and hurricanes/tropical storms, which are defined below.

Hailstorms

Hail forms inside a thunderstorm where there are strong updrafts of warm air and downdrafts of cold water. If a water droplet is picked up by the updrafts, it can be carried well above the freezing level. Water droplets freeze when temperatures reach 32°F or colder. As the frozen droplet begins to fall, it might thaw as it moves into warmer air toward the bottom of the thunderstorm, or the droplet might be picked up again 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, falls to the ground as hail (NSSL 2021).

High Winds

Wind begins with differences in air pressures. It is rough horizontal movement of air caused by 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 by other severe weather events such as thunderstorms, tornadoes, hurricanes, and tropical storms (NWS 2012). The following are descriptions of types of damaging winds:

- **Straight-line Wind:** Used to define thunderstorm wind which is not linked with rotation and is mainly used to differentiate from tornadic winds (NOAA n.d.)
- **Down Draft:** A small scale column of air that sinks towards the ground (NOAA n.d.)
- **Macroburst:** An outward burst of strong winds that are more than 2.5 miles in diameter (NOAA n.d.)
- **Microburst:** A small, concentrated downburst which produces an outward burst of relatively strong winds near the surface (NOAA n.d.)
- **Downburst:** General term to describe macro and microbursts (NOAA n.d.)
- **Gust Front:** Leading edge of rain-cooled air which clashes with a warm thunderstorm inflow (NOAA n.d.)
- **Derecho:** Long lived windstorm associated with rapidly moving precipitation or thunderstorms. If wind damage swatch is more than 240 miles and includes gusts of wind that reach 58 mph or greater, then the event can be classified as a derecho (NOAA n.d.)

Tornadoes

NOAA defines a tornado as a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground (NOAA 2011). Because wind is invisible, it is hard to see a tornado unless it forms a condensation funnel made up of water droplets, dust, and debris. Tornadoes are the most violent of all atmospheric storms and the most hazardous when they occur in populated areas. Tornadoes can topple mobile homes, lift cars, snap trees,

and turn objects into destructive missiles. Among the most unpredictable of weather phenomena, tornadoes can occur at any time of day, in any state in the union, and in any season. While the majority of tornadoes cause little or no damage, some are capable of tremendous destruction, reaching wind speeds of 200 mph or more (NOAA 2023).

Thunderstorms

A thunderstorm is a local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder (NOAA-NSSL n.d.). A thunderstorm forms from a combination of moisture, rapidly rising warm air, and a force capable of lifting air such as a warm and cold front, a sea breeze, or a mountain. Thunderstorms form at the equator to as far north as Alaska. Although thunderstorms generally affect a small area when they occur, they have the potential to become dangerous due to their ability to generate tornadoes, hailstorms, strong winds, flash flooding, and lightning.

Typical thunderstorms are 15 miles in diameter and last an average of 30 minutes. The National Weather Service (NWS) considers a thunderstorm severe only if it produces damaging wind gusts of 58 mph or higher or large hail one inch (quarter size) in diameter or larger or tornadoes (NWS n.d.). An estimated 100,000 thunderstorms occur each year in the U.S., with approximately 10% of them classified as severe (U.S. Department of Commerce; NOAA; NWS 1994). During the warm season, thunderstorms are responsible for most of the rainfall.

Lightning is a bright flash of electrical energy produced by a thunderstorm. The resulting clap of thunder is the result of a shock wave created by the rapid heating and cooling of the air in the lightning channel. All thunderstorms produce lightning, which can be very dangerous. It ranks as one of the top weather killers in the nation and kills approximately 20 people and injures hundreds each year (NWS n.d.). Lightning can occur anywhere there is a thunderstorm.

Nor'Easters

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 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 of the United States (NWS n.d.). To be classified as a Nor'easter, a storm must have the following conditions, as per the Northeast Regional Climate Center (NRCC):

- Persist for at least a 12-hour period
- Have a closed circulation
- Be located within the quadrilateral bounded at 45°N by 65° and 70°W and at 30°N by 85°W and 75°W
- Show general movement from the south-southwest to the north-northeast
- Contain wind speeds greater than 23 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 1,200 miles, impacting large areas of coastline. The forward speed of a Nor'easter is usually much slower than a hurricane, so with the slower speed, a Nor'easter can linger for days and cause tremendous damage to those areas impacted. Approximately 40 Nor'easters occur in the northeastern US every year (NPS 2023). The intensity of a Nor'easter can rival that of a tropical cyclone in that, on occasion, it may flow or stall off the mid-Atlantic coast resulting in prolonged episodes of precipitation, coastal flooding, and high winds.

Hurricanes/Tropical Storms

A hurricane is a tropical storm that attains hurricane status when its wind speed reaches 74 or more mph. Tropical systems may develop in the Atlantic between the Lesser Antilles and the African coast or may develop in the warm tropical waters of the Caribbean and Gulf of Mexico. These storms may move up the Atlantic coast and impact the eastern seaboard or move into the US through the states along the Gulf Coast, bringing wind and rain as far north as New England before moving offshore and heading east.

A tropical storm system is characterized by a low-pressure center and numerous thunderstorms that produce strong winds and heavy rain. Compared to a hurricane, these storms tend to have slower wind speeds. Tropical storms strengthen when water evaporated from the ocean is released as the saturated air rises, resulting in condensation of water vapor contained in the moist air. They are fueled by a different heat mechanism than other cyclonic windstorms such as Nor'easters and polar lows. The characteristic that separates tropical cyclones from other cyclonic systems 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 (NOAA 2023).

Location

Severe storm events occur throughout the State of New York and are not bound by geographic extent. The likelihood of these events affecting certain parts of Rockland County depends on storm conditions.

Hailstorms

Hailstorms can form anywhere; however, they are more likely to fall in areas that have the most thunderstorms. The longer a hailstone spends in the clouds, the larger it becomes as more droplets continue to freeze. Hail falls when it becomes heavy enough to overcome the strength of the thunderstorm updraft and is pulled to the earth by gravity. Smaller hailstones may be blown away from the updraft by horizontal winds, so larger hail typically falls closer to the updraft than smaller hail (NOAA n.d.).

According to the National Risk Index, on the county scale, the County has a relatively low risk to hail; on the census tract scale, the County ranges from a very low risk to a relatively low risk (FEMA 2019).

High Winds

All of Rockland County is subject to high winds from thunderstorms, hurricanes/tropical storms, tornadoes, and other severe weather events. According to FEMA Winds Zones of the United States map, Rockland County is located in Wind Zone II, where wind speeds can reach up to 160 mph. The County is also located in the Hurricane Susceptible Region, which extends along the entire east coast from Maine to Florida, the Gulf Coast, and Hawaii.

According to the National Risk Index, on the county scale, the County has a relatively high risk to strong winds; on the census tract scale, the County ranges from a relatively moderate risk to a relatively high risk (FEMA 2019).

Tornadoes

Approximately 1,200 tornadoes occur in the US each year, with the central portion of the country experiencing the most (NOAA-NSSL n.d.). Tornadoes can occur at any time of the year, with peak seasons at different times for different states. The peak season for southern Plains (Texas, Oklahoma, Kansas, etc.) is from May into early June. The Gulf coast experiences tornado seasons during the spring. For the northern Plains and upper Midwest region (North and South Dakota, Nebraska, Iowa, etc.) tornado seasons are generally seen June through July (NOAA-NSSL n.d.).

The entire State of New York is susceptible to tornado activity and vulnerable to tornado impacts. Based on statistics from 1996 to 2018, it was found that on average eight tornadoes ranging from F0 to F4, occurred each year in the State (NYS 2019). This resulted in an average of \$6.4 million in annualized loss from tornadoes for the State of New York. Approximately 143 injuries and six fatalities were recorded from 1996 to 2018 as a result of tornado impacts (NYS 2019). The entirety of Rockland County is vulnerable to tornado impacts and can experience a tornado at any time when suitable conditions are present.

According to the National Risk Index, on the county scale, the County has a relatively moderate risk to tornadoes; on the census tract scale, the County ranges from a very low risk to a relatively moderate risk (FEMA 2019).

Thunderstorms

Thunderstorms affect relatively small, localized areas, rather than large regions like winter storms and hurricane events. Thunderstorms can strike anywhere, but they are most common in the central and southern US. The atmospheric conditions in these regions of the country are ideal for generating these powerful storms. It is estimated that there are as many as 40,000 thunderstorms each day worldwide (NOAA 2023). The most thunderstorms are seen in the southeast United States, with Florida having the highest incidences (80 to over 100 thunderstorm days each year).

Nor'easters

According to the New York State Hazard Mitigation Plan, the coastal region of the State of New York is extremely vulnerable to Nor'easters; however, these storms can impact the entire state. Therefore, the entire County is exposed and vulnerable to Nor'easters.

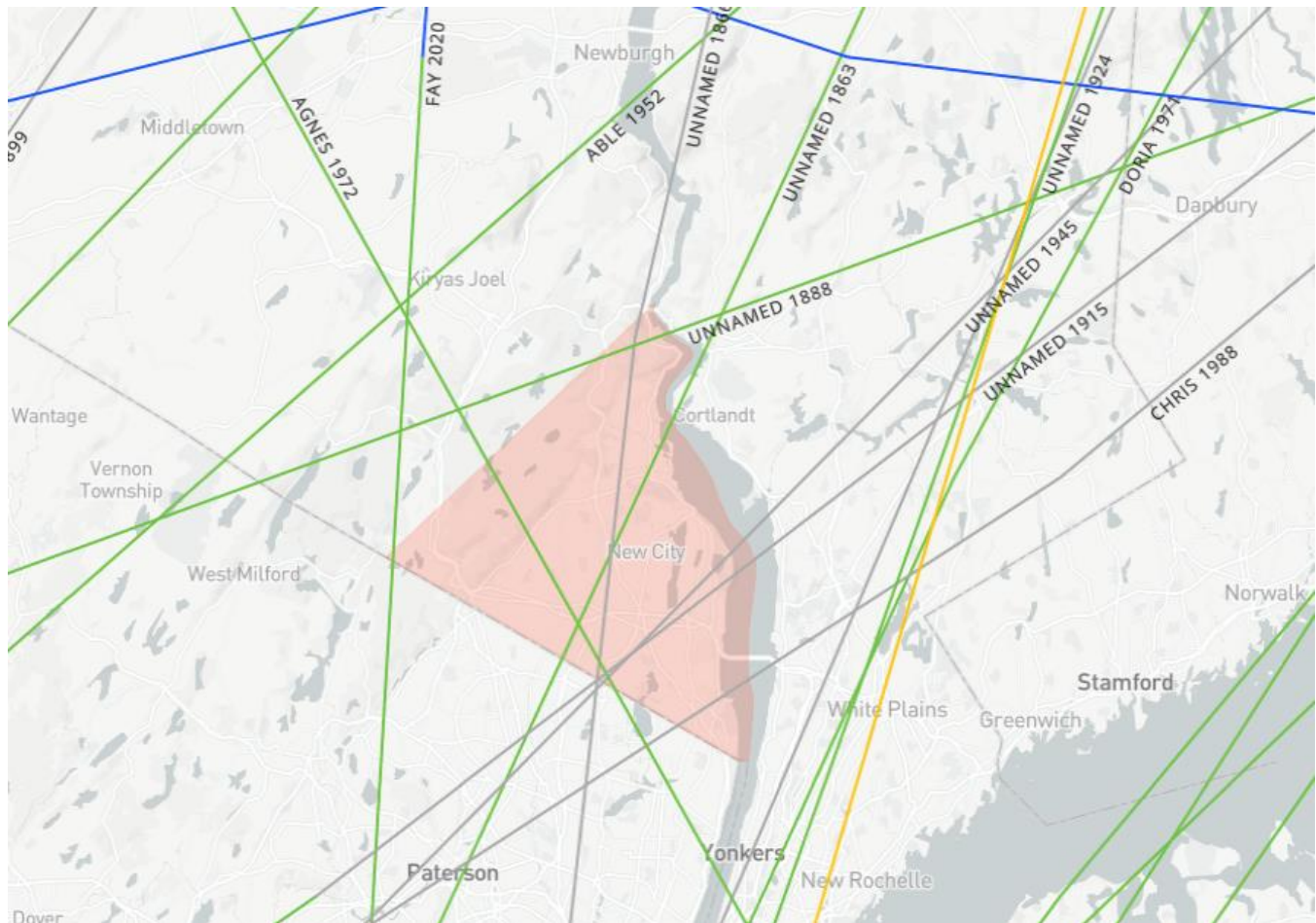
Hurricanes/Tropical Storms

The official hurricane season for the eastern US, including the State of New York, is from June to November. Hurricanes and tropical storms are most likely to affect the State between late July to early due to the coolness of the Atlantic Ocean (NYS 2019).

Rockland County is vulnerable to the impacts of hurricanes and tropical storms. However, it depends on the storm's track. Inland areas, like western Rockland County, are at risk for flooding due to the heavy rain and winds produced by hurricanes and tropical storms. The majority of damage from these events often results from residual wind damage and inland flooding, most recently experienced during Hurricane Irene in August 2011. Additionally, areas of Rockland County bordered by the Hudson River are susceptible to flooding from tidal-influenced storm surge associated with hurricanes and tropical storms.

NOAA's Historical Hurricane Tracks tool is a public interactive mapping application that displays Atlantic Basin and East-Central Pacific Basin tropical cyclone data. This interactive tool catalogs tropical cyclones that have occurred from 1950 to 2023 (latest date available from data source). Between 1950 and 2023, 52 tropical cyclones tracked within 60 nautical miles of Rockland County (NOAA 2021). Figure 4.3.8-1 displays the tropical cyclone tracks for Rockland County that tracked with 60 nautical miles.

Figure 4.3.8-1. Historical Tropical Storm and Hurricane Tracks 1950 to 2023



Source: NOAA NHC 2023

According to the National Risk Index, on the county scale, the County has a relatively moderate risk to hurricanes; on the census tract scale, the County ranges from a very relatively low risk to a relatively moderate risk (FEMA 2019).

Extent

Hailstorms

The severity of hail is measured by duration, hail size, and geographic extent. Hail can exhibit a variety of sizes, though only the very largest hail stones pose serious risk to people, if exposed. It is often estimated by comparing

it to a known object (Figure 4.3.8-2). 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 (NSSL 2021).

High Winds

The NWS issues advisories and warnings for winds. Issuance is normally site-specific. High wind advisories, watches and warnings are products issued by the NWS when wind speeds may pose a hazard or is life threatening. The criterion for each of these varies from state to state. Wind warnings and advisories for the State of New York are as follows:

- **High Wind Warnings** are issued when sustained wind speeds of 40 mph or greater lasting for one hour or longer or for winds of 58 mph or greater for any duration or widespread damage are possible.
- **Wind Advisories** are issues 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 (NWS 2011).

Tornadoes

The Enhanced Fujita Scale (EF-Scale) is the standard used to measure the strength of a tornado. It is used to assign tornadoes a rating based on estimated wind speeds and related damage. When tornado-related damage is surveyed, it is compared to a list of Damage Indicators (DI) and Degree of Damage (DOD), which help better estimate the range of wind speeds produced by the tornado. From that, a rating is assigned, similar to that of the F-Scale, with six categories from EF0 to EF5, representing increasing degrees of damage. The EF-Scale was revised from the original F-Scale to reflect better examinations of tornado damage surveys. This new scale considers how most structures are designed (NWS n.d.). Figure 4.3.8-3 illustrates the relationship between EF ratings, wind speed, and expected tornado damage. Rockland County typically experience tornadoes ranging from EF0 to EF1.

NOAA Storm Prediction Center issues watch and warning alerts for tornado activities. A tornado watch is when conditions are favorable for a tornado to form. A watch can cover parts of a state or span several states (NOAA-NSSL n.d.). A tornado warning is when a tornado is spotted by a radar and indicated action should be taken to ensure safety and shelter. Warnings can cover parts of counties or several counties, depending on the tornadoes path (NOAA-NSSL n.d.). The current average lead time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly, that little, if any, advance warning is possible (NWS n.d.).

Figure 4.3.8-2. Hail Size Chart



Source: NOAA

Figure 4.3.8-3. Explanation of EF-Scale Ratings

EF Rating	Wind Speeds	Expected Damage	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: NWS n.d.







Thunderstorms

Severe thunderstorm statements, watches, and warnings are issued by the local NWS office and the Storm Prediction Center (SPC). The NWS and SPC will update the watches and warnings and notify the public when they are no longer in effect. NWS issues statements, watches, and warnings for thunderstorms:

- **Special Weather Statement:** Issued for strong storms that are below severe levels but may have impacts. Usually reserved for the threat of wind gust of 40–57 mph or hail of 0.5-inches to 0.99-inches in diameter (NWS 2023).
- **Severe Thunderstorm Watches:** A severe thunderstorm watch is issued when severe thunderstorms are possible in and near watch areas (NWS 2023).
- **Severe Thunderstorm Warning:** A severe thunderstorm is imminent or occurring; it is either detected by weather radar or reported by storm spotters. A severe thunderstorm is one that produces winds 58 mph or stronger and/or hail 1 inch in diameter or larger. A warning means to take shelter (NWS 2023).

The NWS has five risk categories for severe weather: marginal, slight, enhanced, moderate, and high. The probabilistic forecast directly expresses the best estimate of a severe weather event occurring within 25 miles of a point (NWS 2022). Figure 4.3.8-4 details the thunderstorm risk categories.

Figure 4.3.8-4. Thunderstorm Risk

Understanding Severe Thunderstorm Risk Categories					
THUNDERSTORMS (no label)	1 - MARGINAL (MRGL)	2 - SLIGHT (SLGT)	3 - ENHANCED (ENH)	4 - MODERATE (MDT)	5 - HIGH (HIGH)
No severe* thunderstorms expected	Isolated severe thunderstorms possible	Scattered severe storms possible	Numerous severe storms possible	Widespread severe storms likely	Widespread severe storms expected
Lightning/flooding threats exist with <u>all</u> thunderstorms	Limited in duration and/or coverage and/or intensity	Short-lived and/or not widespread, isolated intense storms possible	More persistent and/or widespread, a few intense	Long-lived, widespread and intense	Long-lived, very widespread and particularly intense
					
* NWS defines a severe thunderstorm as measured wind gusts to at least 58 mph, and/or hail to at least one inch in diameter, and/or a tornado. All thunderstorm categories imply lightning and the potential for flooding. Categories are also tied to the probability of a severe weather event within 25 miles of your location.					

Source: NOAA

Nor'Easters

Nor'Easters have the potential to impact society to a greater extent than hurricanes and tornadoes. These storms often have a diameter three to four times larger than a hurricane and therefore, impact much larger areas. The severity of a Nor'Easter depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day (e.g., weekday versus weekend), and season.

NOAA's National Climatic Data Center (NCDC) is currently producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the United States. The RSI ranks snowstorm impacts on a scale from 1 to 5 and is based on the spatial extent of the storm, the amount of snowfall, and the interaction of the extent and snowfall totals with population. The NCDC has analyzed and assigned RSI values to over 500 storms since 1900 (NOAA n.d.). Table 4.3.8-1 lists the five categories.

Table 4.3.8-1. Regional Snowfall Index 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+

Source: NOAA-NCDC 2011
RSI Regional Snowfall Index

Hurricanes/Tropical Storms

Hurricanes are classified according to the Saffir-Simpson Hurricane Wind Scale from a Category 1 to Category 5 by sustained wind intensity. Figure 4.3.8-5 below shows the categories and the type of damage they produce.

Figure 4.3.8-5. Saffir-Simpson Hurricane Wind Scale



Source: NWS 2022

The NWS issues hurricane and tropical storm watches and warnings. These watches and warnings are issued or will remain in effect after a tropical cyclone becomes post-tropical, when such a storm poses a significant threat to life and property. The NWS allows the National Hurricane Center (NHC) to issue advisories during the post-tropical stage (NHC NOAA 2010).

Mean Return Period

In evaluating the potential for hazard events of a given magnitude, a mean return period (MRP) is often used. Figure 4.3.8-6 and Figure 4.3.8-7 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 Hazards U.S. Multi-Hazard (HAZUS-MH) model runs for the 100- and 500-year event. The maximum 3-second gust wind speeds for Rockland County range from 74 to 95 mph for the 100-year MRP event. The maximum 3-second gust wind speeds for Rockland County range from 74 to 110 mph for the 500-year MRP event. The associated impacts and losses from these 100-year and 500-year MRP hurricane event model runs are reported in the Vulnerability Assessment.



Figure 4.3.8-6. Wind Speeds for the 100-Year Mean Return Period Event

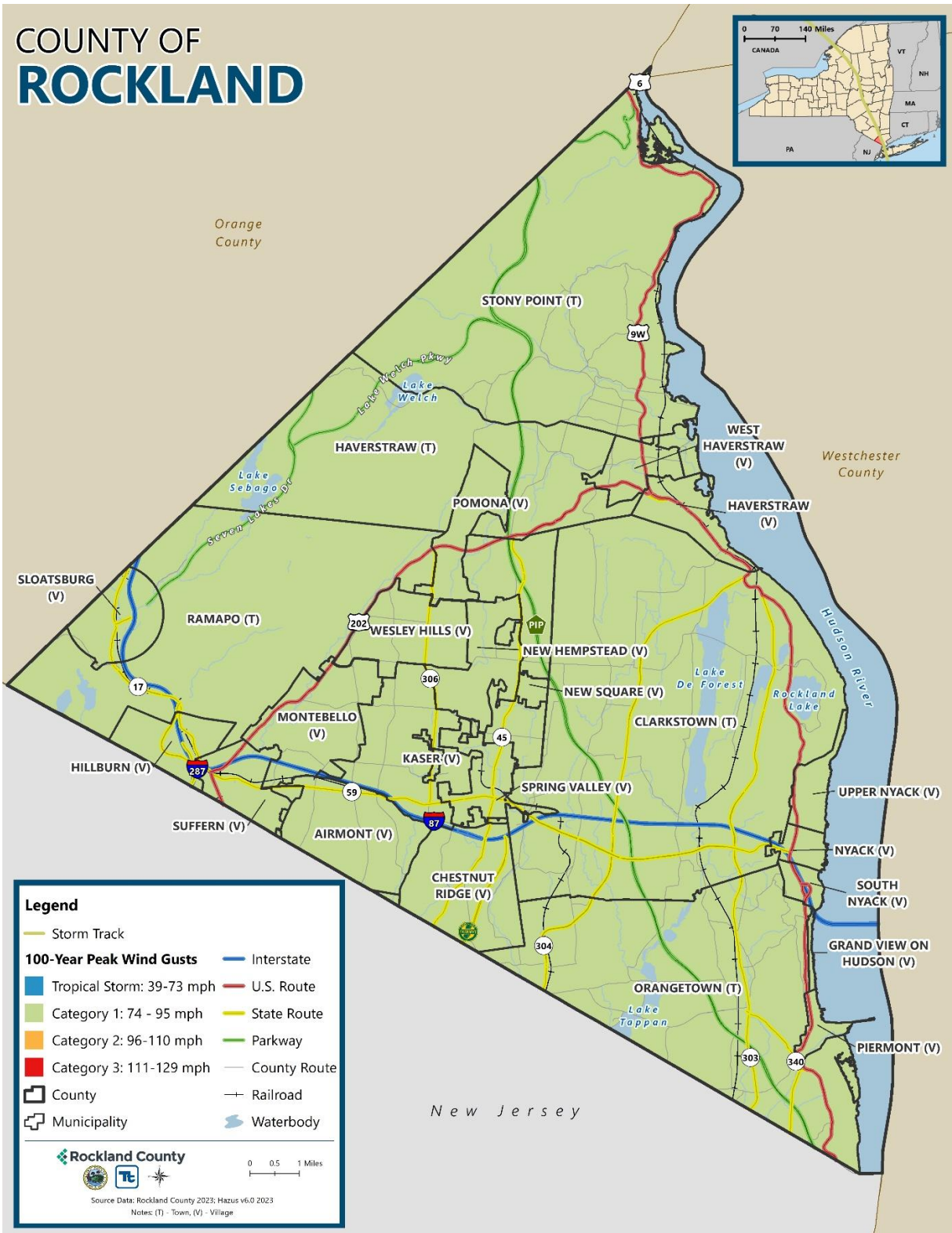
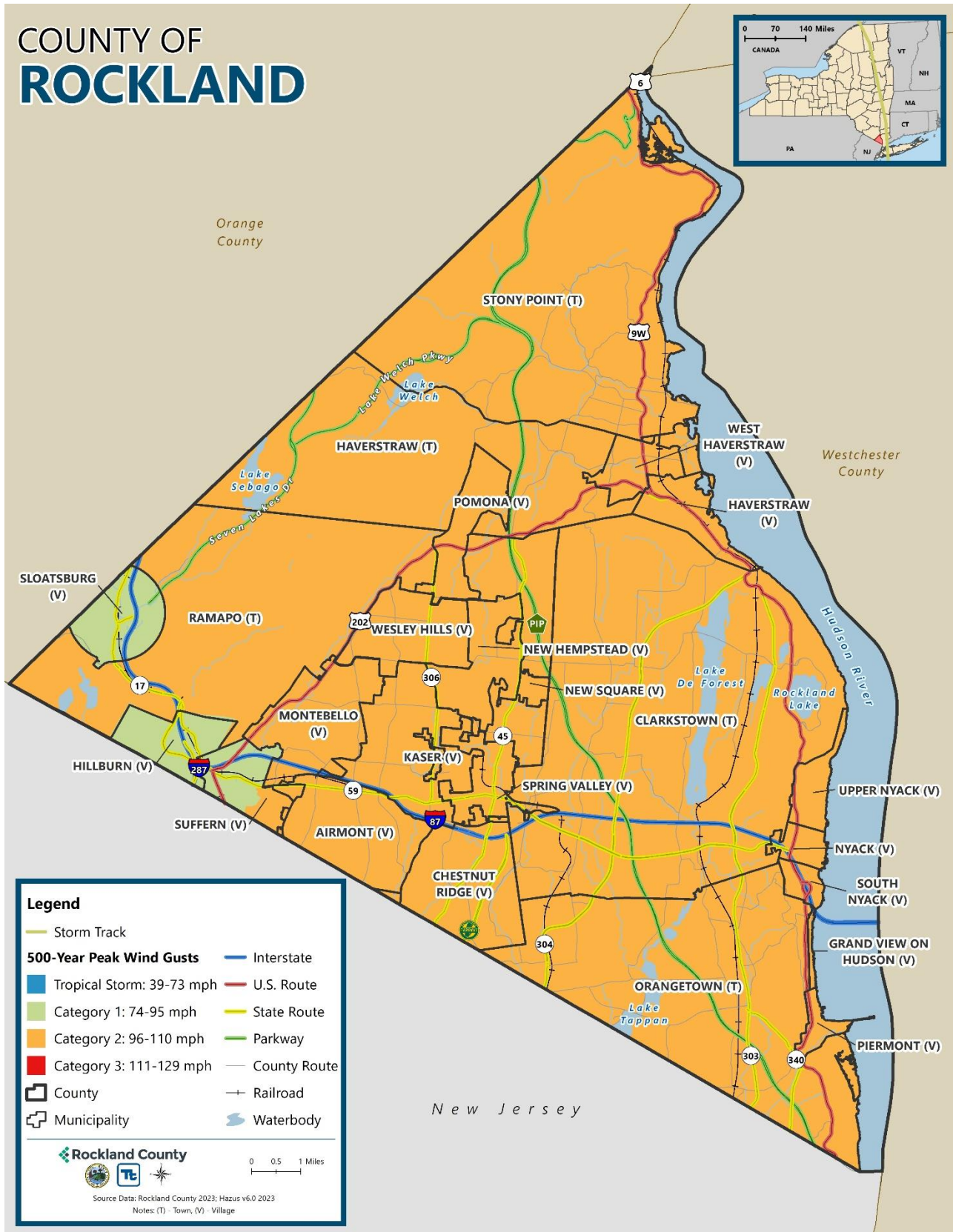


Figure 4.3.8-7. Wind Speeds for the 500-Year Mean Return Period Event



Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, Rockland County was included in 16 major disaster (DR) or emergency (EM) declarations for severe storm-related events (FEMA 2023). These declarations involved events classified as one or a combination of the following hazards: hurricane, flood, severe ice storm, severe storm, and tornado (FEMA 2023). Generally, these disasters cover a wide region of the State and may have impacted many counties. For declarations that occurred between 2017 and 2023, refer to Table 4.3.8-2. Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

Table 4.3.8-2. FEMA Declarations for Severe Storm Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
October 2, 2020	Hurricane	DR-4567	Yes	Nassau, Suffolk, Putnam, Queens, Richmond, Rockland, and Westchester Counties	Tropical Storm Isaias impacted the East Coast of the United States, claiming the lives of over 12 people and leaving millions without power. This severe storm event resulted in approximately \$5.025B in damage, making it the costliest tropical cyclone to impact the Northeastern United States since Hurricane Sandy in 2012.
August 22, 2021	Hurricane	EM-3565	Yes	Countywide	Tropical Storm Henri (downgraded to a tropical storm at landfall) impacted New York and neighboring states, causing thousands of residents to lose power. While Rockland County was spared from the heaviest wind gusts, substantial rainfall and flooding affected the area.
September 2, 2021	Hurricane	EM-3572	Yes	Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Westchester, and Ulster Counties	The remnants of Hurricane Ida impacted New York State, bringing heavy rain, severe wind, and widespread urban flooding. Approximately 31 roadways were closed in Rockland, 212 emergency calls were received by the local fire department, and 1,481 power outages were reported. Additionally, 85 people were rescued from vehicles that were swept away by the floodwaters.
September 5, 2021	Hurricane	DR-4615	Yes	Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Westchester, and Ulster Counties	Remnants of Hurricane Ida impacted New York State, bringing heavy rain, high winds, and severe flooding. Hundreds of millions of dollars in damage resulted from this storm, and more than 40 people lost their lives.
July 22, 2023	Severe Storm	DR-4723	Yes	Clinton, Dutchess, Essex, Frankin, Hamilton, Ontario, Orange, Putnam, and Rockland Counties	Severe storms and flooding impacted multiple counties across New York State, bringing record-breaking levels of precipitation, landslides, and widespread road closures.

