2024 | Hazard Mitigation Plan
Broome County, New York

Volume I: Core Plan

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TETRA TECH

6 Century Drive, Suite 300
Parsippany, NJ 07054

EXECUTIVE SUMMARY

HAZARD MITIGATION OVERVIEW

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

Broome County has developed a hazard mitigation plan (HMP) to reduce risks from disasters to the people, property, economy, and environment within the County's planning area. The County and 23 participating local jurisdictions (the Planning Partners) prepared this plan as an update to the 2019 Broome County HMP. The updated 2024 HMP (also referred to as "the plan") includes a countywide analysis and assessment of hazards, risks, and capabilities.

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

THE PLANNING PROCESS

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

- Developed a Steering Committee consisting of key stakeholders and a countywide Planning Partnership made up of the Steering Committee members, the Planning Partners, and other regional stakeholders.
- Involved a wide range of stakeholders and the public in the plan update process.
- Reviewed the 2019 Broome County Hazard Mitigation Plan.
- Identified hazards of concern to the County to be included in the update.
- Profiled the hazards of concern.
- Estimated the inventory at risk and potential losses associated with these hazards.
- Reviewed and updated the mitigation goals and objectives.
- Reviewed mitigation strategy and actions outlined in the 2019 HMP to denote progress.
- Developed new mitigation actions to reduce the vulnerability of assets from hazards of concern.

- Developed mitigation plan maintenance procedures to be executed after obtaining approval of the plan from NYS DHSES and FEMA.

Involvement by Stakeholders and the Public

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

Participating Jurisdictions Involved in the Mitigation Planning Effort

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

- County of Broome
- Town of Barker
- City of Binghamton
- Town of Binghamton
- Town of Chenango
- Town of Colesville
- Town of Conklin
- Village of Deposit
- Town of Dickinson
- Village of Endicott
- Town of Fenton
- Village of Johnson City
- Town of Kirkwood
- Village of Lisle
- Town of Maine
- Town of Nanticoke
- Village of Port Dickinson
- Town of Sanford
- Town of Triangle
- Town of Union
- Town of Vesta
- Village of Whitney Point
- Town of Windsor
- Village of Windsor

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

Multiple Agency Support for Hazard Mitigation

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

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

Additional input and support for this planning effort were obtained from a wide range of agencies as well as through public involvement. Under the project management of the Broome County Department of Planning and Economic Development, the Broome County Hazard Mitigation Steering Committee provided oversight for the preparation of this plan. The Steering Committee includes representatives from the following:

- Broome County Department of Planning and Economic Development
- Broome County Department of Public Works
- Broome County Health Department
- Broome County Office of Emergency Services
- Broome County Soil and Water Conservation District
- City of Binghamton Engineering
- City of Binghamton Planning Department
- Binghamton University
- Town of Dickinson
- Town of Fenton
- Town of Union Planning
- Town of Vestal
- Village of Johnson City
- Village of Port Dickinson
- NYS DHSES

RISK ASSESSMENT FOR LOCAL HAZARDS OF CONCERN

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

Table ES-1. Broome County Hazards Rankings

Hazard of Concern	Hazard Ranking
Dam and Levee Failure	High
Disease Outbreak	Medium
Drought	Medium
Earthquake	Low
Extreme Temperature	High
Flood	High
Invasive Species	Medium
Severe Storm	High
Severe Winter Storm	High
Wildfire	Medium

CAPABILITY ASSESSMENT AND PLAN INTEGRATION INTO OTHER LOCAL MECHANISMS

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

The HMP includes a capability assessment that reviews relevant local mechanisms for each participating jurisdiction. This assessment identifies where each jurisdiction is currently able to implement hazard mitigation measures and where each would benefit from improved capabilities. The capability assessment summarizes existing plans, programs, and regulatory mechanisms at all levels of government (i.e., federal, state, county, and local) that support hazard mitigation in the County.

In the jurisdictional annexes, each participating jurisdiction identifies how it has integrated hazard risk management into its existing planning, regulatory, and operational/administrative framework, and how it intends to continue to promote this integration.

HAZARD MITIGATION PLAN GOALS AND OBJECTIVES

It is a federal requirement for hazard mitigation plans to include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards of concern. The Broome County HMP planning process included a review and update of mitigation goals and objectives that were established during the 2019 plan process to guide the selection of mitigation actions addressing all hazards of concern. Mitigation goals were updated based on the updated risk assessment, discussions, research, and input from plan participants and stakeholders. The goal development process considered the goals expressed in the New York State Hazard Mitigation Plan, as well as other relevant county and local planning documents. The final goals adopted for the HMP are as follows:

1. Protect life, property, and the economy from natural hazards through planning, preparing, and mitigating.
2. Increase public awareness and enhance current outreach programs to provide resources to stakeholders, local government officials, businesses, and the general public on the different risks, resilience strategies, and safety measures associated with natural hazards.
3. Encourage, expand, and strengthen partnerships between government agencies, private sector businesses, and non-profit organizations to develop public outreach strategies and provide resources and involvement before, during, and after disasters, and to create a more resilient Broome County.

4. Enhance emergency service planning to include natural hazard event planning impacts on populations and property.
5. Improve the resilience of critical facilities, community lifelines, and other buildings located within hazard-vulnerable areas to reduce impacts of natural hazard events and climate change-influenced hazards in Broome County.
6. Ensure consistency between goals, objectives, and mitigation strategies from the Broome County Hazard Mitigation Plan with existing and future land-use planning documents, existing regulatory programs, zoning code updates, and flood damage prevention ordinances, as well as state and federal hazard mitigation strategies.

IMPLEMENTATION OF THE 2019 PLAN

The status of the mitigation projects identified in the 2019 HMP was reviewed for this plan update. Numerous projects and programs have been implemented that have reduced hazard vulnerability to assets in the planning area. Uncompleted projects have been revaluated, modified as necessary, and incorporated into this plan. The Planning Partners' annexes, including the County annex, describe these mitigation activities in more detail, and plan maintenance procedures have been developed to encourage thorough integration with local decisions and processes and regular review of implementation progress.

2024 MITIGATION STRATEGY

Include some sort of summary of recommended actions. Maybe the total number of recommendations by priority, hazard addressed, or mitigation. At the very least, identify how many total actions were developed by all participants.

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SECTION 1. INTRODUCTION

1.1 PURPOSE

Broome County and its participating jurisdictions (the Planning Partnership) have prepared this hazard mitigation plan (HMP) to better protect residents and property throughout Broome 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 2019. 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.

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

For the Broome County HMP, references to local governments generally refer to government agencies below the county level—specifically, townships and municipalities (municipalities include cities and villages).

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 2019 Broome County HMP. During the 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 Broome County.

1.3 PLAN ORGANIZATION

The Broome 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 (NYSDHSES).

Volume I provides information on the overall planning process, hazard profiling, and vulnerability assessments. Its contents provide a basis for understanding risk and identifying mitigation actions and are intended for use as a resource for ongoing mitigation analysis.

Volume II provides an annex for each participating jurisdiction. Each annex summarizes the jurisdiction's legal, regulatory, and fiscal capabilities; identifies vulnerabilities to hazards; documents mitigation plan integration with other planning efforts; records the status of past mitigation actions; and presents an individualized mitigation strategy. The annexes provide a resource for each jurisdiction to implement mitigation projects and pursue grant opportunities, as well as a place for each jurisdiction to record and maintain its local aspect of the multi-jurisdictional plan.

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. Broome 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 Number	Section Name	Contents
Section 4	Risk Assessment	Documentation of the hazard identification and hazard risk ranking process, hazard profiles, and findings of the vulnerability assessment (estimates of the impact of hazard events on life, safety, health, general building stock, critical facilities, and the economy); 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	Information regarding the mitigation goals and objectives in addressing priority hazards of concern and the process by which Planning Partnership mitigation strategies have been developed or updated.
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 Broome County and municipalities containing their 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 Broome 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.
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	Examples of 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 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 2019 HMP have been enhanced and updated for this 2024 HMP. An increased effort to actively engage stakeholders and the public was a focus of the update, 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 2019 process and HMP:

- There was a strong desire on the part of Broome 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 StoryMap:
  - https://www.gobroomecounty.com/planning/hazardmitigation
  - https://storymaps.arcgis.com/stories/6f5336592a674f548ff0bd2c360e849d
- Section 3 (County Profile) has been streamlined and updated:
  - Provides specific and detailed information about Broome 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 eight categories.
- Section 4 (Risk Assessment) includes identification of hazards of concern that impact Broome 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 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).
- 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 2019 previous mitigation strategy status table to more clearly identify 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 across 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 webpage focusing on the HMP, which 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 Broome County.
- 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.
  - Actions are identified, rather than 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 their mitigation actions.
- The plan maintenance strategy is more clearly defined to provide a roadmap for the annual monitoring of the HMP.

Table 1-2 indicates the major changes incorporated into the 2024 HMP update compared to the 2019 HMP update as they relate to 44 CFR planning requirements.

Table 1-2. Broome County HMP Changes Crosswalk

44 CFR Requirement	2019 Plan	2024 Updated Plan
Requirement §201.6(b): In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: • 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.	The 2019 plan followed an outreach strategy utilizing multiple media developed and approved by the Steering Committee. This strategy involved the following: • 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.	Building upon the success of the 2019 plan, the 2024 planning effort deployed the same public engagement methodology. The plan included the following enhancements: • Using social media. • Web-deployed survey. • Informational brochure. • Public website specific to the HMP planning process. • As with the 2019 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.
§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.	The 2019 plan included a comprehensive risk assessment of hazards of concern. Risk was defined as (probability x 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.	The same methodology, using new, updated data, was deployed for the 2024 plan update.
§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.	The 2019 plan presented a risk assessment of each hazard of concern. Each section included the following: • 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.	The same format, using new and updated data, was used for the 2024 plan update. Each section of the risk assessment includes the following: • 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, and the economy, as well as future changes that could impact vulnerability. • The vulnerability assessment also includes changes in vulnerability since the 2019 plan. • Identified issues have been documented in each hazard profile.

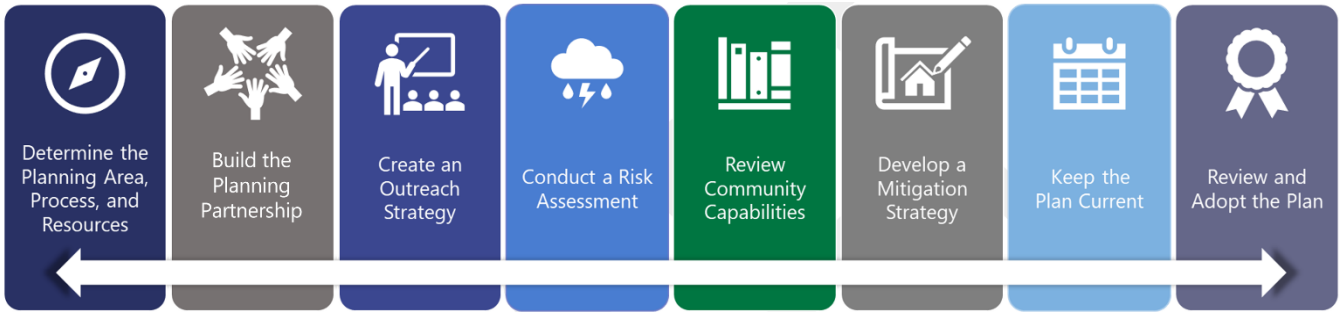
44 CFR Requirement	2019 Plan	2024 Updated Plan
§201.6(c)(2)(ii): [The risk assessment] shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i). This description shall include an overall summary of each hazard and its impact on the community.	Vulnerability 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 were 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.	The same methodology was deployed for the 2024 plan update, using new and updated data. Additional hazards of concern include the following: • Disease Outbreak • Harmful Algal Bloom
§201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program insured structures that have been repetitively damaged floods.	A summary of NFIP-insured properties including an analysis of repetitive loss property locations was included in the plan.	The same methodology was deployed for the 2024 plan update using new and updated data.
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.	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.	The same methodology was deployed for the 2024 plan update using new and updated data and enhanced with the identification of lifeline facilities.
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.	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.	The same methodology was deployed for the 2024 plan update using new and updated data.
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.	There is a summary of anticipated development in the County profile, as well as in each individual annex.	The same methodology was deployed for the 2024 plan update using new and updated data.
§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.]	Each planning partner identified actions that could be implemented within its capabilities. The actions were jurisdiction-specific and strove to meet multiple objectives. All objectives met multiple goals and stand alone as components of the plan. Each planning partner completed an assessment of its planning, regulatory, technical, and financial capabilities.	Each planning partner used the progress reporting from the plan maintenance and evaluated the status of actions identified in the 2019 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.
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.	The 2019 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.	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 five goals and 34 objectives to frame the plan.

44 CFR Requirement	2019 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 2019 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 2019 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 2019 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 2019 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: • 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 2019 plan details a strategy for continuing public involvement.	The 2019 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 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

This section describes the planning process used to update the Broome County HMP—how it was prepared, who was involved in the process, and how the public was involved. The mitigation planning process consisted of the steps shown in Figure 2-1.

Figure 2-1. Broome County HMP Process



2.1 DETERMINE THE PLANNING AREA, PROCESS, AND RESOURCES

2.1.1 Defining the Planning Area

At the onset of the planning process, it was established that Broome County, along with all relevant jurisdictional boundaries within the County, constitute the designated planning area.

2.1.2 Planning Process Overview

The planning process was part of ongoing hazard risk management in Broome County by State, County, and local agencies and individuals. A summary of past and ongoing mitigation efforts provided in Section 6 (Mitigation Strategy) and Volume 2 (Jurisdictional Annexes) gives a historical perspective of the County's activities implemented to reduce vulnerability to hazards.

To ensure that the updated plan meets federal hazard mitigation planning requirements and that the planning process had the broad support of participating jurisdictions, regional and local stakeholders, and the public, the approach to the planning process and plan documentation included the following:

1. The 2024 Broome County HMP is multi-jurisdictional and assesses natural hazards facing the County to satisfy federal hazard mitigation planning requirements.
2. Broome County invited all municipalities in the County to join in the update of the HMP. The County and 23 municipalities are participating in the HMP. The Town of Lisle chose not to participate; however, if it chooses to participate at a later time, it can coordinate with Broome County's Department of Planning and Economic Development and follow the linkage procedures detailed in the appendices to become part of the plan.
3. The HMP was developed following the process outlined by FEMA guidance (April 2022) and NYSDHSES HMP guidance (2022). Following this process ensures that all the requirements are met and supports HMP review.

Many parties supported the preparation of this HMP update: County, township, and municipal officials, stakeholders, and a contract planning consultant. Core participants in the planning process included a contract consultant and a steering committee, as described below.

Contract Planning Consultant

Tetra Tech, Inc. (Tetra Tech) was selected as a contract planning consultant to guide Broome County through the HMP update process. A contract between Tetra Tech and Broome County was executed in April 2023. As a contract consultant, Tetra Tech was tasked with the following:

- Assistance with the organization of the Steering Committee and Planning Partnership
- Assistance with the development and implementation of a public and stakeholder outreach program
- Data collection
- Facilitation and attendance at meetings (Steering Committee, Planning Partnership, stakeholder, public and others)
- 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 strategy 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

Steering Committee

Broome County formed a Steering Committee to provide guidance and direction to the HMP update effort and to ensure that the resulting document will be embraced politically and by the constituency within the County. Steering Committee members were charged with the following:

- Providing guidance and overseeing the planning process on behalf of the Planning Partnership
- Attending and participating in Steering Committee meetings
- Establishing a timeline for completion of the plan
- Assisting with the following:
  - Reviewing and updating the hazards of concern
  - Developing a public and stakeholder outreach program
  - Ensuring that the data and information used in the plan update process is the best available
  - Reviewing and updating the hazard mitigation goals and objectives
  - Identifying and screening appropriate mitigation strategies and activities
  - Reviewing and commenting on plan documents prior to submission to NYSDHSES and FEMA
  - Ensuring that the plan meets federal and state requirements for hazard mitigation planning

The Steering Committee led the update of the Broome County HMP, working with the Planning Partnership and stakeholders throughout the process. The Steering Committee was made up of county departments and agencies, in addition to the following local municipalities and stakeholders:

- Broome County Soil and Water Conservation District
- Binghamton University
- City of Binghamton
- Town of Dickinson
- Town of Fenton
- Village of Johnson City
- Village of Port Dickinson
- Town of Union
- Town of Vestal
- New York Division of Homeland Security and Emergency Services (NY DHSES)

2.1.3 Collection of Information Resources

The Broome County HMP update used the best available technical information, plans, studies, and reports throughout the planning process 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.

Throughout the HMP update process, a concerted effort was made to gather information from local and regional agencies and staff, as well as stakeholders, federal and state agencies, and the residents of the planning area. The HMP Planning Partnership solicited information from local agencies and individuals with specific knowledge of certain hazards and past historical events.

The planning process also included a review of planning and zoning codes, ordinances, and other recent planning decisions. Plans, reports, and other technical information were identified and provided directly by the County, participating jurisdictions, and numerous stakeholders involved in the planning effort, as well as through independent research by the planning consultant. The County and participating jurisdictions were tasked with providing relevant planning and regulatory documents, as applicable. Relevant documents, including plans, reports, and ordinances were reviewed to identify the following:

- 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 in Section 6 (Mitigation Strategy).
- Proposed, in-progress, or potential mitigation projects, actions, and initiatives to be incorporated into the updated county and local mitigation strategies.

The asset and inventory data used for the risk and vulnerability assessments are presented in the County Profile (Section 3). Details of the source of this data, along with technical information on how the data was used to develop the risk and vulnerability assessment, are presented in the Hazard Profiling and Risk Assessment Section (Section 4), specifically within Section 4.3 (Data and Methodology), as well as throughout the hazard profiles in Section 4.4 (Hazard Profiles). Further sources of technical data and information can be found in the references section.

2.2 BUILD THE PLANNING PARTNERSHIP

In June 2023, the County notified all prospective municipalities of the pending planning process and invited them to formally participate. Jurisdictions were asked to notify the county of their intent to participate (via a Letter of Intent to Participate) and to identify planning points of contact (POCs) to facilitate municipal participation and represent the interests of their communities. Completed Letters of Intent to Participate are provided as Appendix B (Participation Matrix), as available. In the letters, each municipality acknowledged planning partner expectations, which established the responsibilities of participants and authorized the Steering Committee to represent the jurisdiction in the completion of certain planning elements.

2.2.1 Participating Jurisdictions

Table 2-1 lists the municipal members of the Planning Partnership at the time of this HMP's publication. Steering Committee members also are part of the overall Planning Partnership, fulfilling their responsibilities on behalf of Broome County.

Table 2-1. Broome County HMP Steering Committee and Planning Partnership

Organization	Name	Title	Steering Committee Member	Planning Partnership Member
Broome County Department of Planning and Economic Development	Stephanie Brewer	Senior Planner	X	X
	Beth Lucas	Director	X	X
	Gillian Sloan	Planner	X	X
	Aimee Dailey	Senior Planner	X	X
Broome County Department of Public Works	Roger Brown	Interim Director	X	X
	Martin Haley	Engineer	X	X
Broome County Health Department	Michael Bender	Public Health Program Coordinator	X	X
	Amy Fassold	Emergency Prep Fellow	X	X
Broome County Office of Emergency Services	Patrick Dewing	Director	X	X
	Cortni Brienza	EM Associate	X	X
	Katie Pierce	EM Associate	X	X
	Joyce Collier	Emergency Manager	X	X
	Kerby Sainclair	Public Safety Coordinator	X	X
Broome County Soil and Water Conservation District	Justin Puglisi	District Manager	X	X
Binghamton University	Dave Hubeny	Executive Director, OEM	X	X
Town of Barker	David Mackey	Highway Superintendent		X
	Jim Dedrick	Code Enforcement/Building Inspector		X
City of Binghamton	Franco Incitti	Engineer	X	X
	Ron Lake	Engineering Commissioner	X	X
	Juliet Berling	Planning Director	X	X
Town of Binghamton	Nick Pappas	Code Enforcement Officer		X
	Zachary Soboleski	Asst. Code Enforcement Officers		X
Town of Chenango	Joyanne Kasmarcik	Secretary to the Highway/Superintendent/Highway		X
Town of Colesville	Bradford McAvoy	Enforcement Officer		X
	Glenn WInsor	Supervisor		X
Town of Conklin	John Mastronardi, PE	Engineer		X
	Nick Pappas	Code Enforcement		X
Village of Deposit	Bryan Moore	Mayor		X
	Karen Budine	Clerk-Treasurer		X
	Peter Hathaway	Code Enforcement Officer		X
Town of Dickinson	Dan Morabito	Deputy Supervisor		X
	Kyle Doyle	Code Enforcement Officer		X
	Michael A. Marinaccio	Town Supervisor		X
	Ron Lake, P.E.	Engineer	X	X

Organization	Name	Title	Steering Committee Member	Planning Partnership Member
Village of Endicott	Anthony Bates	Village Manager		X
	Cameron Williams	Engineering Tech		X
Town of Fenton	John Mastronardi	Town Engineer	X	X
	Gary Holcomb	Supervisor		X
Village of Johnson City	Joshua Holland	Director of Public Works	X	X
	Stephanie Yezzi	Director of Planning	X	X
Town of Kirkwood	John Mastronardi	Engineer		X
	Katie Legg	Councilmember		X
	Kelley Diffendorf	Clerk		X
Village of Lisle	Gerald Mackey	Mayor		X
	Terry Lynch	Trustee		X
Town of Maine	Doug Barton	Assessor		X
	Joseph Dohnalek	Superintendent of Highways		X
	Robert Lawler	Code Enforcer		X
Town of Nanticoke	Robert Hoag	Highway Superintendent		X
	Roy Willis	Supervisor		X
	Scott Whittaker	Town Councilman		X
Village of Port Dickinson	Gene Hulbert Jr.	Engineer		X
	John Broughton	Code Enforcement/Building Inspector		X
	Kevin Burke	Mayor		X
	Robert Moss	Trustee		X
	Ron Lake, P.E.	Village Engineer	X	X
Town of Sanford	Kenneth Wist	Town Supervisor		X
	Paul VanSlyke	Planning Board Member		X
	Shane Lester	Town Board Councilperson		X
Town of Triangle	Charles Manasse	Town Supervisor		X
	Mark Mesceda	Deputy Supervisor		X
Town of Union	Christopher Kylor	Planning Director	X	X
	Marrina Lane	Senior Planner		X
Town of Vestal	Vern Myers	Engineer	X	X
	Maria Sexton	Town Supervisor		X
Village of Whitney Point	Adam Wells	Water Dept		X
	Jason Somers	Mayor		X
	Linda Murphy	Clerk		X
Town of Windsor	Elizabeth Pfister	Town Clerk		X
	Mark Odell	Town Supervisor		X
Village of Windsor	Courtney Decker	Office Clerk		X
	David Decker	Streets and Water Superintendent		X
	Ron Harting	Mayor		X

2.2.2 Planning Partner Expectations

Each planning partner provided a signed "Letter of Intent to Participate." These letters acknowledged the expectation of activities that must be completed in order to be defined as having participated in the planning process.

Planning Partnership POCs were charged with the following:

- Represent their jurisdiction throughout the planning process and ensure participation expectations are met by their jurisdiction.
- Ensure participation of all departments and functions within their jurisdiction that have a stake in mitigation (e.g., planning, engineering, code enforcement, police, emergency services, public works).
- Assist in gathering information for inclusion in the HMP update, including the use of previously developed reports and data.
- Involve the local NFIP Floodplain Administrator in the planning process.
- Solicit and encourage the participation of regional agencies, a range of stakeholders, and residents in the plan development process.
- Support and promote the public involvement process.
- Assist with the development and completion of certain planning elements, including the following:
    - Reviewing and updating the hazards of concern
    - Developing a public and stakeholder outreach program
    - Ensuring that the data and information used in the plan update process are the best available
    - Reviewing and updating the hazard mitigation goals
    - Reporting on the progress of mitigation actions identified in prior HMPs
    - Identifying and screening appropriate mitigation strategies and activities
    - Reviewing and commenting on plan documents prior to submission to NYSDHSES and FEMA
    - Adopting, implementing, and maintaining the plan update

The jurisdictions in Broome County 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 considered in this plan. Broome County's intent was to encourage participation by all jurisdictions, to accommodate their specific needs and limitations, and to help them meet the requirements of plan update participation by, for example, establishing the Steering Committee and engaging the contract consultant to assist with the planning process. The consultant contacted each participant during the planning process to offer support, explain the process, meet individually to collect updated information, and facilitate the submittal and review of critical documents.

Ultimate jurisdictional participation is defined by a completed municipal annex to the HMP (Volume 2) wherein jurisdictions have individually identified their planning POCs; evaluated their risk to the hazards of concern; identified their capabilities to effect mitigation in their community; identified and prioritized an appropriate suite of actions to mitigate their hazard risk; and adopted the updated plan via resolution.

All municipalities in the County actively participate in the National Flood Insurance Program and have a designated National Flood Insurance Program (NFIP) Floodplain Administrator (FPA). All FPAs were informed of the planning process, reviewed the plan documents, and provided direct input to the plan update. Local FPAs are identified in the jurisdictional annexes in Volume 2.

2.2.3 Planning Activities

Members of the Planning Partnership (individually and as a whole), as well as key stakeholders, communicated regularly to share information. They also participated in workshops that focused on a range of planning-related activities:

- Identify hazards
- Assess risks
- Review existing inventories of and identify new critical facilities
- Assist in updating and developing new mitigation goals and strategies
- Provide continuity through the process to ensure that natural hazard vulnerability information and appropriate mitigation strategies were incorporated.

All members of the Steering Committee and Planning Partnership were encouraged to attend the kickoff meeting and the risk assessment and mitigation action workshop. They also had the opportunity to review the draft plan, supported interaction with other stakeholders, and assisted with public involvement efforts. Appendix B (Participation Documentation) identifies the individuals who represented their jurisdictions during this planning effort and how they contributed to the planning process. This matrix gives a broad overview of who attended meetings and when input was provided.

Table 2-2 summarizes Steering Committee and Planning Partnership meetings and key planning process milestones. It also identifies which FEMA HMP requirements each activity satisfies (see FEMA's May 2023 *Local Mitigation Planning Handbook* for additional information on FEMA planning requirements). This table identifies only formal meetings held during plan development. In addition to these meetings, there was a great deal of communication between Broome County, committee members, and the contract consultant through individual local meetings, email, and phone. Appendix C includes meeting agendas, sign-in sheets, and meeting notes.

After completion of the HMP update, implementation and ongoing maintenance will become a function of the Planning Partnership as described in Section 7 (Plan Maintenance). The Planning Partnership will be responsible for reviewing the HMP and soliciting and considering public comment as part of the five-year mitigation plan update.

Table 2-2. Summary of Mitigation Planning Activities / Efforts

Date	FEMA Requirements Addressed (see notes below)	Description of Activity	Broome County	Barker (T)	Binghamton (C)	Binghamton (T)	Chenango (T)	Colesville (T)	Conklin (T)	Deposit (V)	Dickinson (T)	Endicott (V)	Fenton (T)	Johnson City (V)	Kirkwood (T)	Lisle (T)	Lisle (V)	Maine (T)	Nanticoke (T)	Port Dickinson (V)	Sanford (T)	Triangle (T)	Union (T)	Vestal (T)	Whitney Point (V)	Windsor (T)	Windsor (V)	Stakeholders
July 12, 2023	2	Pre-Kickoff Meeting with Broome County: Plan timing and administration, data needs and sharing, hazards of concern, dates, and next steps	X																								
July 19, 2023	2	Steering Committee Meeting #1: Review mitigation and the 2019 HMP; review Planning Partnership guidelines; project schedule and data request; hazards of concern review; stakeholder and public outreach approach; review goals and objectives	X		X				X		X		X	X	X									X		X		
July 19, 2023	2, 3c, 4a	Planning Partnership Meeting #1: Importance of mitigation and HMP; participation requirements; hazards of concern identification and previous events exercise; distribution of outreach materials; review worksheets to obtain jurisdiction-specific information		X	X	X	X		X							X	X	X	X		X		X	X	X		X	
September 14, 2023	2, 3a, 3b, 4a	Steering Committee Meeting #2: Project status update; project schedule; review and finalize hazards of concern; review and finalize goals and objectives; update on public and stakeholder outreach; next steps	X		X				X		X		X	X	X					X			X	X		X		

Date	FEMA Requirements Addressed (see notes below)	Description of Activity	Broome County	Barker (T)	Binghamton (C)	Binghamton (T)	Chenango (T)	Colesville (T)	Conklin (T)	Deposit (V)	Dickinson (T)	Endicott (V)	Fenton (T)	Johnson City (V)	Kirkwood (T)	Lisle (T)	Lisle (V)	Maine (T)	Nanticoke (T)	Port Dickinson (V)	Sanford (T)	Triangle (T)	Union (T)	Vestal (T)	Whitney Point (V)	Windsor (T)	Windsor (V)	Stakeholders
December 6, 2023	2, 3b, 3c, 3d, 3e, 4b	Steering Committee Meeting #3: Project status update; project schedule; review and finalize county hazard rankings; update on public and stakeholder outreach; next steps	X		X				X		X		X	X	X								X		X		
December 7, 2023	2, 3b, 3c, 3d, 3e, 4b	Planning Partnership Meeting #2: Project status update; project schedule; review municipal hazard rankings and how to provide input; update on public and stakeholder outreach; next steps	X		X	X			X		X	X	X	X	X				X	X	X		X		X		X
January 16, 2024	1b	Stakeholder Meeting #1: Overview of the HMP to identified stakeholders; collect input from stakeholders	X																								X
February 1, 2024	2, 3c, 3d, 3e, 4a, 4b	Planning Partnership Meeting #3: Review FEMA and state mitigation strategy requirements; mitigation resources distributed; review mitigation action online form; next steps	X																								
February 21, 2024	4b, 4c	County Department Meeting: A variety of county departments met to discuss mitigation actions to include in the Broome County annex	X																								
TBD	2	Planning Partnership Meeting #4: Overview of the entire plan and sections																									

Date	FEMA Requirements Addressed (see notes below)	Description of Activity	Broome County	Barker (T)	Binghamton (C)	Binghamton (T)	Chenango (T)	Colesville (T)	Conklin (T)	Deposit (V)	Dickinson (T)	Endicott (V)	Fenton (T)	Johnson City (V)	Kirkwood (T)	Lisle (T)	Lisle (V)	Maine (T)	Nanticoke (T)	Port Dickinson (V)	Sanford (T)	Triangle (T)	Union (T)	Vestal (T)	Whitney Point (V)	Windsor (T)	Windsor (V)	Stakeholders
TBD	1b, 2	Draft HMP posted to county website; all plan participants were notified and asked to assist with the public outreach including social media. Neighboring communities and stakeholders were notified of the posting as well.																									
TBD	4b, 4c, 5b	All jurisdictions consider public and stakeholder comments received; update the plan accordingly.																									
TBD	2	HMP submitted to NYSDHSES and FEMA Region 2																									
Upon plan approval by FEMA	1a	Plan adoption by resolution by the governing bodies of all participating jurisdictions																									

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

2.3 CREATE AN OUTREACH STRATEGY

Federal regulations for mitigation plan approval require that stakeholders and the general public be given opportunities to be involved in the planning process. Input from community members strengthens the content and outcomes of the HMP. Broome County implemented an enhanced outreach strategy for the 2024 HMP that included social media posts, press releases, printed materials at county and local offices, and two websites:

- An interactive StoryMap—https://arcg.is/00zWaC
- An HMP page on the Broome County Department of Planning website—https://www.gobroomecounty.com/planning/hazardmitigation/2024HazardMitigationPlanUpdate

2.3.1 Stakeholder Outreach and Involvement

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 then continually throughout the planning process. This HMP update includes information provided by stakeholders where appropriate, as identified in the references. Key elements of outreach to stakeholders were as follows:

- All Planning Partnership meetings were open to the public and advertised on the County's HMP web page.
- In June 2023, over 140 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 Chenango County, Cortland County, Delaware County, Susquehanna County (Pennsylvania), Tioga County, and Wayne County (Pennsylvania). As of February 2024, 24 stakeholders and 11 neighboring communities completed the online survey. All responses to the stakeholder surveys may be found in Appendix D (Public and Stakeholder Outreach).
- On January 16, 2024, the County invited stakeholders and neighboring communities to attend an online webinar. This webinar provided an overview of hazard mitigation and the process Broome County is following to update the HMP. Interactive polls were used to collect input from the stakeholders on problem areas and potential mitigation actions. Sixteen stakeholders attended.
- In September 2023, the County deployed a StoryMap to provide information about hazard mitigation planning and an opportunity for virtual public participation. It also provides an interactive platform to learn about the hazards of concern and view hazard maps prepared for the HMP.

- In June 2024, the draft plan was posted on the Broome County Department of Planning website and advertised using jurisdictional websites and social media platforms. Regional stakeholders and neighboring counties were emailed to notify them that the draft HMP is available for review.

Stakeholder Participation

The following sections list the stakeholders invited to participate in the planning process and how they participated. This is only a summary listing of stakeholders that were aware of or contributed to this HMP update. The planning partners made additional outreach efforts that are not documented here. The summary demonstrates the scope and breadth of the stakeholder outreach efforts. Refer to Appendix B (Participation Documentation) for further details regarding stakeholder agency attendance at meetings. Refer to Appendix D for additional details on the public and stakeholder outreach, including survey responses received.

Federal Agencies

FEMA Region 2 provided updated planning guidance, summarized and detailed NFIP data for the planning area, attended meetings, provided information on potential grant funding for the county and municipalities, and conducted plan reviews.

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

State Agencies

NYS DHSES: Headquarters and Region IV administered the planning grant for this update, facilitated FEMA review, provided updated planning guidance, attended meetings, attended the mitigation strategy workshop in February 2024, and provided a review of the draft and final HMP.

New York State Department of Environmental Conservation (NYSDEC) provided information, supported the identification of mitigation projects, and supported the identification of high-hazard dams, in accordance with

The functions of NYSDEC's Dam Safety Section include: 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. The Dam Safety Section requires dam owners to implement a dam safety program and prepare Emergency Action Plans for Class B and Class D dams.

NYSDEC Dam Safety classifications and maintenance standards. NYSDEC has a Virtual Globe dataset that depicts the location of dams in the New York State Inventory of Dams, which was used to determine the dams and their classifications in Broome County.

County Agencies and Departments

The following County agencies and departments served on the Steering Committee or Planning Partnership or provide services to socially vulnerable populations in Broome County (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):

- **Broome County Department of Planning and Economic Development**—Served on the Steering Committee and Planning Partnership, provided critical data, assisted with the update of events and losses in the county, updated the previous mitigation strategy, facilitated outreach to stakeholders, contributed to the County's capability assessment and updated mitigation strategy, and reviewed draft sections of the HMP.
- **Broome County Department of Public Works**—Served on the Steering Committee, participated in meetings, provided input on the mitigation strategy, reviewed the county annex, and assisted with the update of the HMP's capability assessment, previous mitigation strategy, and updated mitigation strategy.
- **Broome County Division of Engineering**—Participated in meetings, provided input on the mitigation strategy and reviewed the county annex.
- **Broome County Geographic Information System (GIS) Department**—Provided critical facility inventory data and all other relevant GIS data throughout the planning process.
- **Broome County Health Department**—Served on the Steering Committee, participated in meetings, provided input on the mitigation strategy, and reviewed the County annex. The Health Department provides services to all populations, including socially vulnerable populations.
- **Broome County Mental Health Department**—Completed the online survey and provided input during the planning process. The Mental Health Department provides services to all populations, including socially vulnerable populations.
- **Broome County Office of Aging**—Served on the Steering Committee, participated in meetings, provided input on the mitigation strategy, and reviewed the County annex. The Department provides services to all populations, including socially vulnerable populations.
- **Broome County Office of Emergency Services**—Served on the Steering Committee, provided data, reviewed sections, completed surveys, and contributed to the mitigation strategy. This agency provides services to all populations, including socially vulnerable populations.
- **Broome County Soil and Water Conservation District**—Served on the Steering Committee.

Refer to Section 5 (Capability Assessment) for details on each department, their roles during the HMP update, and their overall responsibilities in the planning area.

Regional and Local Stakeholders

Academia

The following schools, universities, and other academic institutions were invited to attend planning process meetings and asked to complete the stakeholder survey; those that served on the Steering Committee or Planning Partnership and those that provide services to the socially vulnerable in Broome County are noted accordingly:

- Binghamton City School District
- Binghamton University—The University's OEM Executive Director served on the Steering Committee during the planning process, provided input throughout the HMP update, and completed the stakeholder survey.
- Broome-Tioga Board of Cooperative Educational Services (BOCES)
- Cornell Cooperative Extension of Broome County
- Chenango Forks Central School District
- Chenango Valley Central School District—Completed the stakeholder survey and provided input during the planning process. This agency provides services to all populations, including socially vulnerable populations.
- Davis College
- Deposit Central School District
- Harpursville Central School District
- Harpursville Central School District
- Johnson City Central School District—Completed the stakeholder survey, attended meetings, and provided input during the planning process. This agency provides services to all populations, including socially vulnerable populations.
- Maine-Endwell Central School District
- Oxford Academy & Central School District
- State University of New York (SUNY) Broome—Completed the stakeholder survey and provided input during the planning process. This agency provides services to all populations, including socially vulnerable populations.
- Susquehanna Valley Central School District
- Union-Endicott Central School District
- Vestal Central School District
- Whitney Point Central School District
- Windsor Central School District

Business, Commercial, and Non-Profit Organizations

The following business, commercial, and non-profit organizations were invited to participate in the HMP update process; those that provide services to the socially vulnerable in Broome County are noted accordingly:

- Achieve New York—Completed the stakeholder survey, attended meetings, and provided input during the planning process. This agency also provides services to all populations, including socially vulnerable populations.
- American Civic Association Inc.
- American Red Cross—Completed the stakeholder survey and provided input during the planning process. This agency provides services to all populations, including socially vulnerable populations.
- Broome County Council of Churches—Completed the stakeholder survey and provided input during the planning process. This agency provides services to all populations, including socially vulnerable populations.
- Binghamton Housing Authority—Completed the stakeholder survey and provided input during the planning process.
- Binghamton Rescue Mission
- Broome County Urban League, Inc.
- Catholic Charities of Broome County
- Community Foundation for South Central New York—Completed the stakeholder survey and provided input during the planning process. This agency provides services to all populations, including socially vulnerable populations.
- Community Options, Inc
- Crime Victims Assistance Center
- Deposit Free Library
- Four County Library System—Completed the stakeholder survey and provided input during the planning process. This agency provides services to all populations, including socially vulnerable populations.
- George F. Johnson Memorial Library
- Greater Binghamton Chamber of Commerce—Attended meetings and provided input during the planning process.
- Greenlight Media and Marketing—Attended meetings and provided input during the planning process.
- Metro Interfaith
- Southern Door Community Land Trust
- Southern Tier 8 Regional Board—Completed the stakeholder survey, attended meetings, and provided input during the planning process.
- Southern Tier Bicycle Club—Attended meetings and provided input during the planning process.

- Southern Tier Independence Center
- The Agency
- United Way of Broome County
- Upper Susquehanna Coalition—Attended meetings and provided input during the planning process.
- Vestal Public Library—Completed the online survey and provided input during the planning process.
- YMCA Broome County
- Your Home Library
- YWCA of Binghamton

Emergency Services

The following local emergency service providers (police, fire, and EMS) were invited to participate in the HMP update process:

- Broome County Office of Emergency Services—The OES director served on the Steering Committee throughout the plan. Broome County OES provided data, reviewed sections, completed surveys, and contributed to the mitigation strategy.
- Broome County Sheriff's Office
- All local emergency service providers

These organizations all provide services to all populations in Broome County, including socially vulnerable populations; those that served on the Steering Committee or Planning Partnership are noted accordingly.

Hospitals and Healthcare Facilities

The following healthcare providers and facilities were invited to participate in the HMP update process:

- Achieve New York—Completed the online survey, attended meetings, and provided input during the planning process.
- UHS Hospitals York—Completed the online survey, attended meetings, and provided input during the planning process. This agency provides services to all populations, including socially vulnerable populations.
- United Methodist Homes
- Rural Health Network of South Central New York—Completed the online survey and provided input during the planning process. This agency provides services to all populations, including socially vulnerable populations.
- Lourdes/Ascension

These organizations all provide services to all populations in Broome County, including socially vulnerable populations.

Public Works and Transportation

The following County and local highway and public works departments were invited to participate in the HMP update process:

- Broome County Transit—Completed the online survey and provided input during the planning process.
- Broome County Public Works, Highway Division

These organizations provide services to all populations in Broome County, including socially vulnerable populations.

Utility Providers

The following utility providers that serve Broome County and its municipalities were invited to participate in the HMP update process:

- NYSEG
- Windsor Village Water Department

These organizations provide services to all populations in Broome County, including socially vulnerable populations.

Additional Stakeholders

The following stakeholders were notified by the Broome County Department of Planning that the draft HMP was available for review and comment:

- Town supervisors, village/city mayors
- Village and town clerks
- Local Emergency Planning Committee (LEPC)
- Community Organizations Active in Disaster (COAD)

Neighboring Communities

Broome County made an effort to keep surrounding counties and municipalities apprised of the project and allowed an opportunity for them to provide input to this planning process. The following adjoining and nearby county representatives were contacted in November 2023 to inform them about the availability of the project website, draft plan documents, and surveys, and to invite them to provide input to the planning process:

- Tioga County, New York—Tioga County Soil and Water Conservation District and County Emergency Services completed the online survey and provided input during the planning process.
- Cortland County, New York—Cortland County Emergency Management completed the online survey and provided input during the planning process.

- Chenango County, New York—Chenango County Office of Emergency Services and Planning Department completed the online survey, attended meetings, and provided input during the planning process.
- Delaware County, New York—Delaware County Planning and Watershed Affairs completed the online survey and provided input during the planning process.
- Susquehanna County, Pennsylvania—Susquehanna County Emergency Services completed the online survey and provided input during the planning process.
- Wayne County, Pennsylvania—Wayne County Emergency Management completed the online survey and provided input during the planning process.

Stakeholder and Neighboring County Survey Summaries

This section provides a summary of the feedback received from stakeholders and adjacent communities who completed project surveys. Refer to Appendix D (Public and Stakeholder Outreach) for the complete results. Survey results were shared with the Steering Committee and Planning Partnership in scheduled meetings for consideration in the development of mitigation strategies. Feedback was integrated into the plan where appropriate.

Stakeholder Survey

The stakeholder survey was designed to help identify general needs for hazard mitigation and resiliency within Broome County from the stakeholder perspective, as well as to identify specific projects that may be included in the mitigation plan. It was distributed to identified stakeholders, including various county and municipal departments and agencies. Invitations to complete the survey were sent via email in July 2023. As of February 21, 2024, 24 stakeholders completed the survey. The survey was broken down into five sections: risk overview; facility information;, capabilities and mitigation strategies; project identification; and social vulnerability and underserved communities. The following are summaries of the survey results:

- **Risk Overview—**A majority of respondents (60 percent) indicated that they have experience and/or expertise in winter storms, followed by flooding (55 percent). Over 56 percent of respondents said their structures have been damaged from hazard events as a result of flooding, winter weather, and fire.
- **Facility Information—**Over 70 percent of respondents stated that they own facilities, with many considered critical facilities. Forty percent of the facilities were identified as being susceptible to hazard impacts, with flooding listed as the primary source of damage.
- **Capabilities and Mitigation Strategies—**Many of the respondents listed capabilities they have to address hazards. This includes emergency action plans, information access, networking with volunteer disaster recovery programs, education and outreach, grant writing abilities, and working with the general public.

- **Project Identification—**The survey asked stakeholders to list projects or programs that have been recently implemented that will reduce vulnerability to hazards. Respondents listed the following types of projects and programs: emergency action plans, needs assessments, generators at facilities, lightning strobes/sirens, weather stations, emergency and crisis response plans, call centers, and continuity of operations plans.
- **Social Vulnerability and Underserved Communities—**Forty percent of respondents are aware of the number and location of vulnerable populations in the County. Of those respondents, 75 percent said they provide assistance to socially vulnerable and underserved communities, which includes housing, financial assistance, meals, library services, emergency disaster health and mental health services, and emergency response.

Neighboring Community Survey

The neighboring community survey was sent via email in November 2023 to the surrounding counties of Broome County due to the fact that effects of hazard events that impact Broome County would be similar to those of their neighbors. As of February 21, 2024, six counties completed the survey. The survey was broken down into three sections: emergency operations and continuity of operations planning; information sharing; and projects, grants, education, and outreach. The following are summaries of the survey results:

- **Emergency Operations and Continuity of Operations Planning—**Twenty-seven percent of respondents have memorandums of understanding with Broome County agencies for technical and financial support and emergency service providers. During disaster response, respondents indicated that they communicate with Broome County through the state, emergency services program, and direct communication via email and phone.
- **Information Sharing—**A majority of respondents (62.5 percent) have access to Broome County's Emergency Operations Center, and mitigation-related information is shared accordingly. The survey asked for examples of hazard concerns that both their jurisdiction and Broome County share. Respondents identified the flooding along the Susquehanna, Delaware, and Chenango Rivers, and flooding along Oquaga Creek.
- **Projects, Grants, Education and Outreach—**Respondents identified the following projects as cross-collaboration projects with Broome County: watershed projects/planning, outreach, floodplain projects/planning, roadway improvements, and stormwater projects. Over 42 percent of respondents said they have collaborated on grant applications with Broome County. Projects included hazardous material grants and the completion of the Upper Delaware Stream Corridor Management Plan.

2.3.2 Public Outreach

Community input on the HMP increases the likelihood of hazard mitigation becoming one of the standard considerations in the evolution and growth of the County. To facilitate better coordination and communication between the Planning Partnership and residents and to involve the public in the planning process, meeting dates and locations were made available to the public via the project web page on the Broome County Planning Department website, the project StoryMap, and social media. The draft HMP is available for public review on the Broome County website and StoryMap. The Planning Partnership made the following efforts toward public participation in the planning process:

- The public project website(see Figure 2-2) was developed and 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 citizen's survey and stakeholder surveys, and sections of the HMP for public review and comment.

Figure 2-2. Broome County HMP Webpage

- The online StoryMap was developed to provide information regarding the hazard mitigation planning process and an opportunity for virtual public participation.

- All Planning Partnership meetings that were open to the public were advertised on the Broome County website and various social media accounts (Facebook, Instagram, and Twitter (now X)). Additional examples of municipal outreach are presented in Appendix D.
- An online hazard mitigation public survey was developed to gauge household preparedness that may impact the County and to assess the level of knowledge of tools and techniques to assist in reducing risk and loss from those hazards. The survey asked quantifiable questions about public perception of risk, knowledge of mitigation, and support of community programs. It also asked several demographic questions to help analyze trends. The survey was available on the public project website from August 2023 to January 2024, and further advertised on additional Planning Partnership websites, social media accounts, and printed materials. Reponses were collected and provided to plan participants for consideration in the mitigation action development (438 responses in total). Appendix D summarizes public input received through the website, the online survey, and other sources.
- Results from the public survey were used to inform the action plans of the planning partners. Based on the most requested types of projects that residents wanted local and County agencies to be doing, many planning partners included actions to improve and strengthen infrastructure, improve the damage resistance of utilities, buy out flood prone properties, improve protective structures, and provide greater control over development in high hazard areas.
- All plan participants were encouraged to post links to the project webpage and public survey. In addition, all participants were requested to advertise the availability of the project website, public survey and stakeholder surveys via local website links and other available public announcement methods (e.g., Facebook, Twitter (now X), and email blasts). Appendix D highlights these local efforts.
- The public and stakeholders were provided with the opportunity to comment on the draft HMP before submittal to FEMA. The HMP was posted on the HMP public website on June 2024, for review. All Planning Partnership participants were requested to assist with advertising that the plan was posted via their websites and social media. Public comments received through July 2024, were distributed to Planning Partnership for their consideration.
- Once approved by NYSDHSES and FEMA, the final HMP will be available on the county website.

Additional examples of public outreach efforts and results of the public survey are presented in Appendix D (Public and Stakeholder Outreach Documentation).

2.4 CONDUCT A RISK ASSESSMENT

This risk assessment provides the factual basis for actions proposed in the mitigation strategy. The hazards and impacts in the risk assessment should be the hazards and impacts the mitigation strategy addresses. A risk assessment was completed for each hazard of concern identified for the 2024 HMP. The Steering Committee and Planning Partnership reviewed the risk assessment results and developed mitigation strategies that focus on reducing impacts of the hazards. Refer to Section 4 (Risk Assessment) for the assessment of each hazard.

2.5 REVIEW COMMUNITY CAPABILITIES

2.5.1 Assessment of Existing Capabilities

The County and participating jurisdictions were tasked with updating the inventory of their Planning and Regulatory capabilities in Volume 2 (capability assessment of each jurisdictional annex).

The following local regulations, codes, ordinances, and plans were reviewed during this process to develop mitigation planning goals, objectives, and strategies that are consistent across local and regional planning and regulatory mechanisms to accomplish complementary and mutually supportive strategies:

- 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
- New York State Standard Multi-Hazard Mitigation Plan, 2019

Refer to Section 5 (Capability Assessment) and Volume 2 (Jurisdictional Annexes) for details on the regulations, codes, ordinances, and plans reviewed for each participant.

2.5.2 Integration With Existing Planning Mechanisms and Programs

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. Within Broome County, there are many existing plans and programs that support hazard risk management, so it is critical that this hazard mitigation plan integrate, coordinate with, and complement, those existing plans and programs.

Section 5 (Capability Assessment) provides a summary and description of the existing plans, programs and regulatory mechanisms at all levels of government (federal, state, county and local) that support hazard mitigation within the County. Within each jurisdictional annex in Volume 2, the County and each participating jurisdiction identified how they integrate hazard risk management into their existing planning, regulatory and operational/administrative framework ("integration capabilities") and how they intend to promote this integration ("integration actions").

A further summary of these continued efforts to develop and promote a comprehensive and holistic approach to hazard risk management and mitigation is presented in Section 7 (Plan Maintenance).

2.6 DEVELOP A MITIGATION STRATEGY

The heart of the mitigation plan is the mitigation strategy. It serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The mitigation strategy describes how the community will accomplish the overall purpose, or mission, of the planning process. Broome County and each participating jurisdiction developed a mitigation strategy for the 2024 HMP. Refer to Section 6 (Mitigation Strategy) and Volume 2 (Jurisdictional Annexes) for details on how the mitigation strategy was conducted.

2.7 KEEP THE PLAN CURRENT

Broome County and participating jurisdictions are committed to the continued involvement of the public in the hazard mitigation process. This HMP update will be posted online at the project website and municipalities will be encouraged to maintain links to the website. Further, the county will make hard copies of the HMP available for review at public locations as identified on the 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.

2.8 REVIEW AND ADOPT THE PLAN

The County and participating jurisdictions will adopt the HMP to show their commitment to carrying out the mitigation strategy and creating a more resilient Broome County. When the HMP receives FEMA approval, the County and jurisdictions adopt the plan through formal resolution. Documentation of adoption is provided to FEMA. Refer to Appendix A (Plan Adoption) for copies of the resolutions.

SECTION 3. COUNTY PROFILE

This section provides general information about Broome County, including its physical setting, general building stock, land use, population, demographics, population trends, and critical facilities. Analyzing this information leads to an understanding of the planning 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, a high percentage of vulnerable persons in an area).

3.1 GENERAL INFORMATION

Broome County was founded in 1806 and named after John Broome, who was the Lieutenant Governor of New York in 1804. It is one of the 62 counties in New York State. The County covers 715 square miles: 705 square miles of land and 10 square miles of water. The total population according to the 2020 U.S. Census is 198,683.

There are 24 municipalities located in the County—one city, 16 towns, and seven villages—as well as several hamlets. The City of Binghamton is the county seat and is located at the confluence of the Susquehanna and Chenango Rivers. The Binghamton area is the crossroads of the Southern Tier, with two interstates and a major state route intersecting there. Interstates 81 and 88, as well as the future Interstate 86 (also known as New York State Highway 17, The Southern Tier Expressway), converge in Binghamton.

The main industry in the County is agriculture. (NYS n.d.). The County is part of the Binghamton NY Metropolitan Statistical Area and includes Binghamton University, which is one of four university centers in the State University of New York system. Other academic institutions in the County include Broome Community College, Davis College, and Ridley-Lowell Business and Technical Institute.

3.2 MAJOR PAST HAZARD EVENTS

Table 3-1 shows federal disaster declarations that included Broome County through January 2024 (records date back to 1954). A review of federal disaster declarations helps establish the probability of reoccurrence for local hazards and identifies targets for risk reduction. These 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). A federal 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.

Table 3-1. History of Federal Disaster Declarations in Broome County

Disaster Number	Event Date	Declaration Date	Incident Type	Title
DR-290-NY	July 22, 1970	July 22, 1970	Flood	Heavy Rains & Flooding
DR-338-NY	June 23, 1972	June 23, 1972	Flood	Tropical Storm Agnes
DR-487-NY	October 2, 1975	October 2, 1975	Flood	Storms, Rains, Landslides & Flooding
DR-515-NY	July 21, 1976	July 21, 1976	Flood	Severe Storms & Flooding
EM-3107-NY	March 13-17, 1993	March 17, 1993	Snowstorm	Severe Blizzard
DR-1095-NY	January 19-30, 1996	January 24, 1996	Flood	Severe Storms & Flooding
DR-1222-NY	May 31-June 2, 1998	June 16, 1998	Severe Storm	Severe Storms & Tornadoes
EM-3155-NY	May 22-November 1, 2000	October 11, 2000	Other	West Nile Virus
DR-1391-NY	September 11, 2001	September 11, 2001	Fire	Fires & Explosions
EM-3173-NY	December 25, 2002 – January 4, 2003	February 25, 2003	Snowstorm	Snowstorms
EM-3184-NY	February 17-18, 2003	March 27, 2003	Snowstorm	Snow
EM-3186-NY	August 14-16, 2003	August 23, 2003	Other	Power Outage
DR-1534-NY	May 13, 2004	August 3, 2004	Severe Storm	Severe Storms & Flooding
DR-1564-NY	August 13-June 17, 2004	October 1, 2004	Severe Storm	Severe Storms & Flooding
DR-1565-NY	September 16-24, 2004	October 1, 2004	Severe Storm	Tropical Depression Ivan
DR-1589-NY	April 2-4, 2005	April 19, 2005	Severe Storm	Severe Storms & Flooding
EM-3262-NY	August 29-October 1, 2005	September 30, 2005	Hurricane	Hurricane Katrina Evacuation
DR-1650-NY	June 26-July 10, 2006	July 1, 2006	Severe Storm	Severe Storms & Flooding
DR-1670-NY	November 16-17, 2006	December 12, 2006	Severe Storm	Severe Storms & Flooding
DR-1993-NY	April 26-May 8, 2011	June 10, 2011	Flood	Severe Storms, Flooding, Tornadoes, & Straight-Line Winds
EM-3341-NY	September 7-11, 2011	September 8, 2011	Severe Storm	Remnants of Tropical Storm Lee
DR-4031-NY	September 7-11, 2011	September 13, 2011	Severe Storm	Remnants of Tropical Storm Lee
EM-3351-NY	October 27-November 8, 2012	October 28, 2012	Hurricane	Hurricane Sandy
DR-4129-NY	June 26-July 10, 2013	July 12, 2013	Flood	Severe Storms & Flooding
DR-4322-NY	March 14-15, 2017	July 12, 2017	Snowstorm	Severe Winter Storm & Snowstorm
DR-4397-NY	August 13-15, 2018	October 1, 2018	Flood	Severe Storms & Flooding
EM-3434-NY	January 20, 2020 – May 11, 2023	March 13, 2020	Biological	Covid-19
DR-4480-NY	January 20, 2020 – May 11, 2023	March 20, 2020	Biological	Covid-19 Pandemic
EM-3565-NY	August 21-24, 2021	August 22, 2021	Hurricane	Hurricane Henri

Source: FEMA 2024

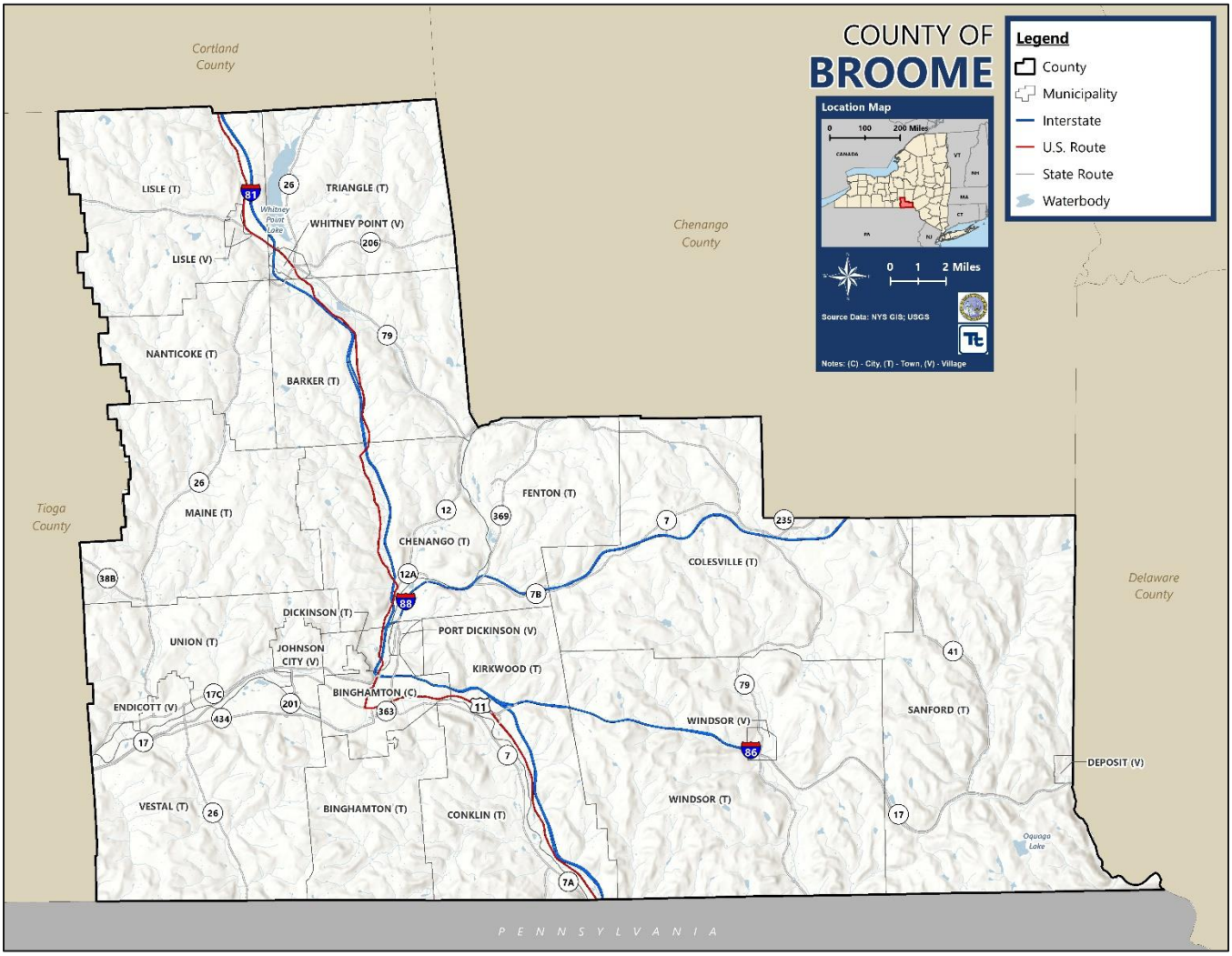
3.3 PHYSICAL SETTING

This section presents the physical setting of Broome County, including its location, topography, water resources, climate, land use, and land cover.