Sources: FEMA, 2023; (Childs 2020, Korn 2021, FEMA 2022, NBC4 New York 2021, CBS4 New York 2021)

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2018 and 2023, Rockland County was included in two Severe Storm-related agricultural disaster declarations. For declarations that occurred between 2017 and 2023, refer to Table 4.3.8-3.

Table 4.3.8-3. USDA Declarations for Severe Storm Events in Rockland County (2017 to 2023)

Event Date	Event Type	USDA Declaration Number	Description
April 10, 2019	Excessive Precipitation	S4479	Thunderstorms in Rockland brought heavy rain and lightning that resulted in power outages for over 42,000 residents.
July 31, 2023	Flash Flooding and Excessive Rain	S5607; S5641	Severe storms struck multiple counties in Upstate New York, resulting in an estimated \$50 million in damage.

Sources: CBS New York 2019, USDA 2024, ABC7 New York 2023

Previous Events

For this 2024 HMP update, known hazard events that impacted Rockland County between January 2017 and December 2023 are discussed in Table 4.3.8-4. For events prior to 2017, refer to the 2018 Rockland County HMP.

Table 4.3.8-4. Hazard Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
March 2, 2018	High Winds	N/A	N/A	Countywide	Strong winds caused several trees to be downed along Treack Road, Palisades Parkway, and Hasting Lane blocking several roadways. One tree was downed on a house and car on a school street in Upper Nyack. Power outages were seen in some neighborhoods in the area.
May 15, 2018	Thunderstorm Wind	N/A	N/A	Nanuet, Nyack, West Nyack, Congers, Doodletown, and Spring Valley, NY	A tree was downed on Red Schoolhouse Road due to thunderstorm winds, resulting in one fatality. The victim was an 80-year-old woman who was inside a car that the tree fell on.
July 3, 2018	Thunderstorm Wind	N/A	N/A	New City, NY	A tree was downed on a car located on Laurel Road due to thunderstorm winds. One victim was injured as a result of being inside the car.

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
October 2, 2018	Tornado	N/A	N/A	Stony Point, NY	A tornado made landfall in Harriman State Park and ended near Wilderness Drive in Stony Point. Several trees were uprooted and downed in the tornado path. Maximum wind speeds were recorded around 100 mph, indicating an EF1 rating. The maximum path width was approximately 100 yards. The tornado covered a length of approximately one and one-half miles for its total duration.
February 25, 2019	High Winds	N/A	N/A	Valley Cottage, NY	A large tree was downed in the afternoon in Valley Cottage. The downed tree knocked out wires and started a small fire on Carlann Lane.
April 13, 2020	High Winds	EM-3434-NY (Unrelated due to COVID-19)	N/A	New Hempstead, NY	Several large trees were downed in the New Hempstead area blocking roadways. Wires were downed by several trees, causing further road closures due to power outages for traffic lights.
June 29, 2020	Thunderstorm Wind	N/A	N/A	Pearl River, NY	A large tree was downed due to high thunderstorm winds and resulted in crushing a car. No one was inside the car.
July 11, 2020	Thunderstorm Wind	N/A	N/A	Upper Nyack, NY	Several trees and power lines were downed due to severe thunderstorm winds in the Town of Valley Cottage.
August 4, 2020	Tropical Storm	N/A	N/A	Countywide	Maximum winds were recorded at 42 mph, with peak wind gusts up to 57 mph. 1 to 3 inches of rainfall was also recorded across the county. Several trees were downed which resulted in power outages and damages seen to homes, cars, and transit systems.
November 15, 2020	Thunderstorm Wind	N/A	N/A	Garnersville, NY	A large tree was downed onto a house on Bloom Street. No injuries or fatalities were reported.
June 8, 2021	Thunderstorm Wind	N/A	N/A	Sparkill, NY; Palisades, NY	A surface trough (region of low-pressure air) in a warm air mass triggered multiple thunderstorms across southeastern New York. One tree and other large branches blocked lanes on NY 303 Northbound, and \$2,000 in property damage was reported. No injuries or deaths were reported as a result of this storm event.
July 6, 2021	Thunderstorm Wind	N/A	N/A	Orangeburg, NY	A region of low-pressure air in a hot and humid air mass triggered severe thunderstorms across southeastern New York. A downed tree on Palisades Interstate Parkway blocked the right lane of traffic, and \$1,000 in property damage resulted from this storm event. No injuries or deaths were reported in this incident.

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
August 12, 2021	Thunderstorm Wind	N/A	N/A	Doodletown, NY	A region of low-pressure air in a hot and humid air mass triggered severe thunderstorms across southeastern New York. Multiple trees were destroyed as a result of these storms, bringing \$3,000 in property damage. No injuries or deaths were reported as a result of this storm event.
July 25, 2023	Thunderstorm Wind	N/A	N/A	Central Nyack, NY	Multiple severe thunderstorms impacted southeastern New York, producing severe wind gusts that resulted in \$1,000 in property damage. No injuries or deaths were reported as a result of this storm event.
September 8, 2023	Thunderstorm Wind	N/A	N/A	Monsey, NY	Thunderstorms moved through southeastern New York bringing severe wind and hailstorms to the area. Hailstones up to one inch in diameter were reported. \$3,000 in property damage resulted from this storm event, and no injuries or deaths were reported.

Sources: NOAA, 2023
 FEMA Federal Emergency Management Agency
 NOAA National Oceanic and Atmospheric Administration
 NYS New York State

Probability of Future Occurrences

For the 2024 HMP update, best available data was used to collect hazard event details. These details were used to calculate the probability of future occurrence of hazard events in the County. Information from the National Oceanic and Atmospheric Administration (NOAA) Storm Events Database, the U.S. Department of Agriculture (USDA) Disaster Designations database, the 2019 State of New York HMP, the 2018 Rockland County HMP, and FEMA were used to identify the number of events that occurred between 1954 and 2023. Table 4.3.8-5 provides the calculated probability of future severe storm events in Rockland County.

Table 4.3.8-5. Probability of Future Severe Storm Events in Rockland County

Hazard Type	Number of Occurrences Between 1954 and 2023	Percent Chance of Occurring in Any Given Year
Severe Storm	196	100%

Sources: FEMA 2023, USDA 2024, NOAA 2024
 Notes: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act, and selected severe storm events since 1968. Due to limitations in data, not all severe storm events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

In Section 4.4, the identified hazards of concern for Rockland County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for severe storm in the County is considered ‘frequent.’

Climate Change Projections

Climate change affects the State of New York’s residents and resources, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt in the State.

According to the 2023 Climate Projections Report by NYSERDA (ClimAID), temperatures in the State of New York are warming, with an average rate of warming over the past century of 0.25° F per decade. Average annual temperatures are projected to increase across the State of New York by 2° F to 3.4° F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the State (NYSERDA 2023).

Regional precipitation across the State of New York is projected to increase by approximately one to eight percent by the 2020s, 3 to 12 percent by the 2050s, and 4 to 15 percent by the 2080s. By the end of the century, the greatest increases in precipitation are projected to be in the northern areas of the State (NYSERDA 2023).

The region encompassing Rockland County, which includes the Catskill Mountains and the West Hudson River Valley, is estimated that temperatures will increase by 3.1°F to 6.9°F by the 2050s and 4.0°F to 10.7°F by the 2080s (baseline of 50.0°F). Precipitation totals will increase between 1 and 14 percent by the 2050s and 2 to 18 percent by the 2080s (baseline of 46.0 inches). Table 4.3.8-6 displays the projected seasonal precipitation change for the Catskill Mountains and West Hudson River Valley ClimAID Region (NYSERDA 2023).

Table 4.3.8-6. Projected Seasonal Precipitation Change in the Catskill Mountains and West Hudson Iver Valley, 2050s (% change)

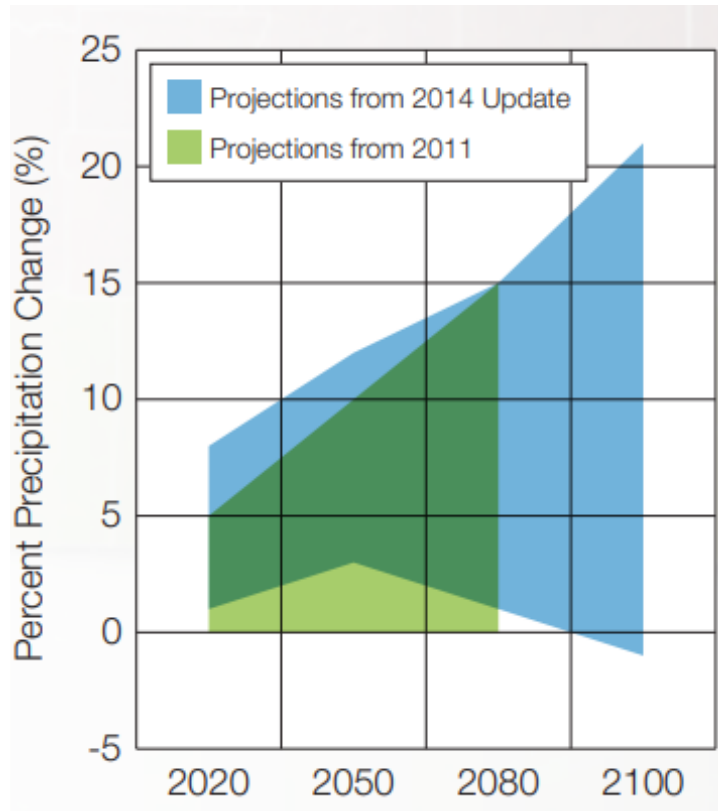
Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: NYSERDA 2011

The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. Downpours are very likely to increase in frequency and intensity, a change which has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways, and transportation hubs; and increase delays and hazards related to extreme weather events (NYSERDA 2023). Less frequent rainfall during the summer months may impact the ability of water supply systems. Increasing water temperatures in rivers and streams will affect aquatic health and reduce the capacity of streams to assimilate effluent wastewater treatment plants (NYSERDA 2023).

Figure 4.3.8-8 displays the precipitation projections for the State of New York, comparing the 2011 data to the most recent 2014 data. The percent precipitation change is projected to increase exponentially as updated information and data has been gathered during the 2014 report (NYSERDA 2023). Rainstorms and other precipitation events will increase in severity and frequency.

Figure 4.3.8-8. Comparison of 2011 and 2014 Precipitation Projections



Source: NYSERDA 2014

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the hazard area identified. The entire County has been identified as exposed for severe storms. Therefore, all assets in the County (population, structures, critical facilities, and lifelines), as described in the County Profile (Section 3), are exposed and vulnerable to severe storm events.

Impact on Life, Health, and Safety

The entire population of Rockland County (461,860) is exposed to this hazard; however, the impact of these events can have on life, health, and safety are dependent upon several factors, including the severity of the event and whether adequate warning time was provided to residents.

Outdoor workers are vulnerable to severe weather 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. Wet weather and high wind conditions can pose a greater threat to employees working in the construction, and shipbuilding industries. For instance, workers in the construction industry are bound to work in open spaces, at heights, with electrical equipment and metals, in excavation areas and trenches, and may handle hazardous materials as a work task, thereby causing exposure to a myriad of safety hazards (Hazwoper OSHA 2020).

As a result of a significant hurricane 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. Hazus estimates that there will not be any displaced households or persons seeking short-term shelter from the 100-year MRP event. Further, Hazus estimates that there will be 124 households displaced and 98 persons seeking short-term sheltering caused by the 500-year MRP event (Table 4.3.8-7).

Table 4.3.8-7. Estimated Displaced Households and Persons Seeking Shelter Caused by the 100-Year and 500-Year MRP Hurricane Events

Jurisdiction	100-Year MRP Hurricane		500-Year MRP Hurricane	
	Displaced Households	Persons Seeking Short-Term Sheltering	Displaced Households	Persons Seeking Short-Term Sheltering
Airmont, Village of	0	0	1	1
Chestnut Ridge, Village of	0	0	0	0
Clarkstown, Town of	0	0	42	29
Grand View on Hudson, Village of	0	0	0	0
Haverstraw, Town of	0	0	5	4
Haverstraw, Village of	0	0	6	11
Hillburn, Village of	0	0	0	0
Kaser, Village of	0	0	0	0
Montebello, Village of	0	0	0	0
New Hempstead, Village of	0	0	1	1
New Square, Village of	0	0	1	2
Nyack, Village of	0	0	11	5
Orangetown, Town of	0	0	22	12
Piermont, Village of	0	0	3	0
Pomona, Village of	0	0	0	0
Ramapo, Town of	0	0	7	8
Sloatsburg, Village of	0	0	0	0
South Nyack, Village of	0	0	3	2
Spring Valley, Village of	0	0	10	12
Stony Point, Town of	0	0	5	4
Suffern, Village of	0	0	3	2
Upper Nyack, Village of	0	0	1	1
Wesley Hills, Village of	0	0	0	0
West Haverstraw, Village of	0	0	3	4
Rockland County (Total)	0	0	124	98

Source: Hazus v6.0

Note: These values are rounded down.

Socially Vulnerable Population

The vulnerable population also includes those who would not have adequate warning from an emergency warning system (e.g., television or radio); this would include residents and visitors. The population adversely affected by severe summer weathers may also include those beyond the disaster area that rely on affected roads for transportation.

Socially vulnerable populations are most susceptible due to their physical and financial ability to react and respond during extreme severe summer weathers. This population includes the elderly, young, and individuals with disabilities or access or functional needs who may be unable to evacuate in the event of an emergency. The elderly are considered most vulnerable because they require extra time or outside assistance during evacuations

and are more likely to seek or need medical attention that might not be readily available due to isolation during a storm event. Section 3 (County Profile) provides statistics of these populations.

Economically disadvantaged people are at high risk for bracing severe summer weathers because of the potential inability to afford up-to-code homes and buildings that are deemed safe from storms passing through. They also may pose health issues, such as exposure to mold and other health issues that water seepage may cause. These populations may also lack access to vehicles for any necessary evacuations.

According to the 2021 ACS, there are 52,060 persons over the age of 65 years, 27,605 persons under the age of five years, 26,990 non-English speakers, 29,008 persons with a disability, 49,451 living in poverty, and 109,704 living below ALICE in Rockland County.

Impact on General Building Stock

All buildings are exposed to severe weather hazards such as hailstorms and lightning strikes. Refer to Section 3 (County Profile) for summaries of the building inventory in Rockland County.

An extreme hailstorm event can carry hail stones traveling at speeds greater than 100 miles per hour (NWS 2019). This could cause structural damage for the general building stock in the County.

Severe summer weather that causes lightning could be a threat to the County's general building stock if the lightning starts a fire. 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 (NFPA 2013).

Potential building damage was evaluated by Hazus across the following damage categories: none, slight, moderate, extensive, and complete. Table 4.3.8-8 provides definitions of these five categories of damage for a light wood-framed building. Definitions for other building types are included in the Hazus technical manual documentation. The results of potential damage states for buildings in Rockland County categorized by general occupancy classes (i.e., residential, commercial, industrial, etc.) from Hazus are summarized in Table 4.3.8-9 for the 100-year MRP event. Hazus estimates that there will be \$98,810,365 in damages to structures caused by the 100-year MRP event, with the estimated residential damage being the most expensive at \$91,389,486, or 98.5 percent of the total damages. Table 4.3.8-10 summarizes the damages to structures for the 500 MRP event, which estimates that there will be \$381,159,445 in damages to structures caused by the 500-year MRP event, with the estimated residential damage being the most expensive at \$314,987,540, or 82.6 percent of the total damages.

Table 4.3.8-8. Example of Structural Damage State Definitions for a Light Wood-Framed Building

Damage Category	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.
Complete	Structure may have large permanent lateral displacement, may collapse, or 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: FEMA 2022

Table 4.3.8-9. Estimated Building Losses Caused by the 100-Year MRP Hurricane by Occupancy

Jurisdiction	100-Year MRP Hurricane	100-Year MRP for Residential Structures Only	100-Year MRP Hurricane for Commercial Structures Only	100-Year MRP Hurricane for All Other Occupancies Structures Only
Airmont, Village of	\$3,875,540	\$3,758,302	\$78,668	\$38,569
Chestnut Ridge, Village of	\$3,438,961	\$3,304,582	\$52,991	\$81,388
Clarkstown, Town of	\$31,171,222	\$29,746,267	\$905,322	\$519,633
Grand View on Hudson, Village of	\$257,798	\$236,319	\$13,248	\$8,231
Haverstraw, Town of	\$4,772,796	\$3,453,670	\$311,083	\$1,008,044
Haverstraw, Village of	\$1,157,497	\$1,052,778	\$54,264	\$50,455
Hillburn, Village of	\$204,894	\$185,896	\$5,819	\$13,179
Kaser, Village of	\$154,562	\$140,436	\$1,500	\$12,626
Montebello, Village of	\$1,980,608	\$1,864,265	\$74,109	\$42,234
New Hempstead, Village of	\$1,917,328	\$1,811,027	\$64,025	\$42,276
New Square, Village of	\$305,532	\$254,426	\$22,733	\$28,373
Nyack, Village of	\$1,628,991	\$1,431,518	\$156,759	\$40,713
Orangetown, Town of	\$20,397,281	\$18,085,335	\$1,720,006	\$591,940
Piermont, Village of	\$1,008,154	\$954,269	\$29,276	\$24,608
Pomona, Village of	\$1,396,339	\$1,109,834	\$142,946	\$143,559
Ramapo, Town of	\$8,530,928	\$8,092,705	\$237,904	\$200,320
Sloatsburg, Village of	\$760,652	\$744,849	\$10,048	\$5,756
South Nyack, Village of	\$850,021	\$808,187	\$8,920	\$32,915
Spring Valley, Village of	\$2,098,454	\$1,901,980	\$90,194	\$106,280
Stony Point, Town of	\$5,941,060	\$5,777,318	\$77,453	\$86,288
Suffern, Village of	\$1,689,762	\$1,603,500	\$39,843	\$46,419
Upper Nyack, Village of	\$1,210,340	\$1,168,919	\$19,546	\$21,876
Wesley Hills, Village of	\$2,414,000	\$2,370,359	\$11,574	\$32,067
West Haverstraw, Village of	\$1,647,645	\$1,532,744	\$61,321	\$53,579
Rockland County (Total)	\$98,810,365	\$91,389,486	\$4,189,551	\$3,231,329

Source: Hazus v6.0

Note: These values are rounded to the nearest dollar/whole value.

Table 4.3.8-10. Estimated Building Losses Caused by the 500-Year MRP Hurricane by Occupancy

Jurisdiction	500-Year Mean Return Period Hurricane	500-Year Mean Return Period Hurricane for Residential Structures Only	500-Year Mean Return Period Hurricane for Commercial Structures Only	500-Year Mean Return Period Hurricane for All Other Occupancies Structures Only
Airmont, Village of	\$11,662,752	\$10,982,360	\$479,887	\$200,505
Chestnut Ridge, Village of	\$11,267,075	\$10,277,654	\$457,302	\$532,119
Clarkstown, Town of	\$117,153,891	\$104,468,941	\$8,291,996	\$4,392,954
Grand View on Hudson, Village of	\$1,065,630	\$855,468	\$143,382	\$66,780
Haverstraw, Town of	\$20,166,985	\$11,464,740	\$3,062,332	\$5,639,913
Haverstraw, Village of	\$5,920,441	\$4,827,029	\$549,008	\$544,405
Hillburn, Village of	\$648,850	\$542,181	\$35,126	\$71,543
Kaser, Village of	\$662,576	\$576,093	\$12,719	\$73,764
Montebello, Village of	\$6,260,226	\$5,552,022	\$500,120	\$208,084
New Hempstead, Village of	\$6,393,804	\$5,676,916	\$487,666	\$229,222
New Square, Village of	\$1,439,521	\$1,149,058	\$129,466	\$160,997
Nyack, Village of	\$8,474,987	\$6,607,973	\$1,498,271	\$368,743
Orangetown, Town of	\$87,638,559	\$61,055,386	\$21,450,813	\$5,132,360
Piermont, Village of	\$4,135,157	\$3,720,494	\$243,494	\$171,169
Pomona, Village of	\$6,277,945	\$3,609,961	\$1,640,457	\$1,027,526
Ramapo, Town of	\$29,199,942	\$26,350,338	\$1,697,257	\$1,152,347
Sloatsburg, Village of	\$2,329,923	\$2,248,809	\$54,443	\$26,671
South Nyack, Village of	\$4,203,332	\$3,781,666	\$93,746	\$327,919
Spring Valley, Village of	\$9,494,963	\$8,116,060	\$665,470	\$713,433
Stony Point, Town of	\$21,851,314	\$20,365,915	\$783,940	\$701,459
Suffern, Village of	\$5,669,638	\$5,123,461	\$235,648	\$310,529
Upper Nyack, Village of	\$5,082,546	\$4,631,026	\$224,906	\$226,615
Wesley Hills, Village of	\$7,539,367	\$7,246,714	\$82,108	\$210,546
West Haverstraw, Village of	\$6,620,023	\$5,757,277	\$480,129	\$382,617
Rockland County (Total)	\$381,159,445	\$314,987,540	\$43,299,684	\$22,872,220

Source: Hazus v6.0

Note: These values are rounded to the nearest dollar/whole value.

Building damage as a result of the 100-year and 500-year MRP hurricanes were estimated for each municipality using Hazus. Table 4.3.8-11 summarizes estimated total building and content losses caused by the 100-year and 500-year MRP events by building occupancy class. For the 100-year MRP event, up to 68 buildings will be moderately damaged by the 100-year MRP event and up to two will be severely damaged. The majority of the losses are estimated to the residential occupancy class. For the 500-year MRP event, up to 1,500 buildings will be moderately damaged by the 500-year MRP event and up to 61 will be severely damaged. The majority of the losses are estimated to the residential occupancy class.

Table 4.3.8-11. Estimated Building Damages (Structure and Contents) from the 100-year and 500-year MRP Hurricane Events

Occupancy Class	Total Number of Buildings Assessed in Occupancy	Severity of Expected Damage	100-Year MRP Hurricane		500-Year MRP Hurricane	
			Building Count	Percent of Buildings in Occupancy Class	Building Count	Percent of Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	104,229	NONE	101,953	97.8%	88,108	84.5%
		MINOR	2,222	2.1%	14,689	14.1%
		MODERATE	55	0.1%	1,378	1.3%
		SEVERE	0	0.0%	29	0.0%
		DESTRUCTION	0	0.0%	24	0.0%
Commercial Buildings	4,971	NONE	4,902	98.6%	4,436	89.2%
		MINOR	57	1.1%	414	8.3%
		MODERATE	12	0.2%	92	1.9%
		SEVERE	1	0.0%	29	0.6%
		DESTRUCTION	0	0.0%	0	0.0%
Industrial Buildings	1,154	NONE	1,136	98.5%	1,046	90.6%
		MINOR	17	1.5%	88	7.6%
		MODERATE	1	0.1%	17	1.4%
		SEVERE	0	0.0%	3	0.3%
		DESTRUCTION	0	0.0%	0	0.0%
Government, Religion, Agricultural, and Education Buildings	2,131	NONE	2,105	98.8%	1,916	89.9%
		MINOR	26	1.2%	202	9.5%
		MODERATE	0	0.0%	13	0.6%
		SEVERE	0	0.0%	0	0.0%
		DESTRUCTION	0	0.0%	0	0.0%

Source: Hazus v6.0

Impact on Critical Facilities and Community Lifelines

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. Power loss can greatly impact households, business operations, public utilities, and emergency personnel. Emergency personnel such as police, fire, and emergency medical services (EMS) will not be able to effectively respond in a power loss event to maintain the safety of its citizens unless backup power and fuel sources are available. 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 until power is restored.

All critical facilities in the County are exposed to the severe weather hazard with similar risks as discussed for the general building stock. It is essential that critical facilities remain operational during natural hazard events. 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 Section 9 (Jurisdictional Annexes).

The Hazus hurricane model was used to assign the range or average probability of each damage state category to the critical facilities and lifelines in Rockland County for the 100-year and 500-year MRP events. For percent probability of sustaining damage, the minimum and maximum damage estimated value for that facility type is presented.

As a result of a 100-year MRP event, Hazus estimates that police stations have the greatest chance of sustaining minor damage, at a range of 1.3 to 2.5 percent. Schools will have the greatest chance of moderate damages, ranging from 0.1 to 0.2 percent. As a result of a 500-year MRP event, Hazus estimates that police stations have the greatest chance of sustaining minor damage, at a range of 5.1 to 11.7 percent. Schools will have the greatest chance of moderate damages, ranging from 0.4 to 6.8 percent. Severe damages to all critical facilities is negligible, with the greatest chance of damages occurring to police stations, which range from 0.0 to 0.2 percent. Table 4.3.8-12 and Table 4.3.8-13 summarize the damage state probabilities for critical facilities during the 100-year and 500-year MRP events, respectively.

Table 4.3.8-12. Estimated Damage for Critical Facilities in Rockland County for the 100-Year MRP Hurricane Event

Facility Type	100-Year MRP Hurricane				
	Loss of Days	Percent-Probability of Sustaining Damage			
		Minor	Moderate	Severe	Complete
Medical Facilities	0	0.4% - 1.4%	0.0% - 0.1%	0.0%	0.0%
Police Stations	0	1.3% - 2.5%	<0.1% - 0.1%	0.0%	0.0%
Fire Stations	0	0.4% - 1.1%	<0.1% - 0.1%	0.0%	0.0%
Schools	0	0.6% - 1.8%	<0.1% - 0.2%	0.0%	0.0%
EOC	0	1.3% - 1.9%	<0.1%	0.0%	0.0%

Source: Hazus v6.0

Table 4.3.8-13. Estimated Damage for Critical Facilities in Rockland County for the 500-Year MRP Hurricane Event

Facility Type	500-Year MRP Hurricane				
	Loss of Days	Percent-Probability of Sustaining Damage			
		Minor	Moderate	Severe	Complete
Medical Facilities	0	1.7% - 8.8%	0.1% - 4.3%	0.0% - <0.1%	0.0%
Police Stations	0	5.1% - 11.7%	0.4% - 2.7%	0.0% - 0.2%	0.0%
Fire Stations	0	1.3% - 6.0%	0.1% - 1.8%	0.0% - 0.1%	0.0%
Schools	0 - 1	2.8% - 9.1%	0.4% - 6.8%	0.0% - 0.1%	0.0%
EOC	0	5.2% - 9.8%	0.4% - 1.7%	0.0% - 0.1%	0.0%

Source: Hazus v6.0

Impact on the Economy

Severe weather events can have short- and 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. Overall, economic impacts include the 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. Impacts to transportation

lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting and goods transport) transportation needs. Utility infrastructure (power lines, gas lines, electrical systems) could suffer damage and impacts can result in the loss of power, which can impact business operations and can impact heating or cooling provision to the population.

Hazus estimates building-related economic losses, including income losses (wage, rental, relocation, and capital-related losses) and capital stock losses (structural, non-structural, content, and inventory losses). Economic losses caused by the 100-year and 500-year hurricane MRP events were estimated by Hazus and are summarized in Table 4.3.8-14. Hazus estimates a difference in losses between the 100-year and 500-year MRP events. Income losses for the 100-year MRP event are \$20,050 and \$6,358,000 for the 500-year MRP event.

Table 4.3.8-14. Total Business Interruption Loss (in Thousands of Dollars)

MRP	Income Loss	Relocation Loss	Building Losses	Wages Losses	Rental Losses
100-Year	\$20,050	\$451,170	\$98,810,370	\$20,350	\$1,345,990
500-Year	\$6,358,000	\$24,764,280	\$381,159,440	\$10,479,450	\$9,287,850

Source: Hazus v6.0

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

For the 100-year MRP event, Hazus estimates that 179,625 tons of debris will be generated. For the 500-year MRP event, Hazus estimates a total of 510,740 tons of debris will be generated county-wide. Table 4.3.8-15 and Table 4.3.8-16 summarize the estimated debris generated because of these events by municipality, respectively.

Table 4.3.8-15. Estimated Debris Created During the 100-Year Mean Return Period Hurricane Wind Event

Jurisdiction	Estimated Debris Created During the 100-Year MRP Hurricane Wind Event			
	Brick and Wood (Tons)	Concrete and Steel (Tons)	Tree (Tons)	Eligible Tree Volume (Cubic Yards)
Airmont, Village of	300	0	543	4,240
Chestnut Ridge, Village of	287	0	846	6,482
Clarkstown, Town of	2,695	0	6,903	50,488
Grand View on Hudson, Village of	25	0	185	630
Haverstraw, Town of	502	0	1,562	4,914
Haverstraw, Village of	161	0	358	2,430
Hillburn, Village of	21	0	216	496
Kaser, Village of	24	0	22	209
Montebello, Village of	162	0	1,699	3,062
New Hempstead, Village of	152	0	462	2,685
New Square, Village of	56	0	54	537
Nyack, Village of	201	0	176	1,639
Orangetown, Town of	1,832	0	4,838	27,073
Piermont, Village of	119	0	150	1,499
Pomona, Village of	159	0	1,333	3,097
Ramapo, Town of	813	0	1,967	10,784

Jurisdiction	Estimated Debris Created During the 100-Year MRP Hurricane Wind Event			
	Brick and Wood (Tons)	Concrete and Steel (Tons)	Tree (Tons)	Eligible Tree Volume (Cubic Yards)
Sloatsburg, Village of	60	0	2	2
South Nyack, Village of	109	0	98	827
Spring Valley, Village of	347	0	355	3,394
Stony Point, Town of	493	0	3,541	9,379
Suffern, Village of	181	0	226	1,562
Upper Nyack, Village of	101	0	234	1,781
Wesley Hills, Village of	177	0	1,128	3,671
West Haverstraw, Village of	178	0	293	2,400
Rockland County (Total)	9,154	0	27,191	143,280

Source: Hazus v6.0

Note: These values are rounded to the nearest whole value.