3.3.1 Location

Broome County is located on the southern border of the state of New York with Pennsylvania to the south. This area is called the Southern Tier. The Susquehanna River, which flows through Pennsylvania, also flows through the eastern portion of Broome County, eventually meeting the Chenango River in Binghamton. The City of Binghamton is the largest in the County with over 47,000 people. **Error! Reference source not found.** shows the location of Broome County.

Figure 3-1. Broome County Overview Map



3.3.2 Topography and Geology

With its location in the Allegheny Plateau, Broome County's land is made up of deeply eroded, steep-sided, flat-bottomed valleys, and flat to rolling plateaus varying in relief (FEMA FIS 2010). The western portion of the County is characterized by hilly, wide valleys, and includes the suburbs of Binghamton. The eastern portion is more rugged, as the land meets the Catskill Mountains. (NYS n.d.). Around the rivers, the topography becomes more level. The County's elevation ranges from 805 feet to 2,040 feet. Many areas in the county have steep slopes, with a majority of land having slopes of greater than 10 percent (Broome County Comprehensive Plan 2013).

3.3.3 Water Resources

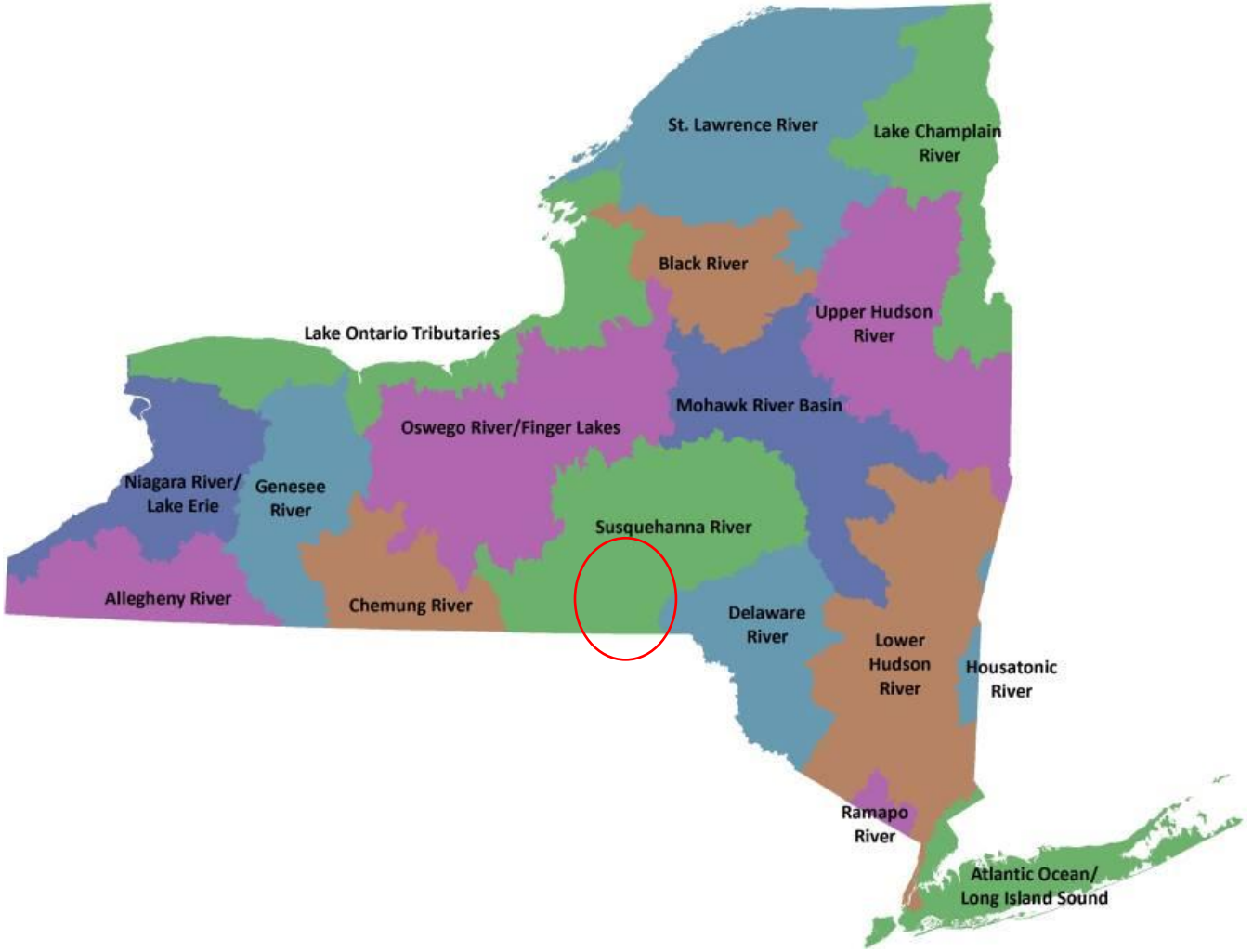
Numerous ponds, lakes, creeks, and rivers make up the water resources of Broome County. The major bodies of water are Whitney Point Lake, the Otselic River, the Tioughnioga River, the Chenango River, the

Delaware River (West Branch), Nanticoke Creek, the Susquehanna River, Oquga Creek, Trout Brook, Still Creek, Brandywine Creek, Little Choconut Creek, Patterson Creek, Brixius Creek, Denton Creek, Ballyhook Creek, Honey Hollow Creek, and Horton Creek (National Atlas 2012, County Input).

Whitney Point Reservoir and Oquaga Lake are the two major lakes in Broome County. Whitney Point Reservoir is the largest lake in the county and drains approximately 225 square miles. It is a U.S. Army Corps of Engineers flood control structure and is located on the Otselic River. Oquaga Lake is located in the eastern portion of Broome County and is approximately 134 acres.

As shown in Figure 3-2, Broome County is located within the Susquehanna and Delaware River Drainage Basins. Within each of the major drainage basins are smaller watersheds. As seen in Figure 3-3, four watersheds are found in Broome County: Upper Susquehanna, Chenango, Owego-Wappasening, and Upper Delaware (National Atlas 2012, NYSDEC, n.d.).

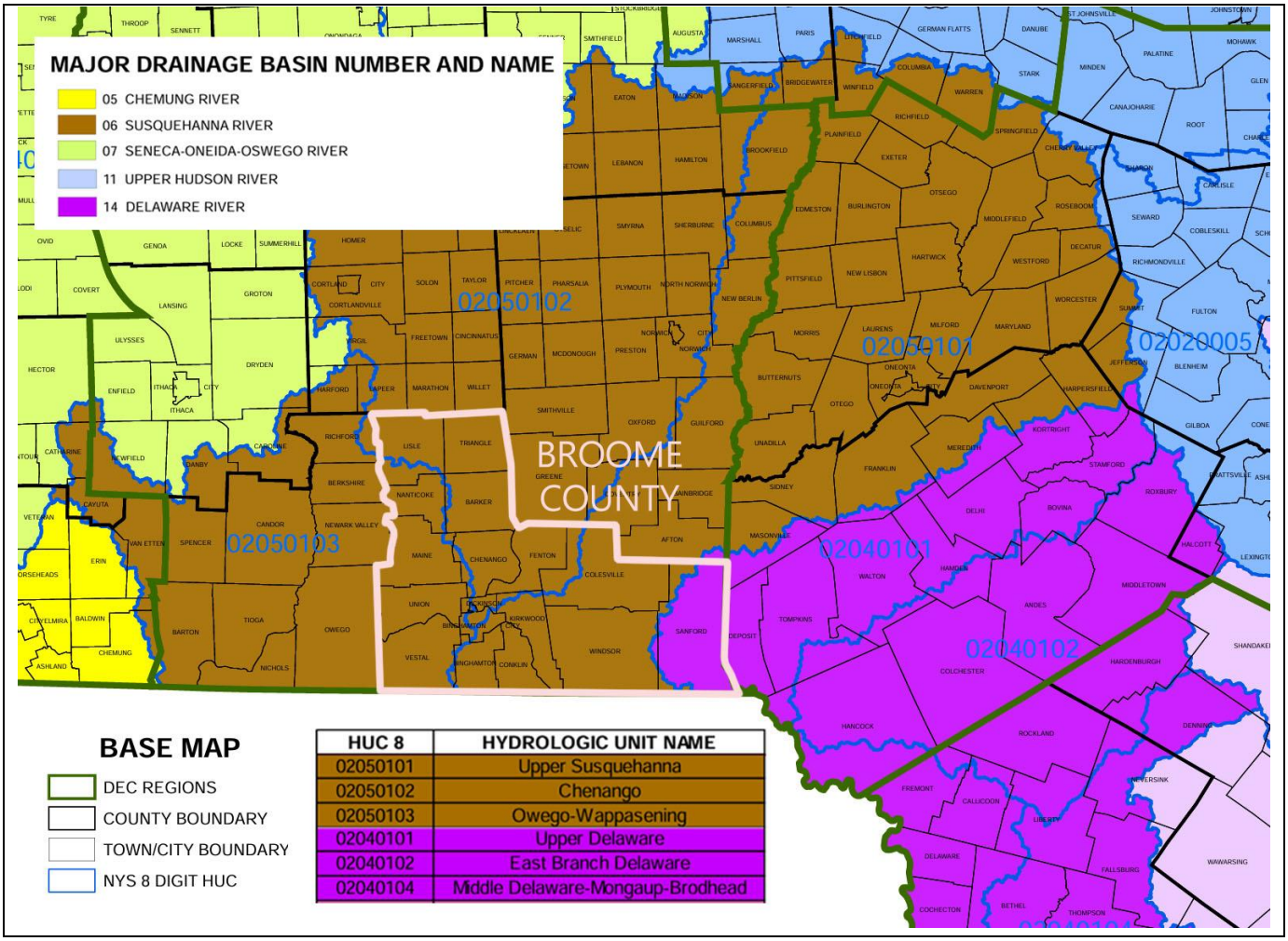
Figure 3-2. Watersheds in New York State



Note: The red circle indicates the approximate location of Broome County.

Source: NYSDEC 2023

Figure 3-3. New York State Drainage Basins in the Vicinity of Broome County



Source: NYSDEC 2012

Susquehanna River Basin

Approximately 90 percent of the county drains into the Susquehanna River Basin. The Susquehanna River Basin is the second-largest river basin east of the Mississippi River and the largest river basin on the Atlantic seaboard. The 444 miles of this river drain 27,500 square miles covering large portions of New York State, Pennsylvania, and Maryland, before emptying into Chesapeake Bay. The basin has 4,520 square miles of land area within New York State and over 8,185 miles of freshwater rivers and streams. The major tributaries to the Susquehanna River in New York State include the Chenango River, the Tioughnioga River, the Unadilla River, and Owego Creek. The 130 significant freshwater lakes, ponds, and reservoirs in the basin include Otsego Lake, Canadarago Lake, and Whitney Point Lake/Reservoir (NYSDEC, n.d.).

Delaware River Basin

About 10 percent of the county is located within the Delaware River Basin along a small portion of the county's southeast boundary. The Delaware River Basin covers parts of New York State, Pennsylvania, New Jersey, and Delaware. About one-fifth of the basin lies within New York State. The Delaware River originates at headwaters in the Catskill Mountains and eventually flows into Delaware Bay and the Atlantic Ocean. The Delaware River Basin encompasses 2,390 square miles of land within New York State, with 4,062 miles of freshwater rivers and streams. The major tributaries to the Delaware River in New York State include the East Branch Delaware, West Branch Delaware, Neversink, and Mangaup Rivers. The main tributary to the Delaware River in Broome County is Oquaga Creek. (Broome County Comprehensive Plan 2013). There are 188 significant lakes, ponds, and reservoirs within this basin (NYSDEC, n.d.).

Groundwater

Approximately 80 percent of water for public use in Broome County comes from groundwater sources. There are several aquifers located beneath the Susquehanna and Chenango Rivers and their surrounding floodplains. These are referred to as unconsolidated aquifers, characterized as having frequent discharge and recharge with the streams that lie above them. Bedrock aquifers, common in rural areas of the county, are hydrologically isolated from large streams and hold water in fractures in the bedrock.

Aquifers are classified based on their importance as a public water supply, productivity, and vulnerability to pollution. The Village of Johnson City, the Town of Union, the Village of Endicott, and the Town of Vestal depend on primary aquifers. There are also numerous principal aquifers, which are classified as highly productive but used by a lower percentage of the population (Broome County Comprehensive Plan 2013). The portion of Broome County that is located within the Susquehanna River Basin is designated by the U.S. Environmental Protection Agency as a sole source aquifer (Clinton Street-Ballpark Aquifer System) (Broome County Comprehensive Plan 2013).

3.3.4 Climate

The climate of New York State is classified as Humid Continental. Differences in latitude, topography, and proximity to large bodies of water all affect climate across New York State. Precipitation during the warm growing season (April through September) is characterized by convective storms that generally form in advance of an eastward-moving cold front or during periods of local atmospheric instability. Occasionally, tropical cyclones move up from southern coastal areas and produce significant quantities of rain. Both types of storms typically are characterized by relatively short periods of intense precipitation that produce substantial surface runoff and little recharge (Cornell Date, n.d.).

The cool season (October through March) is characterized by large, low-pressure systems that move northeastward along the Atlantic coast or the western side of the Appalachian Mountains. Storms that form in these systems are characterized by prolonged periods of steady precipitation in the form of rain,

snow, or ice, and tend to produce less surface runoff and more recharge than the summer storms because they have a longer duration and occasionally result in snowmelt (Cornell Date, n.d.).

Broome County generally experiences seasonable weather patterns characteristic of the Northeast United States. The average annual precipitation for Broome County is approximately 35 inches, most of which occurs between April and October. The average snowfall amount for the county is 50 inches, with extremes of 120 inches occurring occasionally (FEMA FIS 2010). Summer temperatures typically range from about 70 degrees Fahrenheit (ºF) to 82 ºF. Winter high temperatures are usually in the middle to upper 30s ºF, with minimum temperatures of 14 ºF (The Weather Channel 2012).

3.3.5 Land Use

Broome County has a development pattern that consists of a densely populated urban core with associated suburban fringe, narrow transportation corridors that follow the river valleys, rural village points, and open spaces found in the rural areas. (Broome County Comprehensive Plan 2013). The development patterns of the county were initially defined by the county's steep slopes and fertile river valleys. Native Americans and early European settlers used the rivers for navigation and used the valley soils for farming. The urban core of the community first formed around the confluence of the Chenango and Susquehanna Rivers and then spread along the river valleys. (Broome County Comprehensive Plan 2013). As development increased, roads, canals, and railroads were constructed in the river valleys that connected Broome County communities with the remainder of New York State and the developing United States.

The construction of the Erie Canal, which spanned the northern tier of the state, initiated the building of a canal roughly following the Chenango River's course. The Chenango Canal operated between 1836 and 1837 and cut shipping times between the Cities of Binghamton and Albany, connecting the growing manufacturing base with the port of New York City via the Hudson River. By 1848, railroads reached the county and replaced the Chenango Canal. Industrial development in the river valleys flourished due to the rail lines. Today, rail lines remain an important means of transportation for high-volume industrial users (Broome County Comprehensive Plan 2013).

The rise of the automobile in the 1950s and 1960s caused the development pattern of the county to spread further into the suburbs. The federal and state highway systems took precedence over rail for moving goods and materials. Local and county roads were linked to the state and interstate systems and the suburbanization of Broome County began (Broome County Comprehensive Plan 2013).

3.3.6 Land Cover

Land cover was reviewed for this HMP based on the National Land Cover Database (NLCD) developed by the Multi-Resolution Land Characteristics (MRLC) Consortium, a consortium of federal agencies that generates land cover information at the national scale. The 2019 NLCD was converted from a raster to a

vector dataset to represent spatial areas of built and natural land cover areas. The built land cover areas are defined as urban areas and include developed open space in addition to low, medium, and high-intensity development. Non-urban areas are categorized as agricultural, barren land, forest, rangeland, water, and wetlands land cover.

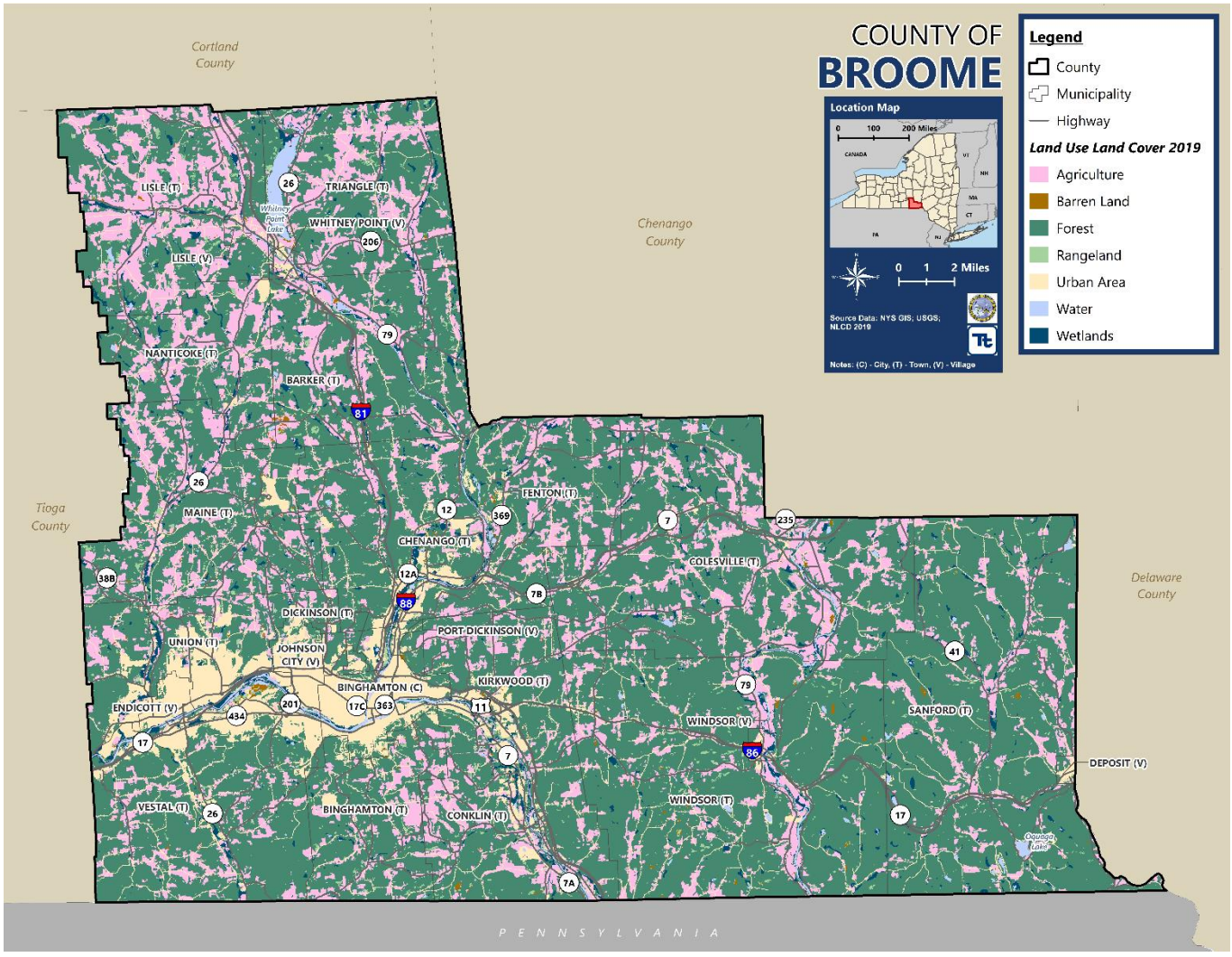
Table 3-2 and Figure 3-4 summarize land cover in Broome County according to the NLCD. Forested land covers the most acreage (292,725 acres or 63.9 percent of total land in the County), followed by agricultural land coverage (88,998 acres or 19.4 percent of the County's total land).

Table 3-2. Broome County Land Cover Classification Table

Land Cover	Acres	Percent of County
Agricultural	88,998	19.4%
Barren	1,225	0.3%
Forest	292,725	63.9%
Rangeland	5,034	1.1%
Urban	55,148	12.0%
Water	5,991	1.3%
Wetland	8,903	1.9%
Broome County (Total)	**458,024**	**100.0%**

Source: NLCD 2019

Figure 3-4. 2018 Land Cover in Broome County



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. For this plan, modeling of the impacts of natural hazards on the population was performed using the Federal Emergency Management Agency's (FEMA's) Hazus model, in which the available population information includes the 2020 U.S. Decennial Census data. That data indicates a county population of 198,683, which is a decrease since 2010. A detailed population table for the 2020 Census is shown in Table 3-3. Figure 3-5 shows the distribution of the 2020 U.S. Census general population density (persons per square mile) by census block

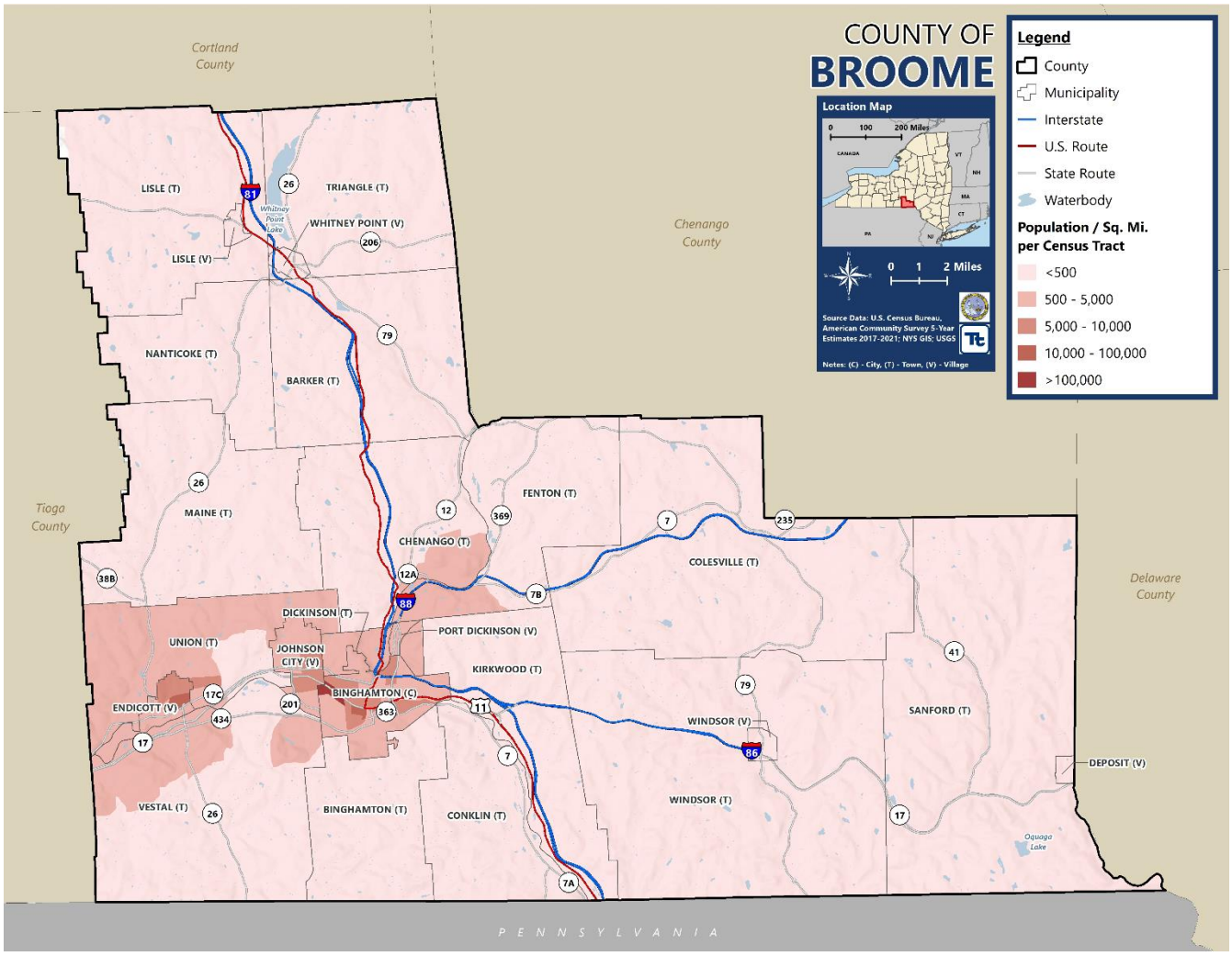
Table 3-3. Broome County Population Statistics (2010 and 2020 U.S. Census)

Municipality	Census 2020 Total Population	Census 2010 Total Population	Change in Population	Percent Change
Barker (T)	2,509	2,732	-223	-8.2%
Binghamton (C)	47,969	47,376	593	1.3%
Binghamton (T)	4,617	4,942	-325	-6.6%
Chenango (T)	10,959	11,252	-293	-2.6%
Colesville (T)	4,868	5,232	-364	-7.0%
Conklin (T)	5,008	5,441	-433	-8.0%
Deposit (V)*	1,387	1,663	-276	-16.6%
Dickinson (T)	3,401	3,637	-236	-6.5%
Endicott (V)*	13,667	13,392	275	2.1%
Fenton (T)	6,429	6,674	-245	-3.7%
Johnson City (V)*	15,343	15,174	169	1.1%
Kirkwood (T)	5,481	5,857	-376	-6.4%
Lisle (T)	2,343	2,431	-88	-3.6%
Lisle (V)*	348	320	28	8.8%
Maine (T)	5,168	5,377	-209	-3.9%
Nanticoke (T)	1,581	1,672	-91	-5.4%
Port Dickinson (V)*	1,699	1,641	58	3.5%
Sanford (T)	1,518	1,588	-70	-4.4%
Triangle (T)	1,849	1,982	-133	-6.7%
Union (T)	27,128	27,780	-652	-2.3%
Vestal (T)	29,313	28,043	1,270	4.5%
Whitney Point (V)*	960	964	-4	-0.4%
Windsor (T)	4,897	5,358	-461	-8.6%
Windsor (V)*	907	916	-9	-1.0%
Broome County (Total)	**198,683**	**200,600**	**-1,917**	**-1.0%**

Source: U.S. Census 2020

The following Villages are contained with Towns, so population totals were adjusted based on the average population (2.33 persons per household) and the count of Residential structures from the General Building Stock data. Deposit (V) is 52% within Sanford (T); Endicott (V) & Johnson City (V) are 100% within Union (T); Lisle (V) is 100% within Lisle (T); Port Dickinson (V) is 100% within Dickinson (T); Whitney Point (V) is 100% within Triangle (T); Windsor (V) is 100% within Windsor (T).

Figure 3-5. Distribution and Density of General Population for Broome County



Various Census Bureau products were used as sources for population trends. The Decennial Census is the official population count taken every 10 years. American Community Survey 5-Year Estimates are used to show annual population changes. The 5-year estimates are the most accurate in the American Community Survey, with the largest sample size, which allows for greater accuracy in smaller geographic areas. The American Community Survey numbers are not official Census counts but are provided to communities so that they may have a greater understanding of population changes within their jurisdictions. The official Census data available in Hazus v6 (representing 2020 data) was used to support analyses for the purposes of this plan.

3.4.1 Vulnerable Populations

Federal guidelines require HMPs to 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. Identifying concentrations of vulnerable populations can assist communities in targeting preparedness, response, and mitigation actions. Vulnerable populations for this HMP include the following:

- Persons aged 65 and over or under 5
- Those identified as living below the poverty threshold (households with two adults and two children with an annual household income below $25,926 per year)
- People with physical or mental disabilities
- Non-English speakers

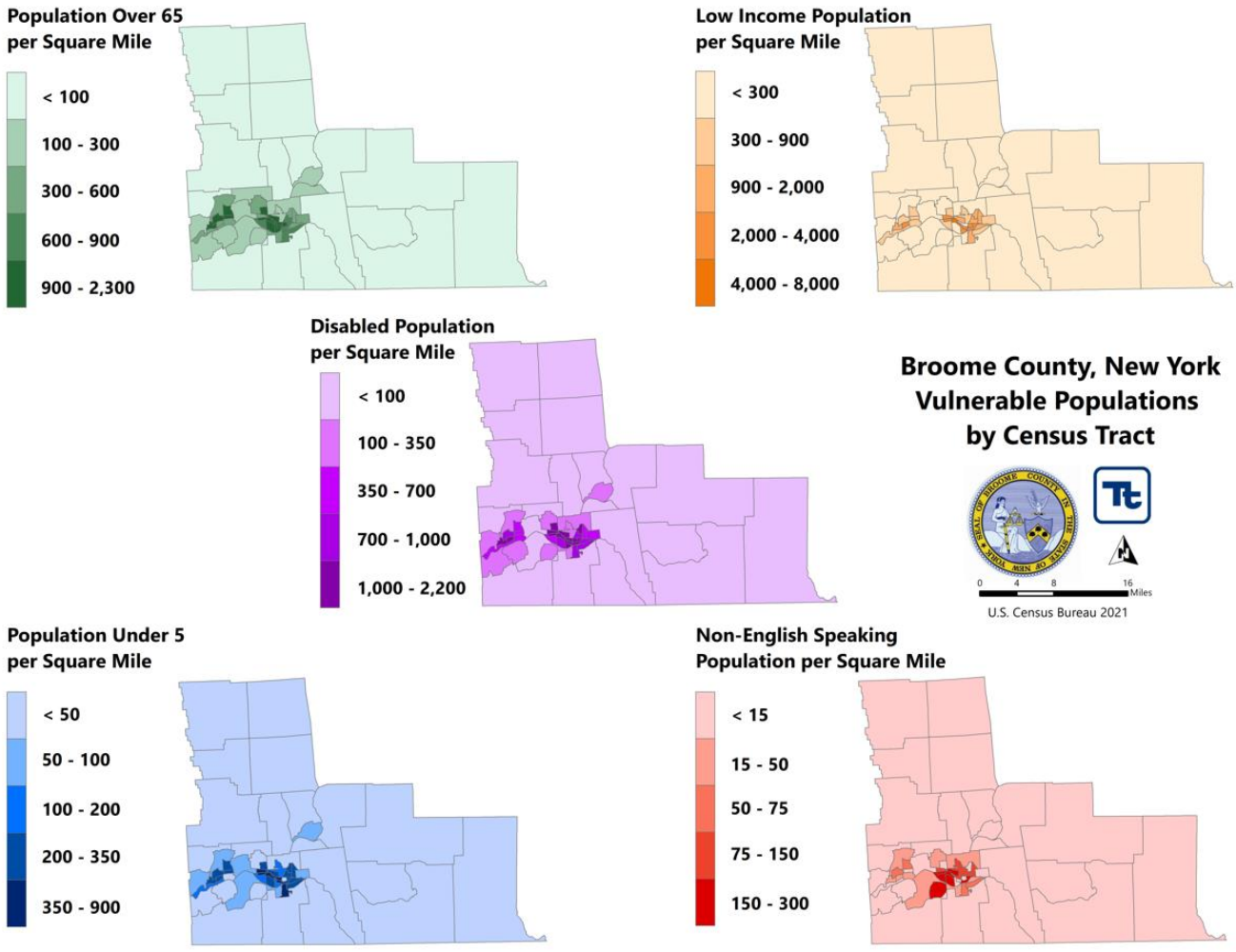
Populations with a higher level of vulnerability can be more seriously affected during an emergency or disaster. Vulnerable populations with a higher level of risk have unique needs that must be considered by public officials to help ensure their safety. Table 3-4 and Figure 3-6 summarize available data on socially vulnerable populations in Broome County.

Table 3-4. Broome County Vulnerable Populations Statistics

Municipality	Total Population	Pop. 65+	Pop. < 5	Non-English Speaking	Disability	Poverty Level
Barker (T)	2,509	465	142	49	342	537
Binghamton (C)	47,969	7,642	2,588	1,051	9,632	14,894
Binghamton (T)	4,617	822	206	5	710	454
Chenango (T)	10,959	2,236	861	37	1,359	1,292
Colesville (T)	4,868	1,299	161	0	812	345
Conklin (T)	5,008	1,116	227	182	637	584
Deposit (V)*	1,387	110	49	0	123	153
Dickinson (T)	5,100	829	32	63	611	345
Endicott (V)*	13,667	2,337	664	107	2,544	3,535
Fenton (T)	6,429	1,223	518	49	828	962
Johnson City (V)*	15,343	2,864	821	356	2,718	2,938
Kirkwood (T)	5,481	1,045	116	61	736	768
Lisle (T)	2,691	373	157	0	405	207
Lisle (V)*	348	48	4	0	45	23
Maine (T)	5,168	1,141	311	0	927	873
Nanticoke (T)	1,581	384	68	0	265	123
Port Dickinson (V)*	1,699	235	77	26	208	223
Sanford (T)	2,239	469	27	0	243	91
Triangle (T)	2,809	300	40	0	298	251
Union (T)	56,138	6,306	1,300	301	3,358	2,549
Vestal (T)	29,313	5,068	1,261	876	3,025	3,318
Whitney Point (V)*	960	221	32	0	168	340
Windsor (T)	5,804	1,002	452	0	713	458
Windsor (V)*	907	217	28	2	150	109
Broome County (Total)	**198,683**	**37,752**	**10,142**	**3,165**	**30,857**	**35,372**

Source: American Community Survey 5-Year Estimates 2017-2021

Figure 3-6. Distribution of Socially Vulnerable Populations in Broome County, New York



Age

Children are vulnerable to hazard events because they are dependent on others to safely access resources during emergencies and may experience increased health risks from hazard exposure. Older adults experience more casualties during and after disasters than other age groups. Factors include a greater prevalence of chronic conditions, multi-morbidity, cognitive impairment, and medication concerns during disasters; greater dependence on assistive devices (i.e., walkers, glasses); support requirements from caregivers and others during disasters; and the likelihood of social isolation (American Red Cross 2020).

According to the 2017-2021 American Community Survey 5-Year Estimates, the median age in Broome County is 39.7 years. Of the County's total population, 19 percent (37,752 persons) is 65 or older and 5.1 percent (10,142 persons) are under the age of 5 (U.S. Census Bureau 2023). Figure 3-6 shows the distribution of persons over age 65 under the age of 5 in Broome County.

Income

The 2017-2021 American Community Survey 5-Year Estimates show a median household income in Broome County of $53,982. The U.S. Census Bureau identifies households with two adults and two children with an annual household income below $25,926 per year as *low-income* (U. S. Census 2021). The American Community Survey 5-Year Estimates indicates that 17.8 percent (35,372 persons) of the County's population live below the poverty level (U.S. Census Bureau 2023). Refer to Figure 3-6 which illustrates the low-income population density in Broome County.

The spatial U.S. Census data for household income provided in Hazus includes two ranges (less than $10,000 and $10,000-$20,000/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 2020 U.S. Census Bureau data. The difference is not believed to be significant for this planning effort; therefore, for the risk assessment, the 2020 U.S. Census data in Hazus is reported.

People with Physical or Mental Disabilities

According to the U.S. Centers for Disease Control, and Prevention (CDC), a disability is a condition of the body or mind that makes it more difficult for the person with the condition to do certain activities and interact with the world around them (CDC 2020). Cognitive impairments can increase the level of difficulty that individuals face during an emergency and reduce their capacity to respond to emergency information. Individuals with a physical disability can face issues related to mobility, sight, hearing, or reliance on specialized medical equipment. According to the 2017-2021 American Community Survey 5-Year Estimates, 15.5 percent of Broome County residents (30,857 persons) are living with a disability.

Figure 3-6 shows the geographic distribution of disabled individuals throughout Broome County. This includes individuals with hearing, vision, cognitive, ambulatory, self-care, and independent living difficulties.

Non-English Speakers

Individuals who do not have a working proficiency in English can have difficulty understanding disaster-related information being conveyed to them. Cultural differences also can add complexity to how information should be conveyed to populations with limited proficiency in English (CDC 2021). According to the 2017-2021 American Community Survey 5-Year Estimates, 10.5 percent of the County's population over the age of 5 primarily speaks a language other than English at home. Figure 3-6 shows the geographic distribution of individuals who speak a language other than English.

The Social Vulnerability Index

> Social vulnerability refers to a community's capacity to prepare for and respond to the stress of hazardous events ranging from natural disasters to human-caused threats.

The CDC Social Vulnerability Index (SVI) is a recent tool used to identify socially vulnerable populations based on 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, including poverty, lack of vehicle access, and crowded housing, and groups them into four related themes. Figure 3-7 through Figure 3-9 displays information for Broome County from the 2020 SVI.

Figure 3-7. CDC Social Vulnerability by Theme for Broome County (2020)

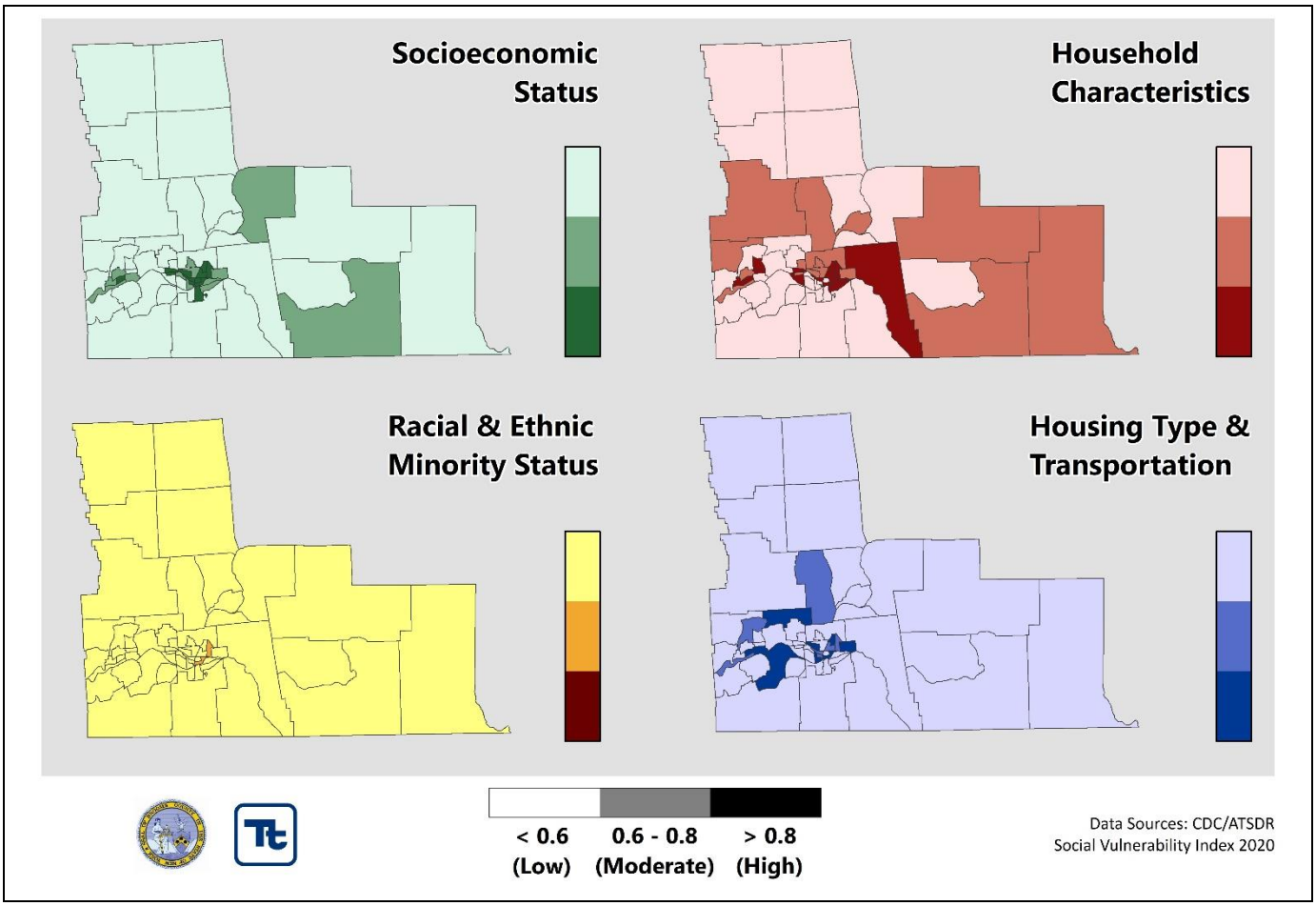


Figure 3-8. Overall SVI Rating for Broome County by Census Tract (2020)

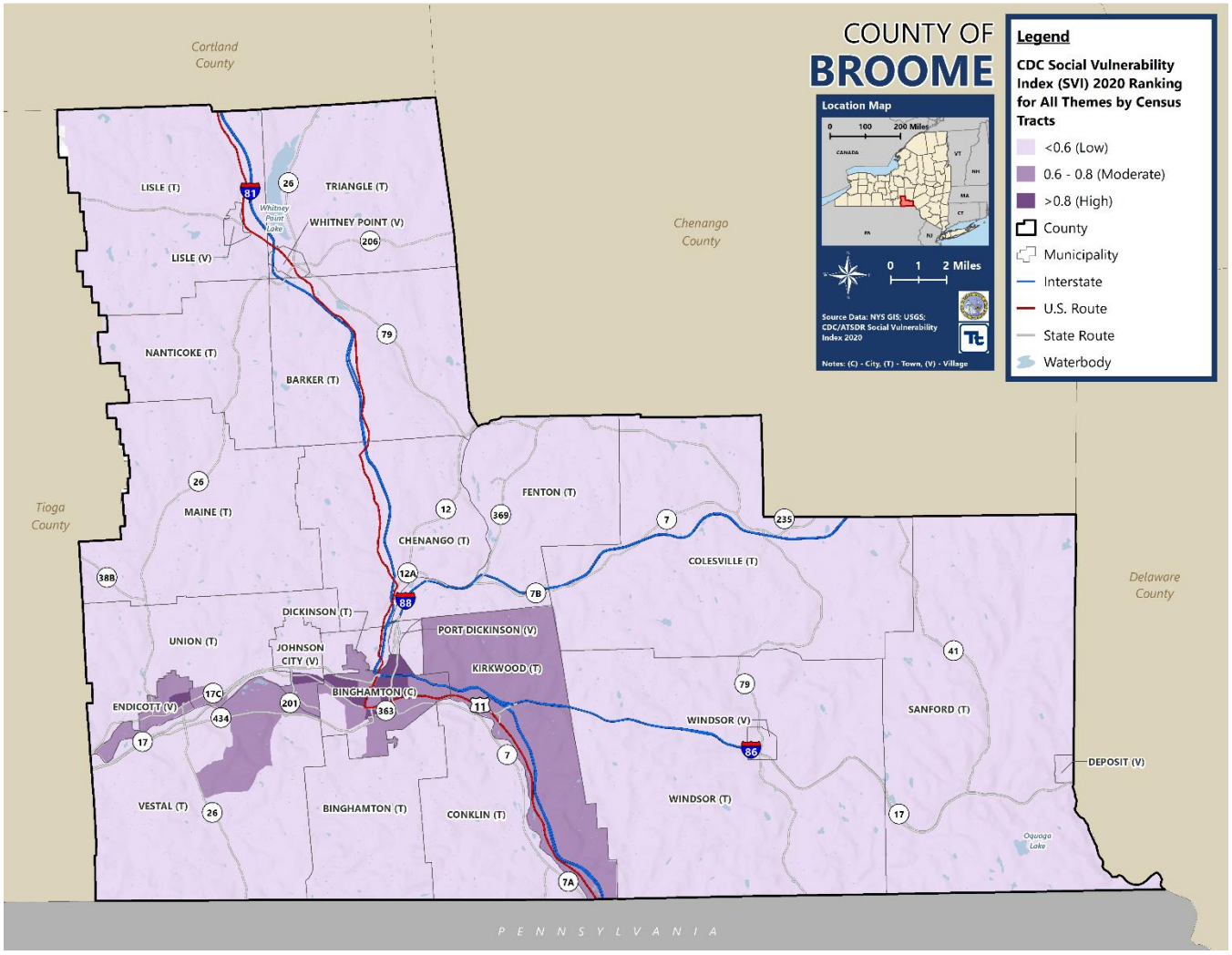
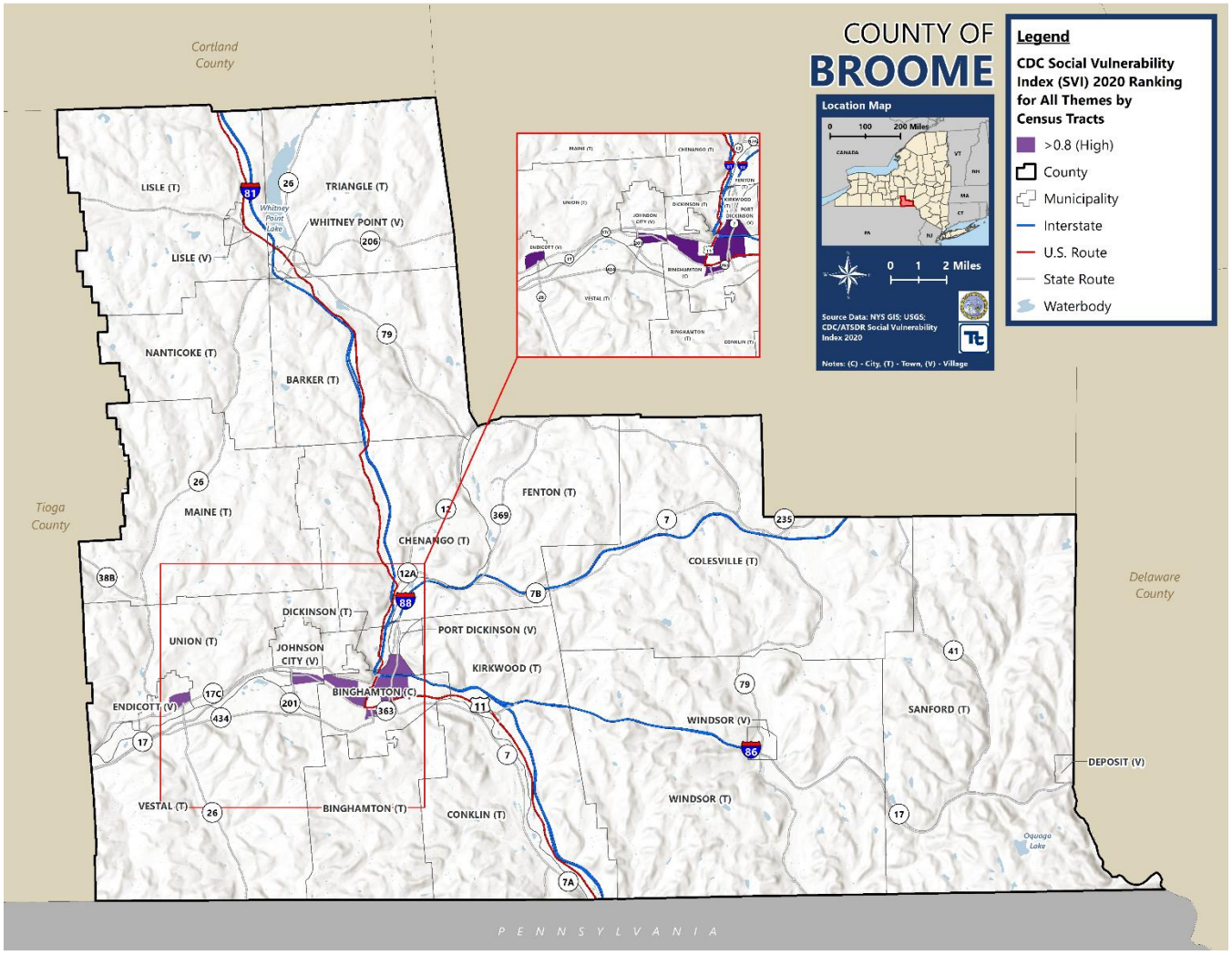


Figure 3-9. High SVI Ranking for Broome County by Census Tract (2020)



3.4.2 General Building Stock

According to the 2022 ACS, there are 93,205 housing units located in Broome County. A housing unit is a house, apartment, mobile home, or trailer, a group of rooms, or a single room intended for occupancy as separate living quarters. A household includes all the people who occupy a housing unit as their usual residence. The median price of a single-family home in Broome County was estimated at $139,200 based on the 2022 ACS (U.S. Census Bureau 2023).

For this update, the default general building stock in Hazus v6.0 was used to estimate the number of structures and replacement cost value (structure and contents) for Broome County. The replacement cost values in Hazus are based on RSMeans 2022 valuations. An inventory of 93,810 structures was developed based on available tax data and spatial data. These structures account for a replacement cost value of approximately $89 billion (**Error! Reference source not found.**).

Table 3-5. Building Stock Count and Replacement Cost Value (RCV) by Occupancy Class

Jurisdiction	Residential		Commercial		Industrial	
	Building Count	Total Replacement Cost Value (Structure + Contents)	Building Count	Total Replacement Cost Value (Structure + Contents)	Building Count	Total Replacement Cost Value (Structure + Contents)
Barker (T)	1,210	$364,501,430	19	$34,047,709	12	$21,608,070
Binghamton (C)	23,674	$18,135,856,741	1,240	$5,199,417,505	116	$955,392,349
Binghamton (T)	2,079	$720,373,103	15	$43,814,987	9	$8,850,208
Chenango (T)	4,865	$1,916,128,491	258	$1,334,454,521	10	$20,114,703
Colesville (T)	2,309	$933,928,458	68	$80,333,075	5	$5,534,776
Conklin (T)	2,346	$701,244,861	116	$478,352,012	31	$236,074,851
Deposit (V)	420	$171,370,811	33	$39,291,840	7	$31,712,881
Dickinson (T)	1,340	$494,751,219	24	$43,827,019	4	$18,061,940
Endicott (V)	6,532	$4,542,772,337	375	$769,599,746	39	$300,855,145
Fenton (T)	2,997	$827,020,183	86	$126,347,887	17	$138,305,082
Johnson City (V)	7,317	$7,946,312,434	486	$8,692,446,963	34	$331,571,470
Kirkwood (T)	2,417	$1,233,017,683	134	$737,842,903	34	$457,324,161
Lisle (T)	1,020	$281,781,935	9	$12,546,120	1	$3,800,641
Lisle (V)	119	$41,873,006	10	$12,473,264	0	$0
Maine (T)	2,325	$724,745,295	69	$500,824,537	8	$39,991,938
Nanticoke (T)	722	$217,460,578	15	$26,876,723	2	$818,848
Port Dickinson (V)	813	$254,527,516	27	$28,613,824	2	$9,784,378
Sanford (T)	1,340	$425,559,621	32	$39,168,613	4	$3,366,430
Triangle (T)	867	$256,816,589	11	$11,182,833	3	$5,635,178
Union (T)	12,369	$8,887,583,686	457	$1,664,702,399	107	$4,446,871,128
Vestal (T)	8,420	$6,042,098,149	855	$5,226,900,266	52	$213,704,991
Whitney Point (V)	380	$290,544,931	41	$76,852,844	4	$5,270,248
Windsor (T)	2,590	$769,062,003	36	$45,409,741	5	$9,489,762
Windsor (V)	400	$342,596,968	15	$17,633,922	2	$2,348,825
Broome County (Total)	**88,871**	**$56,521,928,028**	**4,431**	**$25,242,961,251**	**508**	**$7,266,488,005**

Source: Broome County GIS & Mapping Services; RS Means 2022

The distribution of value density for residential, commercial, and industrial buildings in Broome County is shown in Figure 3-10 through Figure 3-12. Value density is the dollar value of structures per unit area, including building content value. Generally, contents for residential structures are valued at about 50 percent of the building's value. For commercial facilities, the value of the content is generally about equal to the building's structural value. Actual content value varies widely depending on the usage of the structure. Value distribution maps can assist communities in visualizing areas of high exposure and in evaluating aspects of the planning area in relation to specific hazard risks.

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

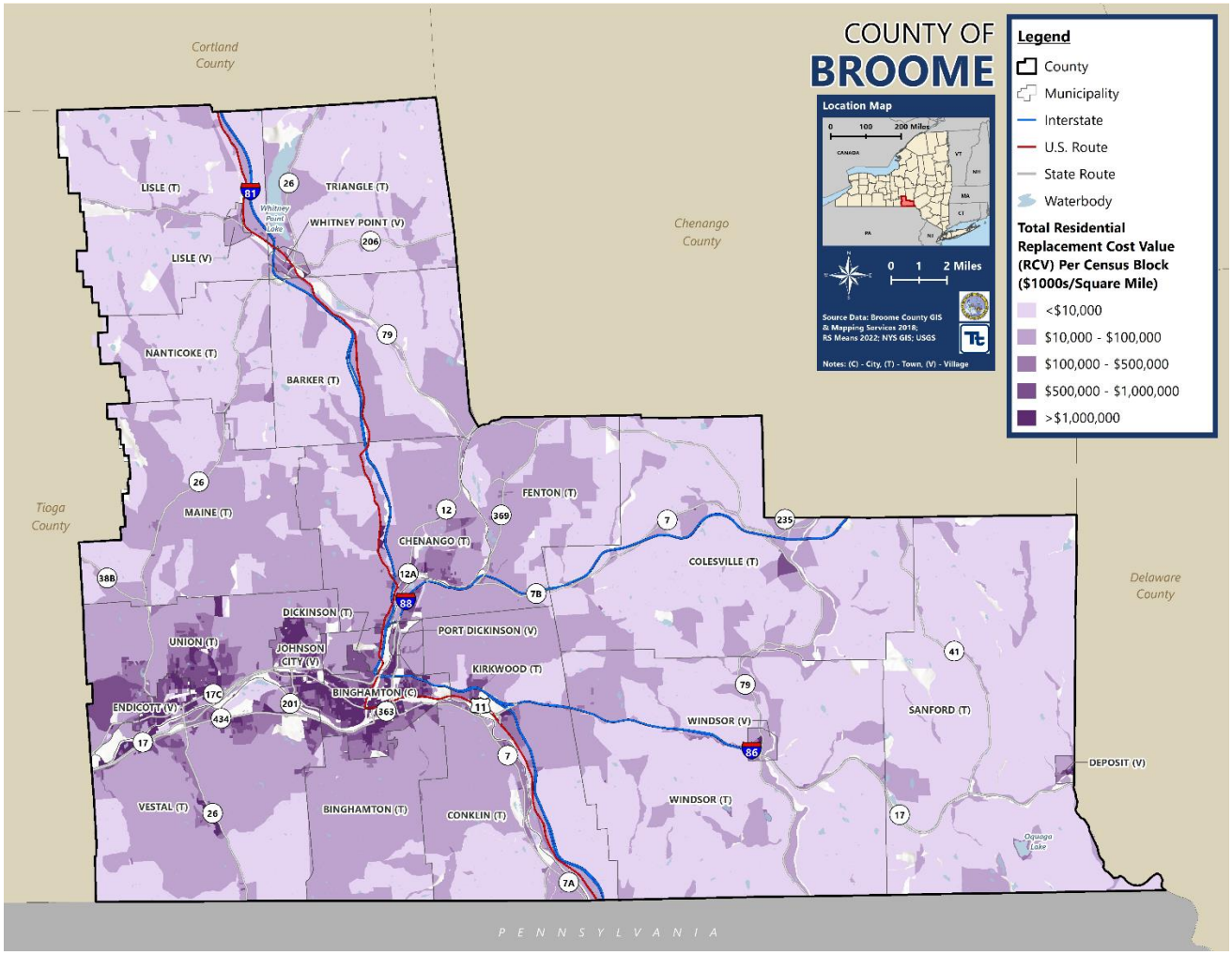


Figure 3-11. Distribution of Commercial Building Stock Value Density in Broome County