Table 4.3.8-16. Estimated Debris Created During the 500-Year MRP Hurricane Wind Event

Jurisdiction	Estimated Debris Created During the 500-Year MRP Hurricane Wind Event			
	Brick and Wood (Tons)	Concrete and Steel (Tons)	Tree (Tons)	Eligible Tree Volume (Cubic Yards)
Airmont, Village of	1,354	0	1,648	12,954
Chestnut Ridge, Village of	1,345	0	1,784	13,624
Clarkstown, Town of	14,509	0	16,692	121,569
Grand View on Hudson, Village of	132	0	349	1,191
Haverstraw, Town of	2,589	0	4,614	16,722
Haverstraw, Village of	900	0	1,085	8,287
Hillburn, Village of	88	0	791	1,820
Kaser, Village of	114	0	67	646
Montebello, Village of	718	0	5,162	9,555
New Hempstead, Village of	765	0	1,326	7,753
New Square, Village of	255	0	190	1,895
Nyack, Village of	1,152	0	568	5,353
Orangetown, Town of	9,478	0	11,009	63,915
Piermont, Village of	579	0	342	3,427
Pomona, Village of	834	0	3,508	8,409
Ramapo, Town of	3,838	0	5,780	31,496
Sloatsburg, Village of	257	0	813	4,371
South Nyack, Village of	609	0	331	2,797
Spring Valley, Village of	1,644	0	1,250	11,927
Stony Point, Town of	2,664	0	11,021	32,011
Suffern, Village of	777	0	780	5,522
Upper Nyack, Village of	647	0	586	4,451
Wesley Hills, Village of	841	0	3,341	10,704
West Haverstraw, Village of	939	0	1,132	9,144
Rockland County (Total)	47,028	0	74,169	389,543

Source: Hazus v6.0

Note: These values are rounded to the nearest whole value.

Impact on the Environment

The impact of severe weather events on the environment varies, but researchers are finding that the long-term impacts of more severe weather can be destructive to the natural and local environment. National organizations such as USGS and NOAA have been studying and monitoring the impacts of extreme weather phenomena as it impacts long-term climate change, streamflow, river levels, reservoir elevations, rainfall, floods, landslides, erosion, etc. For example, severe weather that creates longer periods of rainfall can erode natural banks along waterways and degrade soil stability for terrestrial species. Tornadoes can tear apart habitats causing fragmentation across ecosystems (US EPA 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 (U.S. 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 Rockland County. Refer to Section 4.3.2 (Disease Outbreak) for more information about these stressors.

Future Changes That May Impact Vulnerability

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

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Potential or Projected Development

The ability of new development to withstand extreme summer weather hazard impacts lies in sound land use practices, building design considerations (e.g., Leadership in Energy and Environmental Design [LEED]), and consistent enforcement of codes and regulations for new construction. New development will change the landscape where buildings, roads, and other infrastructure potentially replace open land and vegetation. Surfaces that were once permeable and moist are now impermeable and dry, potentially making them more susceptible to fires caused by lightning. Specific areas of recent and new development are indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 (Jurisdictional Annexes) of this plan.

Projected Changes in Population

Rockland County has experienced an increase in its population since 2010. According to the U.S. Census Bureau, the County's population increased by approximately 8.5 percent between 2010 and 2020 (County of Rockland 2021). Cornell University's Program on Applied Demographics projects Rockland County will have a population of 356,758 by 2030 and 372,432 by 2040 (Cornell University 2018).

Changes in the density of population can increase the number of persons exposed to flooding and erosion. As areas continue to be cleared for new development and run-off persists, the population in the County will remain exposed to this hazard. Refer to Section 3 (County Profile), which includes a discussion on population trends for the County.

Other Identified Conditions

As discussed in previous sections, most studies project that the County will see an increase in average annual temperatures and precipitation. As the climate warms and other changes in climate continue to unfold, the intensity of summer weather may change, producing more ideal conditions for severe storms to form. It is anticipated that the County will continue to experience direct and indirect impacts of severe weather events annually that may induce secondary hazards such as infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents, and inconveniences.

Change of Vulnerability Since 2018 HMP

Overall, the County's vulnerability has not changed, and the entire County will continue to be exposed and vulnerable to severe storm events. As existing development and infrastructure continue to age, they can be at increased risk to failed utility and transportation systems if they are not properly maintained and do not adapt to the changing environment. Since the 2018 HMP, an updated version of Hazus-MH was released. This updated model includes longer historical wind events to pull from to generate probabilistic events.

4.3.9 Severe Winter Storm

Hazard Profile

The following section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for the severe winter storm hazard in Rockland County.

Hazard Description

Severe winter weather is classified as snow, ice, and extremely cold conditions. Winter storms are events in which the dominant forms of precipitation occur only at cold temperatures. The following are common severe winter weather descriptions from the National Weather Service (NWS).

Heavy Snow

According to the National Snow and Ice Data Center (NSIDC), snow is precipitation in the form of ice crystals. Snow falls in different forms: snowflakes, snow pellets, or sleet. Snowflakes are clusters of ice crystals that form from a cloud.

It originates in clouds when temperatures are below the freezing point (32 degrees Fahrenheit, °F) and water vapor in the atmosphere 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 a snow pellet, which then falls to the earth.

Snow pellets are opaque ice particles in the atmosphere. They form as ice crystals fall through super-cooled cloud droplets, which are below freezing but remain a liquid. The cloud droplets then freeze to the crystals.

Sleet

Sleet is made up of drops of rain that freeze into ice as they fall through colder air layers. They are usually smaller than 0.30 inches in diameter (NSSL 2021).

Blizzards

A blizzard is a severe weather condition characterized by high winds and reduced visibilities due to falling or blowing snow. The NWS specifies a blizzard as sustained wind or frequent gusts of 16 miles per second (35 miles per hour) or greater, accompanied by falling and/or blowing snow, frequently reducing visibility to less than 0.25 miles for three hours or longer. Earlier definitions included a condition of low temperatures, on the order of -7°C (20°F) or lower, -12°C (10°F) or lower (severe blizzard) (American Meteorological Society 2014).

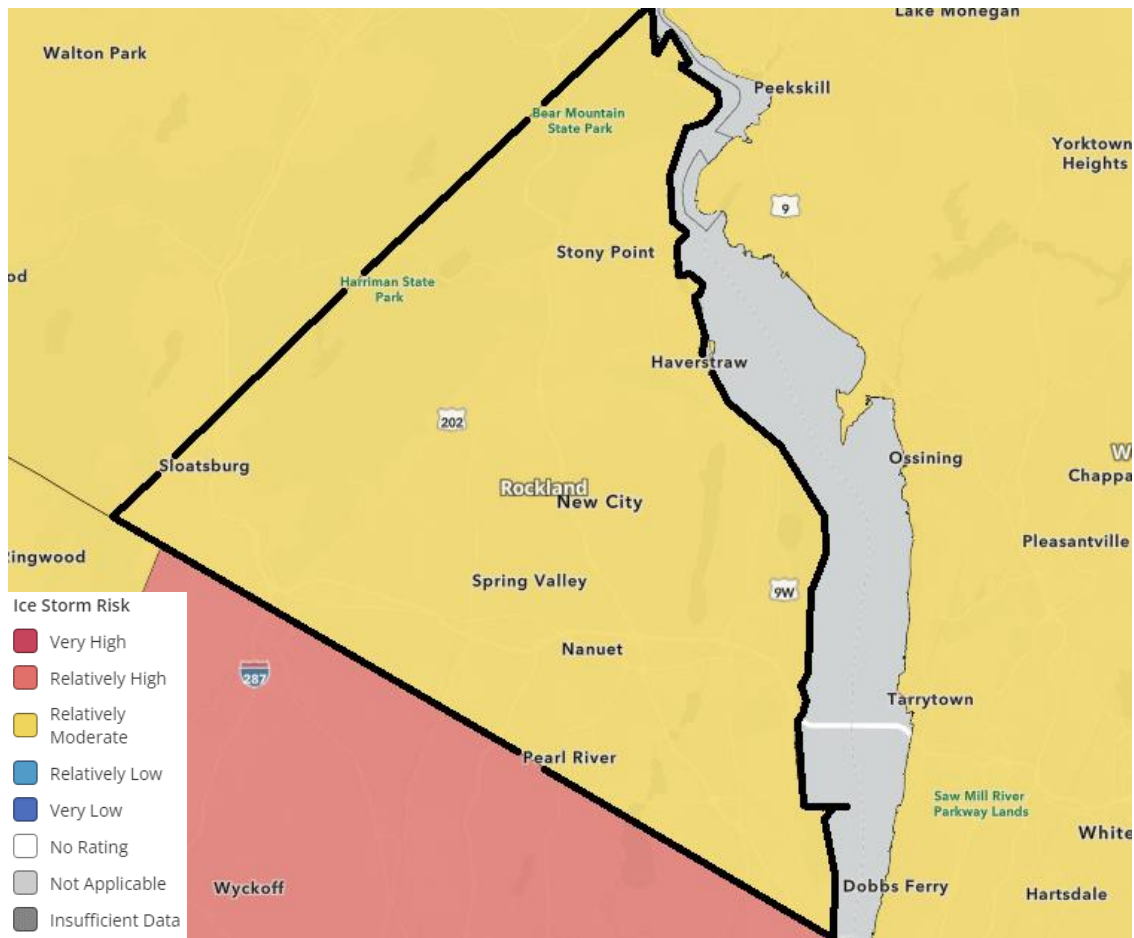
Ice Storms

An ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous. Significant ice accumulations are usually of ¼" or greater (National Weather Service 2009).

Figure 4.3.9-1 and Figure 4.3.9-2 show the Ice Storm Risk Index for Rockland County on the county and census tract scales, respectively. This index helps to understand the susceptibility of the County to ice storms. According

to the National Risk Index, on the county scale, the County has a relatively moderate risk to ice storms; on the census tract scale, the County ranged from a very low risk to a relatively moderate risk (FEMA 2019).

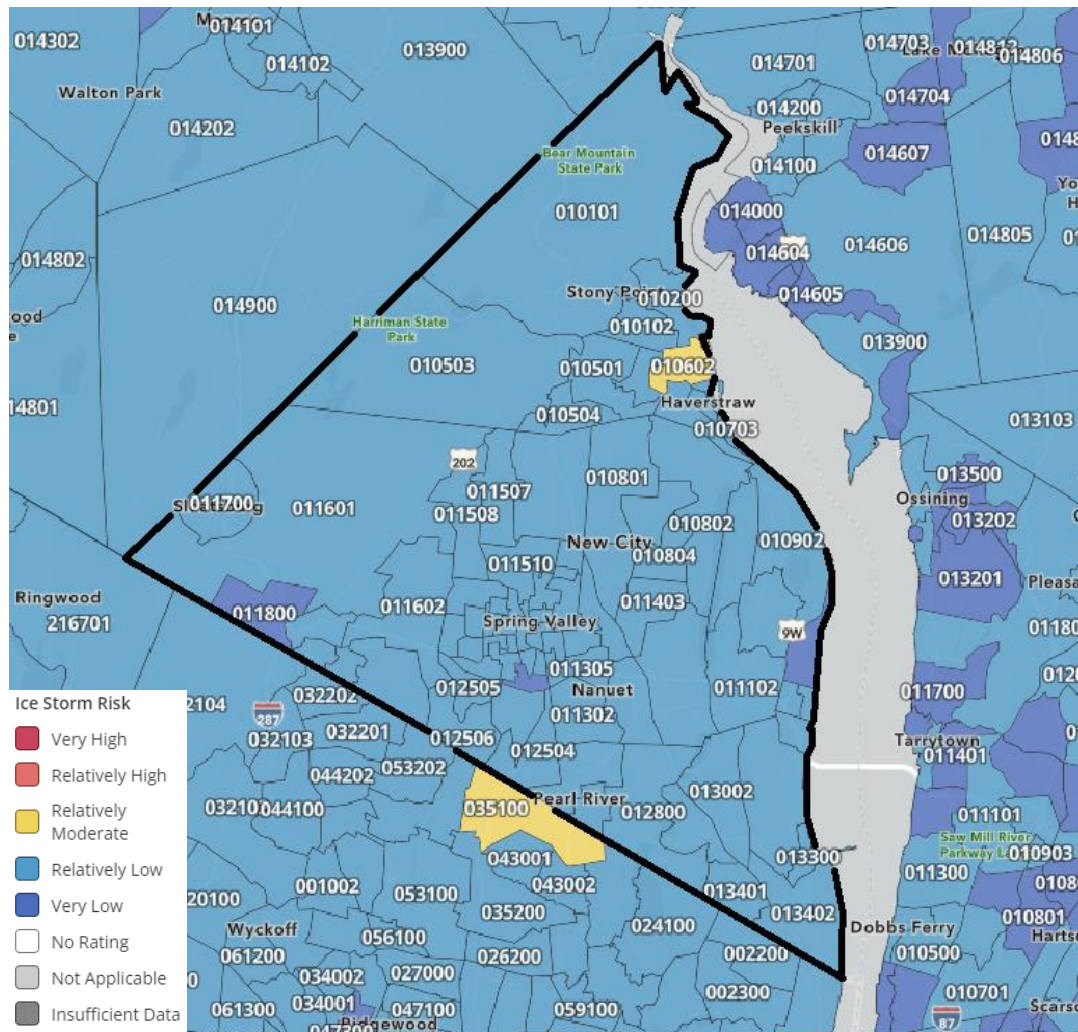
Figure 4.3.9-1. National Risk Index, Ice Storm Risk Index Score Using the County Scale



Source: FEMA 2019

Note: Rockland is outlined in a bolded black border.

Figure 4.3.9-2. National Risk Index, Ice Storm Index Score Using the Census Tract Scale

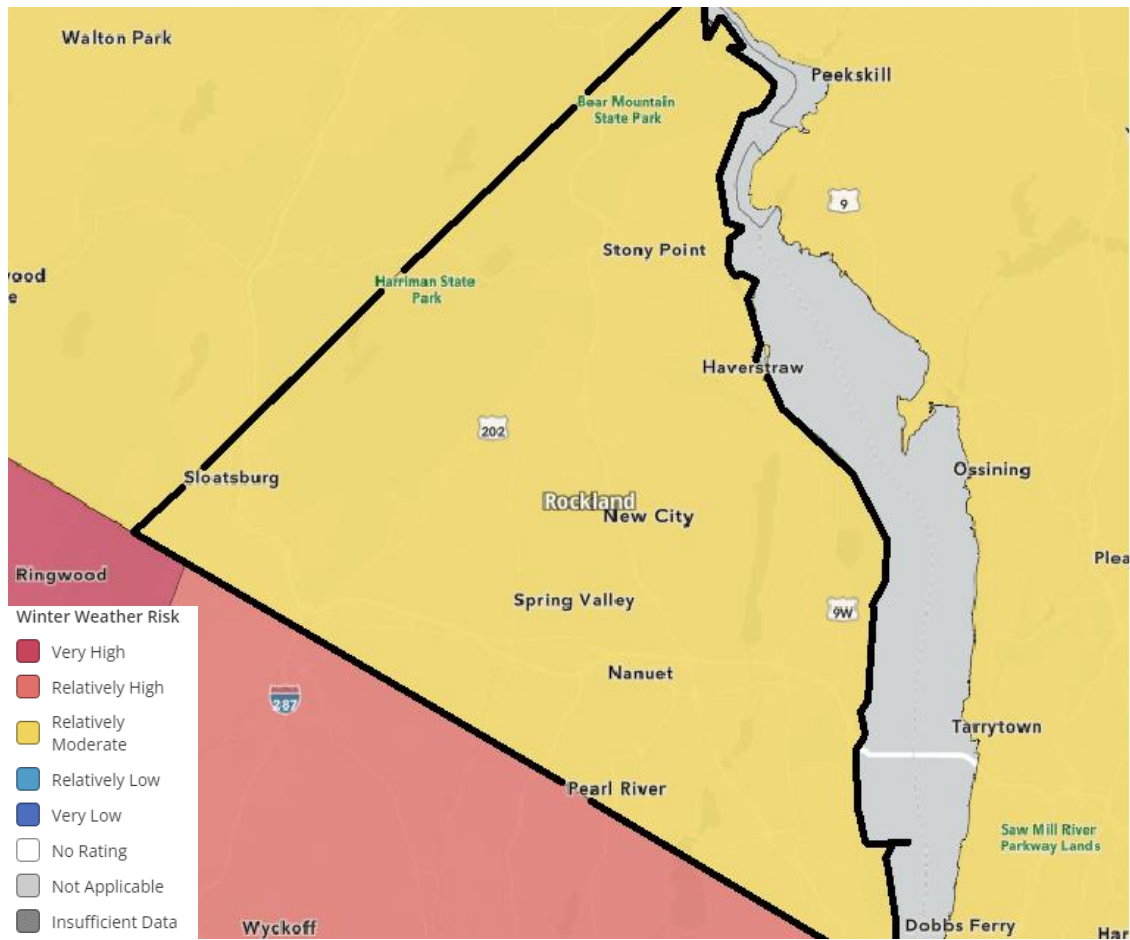


Source: FEMA 2019

Note: Rockland is outlined in a bolded black border.

Figure 4.3.9-3 and Figure 4.3.9-4 show the Winter Weather Risk Index for Rockland County on the county and census tract scales, respectively. This index helps to understand the susceptibility of the County to winter weather. According to the National Risk Index, on the county scale, the County has a relatively moderate risk to winter weather; on the census tract scale, the County ranges from a relatively low risk to a relatively moderate risk (FEMA 2019).

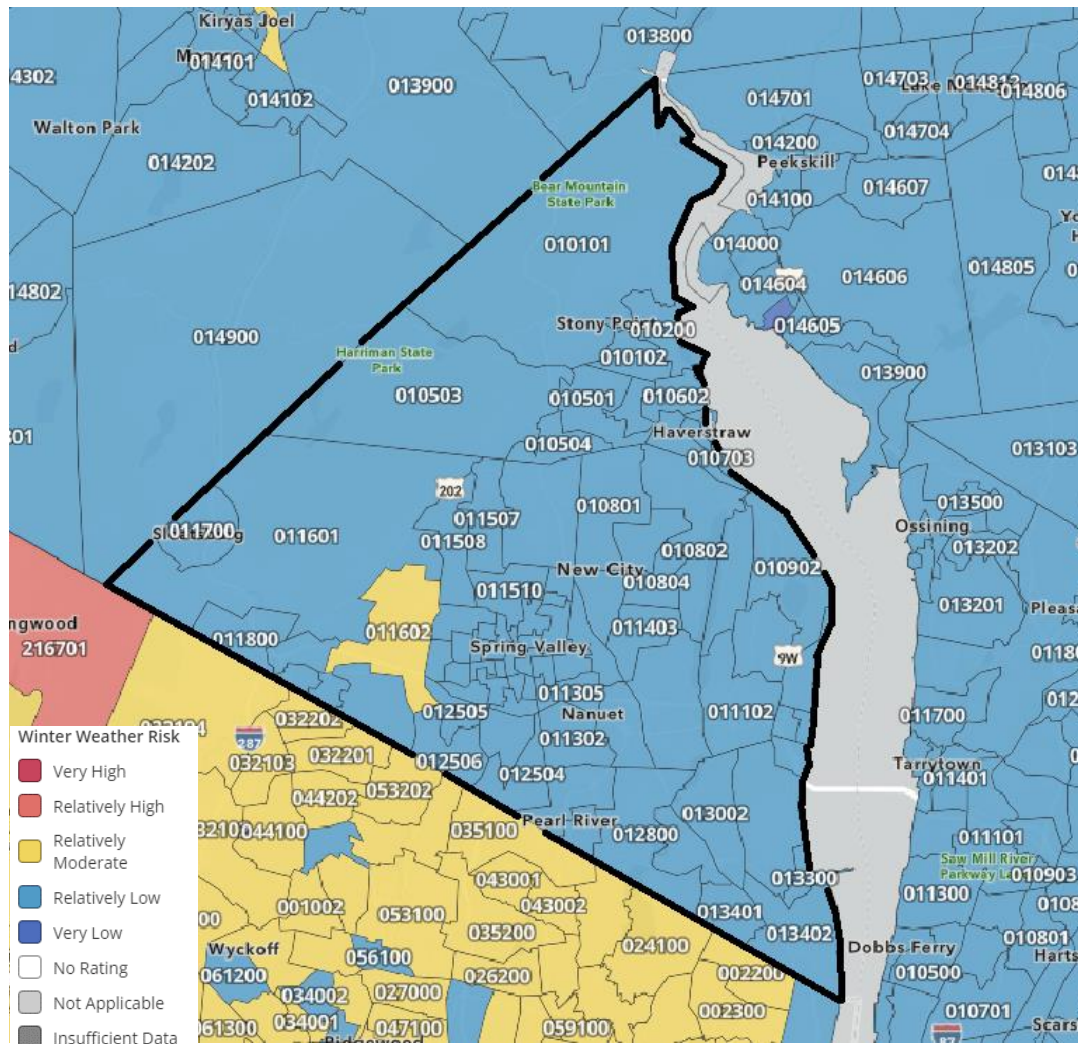
Figure 4.3.9-3. National Risk Index, Winter Weather Risk Index Score Using the County Scale



Source: FEMA 2019

Note: Rockland is outlined in a boldened black border.

Figure 4.3.9-4. National Risk Index, Winter Weather Index Score Using the Census Tract Scale



Source: FEMA 2019

Note: Rockland is outlined in a bolded black border.

Location

The State of New York’s climate is marked by abundant snowfall. Winter weather can reach the State as early as October and is usually in full force by late November with average winter temperatures between 20 and 40 °F. The inland regions of the State receive more snow than most other communities in the nation. Although the entire state is subject to winter storms, the easternmost and west-central portions of the state are more likely to suffer under winter storm occurrences than any other location (NYS DHSES 2019). The average annual snowfall is greater than 70 inches over 60 percent of the State of New York’s area, however Rockland experiences less than 60 inches of snow a year (NYS DHSES 2019).

Extent

The magnitude or severity of a severe winter storm depends on several factors, including snowfall rates, regional climatological susceptibility to snowstorms, snowfall amounts, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day and week (e.g., weekday versus weekend), and time of season.

The extent of a severe winter storm can be classified both by meteorological measurements and by evaluating societal impacts. The National Oceanic and Atmospheric Administration’s (NOAA’s) National Climatic Data Center (NCDC) produces the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the US. The RSI ranks snowstorm impacts based on the spatial extent of the storm, the amount of snowfall, and the interaction of the extent and snowfall totals with population. The NCDC has analyzed and assigned RSI values to over 500 storms since 1900 (NOAA n.d.). Table 4.3.9-1 presents the five RSI ranking categories.

Table 4.3.9-1. 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 2020

Note: RSI=Regional Snowfall Index

The National Weather Service (NWS) operates a widespread network of observing systems, such as geostationary satellites, Doppler radars, and automated surface observing systems that feed into the current state-of-the-art numerical computer models to provide a look into what will happen next, ranging from hours to days. The models are then analyzed by NWS meteorologists who then write and disseminate forecasts. According to NWS (NWS 2021), the magnitude of a severe winter storm can be classified into five main categories by event type, shown in Table 4.3.9-2.

Table 4.3.9-2. Winter Storm Category Thresholds

Winter Storm Event	Threshold
Heavy Snowstorm	Accumulations of 4 inches or more of snow in a 6-hour period, or 6 inches of snow in a 12-hour period.
Sleet Storm	Significant accumulations of solid pellets that form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces, posing a hazard to pedestrians and motorists.
Ice Storm	Significant accumulation of rain or drizzle freezing on objects (trees, power lines, roadways) as it strikes them, causing slippery surfaces and damage from sheer weight of ice accumulations.
Blizzard	Wind velocity of 35 mph or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile prevailing over an extended period.
Severe Blizzard	Wind velocity of 45 mph, temperatures of 10 °F or lower, a high density of blowing snow with visibility frequently measured in feet prevailing over an extended period.

Source: NWS 2021

Additionally, the NWS uses winter weather watches, warnings, and advisories to help people anticipate what to expect in the days and hours prior to an approaching storm (NWS 2021). Refer to Figure 4.3.9-5 for the warning thresholds.

Figure 4.3.9-5. Winter Storm Warning Thresholds



Source: NWS 2021

Previous Occurrences

FEMA Major Disaster and Emergency Declarations

Between 1954 and 2023, Rockland County was included in three major disaster (DR) or emergency (EM) declarations for severe winter storm-related events (FEMA 2023). For declarations that occurred between 2017 and 2023, refer to Table 4.3.9-3. Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

Table 4.3.9-3. FEMA Declarations for Severe Winter Storm Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
March 17, 1993	Snowstorm	EM-3107	Yes	Countywide	Severe Blizzard
January 12, 1996	Snowstorm	DR-1083	Yes	Countywide	Severe Snowstorm
March 27, 2003	Snowstorm	EM-3184	Yes	Countywide	Snow

Sources: Table Note

USDA Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2018 and 2023, Rockland County was not included in any severe winter storm-related agricultural disaster declarations.

Previous Events

For this 2024 HMP update, known hazard events that impacted Rockland County between January 2017 and December 2023 are discussed in Table 4.3.9-4. For events prior to 2017, refer to the 2018 Rockland County HMP.

Table 4.3.9-4. Hazard Events in Rockland County (2017 to 2023)

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
February 9, 2017	Winter Storm	N/A	N/A	Rockland County	Heavy snow and strong winds led to numerous accidents on roadways and led to 2,000 flight cancelations at Kennedy and La Guardia Airports. Around 8-9 inches of snowfall were reported. No damages were reported.
March 14, 2017	Winter Storm	N/A	N/A	Rockland County	Heavy snow, sleet and strong winds led to numerous flights canceled and trees and wires were downed due to strong winds, resulting in 17,000 power outages. 12-20 inches of snowfall were reported, and no damages were reported.
January 4, 2018	Winter Storm	N/A	N/A	Rockland County	Heavy snow and blizzard like conditions developed across the southeastern New York area which resulted in numerous accidents and power outages. No damages were reported.
February 17-18, 2018	Heavy Snow	N/A	N/A	Rockland County	Heavy snow that produced 6-8 inches hit southern New York. No damages were reported.
March 7, 2018	Winter Storm	N/A	N/A	Rockland County	A storm brought heavy, wet snow, strong gusty winds and some thunderstorms to southeastern New York. Snowfall rates hit 1-3 inches per hour in the heavier snow bands. One death was reported as a result of the storm, and no damages were documented.
March 12-13, 2018	Winter Weather	N/A	N/A	Rockland County	A snowstorm resulted in snowfall rates of 1-2 inches an hour during the morning of the 13 th . A total of 2-4 inches of snow was reported and no damages were reported.
March 21-22, 2018	Winter Weather	N/A	N/A	Rockland County	A large and slow-moving storm deposited moderate to heavy snow across the Lower Hudson Valley. Snowfall rates of 2-4 inches an hour was documented, producing near-blizzard like conditions with low visibility and wind speeds up to 35 mph. No damages were documented.
April 2, 2018	Winter Weather	N/A	N/A	Rockland County	Moderate to heavy snowfall fell during the morning with snowfall rates reaching an inch an hour at times. 4-6 inches of snow were documented. No damages were reported.
November 15-16, 2018	Winter Storm	N/A	N/A	Rockland County	A storm produced moderate to heavy wet snowfall, with snow falling at a rate of 1-2 inches per hour. Trees and branches were brought down, and numerous accidents were reported. 5-8 inches total and no damages were reported.
March 2, 2019	Winter Weather	N/A	N/A	Rockland County	A quick depositing snowstorm produced a total of about 3 inches of snow and did not produce any reported damages.

Date(s) of Event	Event Type	FEMA and/or USDA Declaration Number (if applicable)	Rockland County included in declaration?	Location Impacted	Description
March 3-4, 2019	Heavy Snow	N/A	N/A	Rockland County	Snow mixed with rain and sleet occurred overnight which resulted in a reported 6-9 inches of snow. No damages were reported.
December 1-3, 2019	Winter Weather	N/A	N/A	Rockland County	A storm slowly moved through southern New York with 2 to 5 inches of snow reported. No damages were reported.
December 16-17, 2020	Winter Storm	N/A	N/A	Rockland County	Snowfall started on the 16 th , then melted and refroze before snowfall continued on the 17 th . Snowfall rates ranges from 1 to 2 inches an hour, totaling to be 6 to 10 inches reported. Numerous accidents resulted from the snow and icy conditions. No damages were documented.
February 1-2, 2021	Winter Storm	N/A	N/A	Rockland County	A major winter storm hits Southeast New York, with the most significant impacts occurring on February 1, with snowfall rates of 1 to 3 inches per hour reported. Traffic accidents and power outages were reported. 15 to 22 inches of snow were documented. No damages were documented.
February 7, 2021	Winter Weather	N/A	N/A	Rockland County	A band of moderate to heavy snow developed across the southern region which resulted in snow rates as high as 2 inches per hour. 3 to 5 inches of snow total were reported. No damages were reported.
February 18-19, 2021	Winter Weather	N/A	N/A	Rockland County	Moderate to heavy snowfall mixed with sleet deposited a total of 3 to 5 inches of snow in southern New York. No damages were reported.
February 22, 2021	Winter Weather	N/A	N/A	Rockland County	Brief periods of heavy snow produced around 4 inches of snow before temperatures rose and the snow turned into rain. No damages were reported.
January 7, 2022	Winter Weather	N/A	N/A	Rockland County	Moderate snowfall resulted in a total of 3 to 4 inches of snow. No damages were reported.
January 28-29, 2022	Winter Weather	N/A	N/A	Rockland County	Blizzard conditions were verified across the area with wind gusts up to 60 mph documented. 2 to 4 inches were documented across Rockland with no damages reported.
February 4, 2022	Winter Weather	N/A	N/A	Rockland County	Freezing rain spurred an advisory, as reports of over a quarter of an inch of ice were documented. No damages were reported.
February 13, 2022	Winter Weather	N/A	N/A	Rockland County	Snowfall with minimal impacts were documented across southeastern New York. Around 2.5 inches of wet snow was reported. No damages were documented.
February 27, 2023	Heavy Snow	N/A	N/A	Rockland County	Widespread accumulating snowfall of around 6 inches was documented across southeastern New York. No damages were documented.
March 14, 2023	Winter Weather	N/A	N/A	Rockland County	The heaviest snowfall totals were driven by elevation since temperatures were at freezing. Around an inch of snow was documented at lower elevations. No damages were documented.