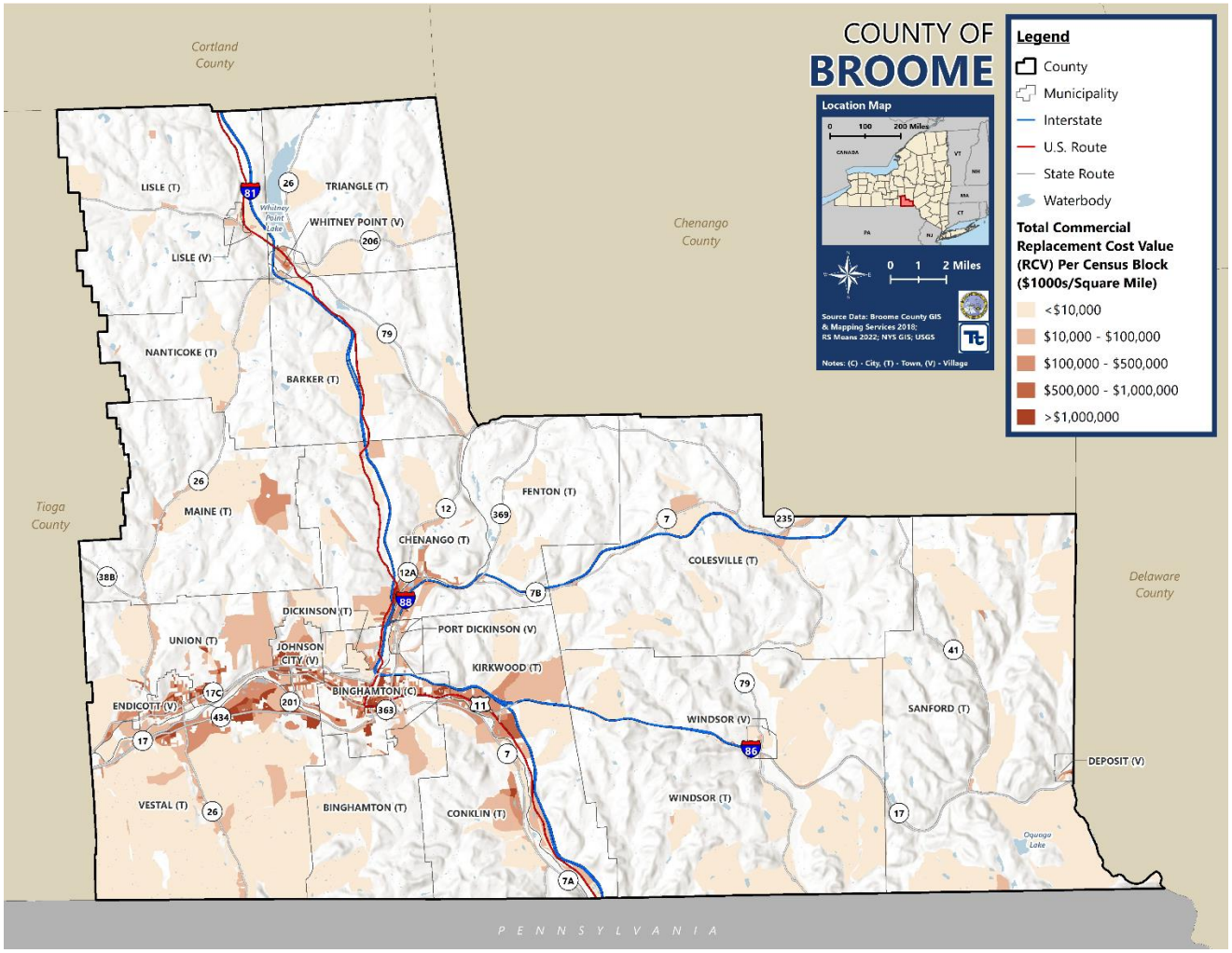
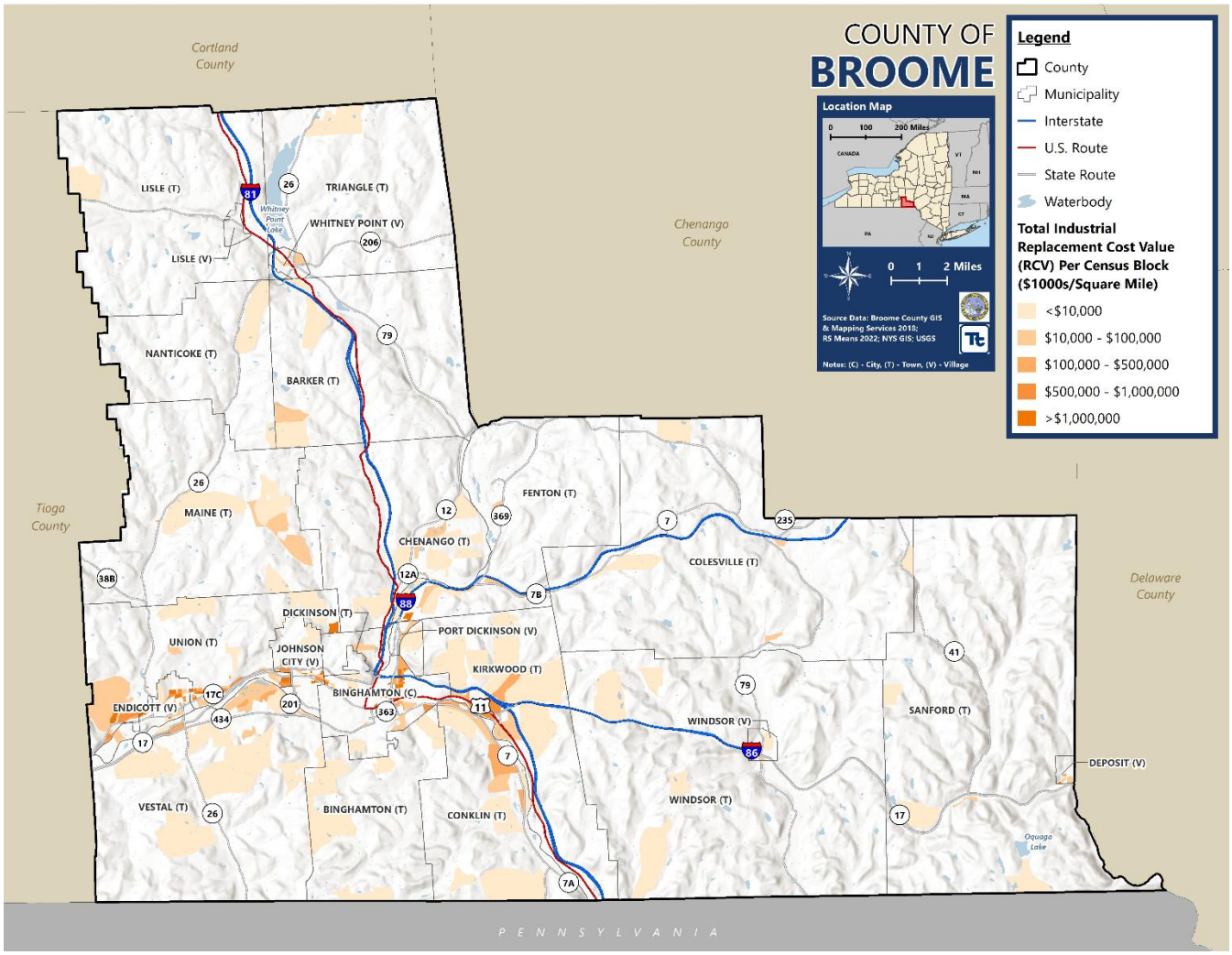


Figure 3-12. Distribution of Industrial Building Stock Value Density in Broome County



3.5 TRENDS

This plan provides a general overview of population, land use, and types of development occurring within the planning area. 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 infrastructure.

3.5.1 Land Use Trends

Federal guidelines require HMPs to consider land use trends, which can impact the need for and prioritization of mitigation options over time. Land use trends significantly impact exposure and vulnerability to various hazards. For example, significant development in a hazard area increases the building stock and population exposed to that hazard. Land use regulatory authority in New York State

is vested in towns, villages, and cities. However, many development and preservation issues transcend location-based political boundaries.

Between 2006 and 2012, approximately 12,800 acres of agricultural land were lost, with approximately half no longer farmed and now considered vacant and 6,600 acres converted to residential uses. This conversion of agricultural land to residential land uses is a concern because, on average, residential land uses do not cover their costs in municipal services (Broome County Comprehensive Plan 2013). Residential land use requires more impervious surface than agricultural land, which can have an impact on flooding patterns throughout the County.

3.5.2 Economic Trends

The following sections present an overview of the county economy including agriculture, retail trade, tourism, industrial, government, leisure and hospitality, and manufacturing.

Agriculture

The 2022 U.S. Department of Agriculture (USDA) Census of Agriculture reports 440 farms in Broome County with a total land area of 70,489 acres and average size of 160 acres. The market value of agricultural products sold from county farms totaled $54.11 million, with total sales averaging $122,982 per farm. Crop sales accounted for $15.85 million (29.3 percent) of total sales and livestock sales accounted for $38.26 million (70.7 percent) of total sales. The lead agricultural products sold were milk from cows, cattle and calves, and other crops and hay (US Department of Agriculture 2024).

Economy

The U.S. Census Bureau's County Business Pattern provides an annual series of economic data by industry covering the majority of the country's economic activity. According to the 2021 Broome County Business Pattern, the county had a total of 4,003 business establishments. The retail trade industry had the greatest number of establishments in the county, making up 15.7 percent of all businesses. The next highest category was "other services (except public administration)," making up 12.3 percent of all businesses (these services include equipment and machinery repair, providing dry cleaning and laundry services, personal care services, pet care services, death services, promoting or administering religious activities, and other similar services). The third largest industry category was "accommodation and food services," making up 12.2 percent of all businesses (U.S. Census 2021). Table 3-6 provides 2021 industry and employment information in Broome County.

Table 3-6. Economic Census for Broome County

Industry	Number of Establishments	Annual Payroll ($1,000)	Number of Employees*
Accommodation and food services	489	152,637	7,144
Administrative and support and waste management and remediation	190	160,701	4,280
Agriculture, forestry, fishing, and hunting	7	310	12
Arts, entertainment, and recreation	71	15,050	522
Construction	395	228,841	2,932
Educational services	38	16,283	660
Finance and insurance	199	157,535	2,064
Health care and social assistance	483	886,126	16,370
Information	76	62,952	1,648
Management of companies and enterprises	29	117,211	1,366
Manufacturing	148	430,815	6,390
Mining, quarrying, and oil and gas extraction	6	1,072	15
Other services (except public administration)	491	72,651	2,525
Professional, scientific, and technical services	294	212,800	3,691
Real estate and rental and leasing	144	39,286	978
Retail Trade	631	320,488	10,359
Transportation and warehousing	103	72,160	1,642
Utilities	16	65,614	794
Wholesale Trade	191	208,113	3,791
Total	**4,003**	**3,220,656**	**67,158**

Source: U.S. Census 2021

3.5.3 Population Trends

Population trends can provide a basis for making decisions on the type of mitigation approaches to be considered 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.

Although Broome County's population has not undergone any notable change since the last hazard mitigation plan, there is a current trend of slight population decline as illustrated in Table 3-3, which shows the annual population change from 2010 to 2020. Two Census Bureau products were used to assess population trends. The 2020 Census is the official population count of a community, which is performed every 10 years. The American Community Survey is performed on a more frequent basis to provide updated population and demographic information to communities.

Overall, most municipalities in Broome County decreased slightly in total population from the 2010 Census to the 2020 Census. Based on historical data, population projections have been created that show Broome County's population continuing to decrease. Broome County's total population is decreasing, although the elderly demographic is increasing. The youth population (individuals aged 5 and under) decreased from 2010 to 2020. These trends mean that further consideration may have to be given to an older demographic during planning processes to ensure the capability to accommodate a higher percentage of socially vulnerable demographic groups.

The Broome County Comprehensive Plan noted that Binghamton University's student population can affect the population statistics of some municipalities. Population and median age figures are skewed in several instances due to the phenomenal growth of Binghamton University over the past decade. Because the U.S. Census is calculated based on residence on April 1, students at the University are counted as residents. This effect is most pronounced in the median age for Vestal, which is substantially lower than other suburban towns in Broome County (Broome County Comprehensive Plan 2013).

The U.S. Census Bureau estimates that Broome County's population in 2020 was 198,683, a roughly 1 percent decrease from the 2010 population of 200,600. Between 1970 and 2020, the county experienced a nearly continual loss in population; from 2000 to 2010 had a small population growth of 249 persons. The largest 10-year decrease was between 1990 and 2000 when the county experienced a 5.6 percent population decrease (11,901 persons) (U.S. Census 2022).

3.5.4 Future Growth and Development

Commercial and residential development is occurring around Broome County, which can bring increased capacity for the population as well as economic benefit. Municipalities with significant amounts of new development include the City of Binghamton, the Town of Binghamton, the Town of Sanford, and the Town of Union. Some of this development is occurring in areas that are potentially vulnerable to natural hazards, such as flooding, wildfires, and earthquakes. Increased development in floodplains or other hazard-prone areas can increase the potential for greater damage during natural hazard events. An understanding of population and land use and types of development occurring within the planning area can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place to protect human health and community infrastructure.

Details regarding development specific to each participating municipality are provided in Volume II (Jurisdictional Annexes), along with locations of development as indicated on the hazard area extent and location maps.

Table 3-7 shows historical population growth and decline and future population projections for Broome County. Over the next 36 years, the population of Broome County is anticipated to experience further decline.

Table 3-7. Broome County Population Growth

Year	Population Historic Population Totals	Change in Population
1970	222,065	-
1980	213,850	-8,215
1990	212,252	-1,598
2000	200,351	-11,901
2010	200,600	+249
2020	198,683	-1,917
Population Projections		
2024	189,737	-
2026	188,809	-928
2028	187,884	-925
2030	186,950	-934
2032	186,076	-874
2034	185,204	-872
2036	184,436	-768
2038	183,782	-654
2040	183,176	-606

Source: Cornell University 2018; U.S. Census 2010, U.S. Census 2020, U.S. Census 2022

3.6 CRITICAL FACILITIES AND COMMUNITY LIFELINES

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. As defined for this HMP, critical facilities include essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities, and hazardous material facilities.

As defined by FEMA, community lifelines are facilities or services that allow for the continuity of operations of critical facilities before, during, and after a disaster and are essential to human health and safety or economic security. 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:

- Safety and Security
- Food, Hydration, Shelter
- Health and Medical
- Energy (power and fuel)
- Communications
- Transportation
- Hazardous Materials
- Water Systems

A comprehensive inventory of critical facilities and lifelines in Broome County was developed from various sources, including input from the Planning Partnership. They include critical facilities and community

lifelines provided and reviewed by Broome 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 facilities owned or leased by the state. Table 3-8 summarizes the number of community lifelines identified, by jurisdiction and lifeline category. Focusing on protecting lifelines, preventing and mitigating potential impacts, and building back stronger will increase the resilience of Broome County and its jurisdictions.

Table 3-8. Community Lifelines in Broome County

Jurisdiction	Safety and Security	Food, Hydration, Shelter	Health and Medical	Energy	Communica-tions	Transporta-tion	Hazardous Materials	Water Systems	Total
Barker (T)	5	-	-	-	2	18	1	2	28
Binghamton (C)	34	15	12	-	12	73	93	7	246
Binghamton (T)	6	2	-	-	13	10	6	5	42
Chenango (T)	18	14	4	-	3	28	22	31	120
Colesville (T)	13	7	2	-	-	50	1	15	88
Conklin (T)	12	10	-	-	-	14	9	12	57
Deposit (V)	5	-	-	-	-	2	-	5	12
Dickinson (T)	24	7	1	-	1	6	6	3	48
Endicott (V)	9	9	4	-	1	9	2	4	38
Fenton (T)	7	8	-	-	-	16	9	22	62
Johnson City (V)	10	10	4	-	2	22	2	4	54
Kirkwood (T)	10	9	-	-	5	54	25	7	110
Lisle (T)	5	-	1	-	2	15	1	7	31
Lisle (V)	2	1	-	-	-	1	-	-	4
Maine (T)	9	3	2	-	2	18	3	21	58
Nanticoke (T)	6	3	-	-	-	7	3	8	27
Port Dickinson (V)	5	2	-	-	-	5	1	1	14
Sanford (T)	1	-	-	-	1	27	-	1	30
Triangle (T)	5	6	-	-	-	10	-	5	26
Union (T)	23	21	4	-	1	32	7	7	95
Vestal (T)	17	23	5	-	12	50	18	14	139
Whitney Point (V)	6	4	-	-	1	10	-	4	25
Windsor (T)	4	3	1	-	2	30	1	10	51
Windsor (V)	7	4	1	-	-	9	-	2	23
Broome County (TOTAL)	**243**	**161**	**41**	**0**	**60**	**516**	**210**	**197**	**1,428**

Sources: Broome County 2023; Hazus v6.0

Note: The critical facilities and community lifelines included in the 2024 HMP were provided and reviewed by Broome 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.

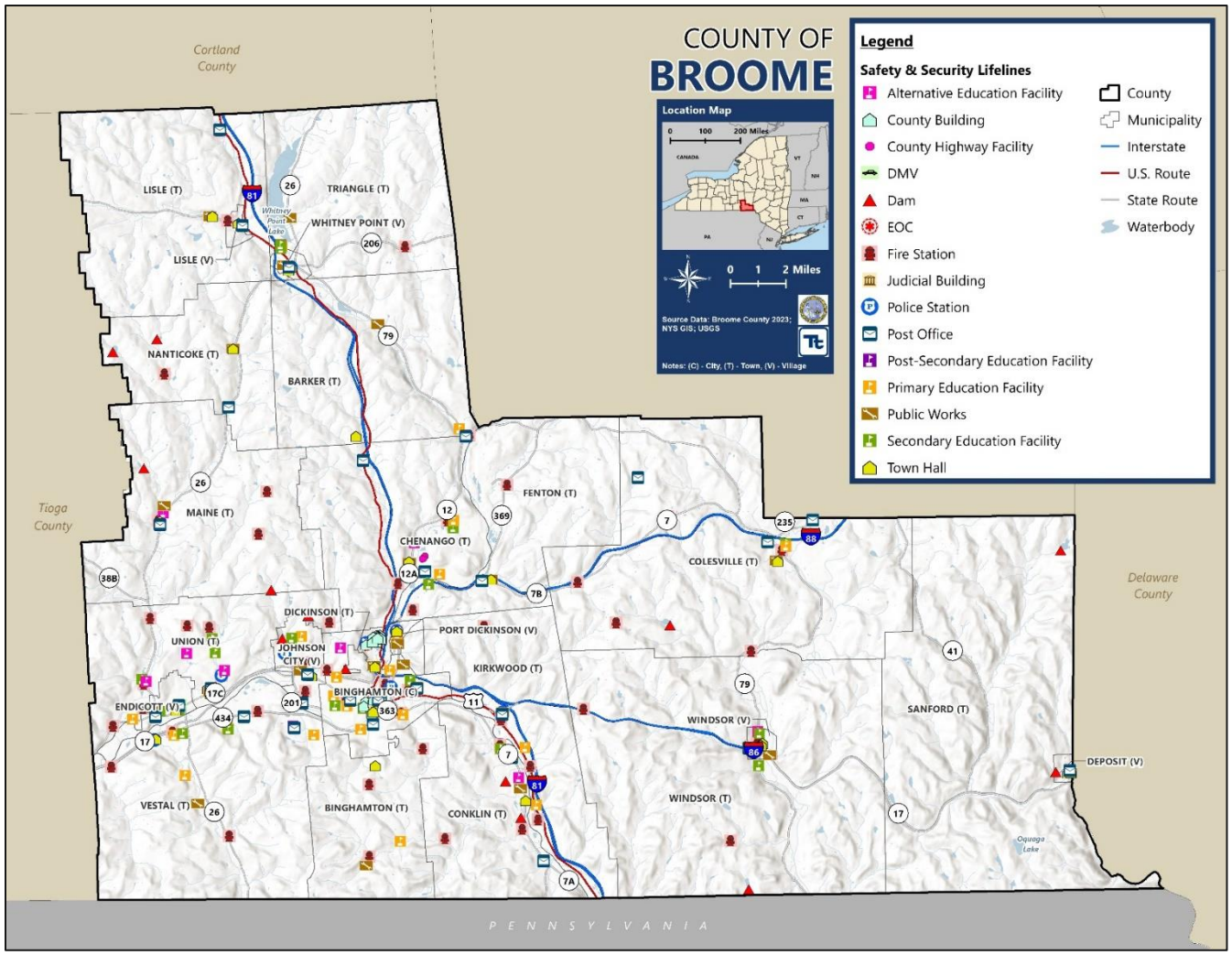
3.6.1 Safety and Security

Safety and security community lifelines include facilities related to law enforcement/security, fire service, search and rescue, government service, and community safety facilities. For the purpose of this HMP update, 243 safety and security facilities were identified, consisting of alternative education facilities, county buildings, county highway facilities, dams, department of motor vehicles facilities, emergency

operation centers, fire stations, jurisdictional buildings, police stations, post offices, post-secondary education facilities, primary education facilities, public works facilities, secondary education facilities, and town halls.

Figure 3-13 shows the location of the safety and security facilities throughout the County. Additional detail on two types of safety and security lifelines—dams and levees—is provided in the subsections that follow.

Figure 3-13. Safety and Security Lifelines in Broome County



Dams

According to the Bureau and Flood Protection and Dam Safety at the NYSDEC Division of Water, there are three hazard classifications of dams in New York State, based on the potential for downstream damage if the dam were to fail:

- *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 cause significant economic loss or serious environmental damage. Failure or mis-operation would result in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or other impacts. Class B dams are often located in predominantly rural or agricultural areas but could be located 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 extensive economic loss. This is a downstream hazard classification 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 (NYS DEC n.d.).

For this plan, NYSDEC data from the New York State GIS Clearinghouse is used. The GIS data lists 163 dams located in Broome County: 23 high hazard, 13 intermediate hazard, 116 low hazard, and 11 negligible or no hazard dams. Table 3-9 displays the high-hazard dams in Broome County, using information from NYSDEC. Figure 3-14 displays the dam inundation areas in Broome County for all classifications of dams.

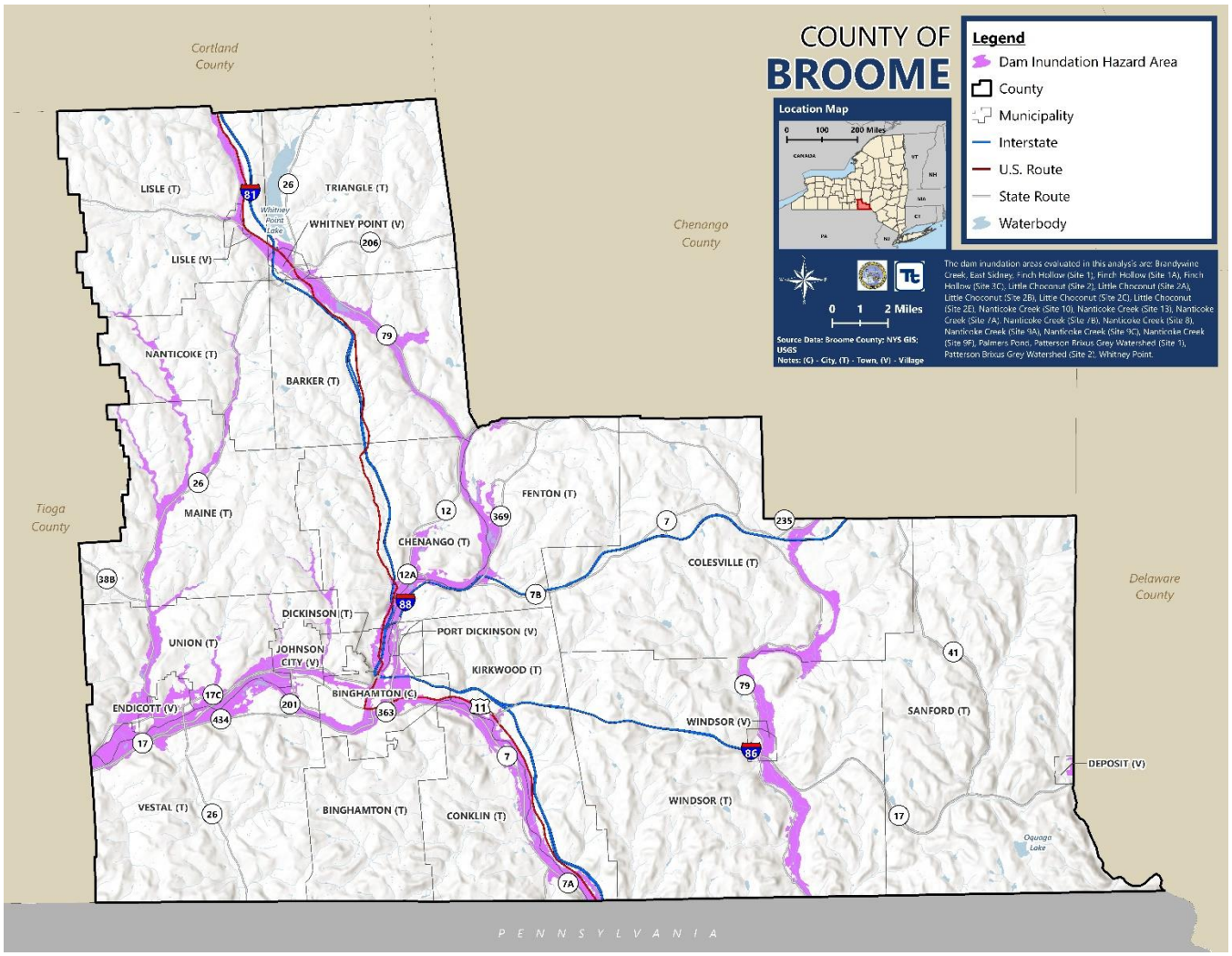
Table 3-9. High Hazard Dams in Broome County

Dam Name	Location
Brandywine Creek Site 1 Dam	Village of Port Dickinson
Broome Corporate Park Pond Dam #2	Town of Conklin
Finch Hollow Site 1 Dam	Village of Johnson City
Finch Hollow Site 2 Dam	Town of Dickinson
Finch Hollow Site 3C Dam	City of Binghamton
Little Choconut Site 1A Dam	Town of Maine
Little Choconut Site 2a Dam	Town of Union
Little Choconut Site 2b Dam	Town of Maine
Little Choconut Site 2c Dam	Town of Maine
Little Choconut Site 2e Dam	Town of Maine
Nanticoke Creek Site 10 Dam	Town of Nanticoke
Nanticoke Creek Site 13 Dam	Town of Maine
Nanticoke Creek Site 3 Dam	Town of Lisle
Nanticoke Creek Site 7a Dam	Town of Maine
Nanticoke Creek Site 8 Dam	Town of Nanticoke
Nanticoke Creek Site 9a Dam	Town of Lisle
Nanticoke Creek Site 9c Dam	Town of Lisle
Nanticoke Creek Site 9e Dam	Town of Nanticoke

Dam Name	Location
Oquaga Creek State Park Dam	Town of Sanford
Palmers Pond Dam	Village of Deposit
Patterson Brixius Grey Watershed 1 Dam	Town of Union
Patterson Brixius Grey Watershed 2 Dam	Town of Union
Whitney Point Dam	Town of Triangle

Source: NYSDEC 2017

Figure 3-14. Dam Inundation Areas in Broome County



Levees

USACE and FEMA both have oversight roles for levees in the United States:

- USACE is responsible for addressing issues related to levee operation and maintenance, risk communication, risk management, and risk reduction under its Levee Safety Program.
- FEMA addresses mapping and floodplain management issues related to levees, and it accredits levees as meeting requirements set forth by the National Flood Insurance Program.

USACE and FEMA may be involved independently with a levee's sponsor (the agency responsible for operating and maintaining the levee). However, when a levee system overlaps both agencies' programs, the sponsor will work with the two agencies jointly. Under both scenarios, the long-term goals are similar: to reduce risk and lessen the consequences of flooding. USACE and FEMA partnering activities related to levees include the following:

- Joint meetings with levee sponsors and other stakeholders
- Integration of levee information into the National Levee Database
- Involvement with state Silver Jackets teams
- Sharing of levee information
- Targeted task forces to improve program alignment

Coordination between USACE and FEMA with regard to levees is standard practice. The agencies coordinate policies, jointly participate in meetings with stakeholders, and participate in multiagency efforts such as the National Committee on Levee Safety, the Federal Interagency Floodplain Management Task Force, and the Silver Jackets Program.