Sources: NOAA 2023; FEMA 2023; USDA 2023

Probability of Future Occurrences

For the 2024 HMP update, best available data was used to collect hazard event details. These details were used to calculate the probability of future occurrence of hazard events in the County. Information from NOAA, USDA, the 2019 State of New York HMP, the 2018 Rockland County HMP, and FEMA were used to identify the number of events that occurred between 1954 and 2023. Table 4.3.9-5 provides the calculated probability of future winter weather events in Rockland County.

Table 4.3.9-5. Probability of Future Severe Winter Storm Events in Rockland County

Hazard Type	Number of Occurrences Between 1954 and 2023	Percent Chance of Occurring in Any Given Year
Blizzard	2	2.74%
Heavy Snow	39	53.42%
Ice Storm	3	4.11%
Sleet	0	0%
Winter Storm	20	27.40%
Winter Weather	19	26.03%
Total	83	100%

Sources: NOAA 2023

Notes: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act, and selected severe winter storm events since 1968. Due to limitations in data, not all severe winter storm events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

According to the National Risk Index, Rockland County has a relatively moderate risk for winter weather based on expected annual loss, social vulnerability, and community resilience. In Section 4.4, the identified hazards of concern for Rockland County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for severe winter storms in the County is considered ‘frequent.’

Climate Change Projections

Climate change affects the State of New York’s residents and resources. As the century progresses, snowfall is likely to become less frequent, with the snow season decreasing in length. It is uncertain if there will be changes in the intensity of snowfall during each storm; however, it is possible that higher temperatures in colder parts of the State of New York could support higher snowfall totals during snowstorm events because warmer air has the ability to hold more water vapor than cold air. (NYSERDA 2011/2014).

Temperatures in the State of New York are warming, with an average rate of warming over the past century of 0.25° F per decade. Average annual temperatures are projected to increase across the State of New York by 2° F to 3.4° F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the State (NYSERDA 2014).

The region encompassing Rockland County, which includes the Catskill Mountains and West Hudson River Valley, is expected to experienced temperature increases of 4.2 to 6.1°F by the 2050s and 5.4 to 9.6°F by the 2080s (baseline of 50.0°F, middle range projection). Precipitation totals are estimated to increase between three to 11 percent by the 2050s and six to 14 percent by the 2080s (baseline of 46.0 inches, middle range projection). Table 4.3.9-6 displays the projected seasonal precipitation change for the region for 2050 (NYSERDA 2011/2014). The winter season is projected to have a precipitation increase of up to 15 percent.

Table 4.3.9-6. Projected Seasonal Precipitation Change in the Catskill Mountains and West Hudson River Valley, 2050s (% change)

Winter	Spring	Summer	Fall
0 to +15	0 to +10	-5 to +10	-5 to +10

Source: NYSERDA 2011

Winter snow cover is decreasing, and spring comes, on average, about a week earlier than it did a few years ago. Nighttime temperatures are measurably warmer, even during the colder months. Overall winter temperatures in The State of New York are almost 5 degrees warmer than in 1970 (NYSERDA 2011/2014). The state has experienced a decrease in the number of cold winter days (below 32 °F) and can expect to see a decrease in snow cover by as much as 25–50 percent by end of the next century. The lack of snow cover may jeopardize opportunities for skiing, snowmobiling, and other types of winter recreation; and natural ecosystems will be affected by the changing snow cover (Cornell University College of Agriculture and Life Sciences 2011).

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the severe winter storm hazard, all of Rockland County has been identified as the hazard area. Therefore, all assets in the County (population, structures, critical facilities, and lifelines), as described in the County Profile (Section 3), are vulnerable to a winter storm event.

For this analysis, a percentage of the custom-building stock structural replacement cost value was used to estimate damages that could result from winter storm conditions. This methodology is based on FEMA’s How-to Series (FEMA 386-2), Understanding Your Risks, Identifying and Estimating Losses (FEMA 2001) and FEMA’s Using HAZUS-MH for Risk Assessment (FEMA 433) (FEMA 2004).

Impact on Life, Health, and Safety

The entire population of Rockland County (336,485) is exposed to severe winter storm events (US Census 2020). According to the NOAA National Severe Storms Laboratory (NSSL), every year, winter weather indirectly and deceptively kills hundreds of people in the U.S., primarily from automobile accidents, overexertion, and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow, extreme cold temperatures, and dangerous wind chills. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. People can die in traffic accidents on icy roads, by heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold (NSSL 2021).

Socially Vulnerable Population

People who experience homelessness, are over the age of 65, and under the age of 5 are considered to be the most susceptible to this hazard. Older adults are susceptible to this hazard due to their increased risk of injuries and death from falls and overexertion, and/or hypothermia from attempts to clear snow and ice. Young children are at risk from experiencing hypothermia or other cold related illnesses due to their inability to care for themselves and their dependency on others. Individuals who experience homelessness are at risk from hypothermia due to lack of a warming shelter from the cold temperatures that are associated with winter weather. Those that are at or around the poverty level in the County are dependent on their limited income and may not be able to afford staying at an alternative shelter, such as a hotel, and may not be able to afford to miss

work, regardless of the weather conditions. People who are non-English speaking may not be able to interpret public emergency warnings and signage which puts them at an increased risk. According to the 2017 to 2021 American Community Survey, there are 49,451 total persons living below the poverty level, 52,060 persons over the age of 65 years, 27,605 persons under the age of 5 years, 26,990 non-English speakers, 29,008 persons with a disability, 49,451 living in poverty, and 109,704 living below ALICE in Rockland County (refer to Table 4.3.9-7). In addition, severe winter storm events can reduce the ability of these populations to access emergency services due to inaccessible roadways. Figure 4.3.9-6 presents the National Risk Index, which is a social vulnerability score that represents Rockland’s rating in comparison to all other communities at the same level (FEMA n.d.).

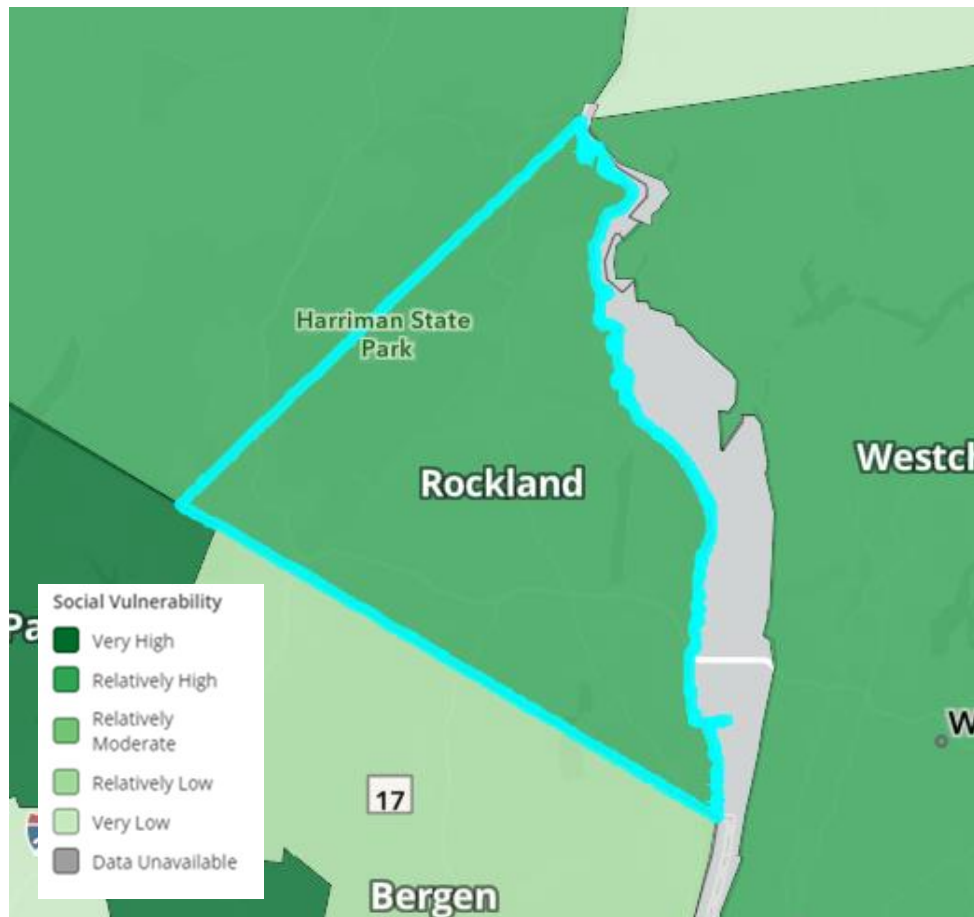
Table 4.3.9-7. Vulnerable Populations in Rockland County by Jurisdiction

Jurisdiction	Vulnerable Population (ACS 5-Year Estimates 2021)					
	Over 65	Under 5	Non-English Speaking	Disability	Poverty Level	Living Below ALICE
Airmont, Village of	1,487	660	355	727	1,067	2,616
Chestnut Ridge, Village of	1,587	1,368	617	1,149	1,947	1,957
Clarkstown, Town of	16,757	3,729	4,251	8,056	3,548	22,733
Grand View on Hudson, Village of	64	13	0	16	13	32
Haverstraw, Town of	2,523	1,093	996	1,228	1,414	5,023
Haverstraw, Village of	1,624	882	2,045	1,500	1,796	4,671
Hillburn, Village of	161	114	48	145	154	362
Kaser, Village of	174	1,319	1,350	102	3,284	1,182
Montebello, Village of	563	193	165	303	516	588
New Hempstead, Village of	816	259	65	383	121	439
New Square, Village of	201	1,523	1,651	319	5,699	1,586
Nyack, Village of	1,521	347	265	862	286	3,653
Orangetown, Town of	6,912	1,804	1,056	3,540	1,626	12,603
Piermont, Village of	539	141	142	181	48	1,214
Pomona, Village of	613	246	116	293	111	520
Ramapo, Town of	4,698	7,183	1,265	2,424	16,194	18,912
Sloatsburg, Village of	513	200	68	380	166	1,437
South Nyack, Village of	535	59	32	371	73	911
Spring Valley, Village of	3,176	3,730	9,690	2,751	7,963	13,385
Stony Point, Town of	2,653	594	265	1,619	667	4,393
Suffern, Village of	2,316	490	866	1,101	706	5,449
Upper Nyack, Village of	479	88	19	161	170	539
Wesley Hills, Village of	862	626	0	406	513	1,008
West Haverstraw, Village of	1,286	944	1,663	991	1,369	4,490
Rockland County (Total)	52,060	27,605	26,990	29,008	49,451	109,704

Source: U.S. Census Bureau, American Community Survey 5-year estimates 2017-2021; ALICE 2021

Notes: Values are rounded down.

Figure 4.3.9-6. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA n.d.

Impact on General Building Stock

The County administers and enforces the New York State Uniform Fire Prevention and Building Code, which is the uniform code contained within Title 19 of the New York Codes, Rules and Regulations (New York State n.d.). The entire general building stock inventory is exposed and vulnerable to the severe winter storm hazard and could be more at risk from aging infrastructure. An extreme blizzard or snowstorm event can carry and deposit significant amounts of snow that are heavy enough to knock down power and telephone lines as well as damage roofs and aging buildings, some of which are critical facilities and community lifelines. In general, the structural impacts include partial damages to roofs and building frames, rather than an entire building.

Estimated damages by percent loss are shown in Table 4.3.9-8. This table considers percent damages that may result from severe winter weather, instead of only considering the total replacement cost value of entire structures. This allows planners and emergency managers to select a range of potential economic impact based on an estimate of the percent of damage to the general building stock. Given professional knowledge and the currently available information, the potential loss for this hazard is many times considered to be overestimated because of varying factors (building structure type, age, load distribution, building codes in place, etc.). Therefore, the following information in Table 4.3.9-8 should be used as estimates only for planning purposes with the knowledge that the associated losses for severe winter storm events vary greatly.

Table 4.3.9-8. Estimated Damages by Percent Loss for Total Replacement Cost Value of Structures in Rockland County

Jurisdiction	Total Replacement Cost Value (RCV)	1% Damage Loss	5% Damage Loss	10% Damage Loss
Airmont, Village of	\$2,712,726,498	\$27,127,265	\$135,636,325	\$271,272,650
Chestnut Ridge, Village of	\$2,590,102,202	\$25,901,022	\$129,505,110	\$259,010,220
Clarkstown, Town of	\$22,578,694,610	\$225,786,946	\$1,128,934,731	\$2,257,869,461
Grand View on Hudson, Village of	\$123,746,894	\$1,237,469	\$6,187,345	\$12,374,689
Haverstraw, Town of	\$14,687,792,118	\$146,877,921	\$734,389,606	\$1,468,779,212
Haverstraw, Village of	\$1,373,775,543	\$13,737,755	\$68,688,777	\$137,377,554
Hillburn, Village of	\$340,797,550	\$3,407,975	\$17,039,877	\$34,079,755
Kaser, Village of	\$434,976,786	\$4,349,768	\$21,748,839	\$43,497,679
Montebello, Village of	\$1,957,771,278	\$19,577,713	\$97,888,564	\$195,777,128
New Hempstead, Village of	\$1,416,579,766	\$14,165,798	\$70,828,988	\$141,657,977
New Square, Village of	\$640,979,013	\$6,409,790	\$32,048,951	\$64,097,901
Nyack, Village of	\$1,930,474,072	\$19,304,741	\$96,523,704	\$193,047,407
Orangetown, Town of	\$19,240,363,073	\$192,403,631	\$962,018,154	\$1,924,036,307
Piermont, Village of	\$520,681,014	\$5,206,810	\$26,034,051	\$52,068,101
Pomona, Village of	\$947,429,629	\$9,474,296	\$47,371,481	\$94,742,963
Ramapo, Town of	\$7,401,302,608	\$74,013,026	\$370,065,130	\$740,130,261
Sloatsburg, Village of	\$780,218,848	\$7,802,188	\$39,010,942	\$78,021,885
South Nyack, Village of	\$628,994,780	\$6,289,948	\$31,449,739	\$62,899,478
Spring Valley, Village of	\$2,977,580,954	\$29,775,810	\$148,879,048	\$297,758,095
Stony Point, Town of	\$4,492,546,145	\$44,925,461	\$224,627,307	\$449,254,615
Suffern, Village of	\$2,011,976,760	\$20,119,768	\$100,598,838	\$201,197,676
Upper Nyack, Village of	\$714,087,836	\$7,140,878	\$35,704,392	\$71,408,784
Wesley Hills, Village of	\$1,597,464,375	\$15,974,644	\$79,873,219	\$159,746,438
West Haverstraw, Village of	\$1,575,031,545	\$15,750,315	\$78,751,577	\$157,503,155
Rockland County (Total)	\$93,676,093,896	\$936,760,939	\$4,683,804,695	\$9,367,609,390

Source: Rockland County, NYS Office of Information Technology Services Geospatial Services and NYS Department of Taxation and Finance’s Office of Real Property Tax Services (ORPTS) 2022; Center for International Earth Science Information Network, New York State Energy Research and Development Authority 2022; U.S. Army Corps of Engineers, National Structure Inventory 2022; RS Means 2022

Impact on Critical Facilities and Community Lifelines

Full functionality of critical facilities, such as police, fire, and medical facilities, is essential for response during and after a severe winter storm event. These critical facility structures are often constructed of concrete and masonry; therefore, they should only suffer minimal structural damage from severe winter storm events. Because power interruption can occur, backup power is recommended. Infrastructure at risk for this hazard includes roadways that could be damaged from the application of salt and intermittent freezing and warming conditions that can damage roads over time. Severe snowfall requires clearing of roadways and alerting of citizens to dangerous conditions; following the winter season, resources for road maintenance and repair are required.

Impact on the 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.

According to FEMA's National Risk Index, Rockland County's expected annual losses from the following severe winter weather events include:

- Ice Storm - \$216,000
- Winter Weather - \$83,000

The cost of snow and ice removal and repair of roads from the freeze/thaw process 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.

Impact on the Environment

Severe winter weather can have a major impact on the environment. Not only does winter weather create changes in natural processes, the residual impacts of a community's methods to maintain its infrastructure through winter weather maintenance may also have an 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 (USGS 2020).

Future Changes That May Impact Vulnerability

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

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including the impacts of climate change

Potential or Projected Development

As discussed in Section 3, areas targeted for future growth and development have been identified across the County. Any areas of growth located could be potentially impacted by severe winter storm events. Current State land use and building codes incorporate standards that address and mitigate snow accumulation. Some local municipalities in the State have implemented the following activities to eliminate loss of life and property and infrastructure damages during winter storm events:

- Removing snow from roadways.
- Removing dead trees and trimming trees/brush from roadways to lessen falling limbs and trees.
- Posting proper road signs that are visible to all drivers.
- Burying electrical and telephone utility lines to minimize downed lines.
- Removing debris/obstructions in waterways and developing routine inspections/maintenance plans to reduce potential flooding.
- Replacing substandard roofs of critical facilities to reduce exposure to airborne germs resulting from leakage.
- Purchasing and installing backup generators in evacuation facilities and critical facilities to ensure essential services are available to residents.

- Installing cell towers in areas where limited telecommunication is available to increase emergency response and cell phone coverage (NYS DHSES 2019).

Projected Changes in Population

Rockland County has experienced an increase in its population since 2010. According to the U.S. Census Bureau, the County's population increased by approximately 8.5 percent between 2010 and 2020 (County of Rockland 2021). Cornell University's Program on Applied Demographics projects Rockland County will have a population of 356,758 by 2030 and 372,432 by 2040 (Cornell University 2018).

An increase in population may impact the ability of persons in the County to mobilize or receive essential services during severe winter storm events. Historically, winter weather events with associated snowfall and ice accumulation have severely impacted transportation corridors, making it difficult for emergency responders to get to specific areas of need that have people who may need medical attention. Winter weather events also negatively impact infrastructure, with aging infrastructure posing more of a risk. Infrastructure damage can lead to power outages and damaged pipes which may limit or prevent the circulation of water and heat in a facility, which poses a risk to people depending on that infrastructure. Refer to Section 3 (County Profile), which includes a more thorough discussion about population trends for the County.

Other Identified Conditions

The State of New York will see an increase in average annual temperatures and precipitation. Climate change has the ability to make winter weather events less frequent, but more severe when they do happen. Annual precipitation amounts in the region are projected to increase, primarily in the form of heavy rainfalls, which have the potential to freeze into heavy snowfall and icing. This increase in snow and ice could 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 severe winter events due to loss of service or access (The Climate Reality Project 2022).

Change of Vulnerability Since 2018 HMP

Rockland County remains vulnerable to severe winter storm events. Since the 2018 analysis, population statistics have been updated using the 2020 U.S. Census. Additionally, this updated analysis estimated exposure and losses at the structure level with updated building stock data. The general building stock was updated using building stock data provided by the County to update the user-defined facility inventory and critical facility inventory dataset. Overall, this vulnerability assessment uses a more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Rockland County.

4.4 HAZARD RANKING

A comprehensive range of hazards that pose a significant risk to Rockland County were selected and considered during the development of this plan; see Section 4.1 (Hazards of Concern Identification) for how these were selected. Each community has differing levels of exposure and vulnerability to each of these hazards. It is important for each community participating in this plan to recognize those hazards that pose the greatest risk to their community and direct their attention and resources accordingly to manage risk and reduce losses most effectively and efficiently. The hazard rankings can be found in the jurisdictional annexes in Volume II, Section 9 (Annexes) of this plan.

A hazard risk ranking process was conducted for the County using the method described below. This method includes four risk assessment categories: probability of occurrence, impact (population, property, and economy), adaptive capacity, and changing future conditions (i.e., climate change). Each category was assigned a weighting factor to calculate an overall ranking value for each hazard of concern. Depending on the calculation, each hazard was assigned a high, medium, or low ranking. Details regarding each of these categories is described in the following sections.

This hazard ranking exercise serves the following four purposes:

- 1) Describe the probability of occurrence for each hazard,
- 2) Describe the impact each would have on the people, property, and economy,
- 3) Evaluate the capabilities a community has with regards to the hazards of concern.
- 4) Consider changing future conditions (i.e., climate change) in Rockland County.

4.4.1 Hazard Ranking Methodology

Estimates of hazard risk for Rockland County were developed using methodologies developed by FEMA's hazard mitigation planning guidance, generated by FEMA's Hazus risk assessment tool, and input from Rockland County and participating jurisdictions.

As described in Section 4.2 (Methodology and Tools), three different levels of analysis were used to estimate potential impacts: historic loss/qualitative analysis; exposure analysis; and loss estimation. All three levels of analysis are suitable for planning purposes; however, with any risk analysis, there is underlying uncertainty resulting from assumptions used to describe and assess vulnerability and the methodologies available to model impacts. Impacts from any hazard event within the County will vary from the analysis presented here based on the factors described for each hazard of concern, namely location, extent, warning time, and mitigation measures in place at the time of an event.

The hazard ranking methodology for some hazards of concern is based on a scenario event, 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; assumptions are included, as appropriate, in the following subsections. 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. The following categories were considered when evaluating the relative risk of the hazards of concern:

- **Probability of Occurrence** of the scenario evaluated was estimated by examining the historic record and/or calculating the likelihood of annual occurrence. When no scenario was assessed, an examination of the historic record and judgement was used to estimate the probability of occurrence of an event that will impact the County.
- **Impact** was considered through the following three hazard impact subcategories: impact to people; impact to buildings; and impact to the economy. The results of the updated risk assessment and/or professional judgement were used to assign the numeric values for these three impact subcategories. A factor was applied to each subcategory, giving impact on population the greatest weight.
 - Population—Numeric value x 3
 - Buildings—Numeric value x 2
 - Economy—Numeric value x 1
- **Adaptive Capacity** describes a jurisdiction’s current ability to protect from or withstand a hazard event. This includes capabilities and capacity in the following areas: administrative, technical, planning/regulatory, and financial. Mitigation measures already in place increases a jurisdiction’s capacity to withstand and rebound from events (e.g., codes/ordinances with higher standards to withstand hazards due to design or location; deployable resources; or plans and procedures in place to respond to an event). In other words, assigning “weak” for adaptive capacity means the jurisdiction does not have the capability to effectively respond, which increases vulnerability; whereas “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 subject-matter input from each jurisdiction.
- **Climate Change** projections were considered as part of the hazard ranking to ensure the potential for an increase in severity/frequency of the hazard was included. This was important to the County to include because the hazard ranking helps guide and prioritize the mitigation strategy development, which should have a long-term future vision to mitigate the hazards of concern. The potential impacts climate change may have on each hazard of concern is discussed in Sections 4.3.1 through 4.3.14. The benchmark values in the methodology are similar to confidence levels outlined in the National Climate Assessment 2017.

Hazard Ranking Equation

$$[\text{Probability of Occurrence} \times 0.3] + [(\text{Impact on Population} \times 3) + (\text{Impact on Property} \times 2) + (\text{Impact on Economy} \times 1) \times 0.3] + [\text{Adaptive Capacity} \times 0.3] + [\text{Climate Change} \times 0.1]$$

Table 4.4-1 summarizes the categories, benchmark values, and weights used to calculate the risk factor for each hazard. Using the weighting applied, the highest possible risk factor value is 6.9. The higher the number, the greater the relative risk. Based on the total for each hazard, a priority ranking is assigned to each hazard of concern (high, medium, or low). The rankings were categorized as follows: Low is values less than 3.9; Medium is between 3.9 and 4.9; and High is greater than 4.9.

Table 4.4-1. Summary of Hazard Ranking Approach

Category		Level / Category	Degree of Risk / Benchmark Value	Numeric Value	Weighted Value
Probability of Occurrence		Unlikely	A hazard event is not likely to occur or is unlikely to occur with less than a 1 percent annual chance probability.	0	0.3
		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	
Impact (Sum of all 3)	Population (Numeric Value x 3)	Low	14 percent or less of your population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	1	0.3
		Medium	15 percent to 29 percent of your population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	2	
		High	30 percent or more of your population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	3	
	Property (Numeric Value x 2)	Low	Property exposure is 14 percent or less of the total number of structures for your community.	1	
		Medium	Property exposure is 15 percent to 29 percent of the total number of structures for your community.	2	
		High	Property exposure is 30 percent or more of the total number of structures for your community.	3	
	Economy (Numeric Value x 1)	Low	Loss estimate is 9 percent or less of the total replacement cost for your community.	1	
		Medium	Loss estimate is 10 percent to 19 percent of the total replacement cost for your community.	2	
		High	Loss estimate is 20 percent or more of the total replacement cost for your community.	3	
Adaptive Capacity		Weak	Weak/outdated/inconsistent plans, policies, codes/ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	1	0.3
		Moderate	Plans, policies, codes/ordinances in place and meet minimum requirements; mitigation strategies identified but not implemented on a widespread scale; county/jurisdiction can recover but needs outside resources; moderate county/Jurisdiction capabilities.	0	
		Strong	Plans, policies, codes/ordinances in place and exceed minimum requirements; mitigation/protective measures in place; county/jurisdiction has ability to recover quickly because resources are readily available, and capabilities are high.	-1	
Climate Change		Low	No local data is available; modeling projections are uncertain on whether there is increased future risk; confidence level is low (inconclusive evidence).	1	0.1
		Medium	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change; confidence level is medium to high (suggestive to moderate evidence).	2	
		High	Studies and modeling projections indicate exacerbated conditions/increased future risk due to climate change; very high confidence level (strong evidence, well documented and acceptable methods).	3	

Note: A numerical value of zero is assigned if there is no impact.

*For the purposes of this exercise, "impacted" means exposed for population and property and estimated loss for economy. For non-natural hazards, although they may occur anywhere in the County, an event will not likely cause countywide impacts; therefore, impact to population was scored using an event-specific scenario.

In an attempt to summarize the confidence level regarding the input utilized to populate the hazard ranking, a gradient of certainty was developed. A certainty factor of high, medium, or low was selected and assigned to each hazard to provide a level of transparency and increased understanding of the data utilized to support the resulting ranking. The following scale was used to assign a certainty factor to each hazard:

- High—Defined scenario/event to evaluate; probability calculated; evidenced-based/quantitative assessment to estimate potential impacts through hazard modeling.
- Medium—Defined scenario/event or only a hazard area to evaluate; estimated probability; combination of quantitative (exposure analysis, no hazard modeling) and qualitative data to estimate potential impacts.
- Low—Scenario or hazard area is undefined; there is a degree of uncertainty regarding event probability; majority of potential impacts are qualitative.

4.4.2 Hazard Ranking Results

Using the process described above, the ranking for the identified hazards of concern was determined for County (refer to Table 4.4-2).

The hazard ranking is detailed in the subsequent tables that present the stepwise process for the ranking. The ranking includes the entire County and may not reflect the highest risk indicated for any of the participating jurisdictions. The resulting ranks of each municipality indicate the differing degrees of risk exposure and vulnerability. The results support the appropriate selection and prioritization of initiatives to reduce the highest levels of risk for each municipality. Both the County and the participating jurisdictions have applied the same methodology to develop the countywide risk and local rankings to ensure consistency in the overall ranking of risk; jurisdictions had the ability to alter rankings based on local knowledge and experience in handling each hazard. Table 4.4-3 presents the total calculations for each hazard ranking value for the hazards of concern in Rockland County.

Table 4.4-2. Ranking for Hazards of Concern for Rockland County

Hazard of Concern	Probability		Impact									Adaptive Capacity	Climate Change	
	Category	Numeric Value	Population			Property			Economy					Total Impact Value
			Impact	Numeric Value	Weighted Value (x3)	Impact	Numeric Value	Weighted Value (x2)	Impact	Numeric Value	Weighted Value (x1)			
Dam Failure	Occasional	2	Medium	2	2 x 3 = 6	Medium	2	2 x 2 = 4	Medium	2	2 x 1 = 2	3.6	Moderate	Medium
Disease Outbreak	Occasional	2	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	3.6	Strong	High
Drought	Occasional	2	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	3.6	Strong	Medium
Earthquake	Rare	1	Low	1	1 x 3 = 3	Medium	2	2 x 2 = 4	High	3	3 x 1 = 3	3.0	Moderate	Medium
Extreme Temperature	Frequent	3	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	3.6	Moderate	High
Flood	Frequent	3	Medium	2	2 x 3 = 6	Medium	2	2 x 2 = 4	Low	1	1 x 1 = 1	3.3	Strong	High
Landslide	Occasional	2	Medium	2	2 x 3 = 6	Low	1	1 x 2 = 2	Medium	2	2 x 1 = 2	3.0	Moderate	Medium
Severe Weather	Frequent	3	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	High	3	3 x 1 = 3	4.2	Strong	High
Severe Winter Weather	Frequent	3	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	3.6	Strong	High
Wildfire	Occasional	2	Medium	2	2 x 3 = 6	Medium	2	2 x 2 = 4	Medium	2	2 x 1 = 2	3.6	Strong	High

Table 4.4-3. Total Hazard Ranking Values for the Hazards of Concern for Rockland County

Hazard of Concern	Probability (0.3)	Total Impact (0.3)	Adaptive Capacity (0.3)	Changing Future Conditions (0.1)	Total Hazard Ranking Value	Hazard Ranking
Dam Failure	0.6	3.6	0	0.2	4.4	Medium
Disease Outbreak	0.6	3.6	-0.3	0.3	4.2	Medium
Drought	0.6	3.6	-0.3	0.2	4.1	Medium
Earthquake	0.3	3.0	0	0.2	3.5	Low
Extreme Temperature	0.9	3.6	0	0.3	4.8	Medium
Flood	0.9	3.3	-0.3	0.3	4.2	Medium
Landslide	0.6	3.0	0	0.2	3.8	Medium
Severe Weather	0.9	4.2	-0.3	0.3	5.1	High
Severe Winter Weather	0.9	3.6	-0.3	0.3	4.5	Medium
Wildfire	0.6	3.6	-0.3	0.3	4.2	Medium

SECTION 5. CAPABILITY ASSESSMENT

44 CFR § 201.6(c)(3) requires that a local mitigation plan describe existing authorities, policies, programs and resources available to each participant and their ability to expand on and improve existing policies and programs to support mitigation strategies. This assessment is an integral part of the planning process. The assessment process enables identification, review, and analysis of current federal, state, and local programs, policies, regulations, funding, and practices that could either facilitate or hinder mitigation.