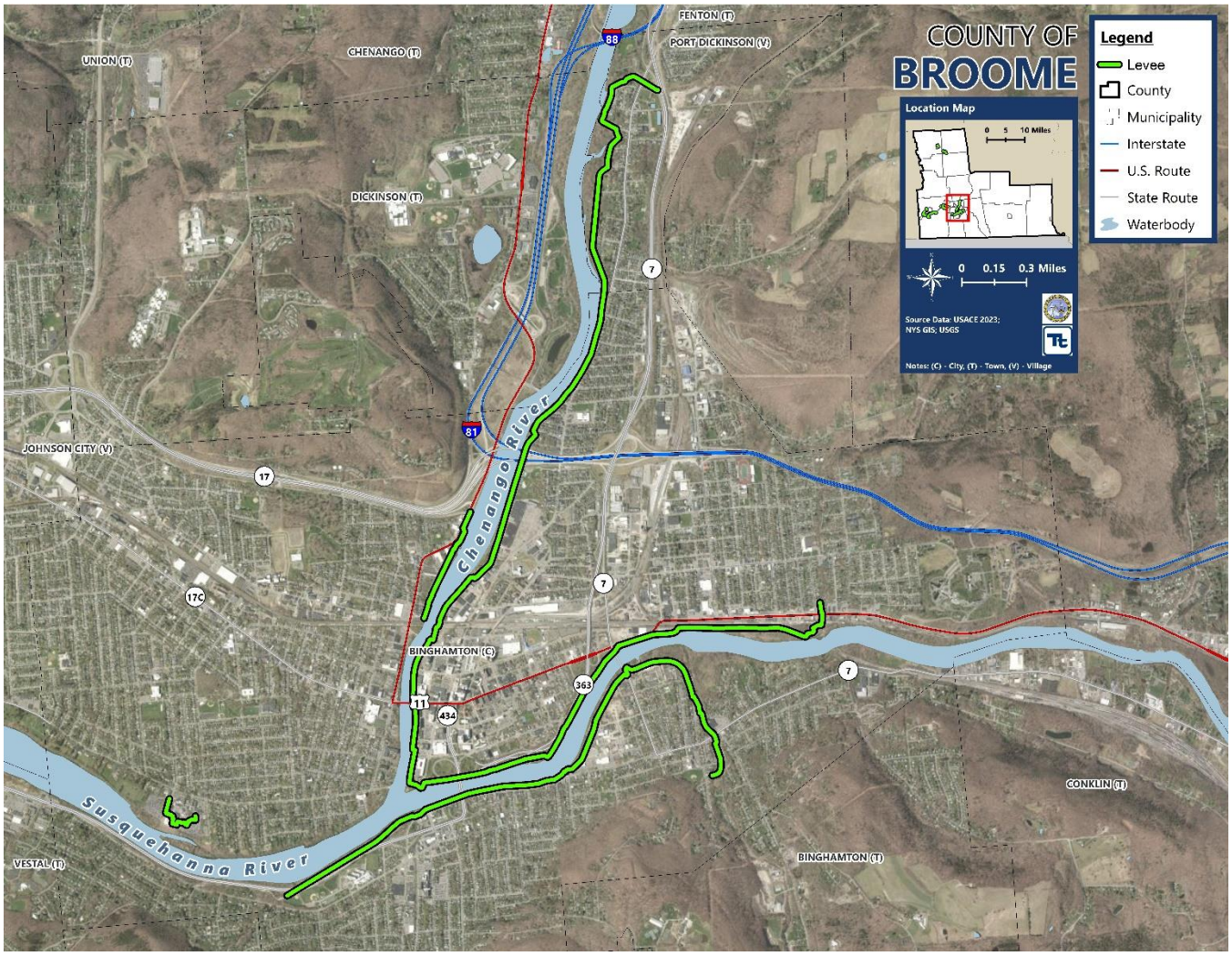
According to the National Levee Database maintained by USACE, there are 12 levee systems in Broome County (USACE 2024). Table 3-10 provides details about those levees, and their locations are shown on Figure 3-15 through Figure 3-18.

Table 3-10. Broome County Levee Systems

Sponsor	System Name	Accredited?	Total Levee Miles	Population at Risk	Buildings at Risk	Property Value	Flood Source	Primary Purpose
NYSDEC Region 7	Lisle	Yes	0.57	202	88	$7.080 million	Tioughnioga River & Dudley Creek	Flood Risk Reduction
NYSDEC Region 7	Whitney Point Village	Yes	1.23	351	204	$51.550 million	Tioughnioga River	Flood Risk Reduction
NYSDEC Region 7; Town of Union	Endicott Northeast	Yes	0.55	253	82	$46.870 million	Nanticoke Creek	Flood Risk Reduction
NYSDEC Region 7	Endicott	Yes	2.84	7,470	2,355	$398 million	Susquehanna River	Flood Risk Reduction
NYSDEC Region 7	Vestal	Yes	2.02	2,191	879	$198 million	Big Chococut Creek, Susquehanna River, Susquehanna River & Willow Run	Flood Risk Reduction
Town of Union	Fairmont Park Flood Control Project	No	0.46	157	44	$18.960 million	Susquehanna River	Flood Risk Reduction
NYSDEC Region 7	Johnson City	Yes	1.19	1,014	354	$59.470 million	Finch Hollow Creek, Little Choconut Creek, Susquehanna River	Flood Risk Reduction
Not Available	Johnson City East	Yes	0.48	462	170	$117 million	Susquehanna River	Flood Risk Reduction
NYSDEC Region 7	Northwest Binghamton	Yes	0.23	2,034	815	$226 million	Chenango River	Flood Risk Reduction
Not Available	Binghamton Lourdes Hospital	No	Not Available	1,248	3	$57.820 million	Susquehanna River	Flood Risk Reduction
NYSDEC Region 7	South Binghamton	Yes	0.99	4,195	1,599	$569 million	Susquehanna River	Flood Risk Reduction
NYSDEC Region 7	Northeast Binghamton	Yes	1.69	14,743	3,550	$2.260 trillion	Susquehanna River, Chamberlin Creek, Chenango River	Flood Risk Reduction

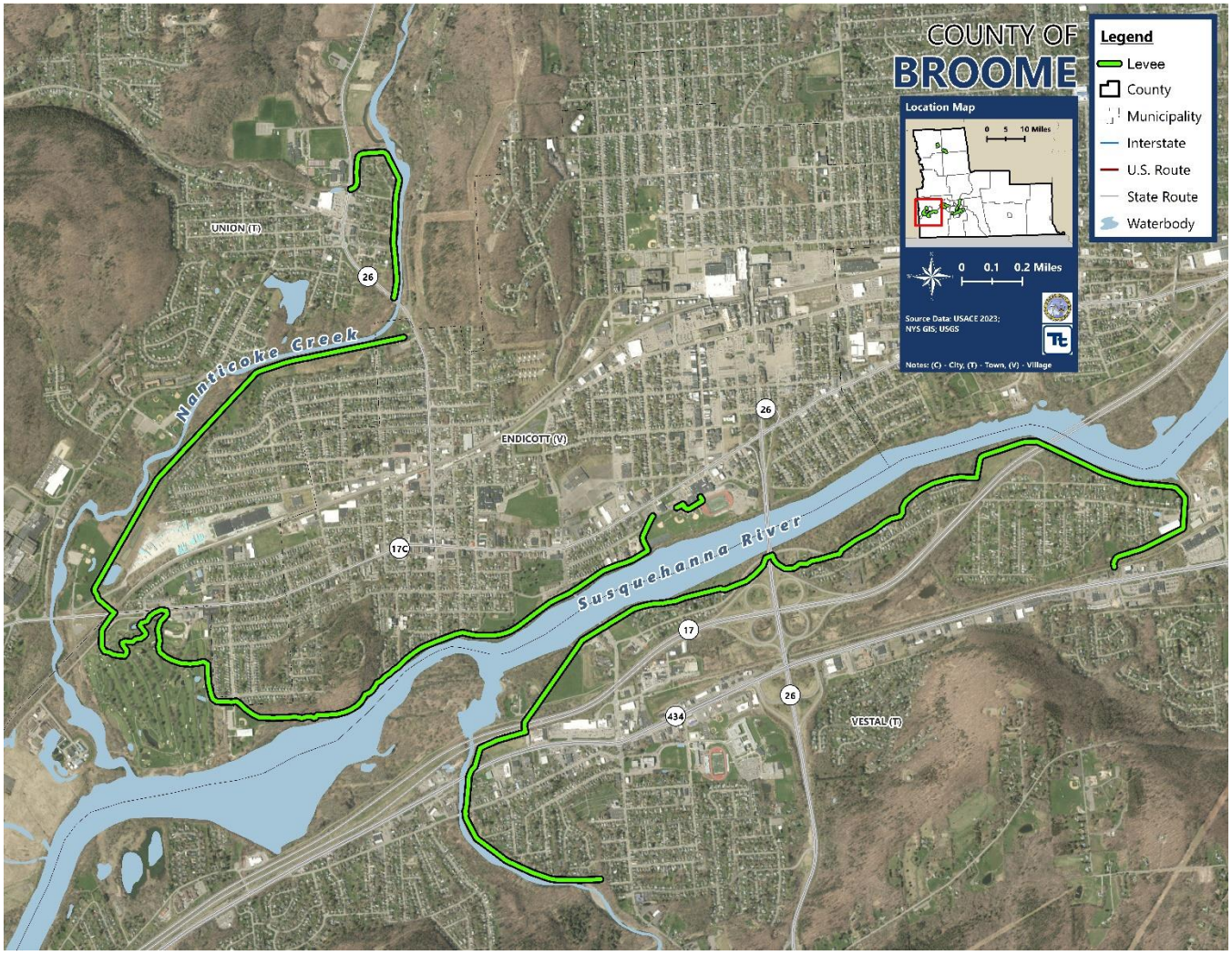
Source: USACE 2024

Figure 3-15. Binghamton-Port Dickinson Levee



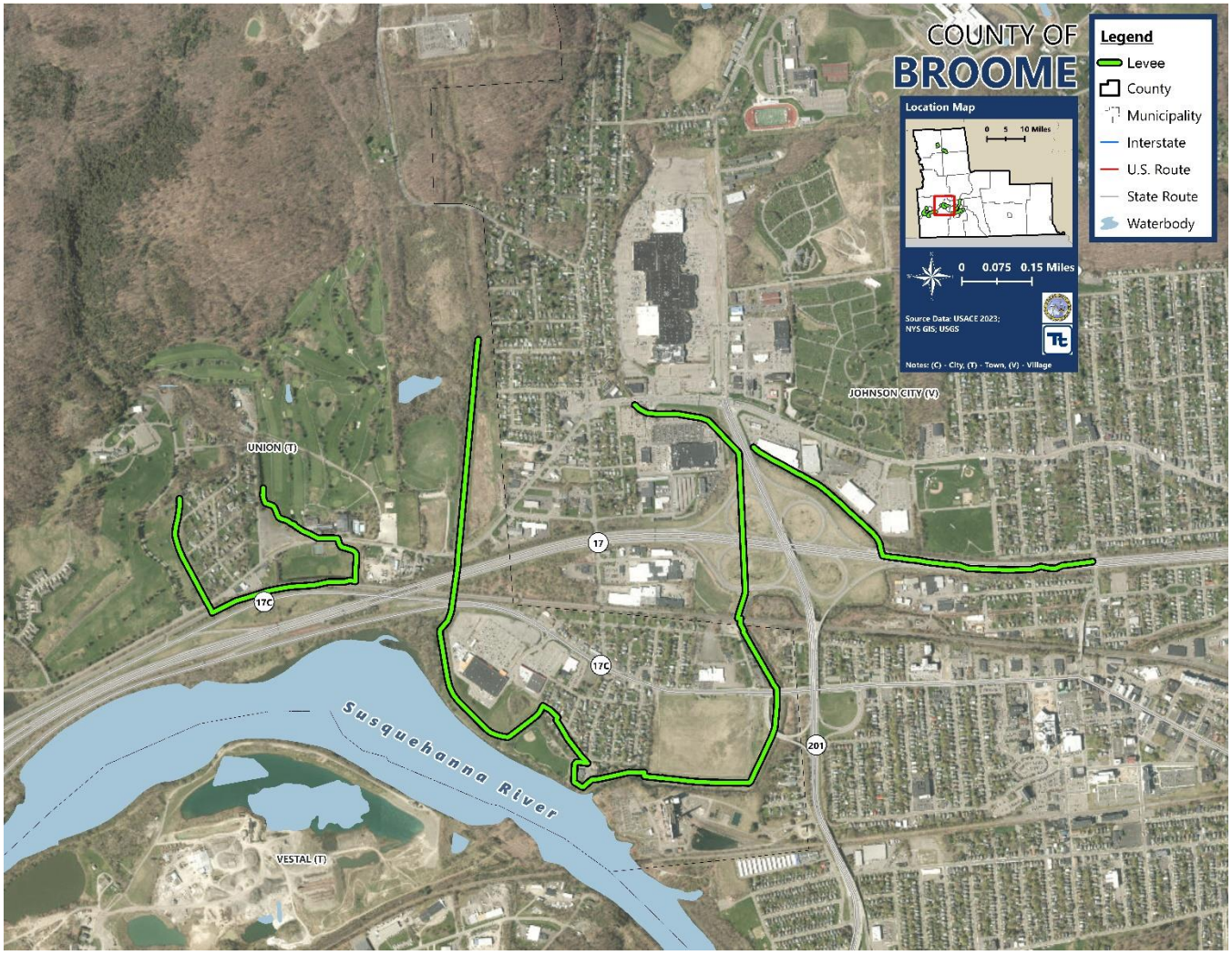
Note: This figure displays the Northwest Binghamton, Northeast Binghamton, South Binghamton, and Binghamton Lourdes Hospital levee systems – together referred to as the Binghamton-Port Dickinson Levee.

Figure 3-16. Endicott-Vestal-Union Levee



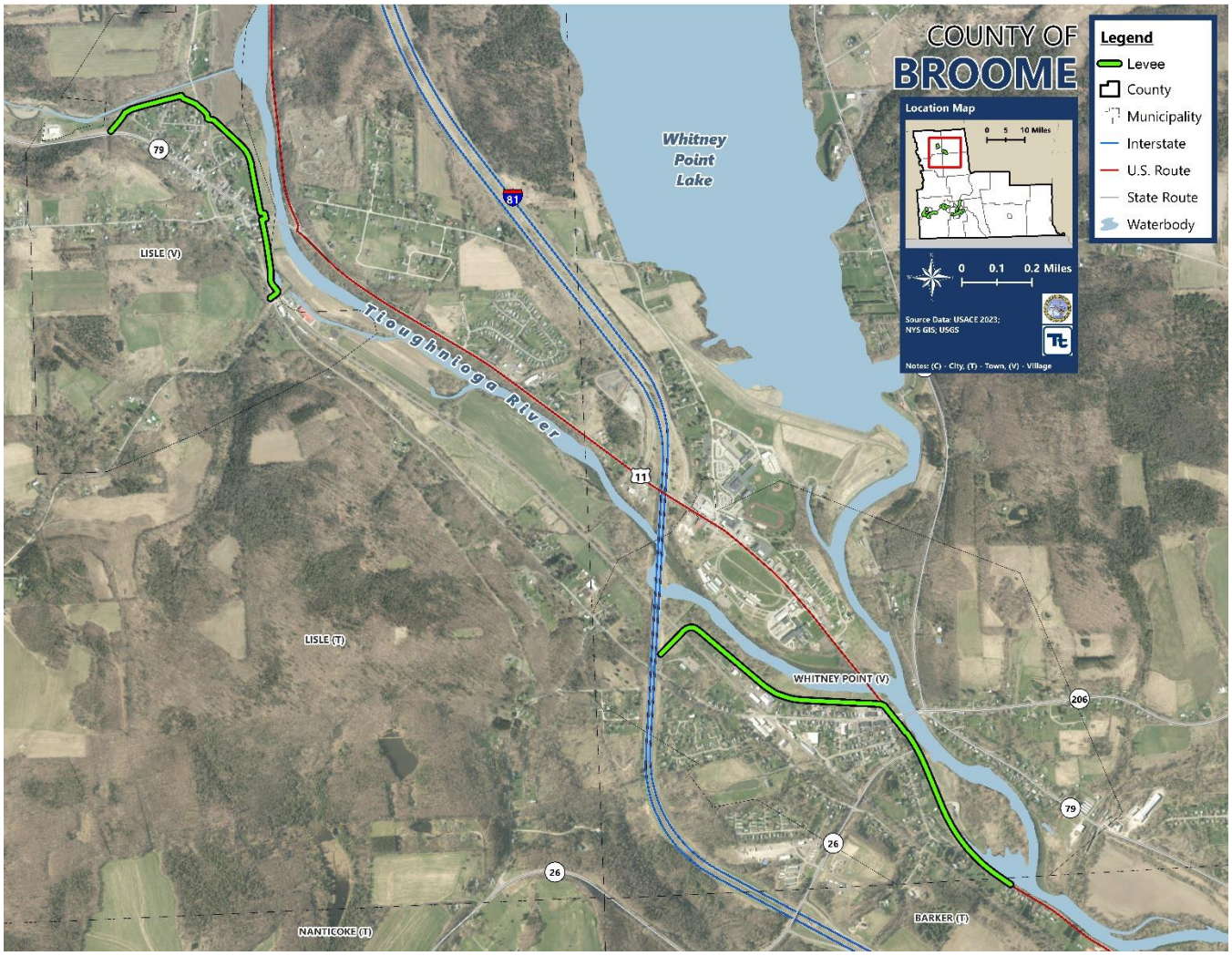
Note: This figure displays the Endicott Northeast, Endicott, and Vestal levee systems – together referred to as the Endicott-Vestal-Union Levee.

Figure 3-17. Johnson City-Union Levee



Note: This figure displays the Fairmont Park Flood Control Project, Johnson City, and Johnson City East levee systems – together referred to as the Johnson City-Union Levee.

Figure 3-18. Lisle-Whitney Point Levee

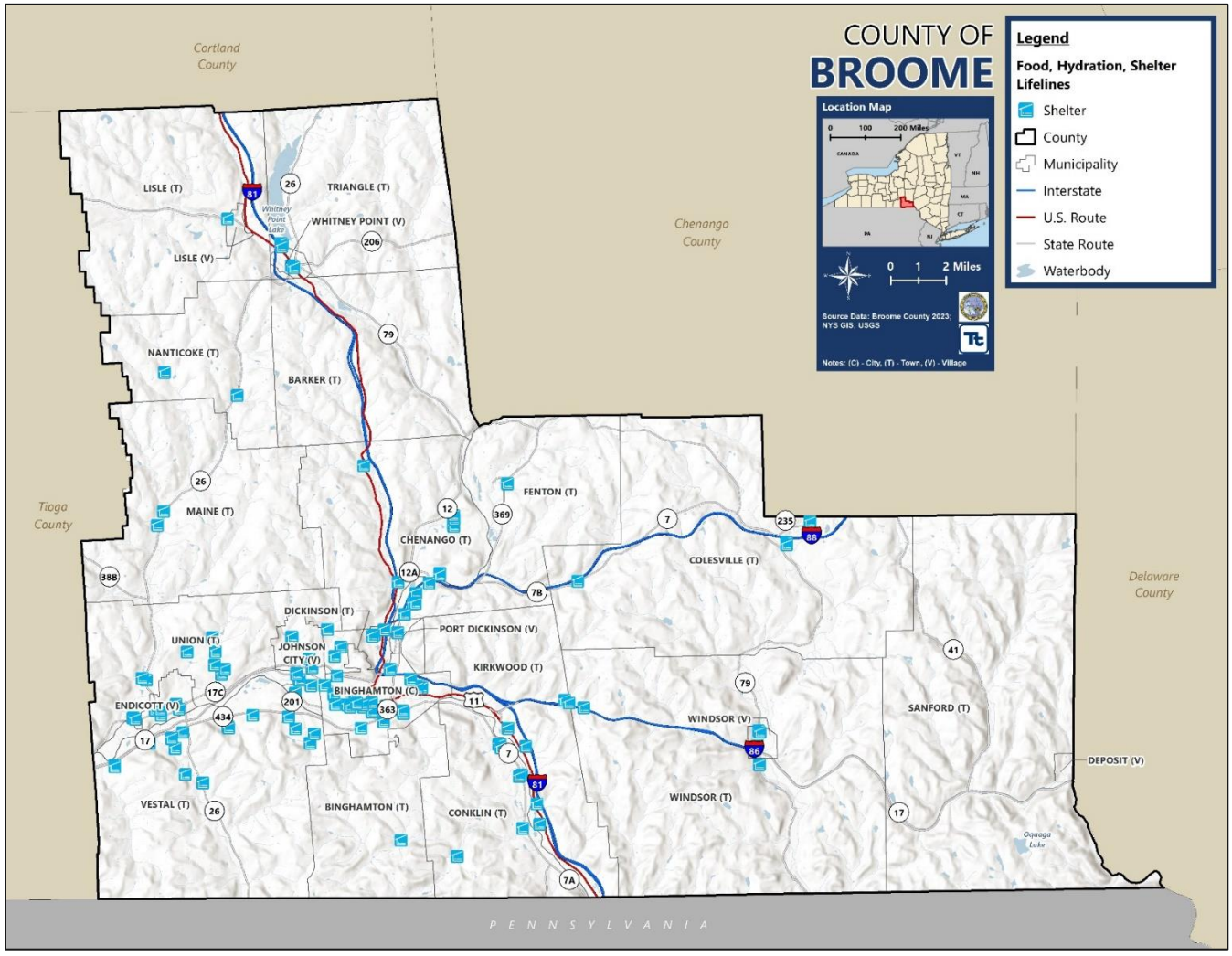


Note: This figure displays the Lisle and Whitney Point Village levee systems – together referred to as the Lisle-Whitney Point Levee.

3.6.2 Food, Hydration, Shelter

Food, hydration, and shelter community lifelines include facilities associated with commercial food distribution, commercial food supply chains, food distribution programs, temporary hydration missions, commercial water supply chains, housing, commercial facilities, animals, and agriculture. For the purpose of this HMP, there are 161 food, hydration, and shelter lifelines in Broome County, all categorized as shelters. Figure 3-19 shows the location of these facilities.

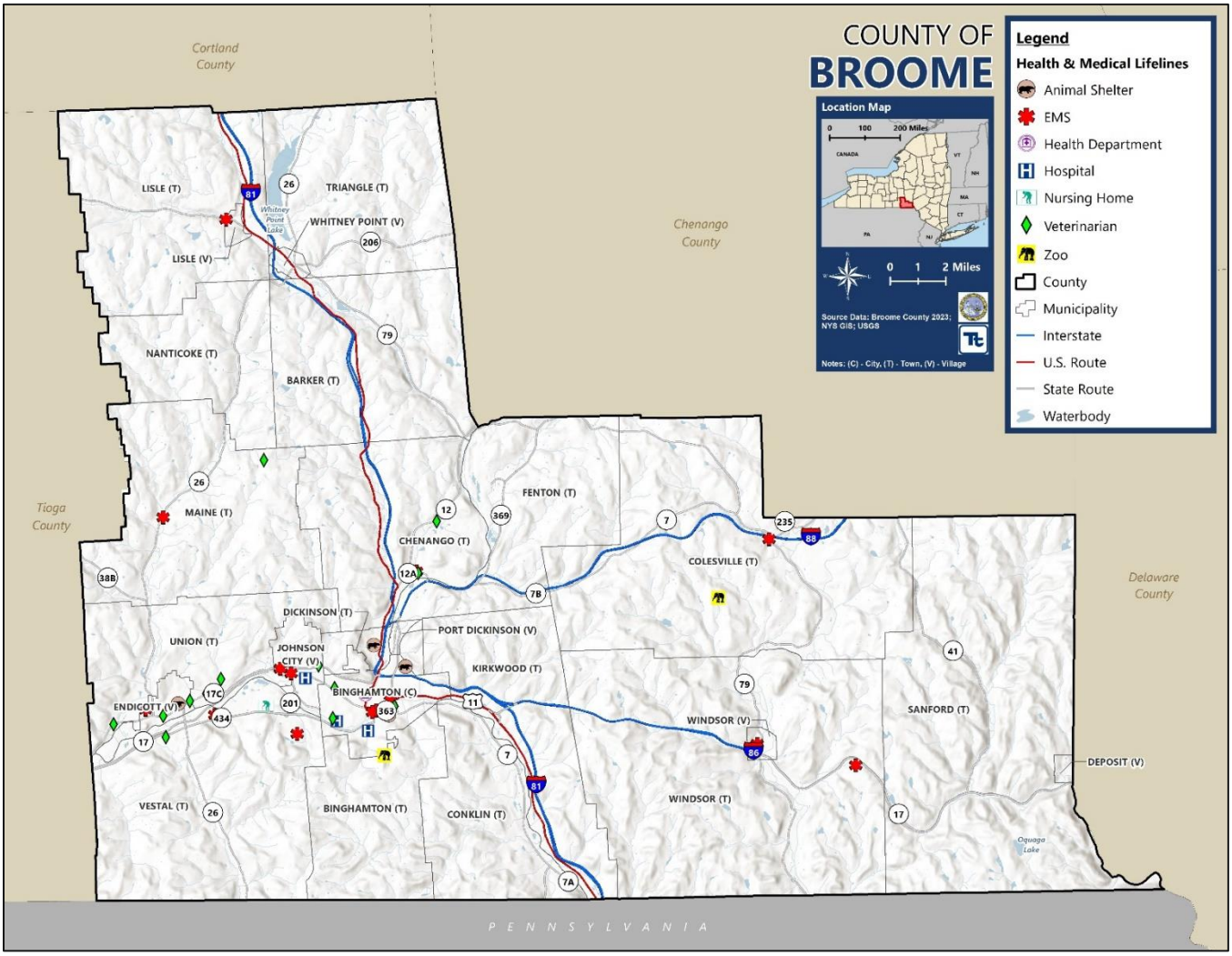
Figure 3-19. Food, Hydration, and Shelter Lifelines in Broome County



3.6.3 Health and Medical

Health and medical community lifelines include facilities related to medical care, patient moving, public health, fatality management, and the medical supply chain. For the purpose of this HMP, there are 41 health and medical lifelines in Broome County, consisting of animal shelters, EMS facilities, health departments, hospitals, nursing homes, veterinarians, and zoos. Figure 3-20 shows the locations of the identified health and medical lifelines in Broome County.

Figure 3-20. Health and Medical Lifelines in Broome County



3.6.4 Energy (Power and Fuel)

Energy (power and fuel) lifelines include the power grid and fuel facilities. For the Broome County HMP update, no energy lifelines were identified.

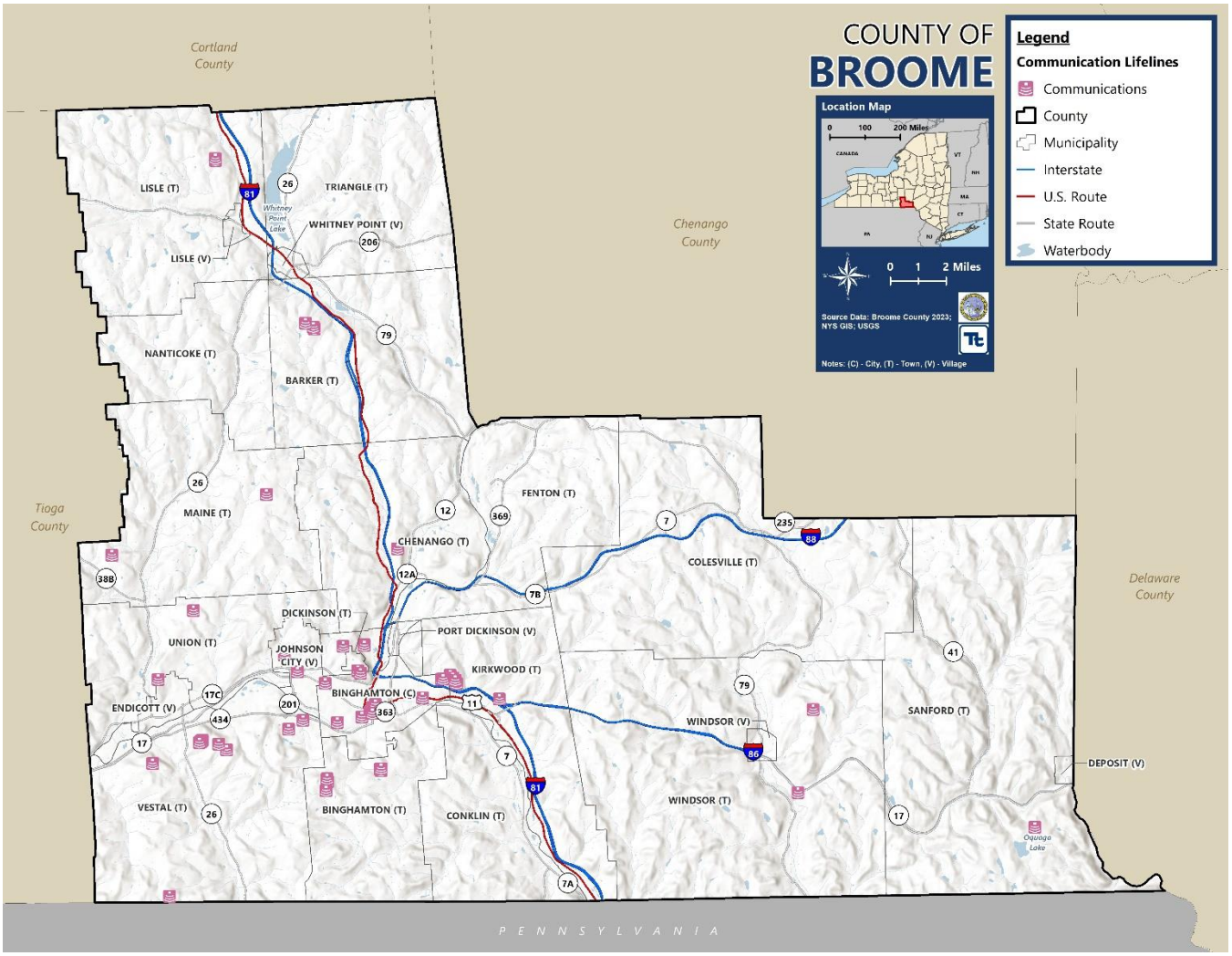
3.6.5 Communications

Communication lifelines include infrastructure, alerts/warnings/messages, 911 and dispatch, responder communications, and finance. For the purpose of this plan, there are 60 communication facilities in Broome County, as shown on Figure 3-21. They include the following:

- Traditional landline, fiber optic, and cellular service provided by multiple companies, such as Verizon, Spectrum, and Frontier.

- An extensive radio communications network that is used by emergency services agencies, hospitals, law enforcement, public works, transportation, and other supporting organizations.

Figure 3-21. Communications Lifelines in Broome County



3.6.6 Transportation

Transportation lifelines include highways/roadways, mass transit, railways, aviation, and maritime. Transportation throughout Broome County runs along Interstates 81, 86, and 88, as well as US Route 11. Broome County supports 17 state routes—7, 12, 17, 26, 41, 79, 201, 206, 235, 363, 369, 434, 7A, 7B, 12A, 17C, and 38B—and over 90 county routes. Figure 3-22 shows the locations of the identified transportation lifelines in Broome County. Additional detail is provided in the subsections that follow.

Highways and Roadways

Travelers from the New York City area generally use Interstate 81, running through Kirkwood into Binghamton, to access Broome County from the south. Interstate 88, connecting Binghamton and Albany,

runs along the eastern portion of Broome County. NYS Route 17 is a major expressway traversing east-west through the county. There are 512 bridges identified in Broome County. The six divisions of the Broome County Department of Public Works—Administration, Engineering, Building and Grounds, Security, Highway, and Solid Waste Management—maintain 17 campuses; 343.24 centerline miles of roads, and county bridges (Broome County n.d.).

Airports and Heliports

The Binghamton Regional/Edwin A. Link Field, also known as the Greater Binghamton Airport, is owned and operated by the Broome County Department of Aviation. It is located 8 miles north of the Binghamton metropolitan area. The Tri-Cities Airport, once a public airport, is now privately owned and managed by Goodwin Aviation. The Luke Airport, Chenango Bridge, and Kirkwood Airpark are privately owned airports in Broome County.

Bus and Other Transit Facilities

The Broome County Department of Transportation owns and operates a public transportation system that offers the following services (Broome County 2019):

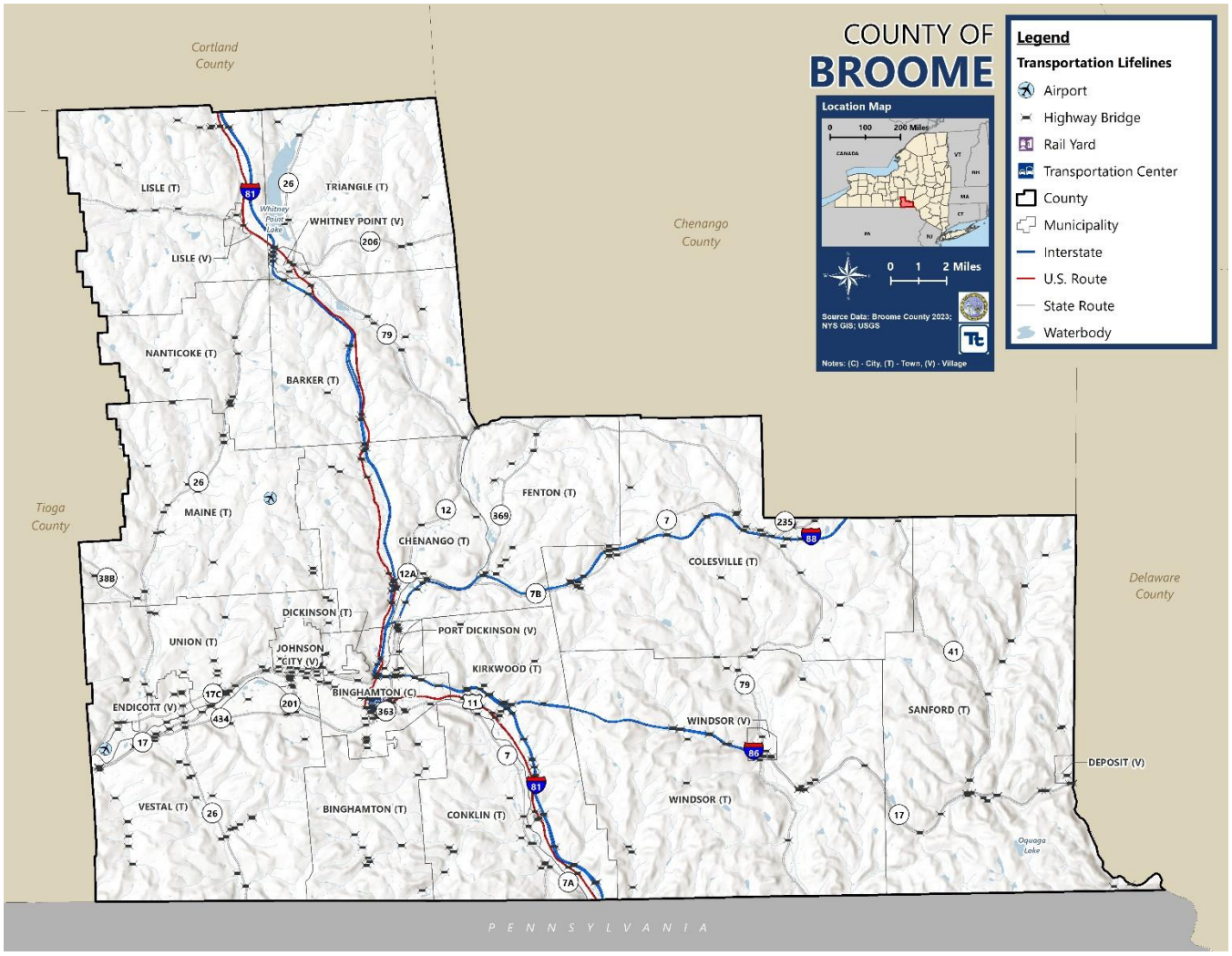
- The B.C. Transit Route Bus fixed-route system serves the City of Binghamton, the Village of Johnson City, the Village of Endicott, and the Town of Vestal.
- The B.C. Lift is a door-to-door bus service for individuals with disabilities in the urban areas of Broome County.
- The B.C. Country is a bus service that travels to the rural areas of Broome County and provides transportation to the more urban areas. B.C. Country's service area includes the Village of Whitney Point, Lisle, Kirkwood, Village of Deposit, Windsor, Maine, and certain locations in Chenango and Vestal.
- The OFA Mini bus is a bus service for people 60 years of age and older who need to travel to the urban areas of Broome County.

All B.C. Transit buses are wheelchair accessible. Of the inventory received, there is one transportation center (the Greater Binghamton Transportation Center) identified in the transportation lifelines, located in the City of Binghamton.

Railroad Facilities

There are approximately 130 miles of railroad in Broome County, including rail owned by the Canadian Pacific Railway (St. Lawrence & Hudson Railway, Delaware and Hudson Railroad), New York Susquehanna and Western Railway (Conrail Railroad, Erie Lackawanna Railroad), and the Norfolk Southern Railway Co. (Conrail Railroad). Of the inventory received, there is one rail yard (QD Rail Yard) identified in the transportation lifelines, located in the City of Binghamton.

Figure 3-22. Transportation Lifelines Identified in Broome County



3.6.7 Hazardous Materials

Hazardous materials lifelines include facilities and hazmat/pollutants/contaminants. There are 210 hazardous material lifelines in Broome County, 209 of these lifelines are identified as hazardous material facilities, with the remaining one location identified as a landfill. Figure 3-23 shows the locations of these lifelines. In this plan, a hazardous material facility is a facility that houses hazardous materials, including, but not limited to: public works facilities, hospitals, gas stations, storage centers, treatment plants, and waste facilities.

A Superfund site is land contaminated by hazardous waste that has been identified by the U.S. Environmental Protection Agency (EPA) as a candidate for cleanup because it poses a risk to human health or the environment. Some of these sites are placed on the National Priorities List (NPL), which identifies high-priority sites among the nation's known releases or threatened releases of hazardous materials. The NPL guides the EPA in determining which sites warrant further investigation. Abandoned hazardous waste

sites placed on the NPL include those that the EPA has determined present a significant risk to human health or the environment; these sites are eligible for remediation under the Superfund Trust Fund Program.

An archived Superfund site has no further interest under the federal Superfund program based on available information and is no longer part of the EPA's Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) inventory. Archived and active Superfund sites are accessible through the same database but are differentiated by status. As of February 28, 2024, Broome County hosts one active hazardous site in the federal Superfund program, which is not listed on the NPL (US EPA 2024). CERCLIS reports that there are two archived Superfund sites in Broome County (US EPA 2024).

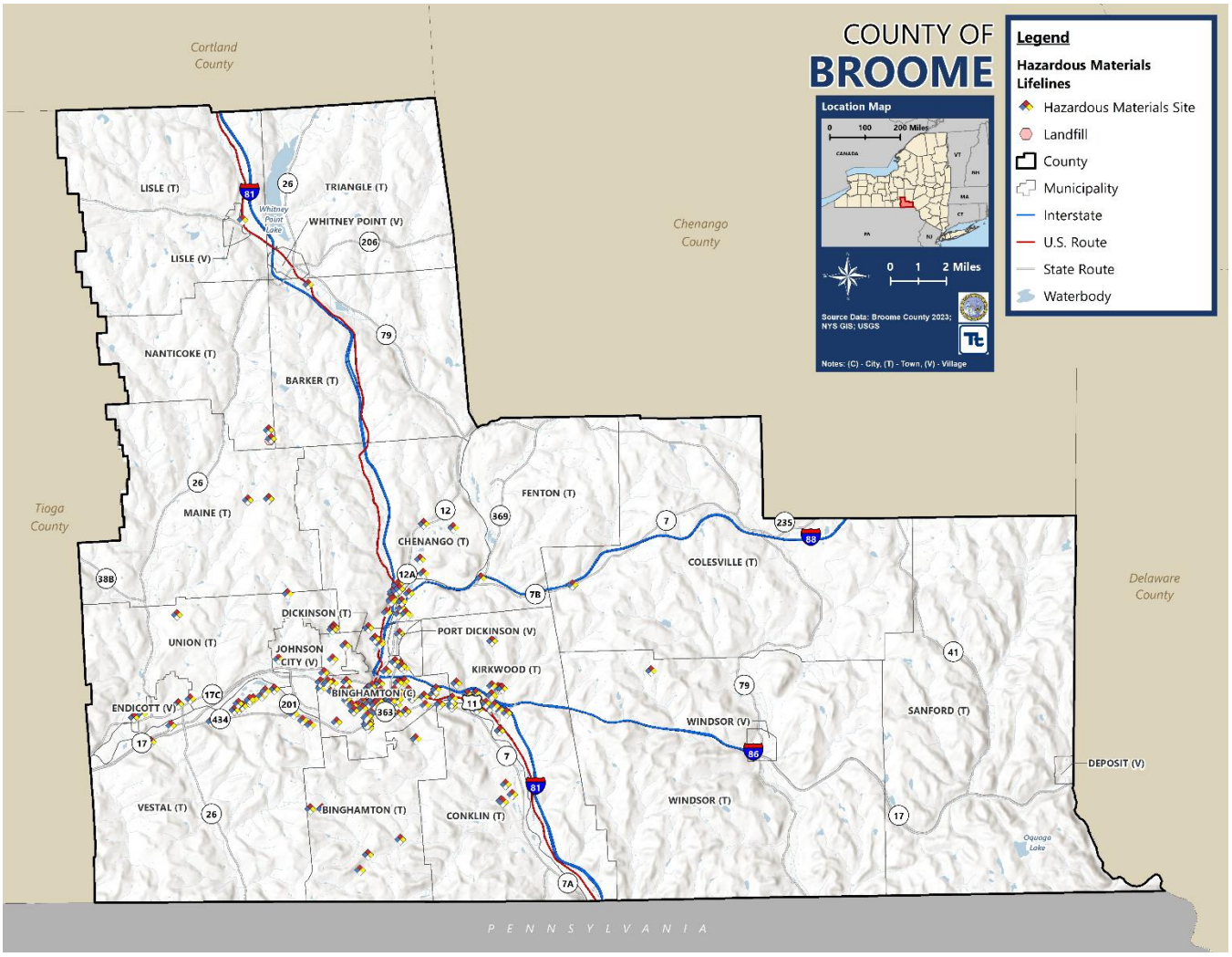
The NYSDEC's Bulk Storage Program maintains a database of three types of facilities that require registration with NYSDEC if they have a total storage capacity of petroleum products as follows:

- Petroleum Bulk Storage—1,100 gallons or more
- Chemical Bulk Storage—185 gallons or more in underground tanks and stationary aboveground tanks
- Major Oil Storage Facilities—400,000 gallons or more.

As of April 2, 2024, 771 sites in Broome County are listed in the NYSDEC's Bulk Storage Program database. Of those 771 sites, 309 are listed as active, 11 are listed as inactive, 4 are unregistered, and 447 are listed as unregulated/closed (NYS DEC 2024).

The EPA's 2023 Toxics Release Inventory (TRI) database indicates there are 10 TRI facilities in Broome County. TRI facilities are those required to report on chemical storage and use based on particular volumes of specified chemicals stored and used (US EPA 2023).

Figure 3-23. Hazardous Materials Lifelines Identified in Broome County



3.6.8 Water Systems

Water system lifelines include potable water infrastructure (e.g., intake, treatment, storage, and distribution) and wastewater management facilities (e.g., collection, storage, treatment, and discharge). For the purpose of this HMP update, there are 197 water system lifelines in the County, consisting of potable water facilities, potable wells, wastewater lift stations, and wastewater treatment plants. Figure 3-24 shows the locations of the identified water system lifelines in Broome County.

Potable Water

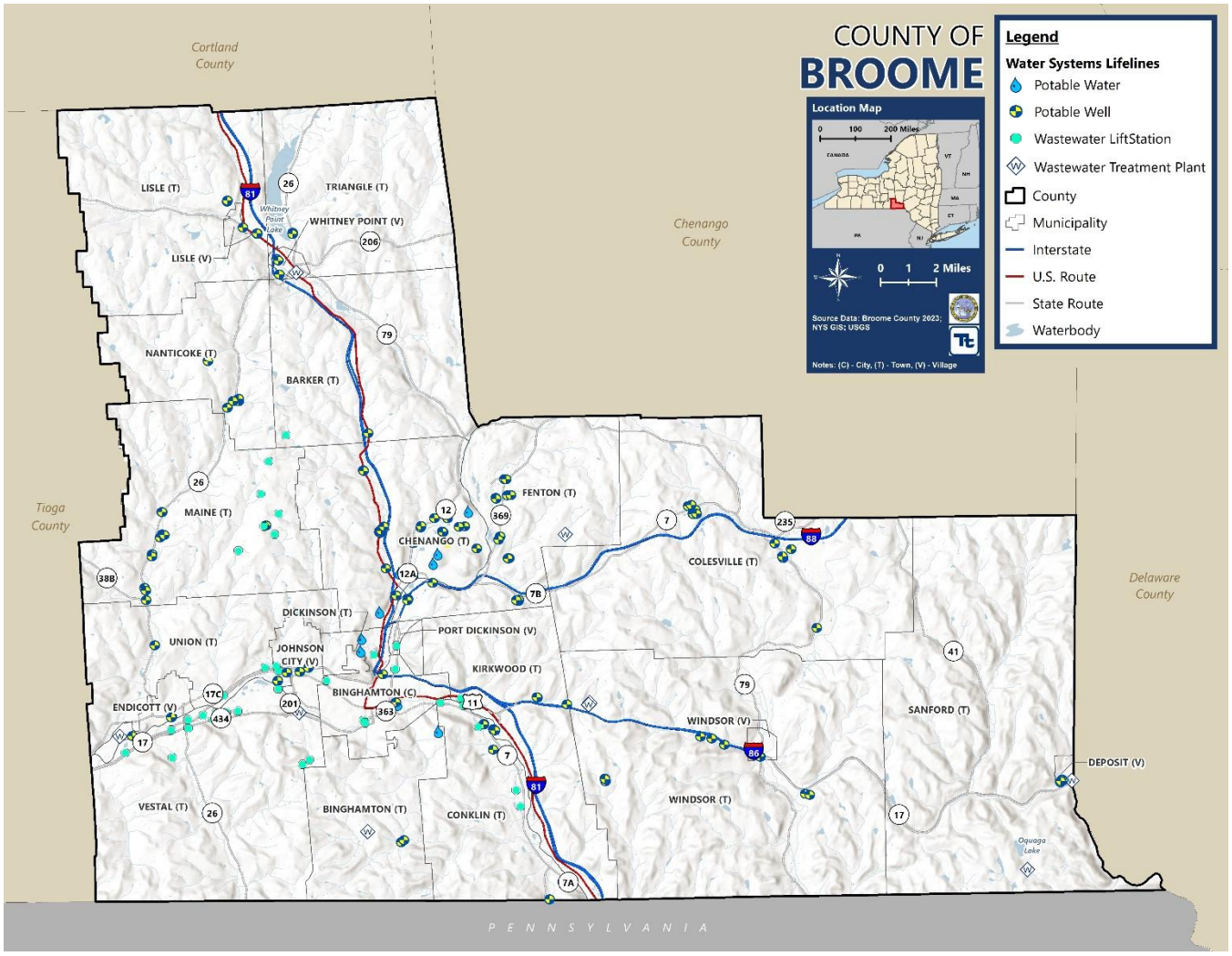
Broome County relies on surface and groundwater for drinking, recreation, industry, and agriculture. Approximately 80 percent of potable water in the county comes from groundwater sources. There are several aquifers beneath the Susquehanna and Chenango Rivers and their surrounding floodplains. Aquifers are classified based on importance as a public water supply, productivity, and vulnerability to

pollution. The municipalities of Johnson City, Endwell, Endicott, and Vestal are dependent on primary aquifers (highly productive, vulnerable aquifers being used, mainly as a water supply, by a large percentage of residents). There are also a number of principal aquifers that are classified as highly productive but used by a lower percentage of the population (Broome County Comprehensive Plan 2013). According to the EPA, there are 65 community water systems; seven non-transient non-community water systems; and 95 transient non-community water systems in Broome County (U.S. EPA 2024).

Wastewater Facilities

Broome County has individual sewer systems providing service to the City of Binghamton, the Village of Deposit, and the Village of Whitney Point. Six towns are partially serviced, including parts of Conklin, Dickinson, Kirkwood, Sanford, Union, and Vestal, as well as parts of the Village of Johnson City. Local systems are operated, maintained, and funded by local municipalities. There are 34 wastewater treatment plants located in the county. Sewer service is dependent on the size of the treatment plant, age of the infrastructure, and quantity being produced compared to the discharge point (New York State Department of Environmental Conservation 2023).

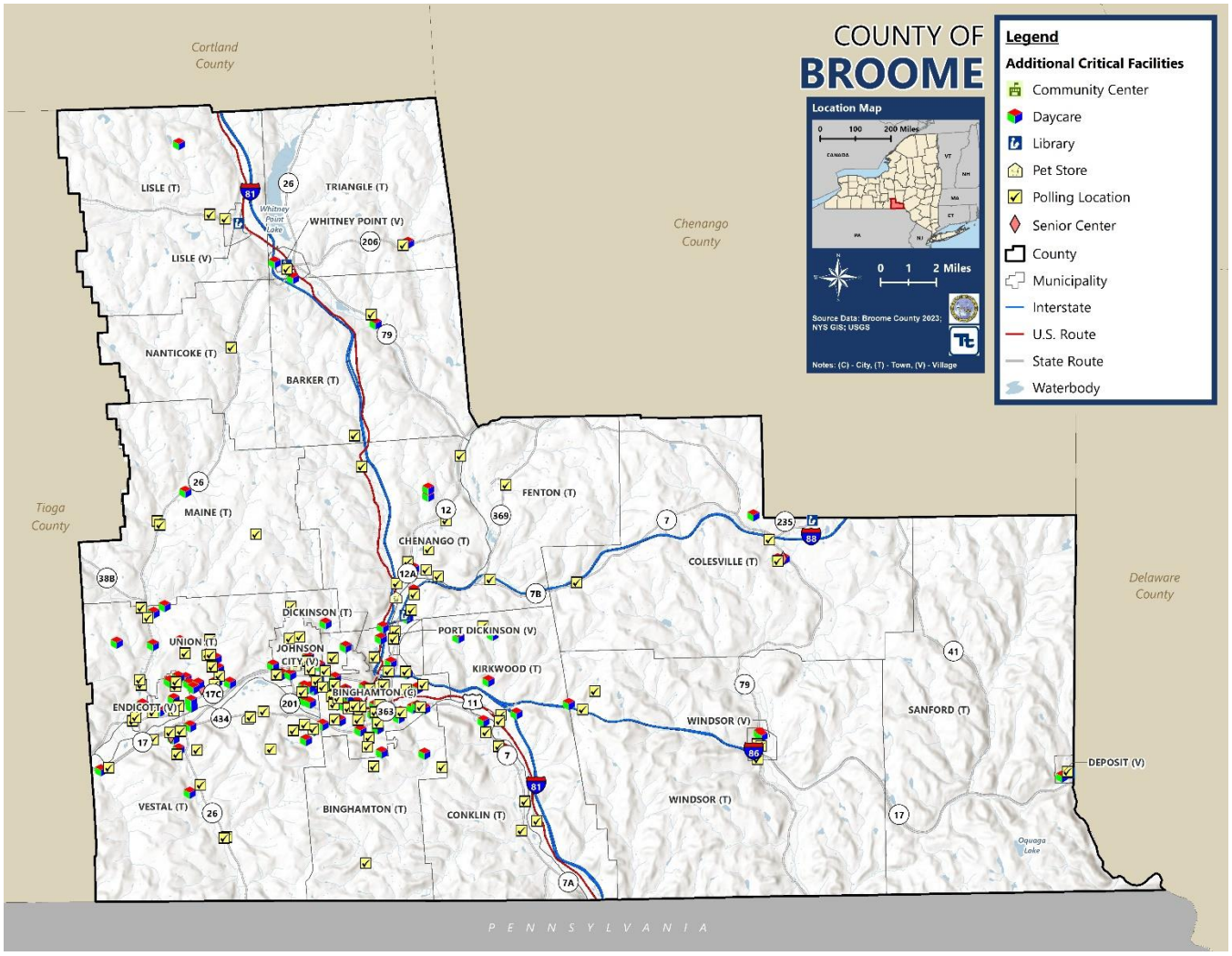
Figure 3-24. Water Systems Lifelines Identified in Broome County



3.6.9 Other Critical Facilities

The Planning Partnership identified additional facilities as critical, including libraries, daycares, community centers, pet stores, polling locations, and senior centers. Figure 3-25 shows the locations of these facilities. These facilities have been incorporated into the Broome County inventory and the hazard risk assessment conducted for the County.

Figure 3-25. Additional Lifelines Identified in Broome 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), Broome County considered 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, reviews of the New York State Hazard Mitigation Plan (NYS HMP 2019) and 2017 Broome County HMP (2019 Broome County Hazard Mitigation Plan), 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 (not human-made) hazards and the perceived vulnerability of the study area's assets to them. Table 4.1-1 documents the process of identifying the natural hazards of concern for further profiling and evaluation.

Table 4.1-1. Identification of Natural Hazard of Concern for Broome County

Hazard	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?
Avalanche	No	No	○ The topography and climate of Broome 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 the National Avalanche Center – American Avalanche Association (NAC-AAA) between 1998 and 2018. ○ Avalanche was identified as a hazard in the 2019 NYS HMP, and there have been occurrences in the state; however, there were no occurrences in Broome County. The Steering Committee and Planning Partnership do not consider the hazard to be a significant concern.
Civil Unrest	Yes	No	○ The 2019 NYS HMP does not identify civil unrest as a hazard of concern for New York State. ○ Broome County has a history of civil unrest. ○ The Steering Committee and Planning Partnership opted to not include civil unrest in the HMP as is addressed in other preparedness plans.
Coastal Erosion	Yes	No	○ The NYS HMP identifies coastal erosion as a hazard of concern for New York State for all coastal counties. However, Broome County does not have a coastline. The Steering Committee and Planning Partnership do not consider the hazard to be a significant concern.
Dam Failure	Yes	Yes	○ The 2019 NYS HMP does not identify dam failure as a hazard of concern for

Hazard	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?
			New York State, though it is included in the Flood hazard profile. ○ According to the NYS DEC, there are 179 dams within Broome County. Of these 179 dams in Broome County: 116 are low hazard, 13 are intermediate hazard, 23 are high hazard, and 27 are negligible or no hazard classification code. ○ The Steering Committee and Planning Partnership has identified dam failure as a hazard of concern for Broome County because of the presence of numerous high-hazard dams.
Disease Outbreak	Yes	Yes	○ The 2019 NYS HMP does not identify the pandemic as a hazard of concern for New York State. ○ The County has been impacted by various diseases e.g., (influenza, COVID-19). ○ The Steering Committee and Planning Partnership has identified disease outbreaks as a hazard of concern for Broome County.
Drought	Yes	Yes	○ The 2019 NYS HMP identifies drought as a hazard of concern. New York State was included in one FEMA drought-related disaster declaration, which did not include Broome County. ○ Broome County has been impacted by several drought events that have occurred in New York State. Agriculture is a substantial industry in Broome County so drought conditions could severely impact the County's economy. Broome County was included in five drought-related USDA disaster declarations between 2012 and 2016.

Hazard	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?
			○ The Steering Committee and Planning Partnership has identified drought as a hazard of concern for Broome County.
Earthquake	Yes	Yes	○ The 2019 NYS HMP identified earthquakes as a hazard of concern. New York State was included in one FEMA earthquake-related disaster declaration (DR-1415); Broome County was not included in this declaration. ○ A 500-year earthquake event could result in a moderate level PGA of 1.4-3.9%g ○ From 2019 to 2023, there have been no significant earthquakes epicenters in Broome County. ○ Based on input from the Steering Committee and Planning Partnership, an earthquake has been identified as a hazard of concern for Broome County.
Expansive Soils	Yes	No	○ The 2019 NYS HMP does not identify expansive soils as a hazard of concern. ○ Broome County does not have the type of soil (swelling clay) that would result in expansive or swelling soils. ○ The Steering Committee and Planning Partnership do not consider the hazard to be a significant concern.
Extreme Temperature	Yes	Yes	○ The 2019 NYS HMP identifies Cold-waves and Heatwaves as hazards of concern for New York State. ○ Broome County was included in two recent USDA disaster declarations related to extreme temperature events, more specifically freeze and frost events. ○ The Steering Committee and Planning Partnership identified extreme temperature as a hazard of concern for Broome County.

Hazard	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?
Flood (riverine, lakeshore, ice jam, dam failure, urban flooding, and flash flooding)	Yes	Yes	○ The 2019 NYS HMP identifies flooding as a hazard of concern for New York State. ○ Between 1956 and 2023, Broome County was included in seven FEMA flood-related declarations. ○ Based on the history of flooding and its impacts on Broome County and input from the Steering Committee and Planning Partnership, flooding has been identified as a hazard of concern for the County.
Hailstorm	Yes	Yes	○ The Steering Committee and Planning Partnership elected to group this hazard into one 'Severe Storm' profile.
Hurricane (tropical cyclones, including tropical storms and tropical depressions)	Yes	Yes	○ The Steering Committee and Planning Partnership elected to group this hazard into one 'Severe Storm' profile.
Ice Jams	Yes	Yes	○ The Steering Committee and Planning Partnership elected to group this hazard into one 'Flood' profile.
Ice Storm	Yes	Yes	○ The Steering Committee and Planning Partnership elected to group this hazard into one 'Severe Winter Storm' profile.
Invasive Species/Infestation	Yes	Yes	○ The 2019 NYS HMP does not identify invasive species as a hazard of concern for New York State, but it has been affected by various instances of invasive species. ○ Broome County has experienced infestations from West Nile virus, Armyworm, Emerald ash borers, and Dutch elm disease. Based on input from the Steering Committee and Planning Partnership, invasive species/infestation has been identified as a hazard of concern for Broome County.

Hazard	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?
Land Subsidence	No	No	○ The 2019 NYS HMP indicates New York State is vulnerable to land subsidence; however, moderate to low land subsidence susceptibility exists for New York State; however, the NYS HMP states that this hazard has a very low risk to population or property. ○ The 2019 NYS HMP does not identify Broome County as a community that has experienced land subsidence in the past. ○ The Steering Committee and Planning Partnership did not identify land subsidence as a hazard of concern for Broome County.
Landslide	Yes	No	○ The 2019 NYS HMP includes landslides as a hazard of concern for New York State. Between 1954 and 2022, New York State was included in one landslide-related disaster declaration, which did not include Broome County. ○ Based on previous occurrences and input from the Steering Committee and Planning Partnership, the landslide hazard was not identified as a hazard of concern for Broome County.
Nor'Easters (extra-tropical cyclones, including severe winter low-pressure systems)	No	No	○ Broome County is in the central part of New York State and is therefore not highly susceptible to Nor'easter systems that come up the eastern seaboard. This hazard is briefly mentioned in the "Severe Storms" profile.
Severe Storm (windstorms, thunderstorms, hail, and tornadoes)	Yes	Yes	○ The 2019 NYS HMP identifies severe storms 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, and hurricanes/tropical storms.

Hazard	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?
			○ For the Broome County HMP, the hazards were combined into one profile. ○ Between 2019 and 2023, Broome County was included in one FEMA severe storm-related declaration in 2021 related to Hurricane Henri. Based on previous occurrences and input from the Steering Committee and Planning Partnership, severe storms are identified as a hazard of concern for Broome County.
Severe Winter Storm (heavy snow, blizzards, ice storms)	Yes	Yes	○ The 2019 NYS HMP identifies ice storms and snowstorms as hazards of concern for New York State. ○ FEMA included Broome County in four snowstorm disaster declarations from 1993 to 2023. ○ Based on previous occurrences and input from the Steering Committee and Planning Partnership, severe winter storms are identified as a hazard of concern for Broome County.
Terrorism	Yes	No	○ Broome County has a history of terrorism and has proximity to an international border. ○ The Steering Committee and Planning Partnership opted not to include terrorism as it is addressed in other preparedness plans.
Tornado	Yes	Yes	○ The Steering Committee and Planning Partnership elected to group this hazard into one 'Severe Storm' profile.
Tsunami	No	No	○ Tsunami is identified as a hazard of concern in the 2019 NYS HMP. ○ The Steering Committee and Planning Partnership do not consider tsunamis to be a hazard of concern for Broome County due to the County's inland location.