Existing laws, ordinances, plans and programs at the federal, state, and local level can support or impact hazard mitigation actions identified in this plan. Hazard mitigation plans (HMPs) are required to include a review and incorporation, if appropriate, of existing plans, studies, reports, and technical information as part of the planning process (44 Code of Federal Regulations [CFR], Section 201.6(b)(3)). Federal and state programs identified through this review are those that affect or intersect with the actions identified in this plan. Each program enhances capabilities to implement mitigation actions or has a nexus with a mitigation action in this plan.

During the 2024 plan update process, all participating jurisdictions were tasked with developing or updating their capability assessment, paying particular attention to evaluating the effectiveness of these capabilities in supporting hazard mitigation and identifying opportunities to enhance local capabilities to integrate hazard mitigation into their plans, programs, and day-to-day operations.

The capability assessment section of each jurisdictional annex in Volume II describes the planning, regulatory, administrative, technical, and fiscal capabilities of each participating jurisdiction.

5.1 UPDATE PROCESS SUMMARY

The purpose of the capability assessment is to understand the planning, regulatory, administrative, technical, and financial capabilities present in Rockland County. This assessment helps the County and other participating jurisdictions identify strengths and opportunities that can be used to reduce losses from hazard events and reduce risks throughout Rockland County.

To complete the capability assessment, the contracted consultant met virtually with each participating jurisdiction to review the capability assessment from the 2018 HMP and update accordingly. The consultant also reviewed plans, codes, and ordinances to enhance the information provided by the jurisdictions.

5.2 PLANNING AND REGULATORY CAPABILITY

Planning and regulatory capabilities are based on the implementation of ordinances, policies, local laws, state statutes, plans, and programs that relate to guiding and 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 as needed. Table 5-1 and Table 5-2 summarize planning and regulatory capabilities at the federal, state, county, and local levels.

Table 5-1. County Planning and Regulatory Capabilities

Capability	Details	
Municipal Land Use Planning and Regulatory Authority	Description:	<p>New York’s counties have the statutory power to create planning boards (General Municipal Law [GML] section 239-c). The county legislative body may prepare a county comprehensive plan or delegate its preparation to the county planning board or to a “special board” (GML section 239-d). Prior to adopting or amending a county official map, the county legislative body must refer the proposed changes to the county planning board and other municipal bodies (GML section 239-e). In addition, the county legislative body may authorize the county planning board to review certain planning and zoning actions, including certain subdivision plats, by municipalities within the county (GML section 239-c(3)).</p> <p>State laws require that any city, town, or village in a county possessing a “county planning agency” or “regional planning council” refer to that agency on certain zoning matters before taking final action on those matters. In addition, where authorized by the county legislative body, certain subdivision plats must be referred to the county by the town, village or city planning board before taking final action. Referral to the county planning agency or regional planning council is an important aid to the local planning and zoning process. It provides local planning and zoning bodies with advice and assistance from professional county and regional staff and can result in better coordination of zoning actions among municipalities by interjecting inter-community considerations. In addition, it allows other planning agencies (county, regional, and state) to better orient studies and proposals for solving local as well as county and regional needs.</p> <p>Floodplain regulations govern the amount, type, and location of development within defined flood-prone areas. Federal standards, applicable to communities that are eligible for federal flood insurance protection, include identification of primary flood hazard areas, usually defined as being within the 1 percent-annual-chance floodplain. Within flood hazard areas, certain restrictions are placed on development activities. Such restrictions include a requirement that buildings be elevated above flood elevations or be flood-protected and a prohibition on development on filled land. Municipalities can adopt their own floodplain regulations, which may be more stringent than the federal standards. Local floodplain regulations can identify a larger hazard area (such as a 500-year floodplain) and may prohibit certain types of construction within flood hazard areas. Municipalities must adopt local floodplain regulations to be eligible for participation in the National Flood Insurance Program (NFIP).</p> <p>The county and municipalities have various land use planning mechanisms that can be leveraged to mitigate flooding and support natural hazard risk reduction. Specific county and local planning and regulatory capabilities are identified in the jurisdictional annexes in Volume II. The Rockland County Planning Department, Rockland Codes Initiative and Rockland Planning Federation all provide local land use planning support to municipalities. The Rockland County Planning Department is available to provide courtesy reviews and input to local Comprehensive Plan updates to ensure that they incorporate the information, findings, and recommendations of this HMP as appropriate.</p> <p>A primary function of the Rockland County Planning Department is the review of site plans, subdivisions, variances, zone changes, zoning code amendments, special permits and other land use, zoning, or environmental actions under the State-mandated GML application process. Planners also offer recommendations and guidance on local master plans and ordinance updates. The department performs a variety of tasks, focusing on topics related to housing, environmental and natural issues, historic and cultural resources, recreation and open space, and infrastructure.</p> <p>A May 2017 Rockland County Executive Order prohibits County departments from issuing permits for developments that have not complied with GML. The GML requires towns and villages to comply with the findings of the County Planning Commissioner or file a reason why a decision has been made to not comply. Failure to do so will result in the County not issuing permits for such uses as water and sewer connections, well permits, rooming house permits, drainage permits, road opening permits, issuance of new addresses, and others.</p>
	Responsible Agency:	Rockland County Planning Department
	Provides Funding for Mitigation:	No

Capability	Details	
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. It promotes communication, cooperation, and understanding among various constituencies affected by the land use and planning decisions of local governments
Emergency and Evacuation Plans	Description:	<p>The Rockland County Office of Fire and Emergency Services plays a lead role in planning, mitigation, coordination, response, and recovery for natural disasters, such as hurricanes, coastal storms, floods, and winter storms. The Office maintains the Rockland County Comprehensive Emergency Management Plan (CEMP) that is reviewed bi-annually. The County CEMP contains annexes related to hurricane/coastal storm, winter storm, and heat. Four of the five towns in Rockland County have CEMPs (updated within the year). Six of the 18 villages have CEMPs, and some villages defer to a town’s plan. The Office of Fire and Emergency Services also maintains the Rockland County Continuity of Operations Plan.</p> <p>Specific evacuation plans are identified in the Rockland County CEMP Hurricane/Coastal Storm Annex and Dam Safety Plans (Emergency Action Plans).</p>
	Responsible Agency:	Rockland County Office of Fire and Emergency Services
	Provides Funding for Mitigation:	No
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. It promotes communication, cooperation, and understanding among various constituencies affected by natural disasters and other emergencies.
Local Waterfront Revitalization Program	Description:	<p>New York State’s approach to managing waterfront areas recognizes that municipalities are in the best position to determine their own waterfront objectives and to adapt to statewide approaches to specific local needs. By preparing a local waterfront revitalization program (LWRP), community stakeholders can evaluate local waterfront resources, develop a strategy for the best use of those resources, propose future projects, and guide appropriate development (NYS DoS 2024).</p> <p>An LWRP expresses a vision for a waterfront area and provides the means to achieve that vision. It is the only planning and regulatory tool that allows a local community to refine statewide coastal policies to apply to a local situation. It may be comprehensive and address all issues that affect a community’s entire waterfront, or it may address the most critical issues facing a significant portion of its waterfront. A new or amended LWRP is reviewed by local, state, and federal agencies. An approved LWRP becomes the basis for aligning local, state, and federal actions to achieve community goals for the waterfront.</p> <p>In Rockland County, four municipalities have LWRPs: Town of Stony Point, Village of Haverstraw, Village of Nyack, and Village of Piermont.</p>
	Responsible Agency:	Rockland County Planning Department
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Facilitated consultation with community-based groups in connection with the preparation and implementation of the LWRP.

Capability	Details	
<p>Flood Mitigation and Resilience Report: Saddle River Watershed (SD114), June 2022</p>	<p>Description:</p>	<p>The analysis of the Saddle River watershed was conducted as part of the Resilient New York Program, an initiative of the New York State Department of Environmental Conservation (NYS DEC). Rockland County, including the Saddle River watershed, has an active history of flooding. According to National Oceanic and Atmospheric Administration (NOAA) historical records, 25 hurricane or tropical storm tracks have passed within 65 miles of Rockland County since 1861, with five passing directly through Rockland County.</p> <p>As part of the analysis, flood-prone High-Risk Areas (HRAs) along West Branch Saddle River, East Branch Saddle River, and Pine Brook were identified, and an analysis of flood mitigation considerations within each HRA was undertaken. Factors with the potential to influence more than one HRA were also evaluated and discussed. An analysis of watershed land use was conducted, and a flood resiliency best practices audit was conducted for each community within the watershed.</p> <p>Flood mitigation scenarios such as dam removal, road closures, replacement of undersized bridges and culverts, and floodproofing measures of individual structures were investigated. Rough order-of-magnitude cost ranges were provided for the recommended flood mitigation scenarios. A range of potential funding sources were also identified.</p>
	<p>Responsible Agency:</p>	<p>NYS DEC, in cooperation with the New York State Office of General Services (NYS OGS)</p>
	<p>Provides Funding for Mitigation:</p>	<p>No</p>
	<p>Hazards Addressed:</p>	<p>Flood</p>
	<p>Supports Underserved Communities and/or Socially Vulnerable Populations:</p>	<p>Yes. Projects must reduce threats to lives and property; be economically, environmentally, and socially defensible; be designed and implemented according to sound technical standards; and conserve natural resources.</p>
<p>Clarkstown New York Rising Community Reconstruction Plan, Sections I and II, December 2014</p>	<p>Description:</p>	<p>The Clarkstown New York Rising Community Reconstruction (NYRCR) Plan, developed during six months of community stakeholder engagement, reflects Clarkstown’s vision and goals, honoring its unique qualities and assets for building a safer, more resilient and sustainable future. The Clarkstown NYRCR planning area is coterminous with the municipal boundaries and includes all eight hamlets. Although some Clarkstown neighborhoods were not directly impacted by flooding or wind damage, these areas contain important recovery and resiliency assets and serve as resources for resilient reconstruction.</p> <p>Most storm-related flooding in Clarkstown comes from the Hackensack River and its many tributaries rising above their banks, flowing into their natural floodplains and inundating the surrounding areas. During the NYRCR process, the Town identified the following issues related to flooding and storms:</p> <ul style="list-style-type: none"> • Emergency service provider access • Flooding in residential neighborhoods • Interruptions to Town services and facilities • Repeated flooding of businesses • Road closures • Widespread and prolonged power outages <p>The plan identified the following strategies to provide protection to the Town from future events:</p> <ul style="list-style-type: none"> • Restore and protect critical infrastructure and transportation assets. • Develop initiatives and financial assistance programs to better protect residents, businesses, and commercial centers from future storm damage and to allow them to recover more quickly. • Improve stormwater infrastructure and drainage systems using green infrastructure practices where possible and cost-effective. • Ensure access to and improve resiliency of critical health and social service facilities and safe havens during and after storm events. • Preserve open spaces and restore natural resources to better support flood mitigation.

Capability	Details	
		<ul style="list-style-type: none"> • Provide education, outreach, and implementation assistance regarding pre-storm preparedness (including proper maintenance of water bodies and stormwater runoff mitigation on private properties), storm protection procedures, and post-storm recovery initiatives to protect from future flooding. • Promote resilience and flood management best practices through land-use planning, policy, and regulation. • Improve regional coordination with neighboring communities and local and state agencies for watershed management to better mitigate flooding and plan for future disasters.
	Responsible Agency:	Town of Clarkstown
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. During the asset risk analysis, community assets that provide services for socially vulnerable populations were identified as they are particularly important both before and following a storm.
Flood Mitigation and Resilience Report: Minisceongo Creek (SD112), November 2021	Description:	<p>The analysis of the Minisceongo Creek watershed was conducted as part of the Resilient New York Program, an initiative of the NYS DEC. Minisceongo Creek originates in west central Rockland County and drains eastward to the Hudson River estuary.</p> <p>This report begins with an overview of the Minisceongo Creek watercourse and watershed, summarizes the history of flooding, and identifies HRAs within the watershed. HRAs were identified based on comments received during stakeholder meetings; conversations with municipal officials, emergency responders, landowners, and business owners; and review of FEMA Flood Insurance Studies and Flood Insurance Rate Maps, HMPs, and other documents. An analysis of flood mitigation considerations within each HRA was undertaken. Flood mitigation recommendations were provided either as HRA-specific recommendations or as overarching recommendations that apply to the entire watershed or stream corridor. Flood mitigation scenarios such as floodplain enhancement and channel restoration, road closures, and replacement of undersized bridges and culverts were investigated and recommended where appropriate.</p>
	Responsible Agency:	NYS DEC, in cooperation with NYS OGS
	Provides Funding for Mitigation:	No
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Projects must reduce threats to lives and property; be economically, environmentally, and socially defensible; be designed and implemented according to sound technical standards; and conserve natural resources.
Flood Mitigation and Resilience Report: Ramapo River (SD113), March 2023	Description:	<p>This analysis of the Ramapo River and its watershed was conducted as part of the Resilient New York Program, an initiative of NYS DEC. The watershed is located northwest of New York City and is part of the New York City metropolitan area. Portions of the watershed are densely developed, especially the downstream portions. Sections of the Ramapo River are confined by roads and railroads, which encroach upon the river's floodplain.</p> <p>As part of the study, flood-prone HRAs within the Ramapo River watershed were identified and an analysis of flood mitigation considerations within each HRA was undertaken. Flood mitigation scenarios, such as floodplain enhancement and channel restoration, dam modifications, road closures, and replacement of undersized culverts, roadway bridges, and railroad bridges, are recommended where appropriate. Recommendations for flood protection at individual properties were provided. An analysis of watershed land use was conducted, and a Flood Resiliency Best Practices Audit was conducted for each community within the watershed.</p> <p>High-priority recommendations for flood hazard mitigation along the Ramapo River include the following:</p> <ul style="list-style-type: none"> • In HRA 1, removal of the abandoned railroad bridge and embankment traversing the Ramapo River floodplain in the Suffern West Ward to reduce flooding of critical water supply and wastewater infrastructure. • In HRA 1, replacement of the Fourth Street bridge over the Ramapo River with a hydraulically adequate span to alleviate flooding of an electrical substation.

Capability	Details	
		<ul style="list-style-type: none"> In HRA 3, replacement of the Arden Road bridge with a hydraulically adequate span and exploring the feasibility of raising the NY-17 and I-87 roadway elevations upstream to reduce or eliminate flooding of these highways. In HRA 4, replacement of the Brookside Drive East culvert with a hydraulically adequate culvert to alleviate flooding of the upstream neighborhood. In HRA 5, exploring the feasibility of removing, relocating, or lowering the Heritage Rail Trail embankment near the Harriman/Monroe village limits to reduce flooding in neighborhoods near Marc Terrace, James Road, and Dorothy Drive. In HRA 5, exploring the feasibility of reducing the spillway elevation (e.g., with collapsible flashboards) or otherwise increasing the spillway capacity of the Monroe Ponds dam to reduce flooding of properties, businesses, and infrastructure surrounding Monroe Ponds. Voluntary buyout or relocation of flood-prone properties and businesses identified throughout the HRAs.
	Responsible Agency:	NYS DEC, in cooperation with NYS OGS
	Provides Funding for Mitigation:	No
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Projects must reduce threats to lives and property; be economically, environmentally, and socially defensible; be designed and implemented according to sound technical standards; and conserve natural resources.
Stony Point New York Rising Community Reconstruction Plan, March 2014	Description:	<p>The Stony Point NYRCR Plan presents proposed programs, policies and construction initiatives developed by the Stony Point NYRCR Community and the Stony Point NYRCR Planning Committee, comprised of Stony Point residents chosen to represent the community. The scope of the planning area includes all areas of the Town of Stony Point outside of Bear Mountain and Harriman State Parks. Some areas within the geographic scope were not directly damaged by Hurricane Irene, Tropical Storm Lee, or Superstorm Sandy, but include potential locations for resilient redevelopment, providing the Town the ability to relocate critical facilities out of flood-prone areas.</p> <p>During the NYRCR process, the Town identified the following issues related to flooding and storms:</p> <ul style="list-style-type: none"> Lack of emergency preparedness Incomplete recovery of the Hudson River waterfront Critical assets vulnerable to flooding Uncertainty surrounding regional energy and infrastructure projects Synergy between local and regional natural and cultural resources <p>The NYRCR plan identified strategies to provide protection to the Town from future events:</p> <ul style="list-style-type: none"> Strengthen current short- and long-term emergency shelters and develop new sheltering opportunities. Encourage economic development and support existing businesses. Improve on existing emergency preparedness, response, and communications. Provide information and assistance to homeowners with pre-storm flood-proofing and post-storm repair, buyouts, and demolition. Promote sustainability and resilience through local land use planning and regulation. Repair, rehabilitate, upgrade and fortify critical infrastructure and transportation. Harness resiliency potential of natural resources.
	Responsible Agency:	NYRCR Stony Point Planning Committee
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	Flood

Capability	Details	
	<p>Supports Underserved Communities and/or Socially Vulnerable Populations:</p>	<p>During the asset risk analysis, community assets that provide services for socially vulnerable populations were identified as they are particularly important both before and following a storm. Public engagement meetings were held throughout the eight-month planning process, with the final meeting conducted after the final plans were complete. These meetings provided the opportunity for Stony Point residents to learn about the NYRCR planning process, assets, and projects, and provide input to help develop community-driven plans for a more resilient future.</p>
<p>Suffern New York Rising Community Reconstruction Plan, December 2014</p>	<p>Description:</p>	<p>The Village of Suffern is in the Town of Ramapo in Rockland County, 20 miles west of the Hudson River and measures 2.1 square miles. The Ramapo River Watershed, which is part of the Passaic River Basin, encompasses the entire Village. The Suffern NYRCR planning area encompasses the entire Village of Suffern, and a small part of the New Jersey Township of Mahwah at the New York and New Jersey border. During the NYRCR process, the Village identified the following issues related to flooding and storms:</p> <ul style="list-style-type: none"> • Emergency access • Flooding in residential neighborhoods • Inundation of critical facilities • Loss of power • Repeated flooding of businesses • Road closures • Stream bank erosion and stream bed sedimentation <p>The plan identified the following goals:</p> <ul style="list-style-type: none"> • Build closer working relationships with neighboring communities and the State of New Jersey to address flooding issues that do not respect municipal boundaries. • Continue high level of emergency services and enhance physical access to neighborhoods. • Enhance infrastructure and stormwater systems where needed. • Preserve community character to maintain small town charm. • Protect and clean Lake Antrim and the Mahwah and Ramapo Rivers. • Protect, promote, and enhance cultural attractions that draw people to the village. • Revitalize downtown businesses and protect from future storm damage.
	<p>Responsible Agency:</p>	<p>Suffern NYRCR Planning Committee</p>
	<p>Provides Funding for Mitigation:</p>	<p>Yes</p>
	<p>Hazards Addressed:</p>	<p>Flood</p>
	<p>Supports Underserved Communities and/or Socially Vulnerable Populations:</p>	<p>Yes. An important component of the NYRCR process was to assess the risk posed to community assets and systems that were affected by past flood events or may be impacted by future storms. Information was added for each asset, including address, geographic coordinates, risk area, asset class and subcategory, community value, critical facility designation, and whether the asset served socially vulnerable populations, including children, the elderly, people with special needs, and low-income community members.</p>
<p>Rockland County Sewer Use Law, Last Amended in 2010</p>	<p>Description:</p>	<p>The law establishes rules and regulations governing the discharge of sewage, industrial wastes and other waste into the Rockland County Sewer District No. 1 and public sewers tributary thereto, providing for the establishment and collection of charges for use of such sewer system and sewers and prescribing penalties for the violation of such rules and regulations.</p> <p>The general purpose of this law is to provide for efficient, economic, environmentally safe, and legal operation of the Rockland County Sewer District’s publicly owned treatment works. It authorizes the issuance of wastewater discharge permits; provides for monitoring, compliance, and enforcement activities; establishes administrative review procedures; requires user reporting; and provides for the setting of fees for the equitable distribution of costs resulting from the programs established within it.</p>
	<p>Responsible Agency:</p>	<p>Board of Commissioners, Rockland County Sewer District No. 1</p>

Capability	Details	
	Provides Funding for Mitigation:	No
	Hazards Addressed:	Disease Outbreak
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The guiding purpose of the law is to equally protect the overall public health, safety, and welfare of the community.
Rockland County Adopted Capital Improvement Program 2024-2029, December 2023	Description:	<p>The purpose of the Capital Improvement Program is to consider the necessity, priority, feasibility, location, cost, and method of financing of all existing and proposed capital projects and to assist in the consideration of a capital program. A Capital Projects Committee consists of the County Executive as Chairperson, the Chairperson of the Legislature, the Superintendent of Highways, the Commissioner of Finance, the Commissioner of Planning, and other persons the County Executive may designate. The County Executive is responsible for the capital program as submitted to the County Legislature.</p> <p>An example capital project to mitigate potential hazards is to provide funding for the design and construction of emergency generators and electrical improvements to the County Office Building, Sain Building, Highway Building and 2 New Hempstead Road Building. These buildings do not have emergency back-up power as required by code. The project is to access the present buildings’ electrical system, design improvements and perform construction for installation of new electrical systems and emergency generators.</p>
	Responsible Agency:	Rockland County Planning Department
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Capital projects are implemented equally in all areas of need within the community. Consideration of comprehensive plans for the County and for any affected municipality therein guides program development.
New York Metropolitan Transportation Council Regional Transportation Plan: Moving Forward, June 2023	Description:	<p>The New York Metropolitan Transportation Council developed a Regional Transportation Plan for New York City, Lower Hudson Valley, and Long Island titled <i>Moving Forward: Your Region, Connected</i>. The plan covers all modes of ground transportation including highways, roads and bridges, streets, rail and bus transit, bicycle and pedestrian facilities, movement of goods, and special needs transportation. Updated every four years, the plan is a blueprint that helps support sustainable growth and guide federal funding for transportation investment in the region. The plan was developed collaboratively with New York Metropolitan Transportation Council member agencies, other stakeholders, and members of public. Rockland County participates in several federally mandated transportation planning programs, including the Regional Transportation Plan.</p> <p>The plan’s Resilience Improvement Plan addendum addresses the immediate and long-range planning activities and investments of the metropolitan planning organization with respect to resilience of the surface transportation system. This systematic approach includes a risk-based assessment of vulnerabilities of transportation assets and systems to current and future weather events and natural disasters. It is consistent with and complements the state and local mitigation plans required under section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5165) and meets the requirements of 23 U.S.C. 176(e). The addendum seeks to enhance the transportation system’s resilience to stressors and disruptions that will have a growing impact across the region in the longer term. These include climate change, sea level rise, and extreme weather; related impacts such as power outages and transportation disruptions; human-caused stressors such as cyberattacks and acts of terrorism; and public health emergencies. The Resilience Improvement Plan addendum also seeks to inform the ongoing recovery process from past and current stresses and disruptions through feasible, cost-effective strategies to reduce and manage vulnerabilities, advance the state of knowledge, and develop methods to assist agencies in the region to plan and invest for long-term, “all hazards” resilience.</p>
	Responsible Agency:	New York Metropolitan Transportation Council
	Provides Funding for Mitigation:	No
	Hazards Addressed:	All

Capability	Details	
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. As an example, the MTA plans for deploying service during evacuation to the vulnerable population by coordinating with the New York City Office of Emergency Management. Rockland County has participated with Hudson Riverfront Communities on resilience issues during the plan development process. In addition, the County is undertaking a study to develop a continuity of operations plan for County government, as well as a County comprehensive plan update that will include countywide resilience strategies.
Rockland Tomorrow: Rockland County Comprehensive Plan, March 2011	Description:	<p>The Comprehensive Plan seeks to preserve what residents love about Rockland. At the same time, it addresses the very real challenges facing the County, including the provision of affordable housing, jobs, traffic congestion, preservation of the natural and scenic qualities of the Hudson River and County, provision of adequate infrastructure, and preservation of open space and other environmental resources. The plan recognizes Rockland County’s historical suburban development patterns, the importance of abundant open space and scenic vistas, and the central role of the automobile in suburban living. Toward these ends, the plan’s vision can be interpreted as a three-part strategy to guide land use patterns: Conservation, Centers, and Corridors and Clusters. This strategy can be seen throughout the document in helping to preserve or otherwise improve the quality of life for the County’s residents in the coming decades.</p> <p>Overall, the goals emphasize a balanced economy with employment opportunities, the reinforcement of centers, the conservation and enhancement of existing neighborhoods, the need for housing options, and the preservation of open space. The goals include the following:</p> <ul style="list-style-type: none"> • Conserve open space. • Promote conservation (cluster) subdivision design to help conserve valuable and sensitive open space. • Reinforce existing County centers through investment in infrastructure and housing, and support of businesses. • Foster and maintain well-designed business and industrial corridors and clusters. • Encourage smart growth, while preserving quality-of-life and existing community and neighborhood character. • Acknowledge the impact of climate change on planning and County operations. • Develop strategies for County departments to explore sustainable development measures and “green” technology to adapt to and mitigate the effects of climate change. • Foster a balance between the home rule authority of Rockland County’s municipalities with the legitimate concerns of adjoining communities.
	Responsible Agency:	County Legislature, County Executive, and County Planning Department
	Provides Funding for Mitigation:	No
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Recommendations to include programs and projects for the underserved communities are evident throughout the plan.
Rockland County Comprehensive Water Conservation and Implementation Plan, March 2020	Description:	<p>The Rockland County Comprehensive Water Conservation and Implementation Plan presents an integrated approach to water conservation that is implementable and cost-effective for Rockland County and its partners. It is intended to complement other resource conservation efforts within the County and support the region’s economic, environmental, and social well-being. The plan was developed through a stakeholder approach envisioned by the County, including a combination of public meetings and stakeholder workshops, then was further refined and finalized through input provided by the Rockland County Planning Department and Task Force on Water Resources Management.</p> <p>The County recognizes that water conservation planning is most effective when interrelationships among water resources, infrastructure, energy use, land use, public and private water supplies, community values, and local governance are addressed. Specifically, the plan addresses current and future water needs while considering implications for water supply, treatment, reuse, watershed health, water quality, instream flows, community wellbeing and fiscal considerations.</p>

Capability	Details	
		<p>As the first Comprehensive Water Conservation and Implementation Plan for Rockland County, the primary focus of this plan is to achieve the following:</p> <ul style="list-style-type: none"> Gain a holistic understanding of current water demand in the entire County. Predict future water demand conditions in the County, then identify short- and long-term water savings goals based on potential savings documented in literature. Develop an implementation plan that the County can use to guide implementation partners in selecting, customizing, and implementing water conservation measures in their jurisdictions. Present a menu of 20 water conservation measures that address the unique challenges facing Rockland County, while also respecting the authority of local jurisdictions.
	Responsible Agency:	Rockland County Task Force on Water Resources Management, Conservation Committee and Planning Department
	Provides Funding for Mitigation:	No
	Hazards Addressed:	Drought
	Supports Underserved Communities and/or Socially Vulnerable Populations:	<p>Yes. The planning process was designed to incorporate technical analysis, best practices, and stakeholder engagement including a combination of public meetings, stakeholder workshops, and detailed review by the Rockland County Planning Department and Task Force. A half-day workshop on March 7, 2019, was attended by more than 100 participants, with representatives from the County's local jurisdictions along with other stakeholders such as the County Department of Health, local school districts and colleges, large water users, utilities and municipalities, and the green industry. Participants provided critical input to the planning process, sharing information and insights regarding programs they may implement. To enhance Plan implementation, the Committee committed to work with stakeholders in the County that know how to successfully engage residents and special populations, including multi-lingual communities and those with special circumstances.</p>
<p>Rockland County Stream Control Act, July 1976, Amended November 2001</p>	Description:	<p>The legislative intent and purpose of this act is the alleviation of recurring flood damage to public and private property and the prevention of damage to public health and safety resulting from floods in Rockland County. It is the intent of this act to protect health, safety, the economy, and general welfare through the following objectives:</p> <ul style="list-style-type: none"> Providing for the protection, preservation, proper maintenance, and use of its water courses, tidal marshes, floodplain lands, watersheds, water recharge areas, and natural drainage systems to minimize their disturbance. Preventing damage from erosion, turbidity, siltation, and saltwater intrusion. Preventing loss of fish or other beneficial marine organisms, aquatic wildlife and vegetation, and the natural habitat thereof. Preventing the danger of flood damage and pollution. Protecting the quality of water courses, wetlands, tidal marshes, shorelines, watersheds and water recharge areas, underground water reserves, and natural drainage systems. Protecting the County's potable fresh water supplies from the dangers of drought, overdraft, pollution, and misuse or mismanagement.
	Responsible Agency:	Rockland County Drainage Agency
	Provides Funding for Mitigation:	No
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Although not specifically, all impacted populations will benefit equally by enforcement of the act.
<p>Ready Rockland—For Older Adults and People with Access</p>	Description:	<p>Ready Rockland is a resource guide for vulnerable populations to prepare for a disaster event. The steps outlined in the guide will help vulnerable populations to better identify and assess their needs and resources during times of disaster and include instructions on the following topics:</p> <ul style="list-style-type: none"> Getting registered

Capability	Details	
and Functional Needs, June 2017		<ul style="list-style-type: none"> Developing a disaster plan Assembling an emergency supply kit Putting together a “go” bag Being prepared to evacuate Sheltering in place Available resources
	Responsible Agency:	Office of Fire and Emergency Services
	Provides Funding for Mitigation:	No
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. This resource specifically aims to provide support for vulnerable populations, such as those who are older than 65 and/or those with access and functional needs.

Table 5-2. State and Federal Planning and Regulatory Capabilities

Capability	Details	
Disaster Mitigation Act 2000	Description:	The Disaster Mitigation Act is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Assistance grant funds are available to communities. This plan update is designed to meet the requirements of the act, improving eligibility for future hazard mitigation funds.
	Responsible Agency:	FEMA
	Provides Funding for Mitigation:	HMPs that meet the requirements of the Disaster Mitigation Act establish eligibility for future FEMA Hazard Mitigation Assistance funds.
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The Act aims to help communities proactively identify and mitigate their vulnerabilities to adverse impacts, including identifying underserved and socially vulnerable populations that may require additional support during an emergency.
National Flood Insurance Program	Description:	<p>The NFIP is a federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damage. The flood hazard profile in Section 4.3.6 provides information on recent legislation related to reforms to the NFIP.</p> <p>All municipalities in Rockland County actively participate in the NFIP. As of November 2023, there were 962 NFIP policies in Rockland County. There have been 3,113 claims made, totaling over \$43 million for damage to structures and contents.</p>
	Responsible Agency:	FEMA
	Provides Funding for Mitigation:	Full compliance and good standing under the NFIP are application prerequisites for all FEMA grant programs for which participating jurisdictions are eligible under this plan.
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program aims to provide incentives for communities that proactively identify and mitigate vulnerabilities, including identifying those that may require additional support during an emergency.
NFIP Community Rating System	Description:	As an additional component of the NFIP, the Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS:

Capability	Details	
		<ul style="list-style-type: none"> • Reduce flood losses. • Facilitate accurate insurance rating. • Promote the awareness of flood insurance. <p>Municipalities and the County can expect significant cost savings on premiums if enrolled in the CRS program. As of October 2023, one community in Rockland County participates in the CRS program. The Village of Suffern is currently a Class 9 CRS community (Verisk Analytics, Inc. 2023).</p>
	Responsible Agency:	FEMA
	Provides Funding for Mitigation:	CRS premium discounts on flood insurance range from 5 percent for Class 9 communities up to 45 percent for Class 1 communities.
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program aims to provide incentives for communities that proactively identify and mitigate vulnerabilities, including identifying those that may require additional support during an emergency.
New York State Floodplain Management	Description:	<p>In 1992, the New York State Legislature found that “it is in the interests of the people of this state to provide for participation” in the NFIP (New York Laws, Environmental Conservation, Article 36). Although the Legislature recognized that “land use regulation is principally a matter of local concern” and that local governments “have the principal responsibility for enacting appropriate land use regulations,” the law requires all local governments with land use restrictions over SFHAs to comply with all NFIP requirements. The law clearly advises local governments that failure to qualify for the NFIP may result in sanctions under federal law and specifies that the state “will cooperate with the federal government in the enforcement of these sanctions.”</p> <p>The 1992 law that provides for local government participation in the NFIP also requires state agencies to “take affirmative action to minimize flood hazards and losses in connection with state-owned and state-financed buildings, roads and other facilities, the disposition of state land and properties, the administration of state and state-assisted planning programs, and the preparation and administration of state building, sanitary and other pertinent codes.” The Commissioner of the NYS DEC assists state agencies in several respects, including reviewing potential flood hazards at proposed construction sites.</p> <p>There are two departments that have statutory authorities and programs that affect floodplain management at the local jurisdiction level in New York State: NYS DEC and the Department of State’s Division of Building Standards and Codes.</p> <p>NYS DEC is charged with conserving, improving, and protecting the state’s natural resources and environment, and preventing, abating, and controlling water, land, and air pollution. Programs that have bearing on floodplain management are managed by NYS DEC’s Bureau of Flood Protection and Dam Safety, which cooperates with federal, state, regional, and local partners to protect lives and property from floods, coastal erosion, and dam failures. These objectives are accomplished through floodplain management and both structural and nonstructural means. The bureau consists of three sections:</p> <ul style="list-style-type: none"> • The Dam Safety Section is responsible for reviewing repairs and modifications to dams and ensuring that dam owners operate and maintain dams in a safe condition through inspections, technical reviews, enforcement, and emergency planning. • The Flood Control Projects Section is responsible for reducing flood risk to life and property through construction, operation, and maintenance of flood control facilities. • The Coastal Erosion and Floodplain Management Section is responsible for reducing flood risk to life and property through management of activities, such as development in flood hazard areas, and for reviewing and developing revised flood maps. The Section serves as the NFIP State Coordinating Agency and in this capacity is the liaison between FEMA and New York communities that elect to participate in the NFIP. The Section provides a wide range of technical assistance.
	Responsible Agency:	NYS DEC and Division of Building Standards and Codes
	Provides Funding for Mitigation:	No

Capability	Details	
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program aims to provide incentives for communities that proactively identify and mitigate vulnerabilities, including identifying those that may require additional support during an emergency.
New York Power Authority	Description:	The New York Power Authority (NYPA) is America’s largest state power organization, with 16 generating facilities and more than 1,400 circuit-miles of transmission lines. State and federal regulations shape NYPA’s diverse customer base, which includes large and small businesses, not-for-profit organizations, community-owned electric systems, rural electric cooperatives, and government entities. NYPA provides the lowest-cost electricity in New York State and is the only statewide electricity supplier.
	Responsible Agency:	New York State
	Provides Funding for Mitigation:	Yes. As part of its commitment to supporting growth, development, and innovation across New York, NYPA provides grants and low-cost power to eligible organizations.
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. NYPA’s Environmental Justice program is driven by a commitment to always be a good neighbor to the historically underserved and marginalized communities located near NYPA facilities and assets. Community collaboration and engagement are the hallmarks of this program. NYPA leverages its expertise in energy and energy technology to provide no-cost programs and services that meet the unique needs of communities.

5.3 ADMINISTRATIVE AND TECHNICAL CAPABILITIES

Table 5-3 and Table 5-4 summarize administrative and technical capabilities at the federal, state, county, and local levels. Detailed information regarding administrative and technical capabilities in the County and the municipalities can be found in each jurisdictional annex found in Volume II.

Table 5-3. County and Local Administrative and Technical Capabilities

Capability	Details	
Rockland County Office of Fire and Emergency Services	Description:	The Rockland County Office of Fire and Emergency Services responds to natural disasters such as snowstorms, floods, and hurricanes; technical disasters such as chemical spills; and hazardous materials incidents. It provides 911 service for the residents of Rockland County and coordinates dispatch of fire companies and ambulance squads. It also conducts Indian Point drills on a regular basis. The Rockland County Office of Fire and Emergency Services provides support and training necessary to its fire service and emergency responders. The Office oversaw the development of this plan update, which will allow its jurisdictions to apply for FEMA Hazard Mitigation Assistance funding, as well as mitigate physical and economic damage resulting from future natural disasters.
	Responsible Agency:	Rockland County Office of Fire and Emergency Services
	Provides Funding for Mitigation:	No
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The Office of Fire and Emergency Services offers a Special Needs Registry User Guide and an Access and Functional Needs Registry for vulnerable populations. All hazards and emergencies are responded to equally.
Local Emergency Planning Committee	Description:	Authorized by Title III of the Superfund Amendments and Reauthorization Act (SARA), the Emergency Planning and Community Right-to-Know Act (EPCRA) was enacted by Congress as the national legislation on community safety. This law is designed to help local communities protect public health, safety, and the environment from chemical hazards.

Capability	Details	
		<p>To implement EPCRA, Congress requires each state to appoint a State Emergency Response Commission (SERC). The SERCs are required to divide their states into Emergency Planning Districts and to name a Local Emergency Planning Committee (LEPC) for each district.</p> <p>Broad representation by fire fighters, health officials, government and media representatives, community groups, industrial facilities, and emergency managers ensures that all necessary elements of the planning process are represented.</p>
	Responsible Agency:	N/A
	Provides Funding for Mitigation:	No
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Represented by community groups.
Rockland County Planning Department	Description:	<p>It is the Rockland County Planning Department’s goal and responsibility to appropriately guide municipal planning decisions using the guidelines set forth by the GML, the Official County Map, and the County’s Comprehensive Plan. The Department’s dedicated professionals and cutting-edge technology assist the County in maintaining a livable, sustainable, suburban community. The Planning Department encourages sustainable development among municipalities; that is, development that looks at the big picture, incorporating land-use and transportation planning measures together with the needs of the community.</p>
	Responsible Agency:	N/A
	Provides Funding for Mitigation:	No
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The Planning Department emphasizes sustainable development, which aims to meet the needs of all residents, including those that are underserved and/or socially vulnerable.
Rockland County Highway Department	Description:	<p>The Rockland County Highway Department has the responsibility for the administration, construction, maintenance, supervision, repair, and care of approximately 340 lane miles of roadways, 83 bridges, and 115 culverts within the County jurisdiction. The department mission is to provide a safe, well-maintained, and efficient operation of the County highway and bridge system. The Highway Department consists of the following six divisions:</p> <ul style="list-style-type: none"> • Engineering Division • Maintenance and Construction Division • Drainage Agency • Permits Division • Traffic Safety Division • Maps and Highway GIS Division
	Responsible Agency:	N/A
	Provides Funding for Mitigation:	No
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The Department works with other County and municipal agencies to ensure all residents can travel safely via private and public transit.
Rockland County Health Department	Description:	<p>The mission of the Rockland County Department of Health is to protect and promote optimal health for all residents. Its goal is a safe, healthy county for County residents to live, work and play, and where everyone has an equal opportunity for a healthy and productive life. To fulfill this mission, the Department fulfills the following duties:</p> <ul style="list-style-type: none"> • Provides family planning services and education. • Operates the WIC (women, infant, children) nutrition program in Rockland.

Capability	Details	
		<ul style="list-style-type: none"> • Offers nutrition, diabetes, stop smoking, and other health promotion and education programs. • Evaluates and offers referrals for children with developmental delays. • Helps protect children from lead poisoning. • Plans for emergency response. • Provides coordination, training and resources to the EMS community, and offers CPR courses. • Practices disease prevention and control.
	Responsible Agency:	N/A
	Provides Funding for Mitigation:	No
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The Department provides services that specifically support low-income households and children, such as the WIC nutrition program.
Rockland County Division of Environmental Resources	Description:	<p>Local Law No. 19 of 1996 established the Division of Environmental Resources (DER). The DER is located within Rockland County government and serves as the core environmental department responsible for informing the County Executive and the County Legislature on all environmental issues. These include but are not limited to, state and federal initiatives, new programs, funding sources, concerns of residents, and environmental problems within the County.</p> <p>The DER includes the Environmental Management Council, Soil and Water Conservation District, Water Quality Committee, Agriculture and Farmland Protection Board, and the Parks Commission. The Division’s goal has been two-fold: to protect Rockland’s environment and to provide County residents both active and passive recreational opportunities. Park acquisitions have been attained through County funds matched with federal and state grants along with land donations, tax delinquency and partnerships with land trusts and other municipalities.</p>
	Responsible Agency:	N/A
	Provides Funding for Mitigation:	No
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The Division aims to protect access to parks and open spaces for all residents by acquiring parks and other initiatives.
Rockland County Open Space Acquisition Program	Description:	<p>The Open Space Acquisition Program launched in 1999 to acquire areas of scenic beauty, environmentally sensitive lands, farms, and Hudson River waterfront areas. Its goal is to protect the rapidly disappearing natural, cultural, and historic resources in Rockland County for the future.</p> <p>Between 1999 and 2010, 31 individual properties were acquired, preserving 1,204 acres of land. A total of \$23,300,000 in County funds were expended while \$11,576,000 in state grants and partnerships with Land Trusts and local municipalities were leveraged. The Open Space Acquisition Program has successfully provided access to the Hudson River (27 acres), preserved steep slopes (500 acres), protected wetlands (350 acres), and preserved a valuable historic resource (0.5 acres). The remaining acreage includes floodplains, scenic vistas, and properties to provide access to other parklands. These parcels are scattered throughout the five Towns in the County and offer a variety of recreational opportunities.</p> <p>In September 2019, the County approved Resolution No. 406 of 2019 authorizing the creation of a 2020 capital project to include \$30,000,000 to acquire open space properties. In 2023, 25 acres were purchased and preserved, and, in the beginning of 2024, 14 acres were preserved.</p>
	Responsible Agency:	Rockland County Division of Environmental Resources
	Provides Funding for Mitigation:	No

Capability	Details	
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The Department aims to protect access to open spaces and natural resources for all residents by acquiring land.
Resilient NY	Description:	In November 2018, New York State launched the Resilient NY program. The overall goal of the program is to improve community resiliency to extreme weather events that result in flooding and ice jam formations. NYS DEC and NYS OGS retained two consulting firms to prepare the Resilient NY studies. The consultants will work with NYS DEC experts, municipalities, and interested stakeholders to collect relevant information about flooding and ice jam formations in each priority watershed and use this information to develop specific mitigation projects and actions. The Resilient NY program supported the development of Flood Mitigation and Resilience Reports for the following watersheds: Hackensack River, Mahwah River, Minisceongo Creek, Ramapo River, Saddle River, and Sparkill Creek.
	Responsible Agency:	NYS DEC and NYS OGS, with support from Rockland County Division of Environmental Resources
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	Drought, Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	No.
	Description:	Rockland County Soil and Water Conservation District’s Environmental Program encourages municipalities and residents to conserve water and to protect existing water resources. It offers guidance in the use of rain barrels and rain gardens and provides educational services for invasive species management.
Rockland County Soil and Water Conservation District	Responsible Agency:	Rockland County Division of Environmental Resources
	Provides Funding for Mitigation:	No
	Hazards Addressed:	Drought, Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	No
Rockland County Task Force on Water Resources Management	Description:	The mission of the Rockland County Task Force on Water Resources Management is to develop a water plan that ensures a safe, long-term water supply for Rockland County and incorporates sustainability, demand-side principles, and conservation. The Task Force will assemble, examine, and investigate relevant data, further County goals regarding protection of floodplains, woodlands, and wetlands, increased groundwater supply, stormwater runoff reduction, and flood damage prevention for residents and businesses. The Task Force will also develop education and outreach programs, seek funding opportunities, and report its findings, conclusions, and recommendations to the Legislative and Executive branches of County government.
	Responsible Agency:	Rockland County Planning Department
	Provides Funding for Mitigation:	No
	Hazards Addressed:	Drought, Flood
Lower Hudson Coalition of Conservation Districts	Description:	The Lower Hudson Coalition of Conservation Districts is comprised of 10 soil and water conservation districts working together to conserve water quality and natural resources in the Hudson River Estuary watershed. The counties of Albany, Greene, Columbia, Ulster, Dutchess, Orange, Putnam, Rockland, Westchester, and NYC each have a soil and water

Capability	Details	
		conservation district. Each district’s professional staff works with public and private landowners to protect and enhance water quality, reduce erosion, prevent pollution, and preserve natural resources. As a coalition, it works to educate and act on a regional scale to keep waters clean.
	Responsible Agency:	N/A
	Provides Funding for Mitigation:	No
	Hazards Addressed:	Drought, Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	No.
Rockland County Sewer District #1	Description:	Rockland County Sewer District No. 1 was formed in 1963. The District primarily services the Towns of Ramapo and Clarkstown and several parcels in the Town of Orangetown. The District operates and maintains major interceptors and pumping stations and all sewers within the Villages of Spring Valley, New Square, Hillburn, and Sloatsburg. The Towns of Ramapo and Clarkstown maintain most of the 8-inch diameter sewers. The District’s wastewater treatment facilities are located in Orangeburg and Hillburn, New York.
	Responsible Agency:	Rockland County
	Provides Funding for Mitigation:	No
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	No.
Rockland County Office of Community Development	Description:	<p>The Office of Community Development serves the people of Rockland County by administering federal grants to provide affordable housing and improve the quality of life to low- and moderate-income residents in Rockland in an ethical, courteous, timely and cost-effective manner.</p> <p>The federal Community Development Block Grant (CDBG) program works to support activities that build stronger and more resilient communities. Activities may address needs such as infrastructure, economic development, public facilities, community centers, housing rehabilitation, public services, clearance/acquisition, microenterprise assistance, code enforcement, and homeowner assistance.</p>
	Responsible Agency:	Rockland County
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Supporting underserved communities is a mandate for expending U.S. Department of Housing and Urban Development CDBG Funds.
Rockland County Office of Buildings and Codes	Description:	The Office of Buildings and Codes is responsible for the administration and enforcement of the New York State Uniform Fire Prevention and Building Code (Uniform Code) and the New York State Energy Conservation Construction Code (Energy Code) in unincorporated areas of Rockland County. It ensures that homes, buildings, and businesses within the unincorporated areas are structurally sound and compliant with New York State Uniform and Energy Code. Adherence to these codes protects the health and safety of residents, visitors and first responders within the County.
	Responsible Agency:	Rockland County
	Provides Funding for Mitigation:	No
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	No

Capability	Details	
Rockland County Agricultural and Farm Protection Board	Description:	The Agricultural and Farm Protection Board’s mission is to advise the County Executive and Legislature on the proposed establishment, modification or termination of any agricultural district and agricultural initiatives. The Board reviews subdivision proposals that may affect agricultural land and approves and revises the County’s Comprehensive Plan objectives on farmland protection. It may request that the New York State Commissioner of Agriculture and Markets intervene in disputes between agriculture producers and government agencies. The board provides public education related to the benefits of preserving and promoting the environmental, cultural, and economic aspects of agriculture. The board is comprised of several representatives from local farms, County legislatures, Cornell Cooperative Extension staff, Soil and Water Conservation District board members and more, working together to protect the County’s agricultural economic and history. The County explored establishing an Agricultural District, but determined the County did not meet the State’s requirements to do so. The Board is currently dormant, but has identified members if needed to advise on agricultural initiatives.
	Responsible Agency:	Rockland County Division of Environmental Resources
	Provides Funding for Mitigation:	No
	Hazards Addressed:	Drought, Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The Board aims to protect the County’s historically active agricultural economy and agribusinesses.

Table 5-4. Federal and State Administrative and Technical Capabilities

Capability	Details	
FEMA	Description:	FEMA is an agency under the U.S. Department of Homeland Security that coordinates the federal government’s role in preparing for, preventing, mitigating the effects of, responding to, and recovering from all domestic disasters, whether natural or man-made, including acts of terror. When a disaster occurs in the United States, the governor of the state in which the disaster occurs must declare a state of emergency and formally request that FEMA and the federal government respond to the disaster.
	Responsible Agency:	FEMA
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes
NOAA	Description:	NOAA is a scientific agency whose services include daily weather forecasts, severe storm warnings, climate monitoring, fisheries management, coastal restoration, and supporting marine commerce. These services support economic vitality and affect more than one-third of America’s gross domestic product. NOAA scientists use cutting-edge research and high-tech instrumentation to provide citizens, planners, emergency managers and other decision makers with reliable information when they need it.
	Responsible Agency:	NOAA
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes
U.S. Geological Survey	Description:	The U.S. Geological Survey (USGS) provides science about natural hazards that threaten lives and livelihoods; water, energy, minerals, and other natural resources; the health of the environment; and the impacts of climate and land-use change. USGS scientists develop methods and tools to supply timely, relevant, and useful information about the Earth and its processes.

Capability	Details	
		USGS is the sole science agency for the Department of the Interior. It is sought out for its natural science expertise and its vast earth and biological data holdings. Its mission is to serve the nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect quality of life.
	Responsible Agency:	USGS
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	Flood, Severe Storm, Severe Winter Storm
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes
U.S. Army Corps of Engineers	Description:	<p>The U.S. Army Corps of Engineers (USACE) is a federal agency under the Department of Defense. USACE has approximately 37,000 civilians and soldiers delivering engineering services to customers in more than 130 countries. With environmental sustainability as a guiding principle, the USACE team works to strengthen the nation’s security by building and maintaining infrastructure and providing military facilities where servicemembers train, work and live.</p> <p>USACE public works programs account for 24 percent of hydropower capacity in the United States. Additionally, USACE has been involved with the following:</p> <ul style="list-style-type: none"> • Planning, designing, building, and operating locks and dams • Flood control and protection projects, beach nourishment, and dredging for waterway navigation • Design and construction management of military facilities for the Army, Air Force, Army Reserve, Air Force Reserve, and other defense and federal agencies • Cleaning sites contaminated with hazardous, toxic or radioactive waste and material
	Responsible Agency:	USACE
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes
U.S. Department of Housing and Urban Development	Description:	<p>The Department of Housing and Urban Development (HUD) is responsible for national policy and programs that address America’s housing needs, improve and develop the nation’s communities, and enforce fair housing laws. HUD underwrites homeownership for lower- and moderate-income families through its mortgage insurance programs. Primary programs administered by HUD include the following:</p> <ul style="list-style-type: none"> • Mortgage and loan insurance through the Federal Housing Administration • Community Development Block Grants (CDBG) to help communities with economic development, job opportunities and housing rehabilitation • HOME Investment Partnership Act block grants to develop and support affordable housing for low-income residents • Rental assistance in the form of Section 8 certificates or vouchers for low-income households • Public or subsidized housing for low-income individuals and families • Homeless assistance provided through local communities and faith-based and other nonprofit organizations • Fair housing public education and enforcement
	Responsible Agency:	HUD
	Provides Funding for Mitigation:	Yes

Capability	Details	
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes
U.S. Department of Agriculture	Description:	The U.S. Department of Agriculture (USDA) proposes programs and implements policies and regulations related to American farming, forestry, ranching, food quality, and nutrition. Its programs help provide the following services, among others: broadband access in rural areas; disaster assistance to farmers, ranchers, and rural residents; soil, water, and other natural resource conservation to landowners; wildfire prevention; and agricultural research and statistics.
	Responsible Agency:	USDA
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes
U.S. Environmental Protection Agency	Description:	The U.S. Environmental Protection Agency protects people and the environment from significant health risks, sponsors and conducts research, and develops and enforces environmental regulations. The agency works to ensure the following: <ul style="list-style-type: none"> • Americans have clean air, land and water. • National efforts to reduce environmental risks are based on the best available scientific information. • Federal laws protecting human health and the environment are administered and enforced fairly, effectively and as Congress intended. • Environmental stewardship is integral to U.S. policies concerning natural resources, human health, economic growth, energy, transportation, agriculture, industry, and international trade, and these factors are similarly considered in establishing environmental policy. • All parts of society—communities, individuals, businesses, and state, local and tribal governments—have access to accurate information sufficient to effectively participate in managing human health and environmental risks. • Contaminated lands and toxic sites are cleaned up by potentially responsible parties and revitalized. • Chemicals in the marketplace are reviewed for safety.
	Responsible Agency:	U.S. Environmental Protection Agency
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes
Small Business Administration	Description:	The Small Business Administration (SBA) helps Americans start, build and grow businesses. Through an extensive network of field offices and partnerships, the Small Business Administration assists and protects the interests of small business concerns. SBA’s programs include help with management, as well as financial and federal contract procurement. SBA provides specialized outreach to women, minorities, and armed forces veterans. SBA loans are available to victims of natural disasters. The agency also offers specialized advice and support in international trade.
	Responsible Agency:	SBA
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All

Capability	Details	
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes
U.S. Economic Development Administration	Description:	The Economic Development Administration provides grants to economically distressed communities to generate new employment and stimulate industrial and commercial growth. Their investment policy is designed to establish a foundation for sustainable job growth and durable regional economies throughout the United States. This foundation builds upon two key economic drivers—innovation and regional collaboration.
	Responsible Agency:	Economic Development Administration
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes
New York State Division of Homeland Security and Emergency Services	Description:	<p>The New York State Division of Homeland Security and Emergency Services (NYS DHSES) is responsible for coordinating the activities of all state agencies to protect New York’s communities, the state’s economic well-being, and the environment from natural and man-made disasters and emergencies. NYS DHSES routinely assists local governments, voluntary organizations, and private industry through a variety of emergency management programs, including hazard identification, loss prevention, planning, training, operational response to emergencies, technical support, and disaster recovery assistance.</p> <p>NYS DHSES administers the FEMA mitigation grant programs in the state, supports local mitigation planning, and develops and routinely updates the State Hazard Mitigation Plan. NYS DHSES prepared the current State Hazard Mitigation Plan working with input from other state agencies, authorities, and organizations. It was approved by FEMA in 2019, and it keeps New York eligible for recovery assistance in all Public Assistance Categories A through G, and Hazard Mitigation Assistance in each of the Unified Hazard Mitigation Assistance Program’s five grant programs. The 2019 New York State HMP was used as guidance in completing the Rockland County HMP Update.</p>
	Responsible Agency:	New York State Division of Homeland Security and Emergency Services
	Provides Funding for Mitigation:	No
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. NYS DHSES examines impacts on socially vulnerable populations in the State HMP. As the administrator of FEMA grant programs, NYS DHSES also aims to provide equitable access to mitigation funding for lower-resourced jurisdictions and communities.
	New York State Department of Environmental Conservation, Division of Water, Bureau of Flood Protection and Dam Safety	Description:
Responsible Agency:		NYS DEC

Capability	Details	
	Provides Funding for Mitigation:	Grant funding is available to assist eligible dam owners with infrastructure repair costs. Funding is provided through FEMA’s High Hazard Potential Dam grant program. NYS DEC accepts applications for grants to assist with technical, planning, design, and other pre-construction activities associated with the rehabilitation of eligible dams classified as high-hazard dams.
	Hazards Addressed:	Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. As the administrator of the FEMA grant programs, the Bureau aims to provide equitable access to mitigation funding for lower-resourced jurisdictions and communities.
New York State Department of State’s Division of Building Standards and Codes	Description:	<p>The New York State Department of State’s Division of Building Standards and Codes provides a variety of services related to the development, administration, and enforcement of the Uniform Fire Prevention and Building Code and Energy Conservation Construction Code. These codes provide for the construction of safe, resilient, and energy efficient buildings throughout New York State.</p> <p>The statutory responsibility for developing and maintaining the Uniform Fire Prevention and Building Code (Uniform Code) and the State Energy Conservation Construction Code (Energy Code) is vested in the State Fire Prevention and Building Code Council (Code Council). If the Code Council decides to amend either code, it commences a process for rule making set forth in the State Administrative Procedure Act. The Code Development Unit administers statutory functions and evaluates proposed changes to the codes.</p> <p>Executive Law §379 authorizes the legislative body of a local government to enact or adopt local laws and ordinances that impose standards for construction that are more restrictive than the corresponding standards imposed by the Uniform Code. Energy Law §11-109 allows counties, cities, towns, villages, school districts or district corporations to promulgate local energy conservation construction codes that are more stringent than the state Energy Code. The Code Council is empowered by Executive Law §379 and Energy Law §11-109 to approve these more restrictive standards and more stringent local energy conservation construction codes when such codes or standards follow Executive Law §379 and Energy Law §11-109. The Code Development Unit assists with reviewing the technical aspects of these local laws and ordinances and reporting its findings to the Code Council.</p> <p>The Division of Building Standards and Codes’ Code Enforcement Disaster Assistance Response (CEDAR) Program provides requesting communities with post-disaster assistance under the leadership of the DHSES Office of Emergency Management and in accordance with Executive Law 2-B. The program’s initial disaster response focuses on performing rapid evaluation safety assessments of damaged structures in affected communities for use as part of the application process to request federal disaster assistance through FEMA. The CEDAR program’s long-term disaster response provides a unified method for communities to access the range of resources available within and beyond the Department of State.</p>
	Responsible Agency:	State Fire Prevention and Building Code Council
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The Department of State offers various grant funding opportunities to help bolster New York’s communities and vulnerable citizens.
	New York State Office of Planning, Development and Community Infrastructure	Description:
Responsible Agency:		N/A
Provides Funding for Mitigation:		No
Hazards Addressed:		Flood

Capability	Details	
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The Office provides assistance in ways that also acknowledge the added stress on communities from development pressures and broader socioeconomic forces.
Climate Smart Communities	Description:	<p>Climate Smart Communities (CSC) is a New York State program that helps local governments take action to reduce greenhouse gas emissions and adapt to a changing climate. The program offers grants, rebates for electric vehicles, and free technical assistance. The CSC certification program recognizes leaders of local governments that have undergone a rigorous review process to confirm their completion of a suite of actions that mitigate and adapt to climate change at the community level. The goals of the CSC certification program are to engage and educate local governments in New York State, provide a robust framework to guide their climate action efforts, and recognize their achievements.</p> <p>The structure of the certification program is based on the CSC pledge elements that were developed in 2009. Participation in the program is voluntary. The program is designed to encourage ongoing implementation of actions that reduce greenhouse gas emissions and help communities adapt to the effects of climate change.</p> <p>In Rockland County, the following municipalities are certified CSC, followed by their ranking:</p> <ul style="list-style-type: none"> • Nyack (V)—<i>Bronze</i> • Piermont (V)—<i>Bronze</i> <p>The following municipalities are registered with the CSC, but have not been ranked:</p> <ul style="list-style-type: none"> • Rockland County • Clarkstown (T) • Haverstraw (V) • Montebello (V) • New Hempstead (V) • Orangetown (T) • South Nyack (V) • Upper Nyack (V) • Wesley Hills (V) • West Haverstraw (V)
	Responsible Agency:	The program is jointly sponsored by the following New York State agencies: NYS DEC; Energy Research and Development Authority; Department of Public Service; Department of State; Department of Transportation; Department of Health, and NYPA. NYS DEC acts as the main administrator of the program.
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program incentivizes mitigation strategies that acknowledge the added stress on communities from being historically underserved or that have a high share of socially vulnerable residents.

5.4 FISCAL CAPABILITIES

Fiscal capabilities are the resources that a jurisdiction has access to or is eligible to use to fund mitigation actions. Table 5-5 provides a list of programs and links for jurisdictions seeking funding sources. This table is not intended to be a comprehensive list, but rather a tool to help begin identifying potential sources of funding.

Table 5-5. Fiscal Capabilities

Capability	Details	
Federal		
Hazard Mitigation Grant Program	Description:	<p>The Hazard Mitigation Grant Program (HMGP) is a post-disaster mitigation program. It is made available to states by FEMA after each federal disaster declaration. The HMGP can provide up to 75 percent funding for hazard mitigation measures. The HMGP can be used to fund cost-effective projects that will protect public or private property in an area covered by a federal disaster declaration or that will reduce the likely damage from future disasters. Examples of projects include acquisition and demolition of structures in hazard prone areas, flood-proofing or elevation to reduce future damage, minor structural improvements, and development of state or local standards. Projects must fit into an overall mitigation strategy for the area identified as part of a local planning effort. All applicants must have a FEMA-approved HMP (such as this plan).</p> <p>Applicants who are eligible for the HMGP are state and local governments, certain nonprofit organizations or institutions that perform essential government services, and Indian tribes and authorized tribal organizations. Individuals or homeowners cannot apply directly for the HMGP; a local government must apply on their behalf. Applications are submitted to NYS DHSES, placed in rank order for available funding, and submitted to FEMA for final approval. Eligible projects not selected for funding are placed in an inactive status and may be considered as additional HMGP funding becomes available.</p>
	Responsible Agency:	FEMA
	Additional Information:	https://www.fema.gov/hazard-mitigation-grant-program
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Projects in socially vulnerable communities are eligible for a lower federal cost share requirement (90 percent federal, 10 percent non-federal).
Flood Mitigation Assistance Program	Description:	<p>Flood Mitigation Assistance (FMA) provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. The FMA is funded annually; no federal disaster declaration is required. Only NFIP-insured homes and businesses are eligible for mitigation in this program. Funding for FMA is limited, and individuals cannot apply directly for the program. Applications must come from local governments or other eligible organizations. The federal cost share for an FMA project is at least 75 percent. At most 25 percent of the total eligible costs must be provided by a non-federal source; of this 25 percent, no more than half can be provided as in-kind contributions from third parties. At minimum, a FEMA-approved local flood mitigation plan is required before a project can be approved. The FMA funds are distributed from FEMA to the state. NYS DHSES serves as the grantee and program administrator for the FMA program.</p>
	Responsible Agency:	FEMA
	Additional Information:	https://www.fema.gov/flood-mitigation-assistance-grant-program
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	Flood, Severe Storm

Capability	Details	
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Projects in socially vulnerable communities are eligible for a lower federal cost share requirement (90 percent federal, 10 percent non-federal).
Building Resilient Infrastructure and Communities Program	Description:	Building Resilient Infrastructure and Communities (BRIC) supports states, local communities, tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency.
	Responsible Agency:	FEMA
	Additional Information:	https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Projects in socially vulnerable communities are eligible for a lower federal cost share requirement (90 percent federal, 10 percent non-federal).
Individual Assistance	Description:	FEMA’s Individual Assistance (IA) program provides financial assistance and direct services to eligible individuals and households who have uninsured and underinsured necessary expenses and serious needs. FEMA makes these funds available after any major disaster declarations and some programs available under emergency declarations. IA supports seven types of activities through the following programs: Mass Care/Emergency Services, Individuals and Households Program, Disaster Case Management, Crisis Counseling Assistance and Training Program, Disaster Legal Services, Disaster Unemployment Assistance, and Voluntary Agency Coordination.
	Responsible Agency:	FEMA
	Additional Information:	https://www.fema.gov/individual-disaster-assistance
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. FEMA works with applicants to afford housing needs within their financial means, which is critical to lower income individuals and those who rent. For example, FEMA can help applicants rent or purchase temporary/transitional house units and in some cases can lower sales or rent prices of these units based on the individual’s financial ability.
Public Assistance	Description:	FEMA’s Public Assistance (PA) provides cost reimbursement aid to local governments (state, county, local, municipal authorities, and school districts) and certain non-profit agencies that were involved in disaster response and recovery programs or that suffered loss or damage to facilities or property used to deliver government-like services. This program is largely funded by FEMA with both local and state matching contributions required.
	Responsible Agency:	FEMA
	Additional Information:	https://www.fema.gov/public-assistance-local-state-tribal-and-non-profit
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The PA program aims to restore critical infrastructure and facilities that provide important services that socially vulnerable population may rely on.
Fire Management Assistance Grant Program	Description:	Assistance for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands that threaten such destruction as would constitute a major disaster. Provides a 75 percent federal cost share and the state pays the remaining 25 percent for actual cost.
	Responsible Agency:	FEMA
	Additional Information:	https://www.fema.gov/fire-management-assistance-grant-program

Capability	Details	
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. This program evaluates applicants based on expected major economic impact to the area.
Assistance to Firefighters Grant Program	Description:	The primary goal of the Assistance to Firefighters Grants is to enhance the safety of the public and firefighters with respect to fire-related hazards by providing direct financial assistance to eligible fire departments, nonaffiliated emergency medical services organizations, and state fire training academies. This funding is for critically needed resources to equip and train emergency personnel to recognized standards, enhance operations efficiencies, foster interoperability, and support community resilience.
	Responsible Agency:	FEMA
	Additional Information:	https://www.fema.gov/welcome-assistance-firefighters-grant-program
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. This program supports under-resourced communities, which may have higher shares of historically underserved and socially vulnerable populations, to increase community capacity and capability to protect people and property from fire and related hazards.
High Hazard Potential Dams Grant Program	Description:	The Rehabilitation of High Hazard Potential Dams Grant Program provides technical, planning, design, and construction assistance in the form of grants to non-federal governmental organizations or nonprofit organizations for rehabilitation of eligible high hazard potential dams.
	Responsible Agency:	FEMA
	Additional Information:	https://www.grants.gov/web/grants/view-opportunity.html?oppId=316238
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	Dam Failure, Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. FEMA evaluates projects based on social and environmental impacts if the dam failed and consequences avoided by bringing it into compliance.
Small Business Administration Loan	Description:	The Small Business Administration (SBA) provides low-interest disaster loans to homeowners, renters, business of all sizes, and most private nonprofit organizations. SBA disaster loans can be used to repair or replace the following items damaged or destroyed in a declared disaster: real estate, personal property, machinery and equipment, and inventory and business assets. Homeowners could apply for up to \$200,000 to replace or repair their primary residence. Renters and homeowners could borrow up to \$40,000 to replace or repair personal property-such as clothing, furniture, cars, and appliances that were damaged or destroyed in a disaster. Physical disaster loans of up to \$2 million are available to qualified businesses or most private nonprofit organizations.
	Responsible Agency:	SBA
	Additional Information:	https://www.sba.gov/managing-business/running-business/emergency-preparedness/disaster-assistance
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. This program provides assistance to individuals that may have limited capital to replace or repair damaged property.
Community Development Block Grant Program	Description:	Community Development Block Grants (CDBG) are federal funds intended to provide low- and moderate-income households with viable communities, including decent housing, a suitable living environment, and expanded economic opportunities. Eligible activities include community facilities and improvements, roads and infrastructure, housing rehabilitation and preservation, development activities, public services, economic development, and planning and administration. Public improvements could include flood and drainage improvements. In

Capability	Details	
		limited instances and during the times of “urgent need” (e.g., post-disaster) as defined by the CDBG National Objectives, CDBG funding could be used to acquire a property located in a floodplain that was severely damaged by a recent flood, demolish a structure severely damaged by an earthquake, or repair a public facility severely damaged by a hazard event.
	Responsible Agency:	U.S. Department of Housing and Urban Development
	Additional Information:	https://www.hudexchange.info/programs/cdbg-entitlement/
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. This program directs funds to communities identified as low- and moderate-income.
Federal Highway Administration Emergency Relief	Description:	Federal Highway Administration (FHWA) Emergency Relief is a grant program through the U.S. Department of Transportation that can be used for repair or reconstruction of federal-aid highways and roads on federal lands that have suffered serious damage because of a disaster. NY DOT serves as the liaison between local municipalities and FHWA.
	Responsible Agency:	U.S. Department of Transportation
	Additional Information:	https://www.fhwa.dot.gov/programadmin/erelief.cfm
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Through the current Justice 40 Initiative, the U.S. Department of Transportation aims to identify and prioritize projects that benefit rural, suburban, tribal, and urban communities facing barriers to affordable, equitable, reliable, and safe transportation.
Federal Transit Administration—Emergency Relief	Description:	Federal Transit Authority Emergency Relief is a grant program that funds capital projects to protect, repair, reconstruct, or replace equipment and facilities of public transportation systems.
	Responsible Agency:	Federal Transit Authority at the U.S. Department of Transportation
	Additional Information:	https://www.transit.dot.gov/funding/grant-programs/emergency-relief-program/emergency-relief-program
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Through the current Justice 40 Initiative, the U.S. Department of Transportation aims to identify and prioritize projects that benefit rural, suburban, tribal, and urban communities facing barriers to affordable, equitable, reliable, and safe transportation.
Disaster Housing Program	Description:	Emergency assistance for housing, including minor repair of homes to establish livable conditions, mortgage, and rental assistance available through the HUD.
	Responsible Agency:	HUD
	Additional Information:	https://www.hud.gov/program_offices/public_indian_housing/publications/dhap
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program provides rent subsidies and housing assistance to help individuals secure temporary or transitional housing, which can especially benefit those with limited incomes or capital, such as those that are over 65 or low-income households.
HOME Investment Partnerships Program	Description:	Grants to local and state government and consortiums for permanent and transitional housing, (including financial support for property acquisition and rehabilitation for low-income persons).
	Responsible Agency:	HUD
	Additional Information:	https://www.hud.gov/program_offices/comm_planning/affordablehousing/programs/home/

Capability	Details	
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program provides rent subsidies and housing assistance to help individuals secure temporary or transitional housing, which can especially benefit those with limited incomes or capital, such as those that are over 65 or low-income households.
HUD Disaster Recovery Assistance	Description:	Grants to fund gaps in available recovery assistance after disasters (including mitigation).
	Responsible Agency:	HUD
	Additional Information:	https://www.hud.gov/info/disasterresources
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program aims to bridge financial gaps in recovery assistance which can especially benefit those with limited incomes or capital, such as those that are over 65 or low-income households.
Section 108 Loan Guarantee	Description:	Enables states and local governments participating in the CDBG program to obtain federally guaranteed loans for disaster-distressed areas.
	Responsible Agency:	HUD
	Additional Information:	https://www.hudexchange.info/programs/section-108/
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. This program directs funds to communities identified as low- and moderate-income.
Smart Growth Implementation Assistance program	Description:	The Smart Growth Implementation Assistance program through the U.S. Environmental Protection Agency focuses on complex or cutting-edge issues, such as stormwater management, code revision, transit-oriented development, affordable housing, infill development, corridor planning, green building, and climate change. Applicants can submit proposals under four categories: community resilience to disasters, job creation, the role of manufactured homes in sustainable neighborhood design, or medical and social service facilities siting.
	Responsible Agency:	U.S. Environmental Protection Agency
	Additional Information:	https://www.epa.gov/smartgrowth
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	No
Partners for Fish and Wildlife	Description:	Financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats.
	Responsible Agency:	U.S. Fish and Wildlife Service
	Additional Information:	https://www.fws.gov/partners/
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	No.

Capability	Details	
Transportation Investment Generating Economic Recovery (TIGER)	Description:	Investing in critical road, rail, transit, and port projects across the nation.
	Responsible Agency:	U.S. Department of Transportation
	Additional Information:	https://www.transportation.gov/tags/tiger-grants
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. Through the current Justice 40 Initiative, the U.S. Department of Transportation aims to identify and prioritize projects that benefit rural, suburban, tribal, and urban communities facing barriers to affordable, equitable, reliable, and safe transportation.
Community Facilities Direct Loan and Grant Program	Description:	This program provides affordable funding to develop essential community facilities in rural areas. An essential community facility is defined as a facility that provides an essential service for the orderly development of the local community in a primarily rural area, and does not include private, commercial, or business undertakings.
	Responsible Agency:	U.S. Department of Agriculture
	Additional Information:	https://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program specifically supports agribusinesses in primarily rural areas.
Emergency Loan Program	Description:	USDA’s Farm Service Agency provides emergency loans to help producers recover from production and physical losses due to drought, flooding, other natural disasters, or quarantine.
	Responsible Agency:	USDA
	Additional Information:	https://www.fsa.usda.gov/programs-and-services/farm-loan-programs/emergency-farm-loans/index
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program specifically supports agribusinesses in primarily rural areas.
Emergency Watershed Protection program	Description:	The Emergency Watershed Protection (EWP) program provides assistance to relieve imminent hazards to life and property caused by floods, fires, drought, windstorms, and other natural occurrences through the Natural Resources Conservation Service (NRCS).
	Responsible Agency:	USDA
	Additional Information:	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program specifically supports primarily rural communities.
Financial Assistance	Description:	Financial assistance to help plan and implement conservation practices that address natural resource concerns or opportunities to help save energy or improve soil, water, plant, air, animal and related resources on agricultural lands and non-industrial private forest land.
	Responsible Agency:	NRCS
	Additional Information:	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/
	Provides Funding for Mitigation:	Yes

Capability	Details	
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program specifically supports primarily rural communities.
Emergency Management Performance Grants Program	Description:	Assists local, tribal, territorial, and state governments in enhancing and sustaining all-hazards emergency management capabilities.
	Responsible Agency:	FEMA
	Additional Information:	https://www.fema.gov/emergency-management-performance-grant-program
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. FEMA aims to support communities that exhibit high rates of social vulnerability.
Reimbursement for Firefighting on Federal Property	Description:	Provides reimbursement only for direct costs and losses over and above normal operating costs.
	Responsible Agency:	FEMA
	Additional Information:	https://www.usfa.fema.gov/grants/firefighting_federal_property.html
	Provides Funding for Mitigation:	Yes
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. FEMA aims to support communities that exhibit high rates of social vulnerability.
Land and Water Conservation Fund	Description:	Matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities (as well as funding for shared federal land acquisition and conservation strategies).
	Responsible Agency:	National Park Service
	Additional Information:	https://www.nps.gov/subjects/lwcf/index.htm
	Provides Funding for Mitigation:	Yes
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. This program supports the equitable access of public open spaces.
State, Local, and Private		
Acres for America	Description:	The National Fish and Wildlife Foundation’s Acres for America program works to permanently conserve wildlife habitat. Since 2005, the Acres for America program has conserved almost 1.5 million acres across the United States and provided almost \$4 million in emergency funding to protect fish and wildlife after the 2010 Gulf of Mexico oil spill and Hurricane Sandy. The Acres for America program prioritizes conserving critical wildlife habitats, minimizing habitat fragmentation, providing public access, and maintaining natural resource-based economic activities. Eligible projects conserve a substantial amount of land and/or land of critical importance to its region. The program prioritizes applications for projects that are endorsed by national, state, and/or nonprofit entities as being a conservation priority.
	Responsible Agency:	National Fish and Wildlife Foundation
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	Drought, Flood
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program considers whether the project would benefit an area with a high share of socially vulnerable residents.

Capability	Details	
Environmental Protection Fund: Local Waterfront Revitalization Program Grants	Description:	The NYS Department of State awards funding to local governments to revitalize coasts and inland waterways by preparing, updating, or implementing an LWRP. LWRPs serve as an opportunity to plan for coastal climate resilience to flooding, sea level rise, and storm surge via natural resource protection and waterfront land use.
	Responsible Agency:	NYS Department of State
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	Flood, Drought
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The Department offers various grant funding opportunities to help bolster New York’s communities and vulnerable citizens.
Partners for Places Funding Program	Description:	The Partners for Place program supports local government efforts toward climate preparedness and mitigation in the United States and Canada. Funding is given to teams including at least one local government sustainability office and one local place-based foundation.
	Responsible Agency:	Funders’ Network for Smart Growth and Livable Communities and the Urban Sustainability Directors Network
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	Yes. The program aims to enhance local capacity and capabilities.
Habitat Restoration Grants	Description:	Habitat Restoration Grant funding supports research on restoration techniques as well as the development of restoration plans for sites in the Hudson River Estuary.
	Responsible Agency:	Hudson River Foundation
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	Flood, Drought
	Supports Underserved Communities and/or Socially Vulnerable Populations:	No.
Climate Adaptation Fund	Description:	The Wildlife Conservation Society’s Climate Adaptation Fund provides grant awards to conservation non-profits across the United States to catalyze innovative, science-driven projects responding to the impacts of climate change on wildlife and people.
	Responsible Agency:	Wildlife Conservation Society
	Provides Funding for Mitigation:	Yes
	Hazards Addressed:	All
	Supports Underserved Communities and/or Socially Vulnerable Populations:	No.

5.5 PLAN INTEGRATION

Rockland County and its municipalities have planning, regulatory, administrative, technical, and fiscal capabilities available that can be leveraged to mitigate and reduce risk to the hazards they face. Municipalities have varying degrees of capabilities to plan and administer and enforce codes and regulations. While smaller jurisdictions often have less internal capacity for technical functions, many access services through contractual arrangements or agreements with other local jurisdictions, outside agencies, or vendors. State and federal agencies also provide technical assistance to extend the range of available local capabilities.

The information on hazard, risk, vulnerability, and mitigation contained in this HMP is based on the best available data accessible at the time this plan was prepared. A review of the capabilities of each participating municipality and how those are being integrated is provided in each of the jurisdictional annexes in Volume II. Some municipalities have limited administrative and technical capabilities, and a small number of employees who handle the duties of more than one position.

The Planning Partnership will continue to incorporate mitigation planning as an integral component of daily government operations. Planning Partnership representatives will continue to work with local government officials to integrate the newly adopted hazard mitigation goals and actions into the general operations of government and partner organizations. Each participating jurisdiction's local governing body intends to incorporate mitigation planning as an integral component of government and partner operations. By doing so, the Planning Partnership anticipates realizing the following objectives:

- Hazard mitigation planning will be formally recognized as an integral part of overall planning and emergency management efforts.
- The hazard mitigation plan, master 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.

Section 7 (Plan Maintenance) provides additional information on the implementation of the mitigation plan through existing programs. Table 5-6 provides mitigation integration and implementation tools available to Rockland County and its municipalities to assist with integrating the HMP with current and future capabilities.

The Rockland County Planning Partnership was tasked with identifying how hazard mitigation is integrated into existing planning mechanisms. Volume II (Jurisdictional Annexes) details how this is done for each participating municipality and the County. During this process, many municipalities recognized the importance and benefits of incorporating hazard mitigation into future municipal planning and regulatory processes and have added new mitigation actions to support this effort.

Table 5-6. Hazard Mitigation Implementation Tools

Plan/Policy	Description	Applicability	Effectiveness
Building Codes	Building standards that include provisions for building in the floodplain, for hurricane or high wind resistant design related to construction, structural design foundation types, and the use of masonry, steel, wood, and glass/glazing, and other materials.	Establish standards for withstanding a variety of hazard forces in the design and construction of structures.	Communities can enact or adopt local laws and ordinances that impose standards for construction that are more restrictive than the corresponding standards imposed by New York State’s Uniform Code and Energy Code.
Capital Improvement Planning/Programs	A short-range plan, usually four to 10 years, which identifies capital projects and equipment purchases, provides a planning schedule, and identifies options for financing the plan.	Secure hazard-prone areas for low-risk uses; strengthen, replace, or realign roads and utilities; and prescribe standards for the design and construction of new facilities.	Communities can include mitigation strategies in their Capital Improvement Plan and incorporate mapped hazard areas into decision-making on projects.
Comprehensive/Master Plans	Overall policy guide for future community growth and development.	Establish land-use policies that discourage development or redevelopment within natural hazard areas. Provide adequate space for expected future growth in areas located outside natural hazard areas. Ensure that safety is explicitly included in growth and development policies.	Communities can include community level communication, preparedness planning, and other non-structural measures and may use mapped hazard areas to rule out areas targeted for future growth or development to minimize increased exposure and vulnerability.
Climate Change Adaptation/Action Plans	An action plan and vulnerability assessment across a broad range of government services to anticipate, plan for, increase awareness of, and build momentum to address and adapt to a changing climate.	Establish a strategic framework to evaluate, comprehend, and decrease greenhouse gas emissions and to mitigate or avoid the projected negative impacts of climate change.	Communities can identify areas that are expected to experience more adverse hazard impacts due to climate change to determine the need for mitigation strategy and/or more resilient building standards and zoning ordinances.
Emergency Operations Plans	Organizational procedures and processes to respond to and recover from an emergency.	Authorize the course of action during an emergency event, including responsibilities, chains of command, and communication protocols.	Communities can develop specific protocols for hazard events they are likely to face based on the HMP.
Floodplain Ordinances	Minimum regulations for compliance with the NFIP. Ensures participating communities consider flood hazards, to the extent that they are known, in all official actions relating to land management and use.	Establish standards for development in the floodplain, including base flood elevations, construction materials, proximity to wetlands and waterways, and allowed structures and uses.	Communities can use the NFIP standards as a baseline and adopt stronger provisions based on the findings from the HMP.
Land Use Plans	Guidance for preventing development in hazardous areas and allowing development that minimizes hazard damage.	Identify mapped hazard areas and keep inappropriate development out of these areas. Land use planning can also be used regionally when governments can collaborate.	Communities can include the special flood hazard area and other mapped hazard areas into the land use planning process to minimize inappropriate development and uses in unsafe areas.
Subdivision Regulations	Construction and location standards for subdivision layout and infrastructure.	Establish standards for such things as stormwater management, erosion control, and subdivision size.	These regulations can reduce the impact of urban flooding, which is often a result of replacing natural land with residential or commercial developments without adequate stormwater drainage.
Local Waterfront Revitalization Programs	Policies and goals to ensure sustainable and economically beneficial development along a waterfront.	Identify areas that are vulnerable to flooding or erosion to keep inappropriate development and uses out of these areas and/or identify potential projects to better protect the waterfront from these hazards.	Communities can use the special flood hazard area and other mapped hazard areas to identify areas for additional oversight or regulation.

Plan/Policy	Description	Applicability	Effectiveness
Parks and Open Space Plans	Goals to protect and preserve a community’s natural landscapes, expand public access, and acquire undeveloped lands.	Identify areas for preservation or acquisition where natural and undeveloped landscapes face high development pressures.	Communities can use mapped hazard areas to identify locations to focus preservation and/or acquisitions efforts. The plan can also identify criteria and goals related to hazard mitigation, such as protecting the community’s permeable land area.
Streambank Buffer Protection Programs	A combination of conservation easements, vegetation management, and landscape restoration of vegetative buffers for streams and waterways to attenuate stormwater runoff quantity and quality issues, decrease streambank erosion, and increase habitat value of the waterway.	Establish design and construction standards for development within a specified distance from streams and waterways. Keeps inappropriate development and uses away from flood- or erosion-prone areas.	Communities can identify areas or projects that may align with the HMP and its mitigation strategy.
Zoning	Laws and ordinances that regulate development by dividing land into zones and setting development criteria for each. Zoning decisions are delegated to local government.	Keep inappropriate development and uses away from hazard-prone areas and designate areas for conservation/open space, public use, or agriculture.	Communities can regulate development in floodplains and other mapped hazard areas and designate areas as “open space” to reduce the effect of flooding by allowing spaces for water to flow unimpeded.

SECTION 6. MITIGATION STRATEGY

The Planning Partnership reviewed the risk assessment for this HMP to identify and develop mitigation actions for Rockland County that will reduce potential exposure and losses associated with identified hazards of concern. This section includes the following:

- Background and past mitigation accomplishments
- General mitigation planning approach
- Problems and solutions
- Review and update of mitigation goals and objectives
- Mitigation strategy development and update

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. These actions can include activities such as revisions to land-use planning, training and education, and structural and nonstructural safety measures.

6.1 BACKGROUND AND PAST MITIGATION ACCOMPLISHMENTS

A review of past mitigation activities provides a foundation for understanding the mitigation goals, objectives, and activities outlined in this plan update. The 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. Highlights are presented in Table 6-1.

Table 6-1. Mitigation Accomplishments in Rockland County

Department	Mitigation Accomplishments
Countywide	<ul style="list-style-type: none"> • The County facilitated the development of the original Rockland County Multi-Jurisdictional Hazard Mitigation Plan (HMP). The current planning process represents the regulatory five-year plan update process, which includes the participation of 23 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 the Federal Emergency Management Agency (FEMA) floodplain mapping and certain minimum standards for building within the floodplain. • The County and its municipalities have implemented mitigation actions to protect critical facilities and community lifelines throughout Rockland County. These actions and others were identified in the 2018 HMP. • In 2020, the County and local municipalities responded to and worked to mitigate the impacts of the coronavirus pandemic through education of the public, enforcement of local and state social distancing and masking measures, and establishment of best practices to slow the spread of COVID-19.
Rockland County Soil & Water Conservation District (SWCD)	<ul style="list-style-type: none"> • SWCD assesses culverts and bridges for flood risk and aquatic passability (the ability for migratory fish to swim into and out of structure). Since 2014, over 400 culverts and bridges have been assessed in the Cedar Pond Brook, Minisceongo Creek and Sparkill Creek subwatersheds (spanning the Towns of Haverstraw, Stony Point, Clarkstown, Orangetown and Ramapo). • In 2016, SWCD completed a pilot study for the Town of Stony Point. 135 culverts and bridges were assessed and made into an inventory document. The goal is to create a town level management plan to help reduce flood risk and increase conservation efforts across waterways and neighboring communities. • Annually, SWCD allocates funds to conceptual design plans and construction of rain gardens, bioswales and other green infrastructure features across the County. These features aid with groundwater recharge, flooding control, and beautification of public spaces. Interpretive signage is also placed at each site to educate visitors of the benefits of green infrastructure.

Department	Mitigation Accomplishments
Rockland County Open Space Acquisition Program	<ul style="list-style-type: none"> Between 1999 and 2010, 31 individual properties were acquired, preserving 1,204 acres of land. A total of \$23,300,000 in County funds were expended and \$11,576,000 in state grants and partnerships with land trusts and local municipalities were leveraged. The Open Space Acquisition Program has successfully provided access to the Hudson River (27 acres), preserved steep slopes (500 acres), protected wetlands (350 acres), and preserved a valuable historic resource (0.5 acres). The remaining acreage includes floodplains, scenic vistas, and properties to provide access to other parklands. These parcels are scattered throughout the five Towns in the County and offer a variety of recreational opportunities. In September 2019, County Executive Ed Day and the County Legislature approved Resolution No. 406 of 2019 authorizing the creation of a 2020 Capital Project to include \$30,000,000 to acquire open space properties through the County’s Open Space Acquisition Program.
Stormwater Consortium of Rockland County	<ul style="list-style-type: none"> The Stormwater Consortium of Rockland County was formed between Cornell Cooperative Extension and the towns and villages of Rockland County to collaborate and share resources on stormwater management. The consortium consists of all 23 towns and villages in Rockland County who must abide by the NYSDEC stormwater permit. Since the last HMP, municipalities focused on reducing and/or eliminating flooding related to stormwater by cleaning retention ponds, installing berms, installing larger drainage pipes along roadways, and replacing damaged drainage pipes. Flood mitigation and resilience reports were completed for the Saddle River Watershed (June 2022) and Ramapo River Watershed (March 2023). These were completed for NYSDEC to determine floodprone areas and identify potential flood mitigation considerations.

6.2 GENERAL MITIGATION PLANNING APPROACH

The overall approach used to update the County and local hazard mitigation strategies is based on FEMA and New York State regulations and guidance regarding local mitigation plan development:

- DMA 2000 implementation regulations, specifically 44 Code of Federal Regulations (CFR) 201.6 (local mitigation planning).
- FEMA *Local Mitigation Planning Handbook*, May 2023.
- FEMA *Local Mitigation Plan Review Guide*, April 2022.
- FEMA *Integrating Hazard Mitigation into Local Planning*, March 1, 2013.
- FEMA *Plan Integration: Linking Local Planning Efforts*, July 2015.
- FEMA *Mitigation Planning How-To Guide #3, Identifying Mitigation Actions and Implementing Strategies* (FEMA 386-3), April 2003.
- FEMA *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, January 2013.
- NYS DHSES *New York State Hazard Mitigation Planning Standards*, 2022.
- NYS DHSES *New York State Hazard Mitigation Planning Standards Guide*, 2017.

The mitigation strategy update approach is further detailed in the remaining subsections of this section.

6.3 PROBLEM AND SOLUTIONS IDENTIFICATION

An exercise to identify problems and solutions was completed via online survey by the participating jurisdictions. Participants were asked to do the following for each of the ranked hazards of concern for the 2024 HMP update:

- Identify a problem caused by each hazard.
- Identify potential solutions to each problem.
- For each solution, describe anticipated costs, benefits, funding sources, and project feasibility.

The results were used by the participants to help identify capabilities and potential mitigation actions.

6.4 REVIEW AND UPDATE OF MITIGATION GOALS AND OBJECTIVES

According to CFR 201.6(c)(3)(i): “The hazard mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.”

The Steering Committee reviewed the 2018 goals and objectives and made revisions for the 2024 update based on the risk assessment results, discussions, research, and input from the Steering Committee, existing authorities, policies, programs, resources, stakeholders, and the public. For the purposes of this plan, goals and objectives are defined as follows:

- **Goals** are general guidelines that explain what is to be achieved. They are usually broad, long-term, policy-type statements and represent global visions. Goals help define the benefits that the plan is trying to achieve. The success of the plan, once implemented, should be measured by the degree to which its goals have been met (that is, by the actual benefits in terms of hazard mitigation).
- **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.

The review of goals and objectives from the 2018 HMP considered hazard events and losses since the 2018 plan, the updated hazard profiles and vulnerability assessment developed for this update, the goals and objectives established in the New York State 2019 HMP, Rockland County and local risk management plans, and direct input on how the County and municipalities need to move forward to best manage their hazard risk. As a result of this review, the goals and objectives for the 2024 update were updated to those in Table 6-2 and Table 6-3. Amendments to the goals and objectives express the Planning Partnership’s interests in integrating this plan with other planning mechanisms and supporting mitigation through the protection of natural systems.

Table 6-2. Rockland County 2024 HMP Goals

Goal Number	Goal
1	Protect life from natural and man-made hazards through planning, preparation, mitigation, and integration.
2	Protect existing and future property including critical facilities, community lifelines, infrastructure, public, and private structures.
3	Increase hazard risk and mitigation education and awareness programs for government agencies, private sector businesses, non-profit organizations, residents, and property owners.
4	Preserve and restore natural systems through sustainable, cost-effective, and resilient mitigation projects and programs.
5	Build emergency management capabilities through continuity of operations before, during, and after hazard events.
6	Promote and encourage sustainability practices to reduce or eliminate impacts from natural and man-made hazard events.
7	Integrate the hazard mitigation plan to ensure consistency with existing and future planning documents, regulatory programs, codes, ordinances, and state and federal hazard mitigation strategies.

Table 6-3. Rockland County 2024 HMP Objectives

Objective Number	Objective
1	Enhance early notification systems and communication infrastructure to provide adequate warning and information regarding all hazards
2	Review, strengthen and enforce existing building codes, ordinances, and safety procedures to increase the resilience of construction to the impacts of hazards.
3	Identify and implement cost-effective structural and property protection projects to reduce the impacts from flooding, including acquisition, elevation, and relocation projects.
4	Develop and distribute public awareness materials about natural hazard risks, preparedness, and mitigation.
5	Ensure continuity of government operations, emergency services, and essential facilities and adequate supplies for emergency response services at the local level during and immediately after hazard events.
6	Strengthen communication and cooperation between public agencies, citizens, non-profit groups, and businesses to implement mitigation activities effectively.
7	Maintain and encourage ongoing relationships between state agencies and partners to play an active and vital role in preservation and restoration of vulnerable natural systems.
8	Pursue mitigation actions that will preserve or restore the environment’s natural abilities to absorb the impacts of natural and man-made hazards.
9	Encourage smart growth, neighborhood revitalization and economic development with an awareness of the existence and location of natural hazard areas to mitigate impacts of hazards on life, property, and the economy, while exploring sustainable development measures and preserving quality of life and existing community and neighborhood character.
10	Improve hazard data through participation in studies, research, and mapping to enhance information related to the impacts of hazards and related risks, vulnerability, and losses.
11	Continue to participate in state, regional, and local programs and efforts that focus on practices that support or enhance resiliency.

6.5 MITIGATION STRATEGY DEVELOPMENT AND UPDATE

As required by FEMA, the County and other participating jurisdictions completed a comprehensive evaluation of the mitigation strategies and actions from the 2018 HMP and reported on the status of each. Their updates may be found in each jurisdictional annex (Volume II). In addition, the County and other participating jurisdictions were provided the opportunity to include new strategies or actions in the 2024 HMP. New actions were prioritized to ensure they are cost-effective, environmentally sound, and technically feasible using the methodology outlined below.

6.5.1 Update of Municipal Mitigation Strategies

For each mitigation action identified in the 2018 HMP, jurisdictions were asked to provide a status (*No Progress, In Progress, Ongoing Capability, Discontinue, or Completed*) and comments. They were requested to quantify the extent of progress and provide reasons for the level of progress or why actions were being discontinued. Each jurisdictional annex in Volume II provides a table identifying the jurisdiction’s prior mitigation strategy, the status of each action, and its disposition within the updated strategy.

Local mitigation actions identified as Completed or Discontinued are not included in the updated strategies. Actions identified as No Progress or In Progress, as well as certain actions/initiatives identified as Ongoing Capability, have been carried forward to the updated mitigation strategies. Municipalities were asked to provide further details on these projects to better define the work, identify benefits and costs, and improve implementation.

As potential new mitigation actions became evident during the plan update process—through public and stakeholder outreach or the updated risk assessment—jurisdictions were made aware of these through direct communication (local meetings, email, phone), at Steering Committee and Planning Partnership meetings, or via the draft jurisdictional annex development.

Throughout the planning process, the planning consultant worked directly with each community by phone or email to assist with the development and update of their annex and include mitigation strategies. The focus was on well-defined, implementable projects with a careful consideration of benefits (risk reduction, losses avoided), costs, and possible funding sources (including mitigation grant programs).

6.5.2 Identification and Analysis of Mitigation Techniques

Concerted efforts were made to ensure that participating jurisdictions develop updated mitigation strategies that cover the range of mitigation action types described in recent FEMA planning guidance (*FEMA's Local Mitigation Planning Handbook* [May 2023]), specifically:

- **Local Plans and Regulations**—These actions include government authorities, policies or codes that influence the way land and buildings are being developed and built.
- **Structure and Infrastructure Projects**—These actions 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 critical facilities and infrastructure.
- **Natural Systems Protection and Nature-Based Solutions**—These actions can include green infrastructure and low impact development, nature-based solutions, Engineering with Nature (an initiative of the U.S. Army Corps of Engineers), and bioengineering to incorporate natural features or processes into the built environment.
- **Education and Awareness Programs**—These actions keep residents informed about potential natural disasters. Many are eligible for funding through the FEMA Hazard Mitigation Assistance (HMA) program (FEMA 2023).

6.5.3 2024 HMP Mitigation Action Plan

Problem Statements

To support development of the mitigation strategy, each participating jurisdiction's annex provides a summary of hazard vulnerabilities identified during the plan update process by local representatives, the updated risk assessment, or review of county and local plans and reports.

In December 2023, the Planning Partnership participated in a mitigation strategy development workshop, supplemented by emails and phone calls between jurisdictions and the contract consultant. The workshop helped participating jurisdictions to develop focused problem statements based on the impacts of natural hazards in their communities. Each problem statement provides a detailed description of a problem area, problem impacts, past damage, loss of service, etc. Where possible, the problem statements list the street address of affected properties, adjacent streets, water bodies, well-known nearby structures, and existing conditions of the site (topography, terrain, hydrology). These problem statements form a bridge between the hazard risk assessment, which quantifies impacts on each community, and the development of actionable mitigation strategies.

As discussed in the hazard profiles in Section 4.3, the long-term effects of climate change are expected to exacerbate the impacts of weather-related hazards, including flood, severe summer weather, severe winter

weather, and tornado. Participating jurisdictions are working to evaluate the long-term implications of these climate change-sensitive hazards and to incorporate appropriate planning and capital improvement updates in their local mitigation strategies and integration actions.

Solutions

The local mitigation strategies focus on clearly defined, readily implementable actions that meet the definition of mitigation. Broadly defined solutions were eliminated unless accompanied by concrete actions, projects, or initiatives. Some continuous or ongoing activities that represent programs that are fully integrated into the normal operational and administrative framework of the community have been removed from the updated mitigation strategy and included in the capabilities section of each annex.

Each plan participant considered a comprehensive range of mitigation actions to reduce the effects of hazards. Some of these are previous actions carried forward for this plan update. These actions are dependent upon available funding (grants and local match availability) and may be modified or omitted based on the occurrence of new hazard events and changes in municipal priorities.

Throughout the course of the plan update process, 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 county and regional agencies
- Input received through the public and stakeholder outreach process

To assist with the development of mitigation actions, municipalities were provided with the following:

- 2024 HMP goals and objectives
- 2018 HMP mitigation strategies
- Risk assessment results
- Outcome of the problem and solutions exercise
- Mitigation catalog
- Stakeholder and public input (e.g., citizen and stakeholder survey results)
- FEMA resources

6.5.4 Mitigation Best Practices

Catalogs of hazard mitigation best practices were developed that present a broad range of alternatives to be considered for use in Rockland County, in compliance with 44 CFR 201.6(c)(3)(ii). One catalog was developed for each natural hazard of concern evaluated in this plan. The catalogs, included in Appendix F (Mitigation Strategy Supplementary Data), 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 exposure to the hazard
 - Reduce vulnerability to 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 action plan 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.

6.5.5 Mitigation Strategy Evaluation and Prioritization

Actions could be prioritized by ranking them as high, medium or low importance. The plan must clearly define each of these terms. Actions may also be prioritized by start date or other methods. Prioritization may change over time as community characteristics, risks and available resources shift. The evaluation and prioritization process helps the Planning Partnership weigh the advantages and disadvantages of different actions (FEMA 2023). Each mitigation strategy was prioritized using the following criteria:

- 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?
- Property Protection—How significant will the action be at eliminating or reducing damage to structures and infrastructure? Does it help to manage development in the floodplain or other high-risk areas?
- Cost-Effectiveness—Are the costs to implement the project or initiative commensurate with the benefits achieved?
- 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?
- Legal—Does the jurisdiction have the authority to implement the action?
- Fiscal—Can the action be funded under existing program budgets (i.e., is it currently budgeted for)? Or would it require a new budget authorization or funding from another source such as grants?
- Environmental—What are the potential environmental impacts of the action? Will it comply with environmental regulations? Are there co-benefits of this action?
- Social Vulnerability—Does the action benefit socially vulnerable populations and underserved communities? Additional considerations can include the SVI index and other appropriate measures of social vulnerability.
- Administrative—Does the jurisdiction have the personnel and administrative capabilities to implement the action and maintain it or will outside help be necessary?
- Hazards of Concern—Does the action address one or more of the jurisdiction's high-ranked hazards?
- Climate Change—Does the action address the effects of climate change on future hazard occurrence and impacts?

- **Timeline**—Can the action be completed in less than 5 years (within the planning horizon of the HMP)?
- **Community Lifelines**—Does this project benefit community lifelines?
- **Other 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?

For each mitigation action, the jurisdictions were asked to assign one of the following numeric scores for each evaluation criterion:

- 1 = Highly effective or feasible
- 0 = Neutral
- -1 = Ineffective or not feasible

Jurisdictions were asked to provide a summary of the rationale behind the numeric rankings assigned, as applicable. The numerical results were totaled to assist each jurisdiction in selecting mitigation actions for the updated plan.

As the initial step in the prioritization process, actions that had a numerical value between 0 and 4 were prioritized as low; actions with numerical values between 5 and 9 were categorized as medium; and actions with numerical values between 10 and 14 were categorized as high. These attributes are included in the mitigation strategy table and for FEMA-eligible projects in the mitigation worksheets in Volume II.

For the plan update, there has been an effort to develop more clearly defined and action-oriented mitigation strategies. These local strategies include actions that are seen by the community as the most effective approaches to advance their local mitigation goals and objectives within their capabilities. In addition, each jurisdiction was asked to develop problem statements. With this process, participating jurisdictions were able to develop action-oriented and achievable mitigation strategies.

6.5.6 Benefit-Cost Review

Under Section 201.6.c.3iii of 44 CFR, cost-effectiveness is one of the criteria that must be applied during the evaluation and prioritization of actions included in the mitigation strategy. A qualitative benefit-cost review was used in the prioritization of actions for this this plan update. For all actions identified in the local strategies, jurisdictions have identified the associated costs and benefits:

- **Costs** include the total estimated project cost. 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 damage, loss of service or function, and economic and environmental damage and losses.

Where quantitative estimates of costs and/or benefits were not available, qualitative ratings were assigned using the definitions shown in Table 6-4. 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-beneficial and are prioritized accordingly.

Table 6-4 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.

For some of the mitigation actions identified in this HMP, the Planning Partnership may seek financial assistance under FEMA’s HMGP or HMA programs. The qualitative benefit/cost review does not include the level of detail required by FEMA for project grant eligibility under HMA grant programs. When funding applications for these projects are prepared, detailed analyses will be performed using the FEMA BCA model process. 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 HMP. The Planning Partnership is committed to implementing mitigation strategies with benefits that exceed costs.

SECTION 7. PLAN MAINTENANCE PROCEDURES

This section details the formal process of maintaining the Rockland County Hazard Mitigation Plan (HMP) as its recommendations begin to be implemented over the next five years (a timeframe referred to as the plan’s “performance period”). Plan maintenance includes monitoring and evaluating the plan annually and producing an updated plan every five years. The identified maintenance procedures will ensure that the HMP remains an active and relevant document and that the planning partners maintain their eligibility for applicable funding sources.

Included in the maintenance procedures are measures for supporting ongoing public participation throughout the plan’s implementation and maintenance. Maintenance also includes guidance for integrating the HMP’s mitigation strategies into existing local planning mechanisms and programs, such as comprehensive land use planning processes, capital improvement planning, and building code enforcement.

An HMP Coordinator representing Rockland County will manage the maintenance of the plan during its performance period. The currently designated coordinator is:

Christopher F. Jensen, Program Coordinator
Rockland County Office of Fire and Emergency Services
(845) 364-8902 | JensenC@co.rockland.ny.us

The HMP Coordinator will convene the Planning Partnership, be the prime point of contact for questions regarding the plan and its implementation and coordinate the incorporation of additional information into the plan.

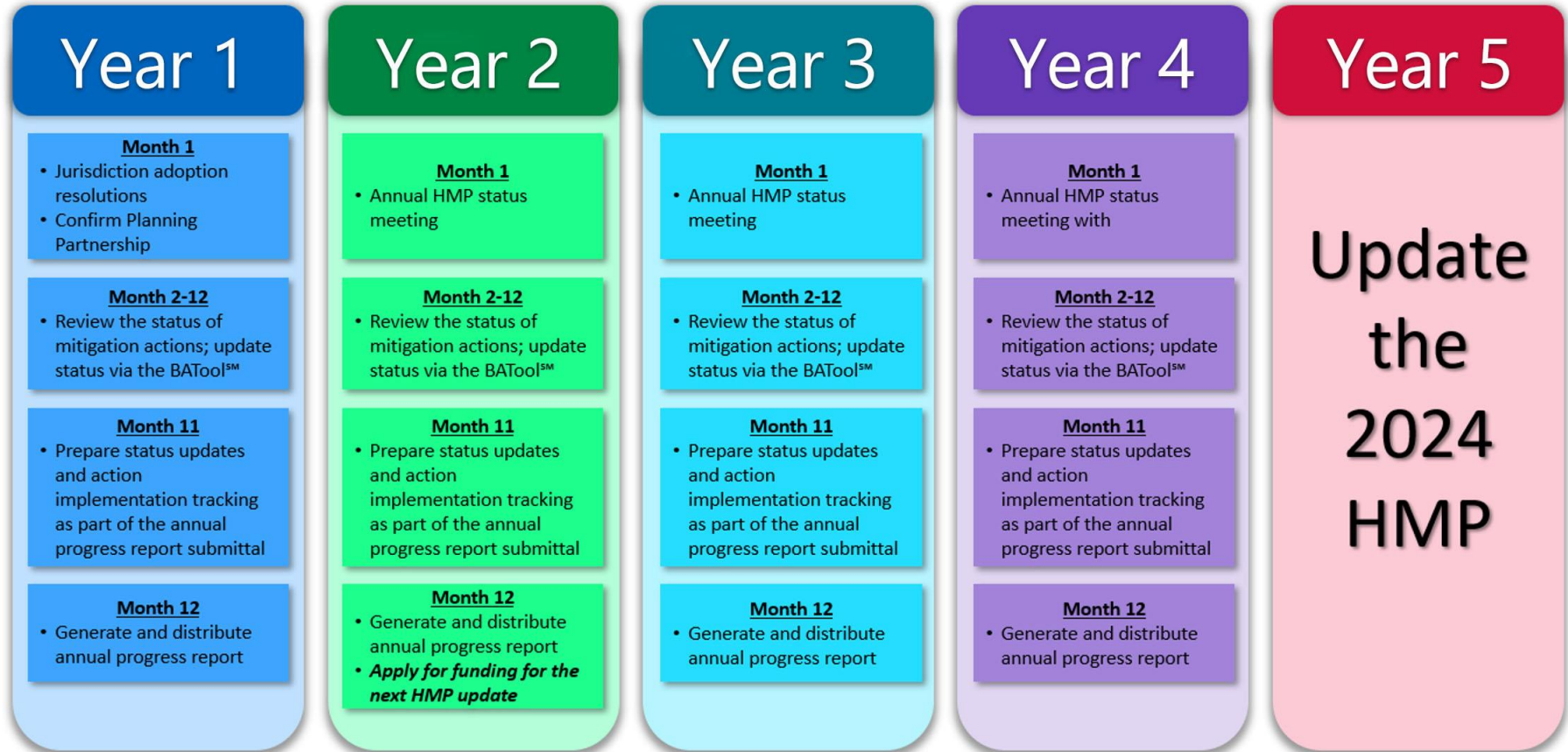
The Planning Partnership, consisting of a representative from each participating jurisdiction, will fulfill the monitoring, evaluation, and updating responsibilities identified in this section. Each jurisdiction is expected to maintain a representative on the Planning Partnership throughout the plan performance period. Primary and secondary mitigation planning representatives (points-of-contact) as of the date of this plan are identified in each jurisdictional annex in Volume II. As individual commitments change over time, it will be the responsibility of each jurisdiction to inform the HMP Coordinator of any changes in representation on the Planning Partnership. The HMP Coordinator will strive to keep the Planning Partnership makeup as a uniform representation of the participating jurisdictions and stakeholders across Rockland County.

Table 7-1 summarizes the maintenance approach and responsibilities. A timeline of activities over the performance period is presented in Figure 7-1.

Table 7-1. Plan Maintenance Matrix

Task	Approach	Frequency	Lead Responsibility	Support Responsibility
Monitor	Track and report progress on project implementation, integration, recommendations for updating mitigation strategies, identification of new projects, and current information on funding opportunities.	Annually or after the occurrence of a presidentially declared disaster	Jurisdictional points of contact identified in Volume II	Jurisdictional implementation leads identified in Volume II
Evaluate	Review the status of action implementation, as submitted by the monitoring task lead, and assess the effectiveness of the plan; compile and finalize an update of the mitigation strategy.	Annually	Jurisdictional points of contact identified in Volume II	Alternate jurisdictional points of contact identified in Volume II
Update	Reconvene the planning partners to guide a comprehensive update to review and revise the plan.	Every five years or upon major update to the Comprehensive Plan or after the occurrence of a major disaster	HMP Coordinator	Jurisdictional points of contact identified in Volume II
Integrate	Distribute the safe growth worksheet (see Section 7.1.2) for annual review and update by all participating jurisdictions.	Annually with interim email reminders to address integration in county and municipal activities	HMP Coordinator and jurisdictional points of contact identified in Volume II	—
Involve the Public	Use the internet and social media to distribute information about the HMP, make Planning Partnership meetings open to the public, accept and track public comments on the HMP and its progress and incorporate them as appropriate	Continuously through the performance period	HMP Coordinator	Jurisdictional points of contact identified in Volume II

Figure 7-1. Plan Maintenance Timeline Over Five-Year Performance Period



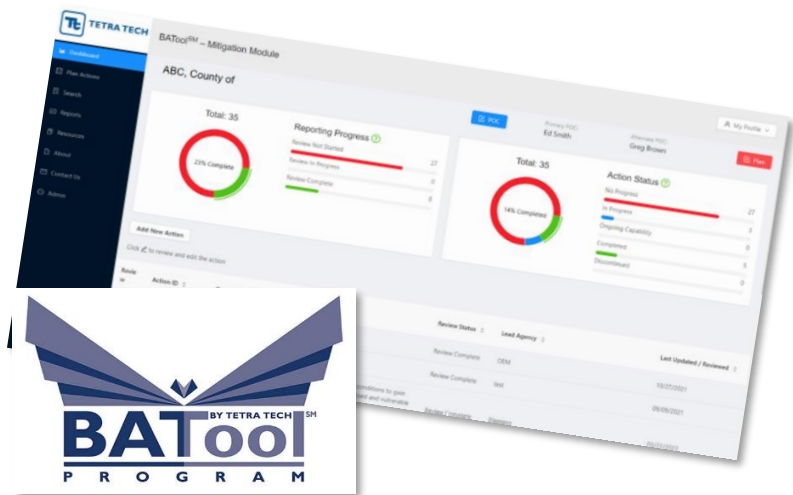
7.1 MONITOR

The Planning Partnership will be responsible for monitoring and documenting progress on implementation of the HMP. The information that Planning Partnership representatives will be expected to document, as needed and appropriate, includes the following:

- Progress on the implementation of mitigation actions, including obstacles to the implementation of actions
- Additional mitigation actions believed to be appropriate and feasible
- Progress on efforts to integrate hazard mitigation principles into a range of local planning processes
- Efforts to obtain outside funding, including any grant applications filed
- Hazard events and losses
- Public and stakeholder input

7.1.1 Implementation of Mitigation Actions

Each year, beginning one year after plan development, Rockland County and local Planning Partnership representatives will collect and process information from the departments, agencies, and organizations involved in implementing mitigation actions identified in their jurisdictional annexes (Volume II of this plan). In the first year of the performance period, this will be accomplished by utilizing an online performance progress reporting system (the BAToolSM) that will enable municipal and county representatives to directly



access and update the status of each project, document successes or obstacles to implementation, and add or delete projects. Planning partners will be prompted by the tool to update progress quarterly, providing an incentive for them to refresh their mitigation strategies and continue the implementation of projects. By facilitating the sorting and prioritization of projects, this reporting system can support the submittal of an increased number of project grant fund applications.

Plan monitoring for years two through four of the plan performance period will be addressed via the BAToolSM or manually.

7.1.2 HMP Integration into Municipal Planning Programs

Each participating jurisdiction will be asked to document how it is incorporating the Rockland County HMP 2024 update into its day-to-day operations and planning and regulatory processes. The annual HMP progress report (see Section 7.2) will identify additional policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions. The checklist presented in Table 7-2, adapted from FEMA's 2023 Local Mitigation Handbook, will help communities analyze how hazard mitigation is integrated into local plans, ordinances, regulations, and policies.

Table 7-2. Jurisdictional Capabilities and Integrating the Hazard Mitigation Plan

Planning Mechanisms	Does the jurisdiction do this?		Describe how this is being done or how it can be done.
	Yes	No	
Comprehensive Plan			
Does the future land-use map identify natural hazard areas?			
Do the land use policies discourage development or redevelopment within natural hazard areas?			
Does the plan leave enough space for expected future growth in areas outside natural hazard areas?			
Transportation Plan			
Does the transportation plan limit access to hazardous areas?			
Is transportation policy used to guide growth to safe locations?			
Are movement systems designed to function under disaster conditions (e.g., evacuation)?			
Does the transportation plan promote compact, mixed-use development near transit hubs and away from high-hazard areas?			
Zoning Ordinance			
Does the zoning ordinance conform to the comprehensive plan in terms of discouraging development or redevelopment within natural hazard areas?			
Does the ordinance contain natural hazard overlay zones that set conditions for land use within such zones?			
Does the ordinance prohibit development within, or filling of, wetlands, floodways, and floodplains?			
Is a zoning code in place to encourage resilient development through density bonuses for projects outside of natural hazard areas?			
Do rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use?			
If applicable, is there a wildland-urban interface development code in place to prohibit or limit development in high wildfire-risk areas?			
Overlay Districts			
Is a Conservation Overlay Zoning District in place to help protect environmentally sensitive areas?			
Is a Coastal Flood Resilience Overlay District in place to encourage development away from coastlines and floodplains?			
Are there Climate Hazard Overlay Zones in place to identify natural hazard risk areas and assign appropriate zoning ordinances to mitigate or adapt to those hazards?			
Subdivision Regulations			
Do the subdivision regulations restrict the subdivision of land within or next to natural hazard areas?			
Do the regulations provide for conservation subdivisions or cluster subdivisions to conserve environmental resources?			
Do the regulations allow density transfers where hazard areas exist?			
Stormwater Master Plan			

Planning Mechanisms	Does the jurisdiction do this?		Describe how this is being done or how it can be done.
	Yes	No	
Does the stormwater master plan promote the use of porous building materials through incentive programs?			
Does the stormwater master plan include green stormwater infrastructure in impaired watersheds?			
Does the stormwater master plan include stormwater management best practices in areas that flooding affects the most?			
Does the placement of stormwater management projects prioritize socially vulnerable communities?			
Resilience Plan			
Does the plan identify sea level rise inundation zones, high wildfire risk areas, storm surge inundation zones, or other areas at high risk of natural disaster impacts?			
Does the plan develop actions to recover from natural hazard events? Do those actions align with those the local hazard mitigation plan identifies?			
Does the plan identify areas in which socially vulnerable populations and underserved communities have a high risk of exposure to natural hazards? If so, do the actions identified to address that risk align with those in the local hazard mitigation plan?			
Local Environmental Plan			
Does the plan identify and map environmental systems that protect development from hazards?			
Do environmental policies maintain and restore protective ecosystems?			
Do environmental policies encourage development outside of protective ecosystems?			
Public Health and Safety Plan			
Do the goals and policies of the comprehensive plan relate to those of the local hazard mitigation plan?			
Do the plan’s growth and development policies address safety?			
Does the monitoring and implementation section of the plan cover safe growth objectives?			
Parks and Recreation Plan			
Does the plan prioritize open green spaces? Are such spaces planned in areas with high impervious surface coverage?			
Does the plan keep in mind the need for tree cover to mitigate the urban heat island effect? Are tree cover expansion projects planned in high-heat areas?			
Capital Improvements Plan			
Does the capital improvement program limit spending on projects encouraging development in areas vulnerable to natural hazards?			
Do infrastructure policies limit the extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards?			
Does the capital improvement program provide funding for hazard mitigation projects identified in the FEMA Mitigation Plan?			
Climate Action Plan			

Planning Mechanisms	Does the jurisdiction do this?		Describe how this is being done or how it can be done.
	Yes	No	
Does the plan have specific and measurable targets for carbon emissions reduction?			
Does the plan include realistic and actionable strategies for reducing carbon emissions?			
Building Codes			
Does the building code have provisions to strengthen or elevate construction to withstand hazard forces?			
Are there building codes in place that meet or exceed those outlined in the National Flood Insurance Program’s guidelines for safe building practices?			
Do existing building codes include development standards for withstanding storm surge, wind damage, earthquakes, or other relevant natural hazards?			
Economic Development Plan			
Do economic development or redevelopment strategies include provisions for mitigating natural hazards?			
Emergency Action Plan			
Is there an adopted evacuation and shelter plan to deal with emergencies from natural hazards?			
Are evacuation routes outside floodplains, sea level rise inundation zones, or liquefaction zones?			
Are there emergency communication systems in place? Are those systems deployed in areas with the highest potential hazard exposure?			
Integrated Watershed Management Plan			
Does the plan include policies that restrict development that would increase downstream flooding?			
Does the plan include policies that restrict development that would increase sedimentation or erosion?			

Adapted from: FEMA 2023

Completing the checklist will help to identify areas that integrate hazard mitigation currently and where to make improvements to reduce vulnerability to future development. This will help make the integration of mitigation into jurisdictional activities an ongoing culture across the County.

7.1.3 Grant Coordination and Application

Rockland County intends to be a resource to the Planning Partnership by supporting grant writing and project development. The degree of this support will depend on the level of assistance requested by the partnership during openings for grant applications. As part of grant monitoring and coordination, Rockland County intends to provide the following assistance:

- 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 selecting appropriate projects

Grant monitoring and coordination will be integrated into the annual progress report (see Section 7.2) or as needed based on the availability of non-HMA or post-disaster funding opportunities.

7.2 EVALUATE

The 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 will be evaluated on an annual basis to determine the effectiveness of the programs and to reflect changes that could affect mitigation priorities or available funding.

The status of the HMP will be discussed and documented at an annual Planning Partnership plan review meeting to be held either in person or via teleconference approximately one year from the date of local adoption of this update, and successively thereafter. At least two weeks before the annual plan review meeting, the HMP Coordinator will advise Planning Partnership members of the meeting date, agenda, and expectations of the members.

The HMP Coordinator will be responsible for calling participants, coordinating the annual plan review meeting, and soliciting input regarding progress toward plan goals and objectives. The meetings will assess the following:

- Do goals and objectives address current and expected conditions?
- Has the nature or magnitude of the risks changed?
- Are current resources appropriate for implementing the HMP, or are different or additional resources now available?
- Have actions been cost-effective?
- Are schedules and budgets feasible?
- Have there been problems with implementation, such as technical, political, legal, or coordination issues with other agencies?
- Have outcomes occurred as expected?
- Have changes in county, city, town, or village resources impacted plan implementation (e.g., funding, personnel, and equipment)?
- Are new agencies/departments/staff included, involving other local governments as defined under 44 Code of Federal Regulations (CFR) 201.6.

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

The Planning Partnership will evaluate whether other programs and policies have conflicted with or augmented planned or implemented measures 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 the following topics:

- Economic development
- Environmental preservation
- Historic preservation
- Redevelopment
- Health and/or safety
- Recreation
- Land use/zoning
- Public education and outreach
- Transportation

The Planning Partnership should refer to the evaluation forms in FEMA's *Local Mitigation Planning Handbook* (Worksheets #9 and #10; May 2023) to assist in the evaluation process (see Appendix F – Plan Maintenance Tools). 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 established for prior or existing local HMPs within the County.

The HMP Coordinator will be responsible for preparing an annual HMP progress report for each year of the performance period, based on the information provided by the Planning Partnership and municipal points of contact and other information as appropriate and relevant. 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 projects are completed, which are no longer feasible, and which projects should require additional funding.

Following any major disasters, the HMP will be evaluated 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 Section 4.3 (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.

7.3 UPDATE

Federal regulations (44 CFR 201.6.d.3) require that local hazard mitigation plans be reviewed, revised as appropriate, and resubmitted for approval to remain eligible for certain federal benefits. The Planning Partnership intends to update this plan on a five-year cycle from the date of initial plan adoption. The plan's format allows sections to be reviewed and updated with newly available data to keep the plan current and relevant.

To facilitate the update process, the HMP Coordinator, with the 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. Before the five-year update, the HMP Coordinator will invite representatives from the New York State Division of Homeland Security and Emergency Services (NYS DHSES) to guide 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 five-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.

7.4 INTEGRATE HAZARD MITIGATION INTO EXISTING PROGRAMS

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. This HMP must integrate with and complement existing County plans and programs that support hazard risk management.

The Capability Assessment in Section 5 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 Rockland County. In the jurisdictional annexes in Volume II, the County and each participating jurisdiction identified how they have integrated hazard risk management into their existing planning, regulatory, and operational/administrative framework (“existing integration”) and how they intend to promote this integration (“opportunities for future integration”).

Planning Partnership representatives intend to incorporate mitigation planning as an integral component of daily government operations. They will work with local government officials to integrate the hazard mitigation goals and actions into the general operations of government and partner organizations. By doing so, the Planning Partnership seeks to realize the following objectives:

- 1) Formally recognize hazard mitigation planning as an integral part of overall emergency management efforts.
- 2) Make the HMP, comprehensive plan, emergency management plan, and other relevant planning mechanisms 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/improved public participation
- Educational programs
- Continued interagency coordination

Some action items do not need to be implemented through regulation. Instead, they can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation.

During the annual plan evaluation process, the Planning Partnership representatives 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, as described in Section 7.1.2.

7.5 SUPPORT CONTINUED PUBLIC INVOLVEMENT

Rockland County and participating jurisdictions 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: <https://www.rocklandhmp.com/>. In addition, public outreach and dissemination of the HMP will include the following activities:

- Links to the plan on municipal websites of each jurisdiction with capability.
- Continued utilization of existing social media outlets (Facebook, X [formerly known as Twitter], 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 maintain this website, posting new information and maintaining an active link to collect public comments.

The public can also provide input at the annual review meeting for the HMP and during the next five-year plan update. 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 five-year plan update as appropriate. Additional meetings might be held as deemed necessary by the Planning Partnership to provide the public an opportunity to express concerns, opinions, and ideas about the mitigation plan.

The HMP Coordinator and Planning Partnership representatives will be responsible for ensuring the following:

- Public and stakeholder comments and input on the plan, and hazard mitigation in general, are collected, recorded, and addressed as appropriate.
- The Rockland 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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