Hazard	Is this a hazard that may occur in Broome County?	If yes, does this hazard pose a significant threat to Broome County?	Why was this determination made?
Utility Failure	Yes	Yes	○ Broome County experiences utility failures (i.e., power outages) several times each year. These failures are usually due to severe storms or severe winter storms that affect the county. ○ The Steering Committee and Planning Partnership consider utility failure a cascading impact of severe storms, severe winter storms, and flooding events and included discussion of utility failure in those hazard profiles.
Volcano	No	No	○ The 2019 NYS HMP identifies volcano as a hazard of concern for New York State, however, the Steering Committee and Planning Partnership do not consider volcano to be a hazard of concern for Broome County because there are none located within the state.
Wildfire	Yes	Yes	○ The 2019 NYS HMP identifies wildfire as a hazard of concern for New York State. ○ Wildfires have occurred within Broome County, but Broome County was not included in any FEMA wildfire-related disaster declarations. Based on available data and the nature of the county, the Steering Committee and Planning Partnership identified Wildfire as a hazard of concern. ○
Windstorm	Yes	Yes	○ The Steering Committee and Planning Partnership elected to group this hazard into one 'Severe Storm' profile.

DR *Presidential Disaster Declaration Number*
EM *Presidential Disaster Emergency Number*
FEMA *Federal Emergency Management Agency*
NYS DEC *New York State Department of Environmental Conservation*

NYS HMP *New York State Hazard* *Mitigation Plan*

PGA *Peak ground acceleration*
USDA *U.S. Department of Agriculture*

4.1.1 Changes from the 2019 Hazard Mitigation Plan

The 2019 Broome Hazard Mitigation Plan did not identify Disease Outbreak as a hazard of concern. Members of the Steering Committee and Planning Partnership identified this hazard as a hazard of concern for the 2024 Hazard Mitigation Plan Update. The Steering Committee also chose to break Dam/Levee Failure out of the Flood profile for its own stand-alone hazard of concern for the 2024 HMP.

4.1.2 Hazard Groupings

The Steering Committee approved the use of the following hazard event groupings, which are consistent with those provided by the Federal Emergency Management Agency (FEMA) guidance documents (FEMA 386-2 Understanding Your Risks, Identifying Hazards and Estimating Losses; Multi-Hazard Identification and Risk Assessment – The Cornerstone of the National Mitigation Strategy; Local Mitigation Planning Handbook), and with consideration of hazard groupings in the NYS HMP 2019.

The *Dam/Levee 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, or low hazard. High-hazard dam breaks would most likely result in loss of life and significant property damage.

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, and can have negative health impacts on humans and animals.

A *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.

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. Earthquakes can damage infrastructure, which can harm people inside facilities where the infrastructure may be compromised by an earthquake.

The *Extreme Temperature* hazard includes both heat and cold events, which can have a significant impact on 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 *Flood* includes riverine flooding, lakeshore, flash flooding, shallow flooding, ice jam flooding, urban drainage flooding, and dam failure flooding. The 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 *Infestation and Invasive Species* profile includes infestations of native species and invasive species. An infestation is the presence of pest organisms within an area or field, on the surface of a host, or in soil in numbers or quantities large enough to harm, threaten, or otherwise negatively affect native plants, animals, and humans. Invasive species are non-native species that can harm the environment, the economy, or human health.

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 Storms include 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 wildfires, human-caused wildfires, and prescribed fires. They may be highly destructive and become difficult to control. Wildfires result in the disturbance of forest and brush and the destruction of real estate and personal property and have secondary impacts on other hazards, such as flooding, by removing vegetation and disturbing watersheds.

4.1.3 Summary of Hazards of Concern

In summary, a total of ten hazards of concern were identified as significant hazards affecting the entire County, to be addressed at the County level in this plan (shown here in alphabetical order):

- Dam/Levee Failure
- Drought
- Disease Outbreak
- Earthquake
- Extreme Temperature
- Flood
- Invasive Species
- Severe Storm
- Severe Winter Storm
- Wildfire

Other natural and technological hazards of concern have occurred within Broome County, but have a low potential to occur, are addressed by other planning mechanisms, and/or do not result in significant impacts within the County. Therefore, these hazards will not be further addressed within this plan update. However, if deemed necessary by the County, these hazards may be considered in future versions of the Plan.

SECTION 4. RISK ASSESSMENT

4.2 RISK ASSESSMENT METHODOLOGY AND TOOLS

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

- **Identify Hazards of Concern**—Use all available information to determine what types of hazards may affect a jurisdiction.
- **Profile Each Hazard**—Understand each hazard in terms of the following elements: location, extent (i.e., severity), previous occurrences and losses, and probability of future occurrences (including impacts of climate change).
- **Assess Risk**—Use all available information to estimate to what extent populations and assets may be adversely affected by a hazard through three foundational steps:
  - **Determine vulnerability**—Estimate the number of assets in the jurisdiction that are likely to experience a hazard event if it occurs by overlaying hazard maps with the asset inventories.
  - **Estimate potential impacts**—Assess 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.
  - **Evaluate future changes that may affect vulnerability and impacts**—Analyze how demographic changes, projected development, and climate change impacts can alter current vulnerability and potential impacts.

The Broome County risk assessment was updated using the following resources:

- An updated building stock inventory based on a building footprint spatial layer, address points, and tax assessor parcel information provided by Broome County GIS and Mapping Services, as well as cost adjustment values from 2022 RSMeans.
- 2021 American Community Survey 5-year Population Estimates
- An inventory of critical facilities identified by Broome County and updated based on review by officials from each participating jurisdiction.

- The Federal Emergency Management Agency's (FEMA) lifeline definition to categorize critical facilities as community lifelines.
- FEMA's open-source Hazus software (version 6.0) to estimate the potential impacts of earthquake, flood, and wind hazards.
- Best-available hazard data, as described in Section 4.2.4.

4.2.1 Asset Inventories

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

Broome County assets were identified to assess potential vulnerability and impacts associated with the hazards of concern. For the HMP update, Broome County assessed vulnerability and potential hazard impacts for the following types of assets: population, buildings, critical facilities and community lifelines, the environment and land cover, and new development. Some assets may be more susceptible to impacts because of their physical characteristics or socio-economic uses. Each asset type is described in the following sections. 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.

Population

This HMP uses total population data from the 2021 American Community Survey (ACS) 5-year estimate to assess vulnerability and potential impacts on the County's population. This dataset was selected in lieu of the 2020 Decennial Census due to the availability of more detailed demographic information, such as age, poverty level, race, or ethnicity. However, Hazus, which does use the 2020 Decennial Census data, was used to estimate sheltering and injuries as part of the hazard analysis.

To determine population statistics for villages and towns, village population totals were subtracted from the total town population. Where villages were split between towns, the percentage of the geographic area of the village within each town was calculated and applied to the total population of the village to estimate the population that would be subtracted from each respective town. 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 using only 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.

Vulnerable populations in Broome County included in the risk assessment are children, the elderly, populations below the poverty level, non-English speaking individuals, and persons institutionalized with a disability.

Buildings

A custom general building stock was created for this risk assessment. The general building stock was updated countywide with a custom-building inventory using building footprint spatial layer, address points, and 2018 tax assessor parcel information provided by Broome County GIS and Mapping Services. Attributes provided in the associated files were used to further define each structure, such as the 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 replacement cost values (RCV) were calculated for each building using the available assessor data, the building footprint, and RSMeans 2022 values. Regional location factors based on zip code were applied. For Broome County (zip codes starting with 137 – 139), the factors are as follows:

- Residential – 0.99
- Non-Residential – 0.98

RCV is the cost for the total replacement of an asset to its pre-damaged condition using the present-day cost of labor and materials. Total RCV consists of both the structural cost to replace a building and the estimated value of the 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 the analysis and presentation of results. Residential loss estimates addressed both multi-family and single-family dwellings.

Critical Facilities and Community Lifelines

> A community lifeline provides indispensable service that enables the continuous operation of critical business and government functions, and is critical to human health and safety, or economic security (FEMA 2023).

Critical facilities are defined as structures from which essential services and functions for victim survival, continuation of public safety actions, and disaster recovery are performed or provided. Community lifelines are critical facilities that enable the continuous operation of critical government and business functions and are essential to human health and safety or economic security. Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function.

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

New Development

The risk assessment examined recent and anticipated new development, identified by Broome County as either anticipated in the next five years or developed since the 2019 HMP. A spatial analysis was conducted to determine the hazard vulnerability of the anticipated development sites.

Integrating new developments into the risk assessment provides information for communities to consider when developing a mitigation strategy to reduce vulnerabilities in the future. The new development is listed in Section 3. The hazard vulnerability analysis results are presented in the jurisdictional annexes in Volume II.

4.2.2 Methodology

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

- **Historical Occurrences and Qualitative Analysis (Q)—**This analysis examines historical impacts to understand potential impacts of future events of similar size. Potential impacts and losses are discussed qualitatively using best-available data and subject matter expertise.
- **Vulnerability Analysis (V)—**This analysis overlays available spatial hazard layers with the asset inventory to determine which assets intersect with the hazard's expected path and impacts.
- **Loss Estimation (H)—**The FEMA Hazus modeling software was used to estimate potential losses for the following hazards: flood, earthquake, and hurricane.

Table 4.2-1 summarizes the type of analysis conducted by hazard of concern.

Table 4.2-1. Summary of Risk Assessment Analyses

Hazard	Population	General Building Stock	Critical Facilities	New Development
Dam Failure	V	V	V	V
Disease Outbreak	Q	Q	Q	Q
Drought	Q	Q	Q	Q
Earthquake	V, H	V, H	V, H	V
Extreme Temperature	Q	Q	Q	Q
Invasive Species	V, H	V, H	V, H	V
Flood	Q	Q	Q	Q
Severe Storm	H	H	H	Q
Severe Winter Storm	Q	Q	Q	Q
Wildfire	V	V	V	V

Notes: V = Vulnerability analysis; H = Hazus analysis; Q = Qualitative analysis

Hazus

Hazus is a GIS-based software tool developed by FEMA that applies engineering and scientific risk calculations, which have been developed by hazard and information technology experts, to estimate damage and losses. The GIS framework supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards.

Hazus produces detailed maps and analytical reports that estimate direct physical damage or loss to people, buildings, critical facilities, transportation systems, and utility systems that a community can expect during the specified hazard. To generate this information, Hazus uses default data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. **Error! Reference source not found.** displays the levels of analysis that can be conducted using the Hazus software.

Table 4.2-2. Summary of Hazus Analysis Levels

Level 1	Hazus provides hazard and inventory data with minimal outside data collection or mapping.
Level 2	The analysis involves augmenting the Hazus-provided hazard and inventory data with more recent or detailed data for the study region, referred to as "local data"
Level 3	The analysis involves adjusting the built-in loss estimation models used for the hazard loss analyses. This Level is typically done in conjunction with the use of local data.

Damage reports can include induced damage (e.g., inundation, fire, threats posed by hazardous materials, and debris) and direct economic and social losses (e.g., casualties, shelter requirements, economic impacts), depending on the hazard and available local data.

The Hazus methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards. The software's open data architecture can be used to manage community GIS data in a central location. The use of this software also promotes consistency of data output now and in the future and standardization of data collection and storage.

In general, modeled losses for the flood analysis were estimated in the program using depth grids. For hurricane wind and seismic hazards, probabilistic analyses were performed. The probabilistic model generates estimated damage and losses for specified mean return periods (MRP) (e.g., 100- and 500-year). Compared to the 2019 HMP, the updated model includes longer historical records to pull from to generate probabilistic events, as well as updated population statistics.

Hazard-Specific Methodologies

Dam Failure

A vulnerability analysis was conducted for the County's assets using mapping provided by Broome County for 22 dam failure inundation areas:

- Brandywine Creek
- East Sidney
- Finch Hollow (Site 1)
- Finch Hollow (Site 1A)
- Finch Hollow (Site 3C)
- Little Choconut (Site 2)
- Little Choconut (Site 2A)
- Little Choconut (Site 2B)
- Little Choconut (Site 2C)
- Little Choconut (Site 2E)
- Nanticoke Creek (Site 10)
- Nanticoke Creek (Site 13)
- Nanticoke Creek (Site 7A)
- Nanticoke Creek (Site 7B)
- Nanticoke Creek (Site 8)
- Nanticoke Creek (Site 9A)
- Nanticoke Creek (Site 9C)
- Nanticoke Creek (Site 9E)
- Palmers Pond
- Patterson Brixus Grey Watershed (Site 1)
- Patterson Brixus Grey Watershed (Site 2)
- Whitney Point.

To conduct the analysis, a composite dam failure inundation area was developed for all 22 dams. If an asset is indicated as vulnerable, it is located in at least one of the mapped dam failure inundation areas.

Disease Outbreak

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

Drought

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

Earthquake

Damage Estimates

A probabilistic assessment was conducted for Broome County for the 500 and 2,500-year MRPs through a Level 2 analysis in Hazus to analyze the earthquake hazard and provide a range of loss estimates. The probabilistic method uses information from locations and magnitudes of historical earthquakes and inferred faults to compute the probable ground shaking levels that could be experienced during a recurrence-period event, by census tract.

The default assumption is a magnitude 7.0 earthquake for all return periods. Damage and loss due to liquefaction, landslide, or surface fault rupture were not included in this analysis.

Although damage is estimated at the census tract level, results were presented at the municipal level. For census tracts encompassing multiple municipalities, the default general building stock inventory was used to calculate the percent of the total census tract replacement cost value in each municipality. This percentage was applied to the census tract losses to estimate the municipal-level losses. For example:

As noted in the Hazus Earthquake User Manual, "Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects on buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics, and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the Hazus Earthquake Model, possibly at best by a factor of two or more" (FEMA 2015f). However, Hazus' potential loss estimates are acceptable for this HMP.

- The census blocks from Municipalities A and B are located within one census tract.
- The total replacement cost value of Municipality A is 60 percent of the total census tract replacement cost value
- The total replacement cost value of Municipality B is 40 percent of the total value.
- Therefore, 60 percent of the losses for the census tract will be applied to Municipality A and 40 percent will be applied to Municipality B.

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

Vulnerability Estimates

Ground shaking is the primary cause of earthquake damage to human-made structures, and soft soils amplify ground shaking. One contributor to a site's amplification that impacts the severity of an earthquake is the velocity at which the rock or soil transmits shear waves (S-waves). The National Earthquake Hazard Reductions Program (NEHRP) has developed five soil classifications defined by their shear-wave velocity. The soil classification system ranges from A to E, 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.

A vulnerability analysis was also conducted for the County's assets using the NEHRP soil data. 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 of assets located on these soil types.

Extreme Temperature

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

Invasive Species

To assess the vulnerability of the County to invasive species and their associated impacts, a qualitative assessment was conducted.

Flood

The 1- and 0.2-percent annual chance flood events were examined to evaluate the County's risk from flooding. These flood events are generally those considered by planners and evaluated under federal programs, such as the National Flood Insurance Program (NFIP).

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

- The Broome County FEMA Preliminary Digital Flood Insurance Rate Map (DFIRM) dated February 05, 2010.
- A depth grid was created using the 2010 Preliminary DFIRM and the 2019 digital elevation model (DEM) provided by NYS GIS Clearinghouse.

The 2010 Preliminary DFIRM was used to evaluate vulnerability for the 1- and 0.2-percent annual chance flood events. The depth grid generated using the DFIRM and 1-meter 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 vulnerability to the 1- and 0.2-percent annual chance flood events, the DFIRM flood boundaries were overlaid on the centroids of updated assets and the polygons for anticipated new development. Centroids or polygons that intersected the flood boundaries were totaled to estimate the building RCV and population vulnerable to 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. Once updated with the inventories, the Hazus riverine flood model was run to estimate potential losses in Broome 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 damage to the general building stock, and potential damage to critical facilities based on the depth grids generated and the default Hazus damage functions in the flood model.

Severe Storm

A Hazus probabilistic analysis was performed to analyze the wind hazard losses for Broome County for the 100- and 500-year MRP events. The probabilistic Hazus hurricane model leverages 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 associated with Broome 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 demographics and updated building and critical facility inventories in Hazus were used for the analysis. Although damage is estimated at the census tract level, results were presented at the municipal level. Because multiple census tracts 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 Storm

The entire general building stock inventory in Broome County is 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 structural RCV was used to estimate damage 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 for Risk Assessment (FEMA 433) (FEMA 2004).

Given professional knowledge and the currently available information, the potential losses for this hazard may be overestimated and should be viewed as a conservative estimate for losses associated with winter storm events.

Wildfire

Wildfire hazard areas for Broome County were delineated using wildland-urban interface (WUI) mapping developed by the Department of Forest Ecology and Management SILVIS Laboratory at the University of Wisconsin at Madison. This mapping is based on the 2010 Decennial Census and 2006 National Land Cover Dataset and the Protected Areas Database. The WUI area is divided into two categories: intermix and interface.

The California Fire Alliance determined that 1.5 miles is the approximate maximum distance that firebrands can be carried from a wildfire to the roof of a house. Therefore, even structures not within the

forest are at risk from wildfire. This buffer distance, along with housing density and vegetation type, were used to define the WUI.

For this risk assessment, the high-, medium-, and low-density interface areas were combined and used as the interface hazard areas. The high-, medium-, and low-density intermix areas were combined and used as the intermix hazard areas.

The asset inventory was used to support an evaluation of assets exposed to this 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 Rating Probability of Occurrence

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

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

4.2.4 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
Building Inventory	Broome County GIS and Mapping Services; RSMeans 2022	2018; 2022	Digital (GIS) format
Critical Facilities and Lifelines	Broome County	2023	Digital (GIS) format
Land Cover	National Land Cover Database	2019	Digital (GIS) format
Digitized Preliminary FIRM Maps	FEMA	2010	Digital (GIS) format
1-Meter Digital Elevation Model	NYS GIS Clearinghouse	2019	TIFF
New Development Data	Participating Broome County Municipalities	2023	Digital (GIS) Format
NEHRP Soils	NYS DHSES	2014	Digital (GIS) format
Wildfire Hazard Data	Department of Forest Ecology and Management, SILVIS Laboratory at the University of Wisconsin at Madison	2012	Digital (GIS) format

Data	Source	Date	Format
Social Vulnerability Index	Centers for Disease Control and Prevention	2020	Digital (GIS) format
Dam Inundation	Broome County	2023	Digital (GIS) format

FEMA = Federal Emergency Management Agency; NEHRP = National Earthquake Hazard Reductions Program; NYS DHSES = New York State Division of Homeland Security and Emergency Services; NYS GIS = New York State Geographic Information Systems

4.2.5 Limitations

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

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

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of two or more. Therefore, potential vulnerability and loss estimates are approximate and should be used for planning purposes only. These results do not predict precise results and should be used to understand relative risk. Over the long term, Broome 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. Significant impacts may occur to critical facilities and infrastructure because of hazard events, causing great economic loss. However, estimates of economic impacts and monetized damage to critical facilities and infrastructure were not quantified and require more detailed loss analyses. In addition, economic impacts on industries such as tourism and the real estate market were not analyzed due to limited readily available data.

4.2.6 Considerations for Mitigation and Next Steps

The following items are to be discussed for consideration for the next plan update to enhance the risk assessment:

- All Hazards
    - Create an updated user-defined general building stock dataset using up-to-date parcels, footprints, and RSMeans values.
    - Use updated and current demographic data.

- Use assessor data, including updated occupancy class attributes, in general building stock.

- Earthquake
  - Identify unreinforced masonry in critical facilities and privately owned buildings (i.e., residences) by accessing local knowledge, tax assessor information, and/or pictometry/orthophotos. These buildings may not withstand earthquakes of certain magnitudes, and plans can be developed to provide emergency response or recovery efforts at these properties.
- Extreme Temperatures
  - Track extreme temperature data for injuries, deaths, shelter needs, pipe freezing, agricultural losses, and other impacts to determine distributions of the 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, update the vulnerability 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.

SECTION 4. RISK ASSESSMENT

4.3 HAZARD PROFILES

4.3.1 Dam Failure

This 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 dam failure in Broome County.

Hazard Profile

Hazard Description

Dam Failure

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 (ASDSO 2022).

Man-made dams can be classified according to the type of construction material used, methods applied in construction, slope or cross-section of the dam, how the dam resists forces of water pressure behind it, means used to control seepage, or 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 (ASDSO 2022).

Dams typically fail when spillway capacity is inadequate and excess flow overtops the dam or when internal erosion 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 2018).

Dam failures can result from the following scenarios (FEMA 2018):

- Overtopping caused by floods that exceed the 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
- Internal erosion of soil in embankment dams
- Inadequate maintenance and upkeep

Regulatory Oversight of Dams

The potential for catastrophic flooding caused by dam failures led to the enactment of the National Dam Safety Act (Public Law 92-367), which has protected Americans from dam failures for 30 years. The National Dam Safety Program is a partnership among 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 purchases of needed equipment. FEMA has also expanded existing training programs and initiated new ones. Grant assistance from FEMA provides support for the improvement of dam safety programs that regulate most dams in the United States (FEMA 2021).

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

- New York State Department of Environmental Conservation (NYSDEC)—Environmental Conservation Law (ECL) Article 15, Part 673
- U.S. Army Corps of Engineers (USACE)—EP 1110-2-13, Dam Safety Preparedness
- Federal Energy Regulatory Commission (FERC)—18 Code of Federal Regulations (CFR) 12.22-24

Dam safety emergency action plans (EAP) are formal dam failure procedures written by the dam owner or operator. EAPs are site-specific plans and relate only to the facility's procedures to prevent or mitigate the 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 NYSDEC Dam Safety Section holds responsibility for dam safety. The Dam Safety Section conducts safety inspections of dams, technical review of proposed dam construction or modification, monitoring of remedial work for compliance with dam safety criteria, and emergency preparedness (NYSDEC n.d.).

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).

U.S. 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 the 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

FERC has the largest dam safety program in the United States. FERC cooperates with several 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 2022):

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

Every 5 years, an independent FERC-approved consulting engineer must inspect and evaluate projects with dams higher than 32.8 feet (10 meters) or with a total storage capacity of more than 2,000 acre-feet (FERC 2022).

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 evaluate the effects of potential and actual large floods on the safety of dams. FERC staff visit dams and licensed projects during and after floods, assess the extent of damage, and direct any studies or remedial measures the licensee must undertake. FERC's *Engineering Guidelines for the Evaluation of Hydropower Projects* guide FERC engineering staff and licensees in evaluations of dam safety. The publication is frequently revised to reflect current information and methodologies (FERC 2017).

FERC requires licensees to prepare EAPs 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 2017).

Levee Failure

Levees are man-made structures, usually consisting of an engineered earthen embankment designed and constructed to contain, control, or divert the flow of water to protect from temporary flooding. A levee is built parallel to a body of water, typically a river, to protect the lives and properties behind it. Typically built as barriers between floodwaters and a nearby municipality, levees include a series of culverts, canals, ditches, storm sewers, or pump stations, called interior drainage systems. These systems channel water from the land side of a levee through to the waterside. There are thousands of miles of levees across the United States, none of which provides full protection from flooding (FEMA 2020).

Overtopping occurs when floodwaters exceed the height of a levee. When overtopping occurs, water passing over the levee can erode the structure, worsening the flooding and potentially causing an opening or beach in the levee through which floodwaters may pass. A breach can occur gradually or suddenly, but the most dangerous and damaging breaches happen quickly during periods of high water. The ensuing surge of water can flood a large area behind the failed levee with little to no warning (USACE 2019).

U.S. Army Corps of Engineers (USACE) operates, maintains, and evaluates levees to determine whether they meet accreditation requirements. Most levees are owned by local communities and flood control districts that also ensure proper operation and maintenance of the levee system (FEMA 2020).

According to the 2023 New York State (NYS) HMP, levees are one of many types of flood-control projects overseen by State agencies. The nature and design of levees often require significant amounts of land that are obtained by NYS as lands in fee title and permanent easements in order to construct, operate, and maintain these projects. These property rights allow the New York State Department of Environmental Conservation (NYSDEC) and its agents to access project lands to conduct maintenance activities including mowing, sediment removal from drainage channels and waterways, concrete repair, and functional equipment checks (NYS 2023).

Regulatory Oversight of Levees

USACE and FEMA have differing roles and responsibilities related to levees. Under the Levee Safety Program, USACE is responsible for addressing a range of operations and maintenance, risk communication, risk management, and risk reduction issues. FEMA addresses mapping and floodplain management issues related to levees, and it accredits levees as meeting requirements set forth by the National Flood Insurance Program (NFIP).

USACE and FEMA may be involved with the levee sponsor and community independently. Alternatively, when a levee system overlaps both agency programs, the sponsor will work with the two agencies jointly. Under both scenarios, the long-term goals are similar: to reduce risk and lessen the devastating consequences of flooding. Some USACE and FEMA partnering activities related to levees include:

- Joint meetings with levee sponsors and other stakeholders
- Integration of levee information into the National Levee Database
- State Silver Jackets teams
- Sharing of levee information
- Targeted task forces to improve program alignment

Coordination between USACE and FEMA with regard to levees is now standard practice. The agencies coordinate policies, jointly participate in meetings with stakeholders, and participate in multiagency efforts such as the National Committee on Levee Safety, the Federal Interagency Floodplain Management Task Force, and the Silver Jackets Program.

The Silver Jackets is a program intended to bring together multiple state, federal, and sometimes tribal and local agencies across the country to learn from one another and apply their knowledge to reduce the risk of flooding and enhance response and recovery efforts when such events do occur. The program's primary goals include the following:

- Create or supplement a mechanism to collaboratively identify, prioritize, and address risk management issues and implement solutions
- Increase and improve risk communication through a unified interagency effort
- Leverage information and resources and provide access to such national programs (FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) Program and USACE's Levee Inventory and Assessment Initiative)
- Provide focused, coordinated hazard mitigation assistance in implementing high-priority actions such as those identified by state hazard mitigation plans
- Identify gaps among agency programs and/or barriers to implementation, such as conflicting agency policies or authorities, and provide recommendations for addressing these issues

The Silver Jackets are currently active in New York State.

National Committee on Levee Safety

Congress created the National Committee on Levee Safety (NCLS) to "develop recommendations for a national levee safety program, including a strategic plan for implementation of the program" (NCLS 2010). The Committee adopted the vision of "an involved public and reliable levee systems working as part of an integrated approach to protect people and property from floods," and has been working toward this goal since October 2008 (NCLS 2010). The Committee is made up of representatives from state, regional, and local agencies; the private sector; USACE; and FEMA.

New York State

Under New York Environmental Conservation Law Article 16, NYSDEC is required to be the non-federal sponsor to participate in the Federal Flood Control Program. The two major components of the program are described below:

- Project Operation and Maintenance and Major Repair and Rehabilitation: NYSDEC is required by contract with the federal government to operate, maintain, and rehabilitate projects in an "as constructed" state of readiness. The NYSDEC Division of Water (DOW) and Division of Operations (OPS) jointly perform duties to operate these projects. The DOW observes weather and local conditions to determine when a project needs to initiate and cease operation. DOW also identifies critical work needs, whereas the OPS performs maintenance and operations work, including mowing levees; cleaning ditches; lubricating equipment; and operating pumps, closures, structures, and gate valves. Repair and replacement work such as stabilization in areas of channel bank erosion

threatening levees and walls is accomplished in conformance with NYS and USACE requirements to assure flood protection reliability.

- New Project Development: The Development of new levees and other flood protection projects are coordinated between NYS and the federal government, including conducting studies of economical and environmentally sensitive alternatives to provide flood protection, reduce flooding damages, and upgrade existing projects.

Location

Dam Failure

There are 179 dams located throughout Broome County, the high-hazard dams are listed in Table 4.3.1-1. Category C (high hazard) dams require Emergency Action Plans, which detail safety measures in pace and response operations in the event of an incident. According to information received from the New York State Department of Environmental Conservation, there are 116 Category A dams, 13 Category B dams, 23 Category C dams, and 27 Category D dams. Figure 4.3.1-1 displays the dam inundation areas in Broome County.

There are 23 high-hazards dams in Broome County and 21 are owned by Broome County, 1 is owned by the State of New York, and 1 is owned by the Army Corps of Engineers. Broome County conducted outreach with the NY Department of Environmental Conservation, which included gathering data from provided Emergency Action Plans and inundation maps for each high-hazard dam. This data was incorporated in compiling referenced maps and in the Identified Issues section of each municipality annex with high-hazard dams identified for their municipality. EAPs and associated inundation maps are kept on file with each municipality and Broome County to protect the confidential and sensitive information contained within the documents.

Emergency Action Plans, along with inundation maps for each jurisdiction are on file with each municipality and can be requested due to the confidential and sensitive information contained in each plan and map.

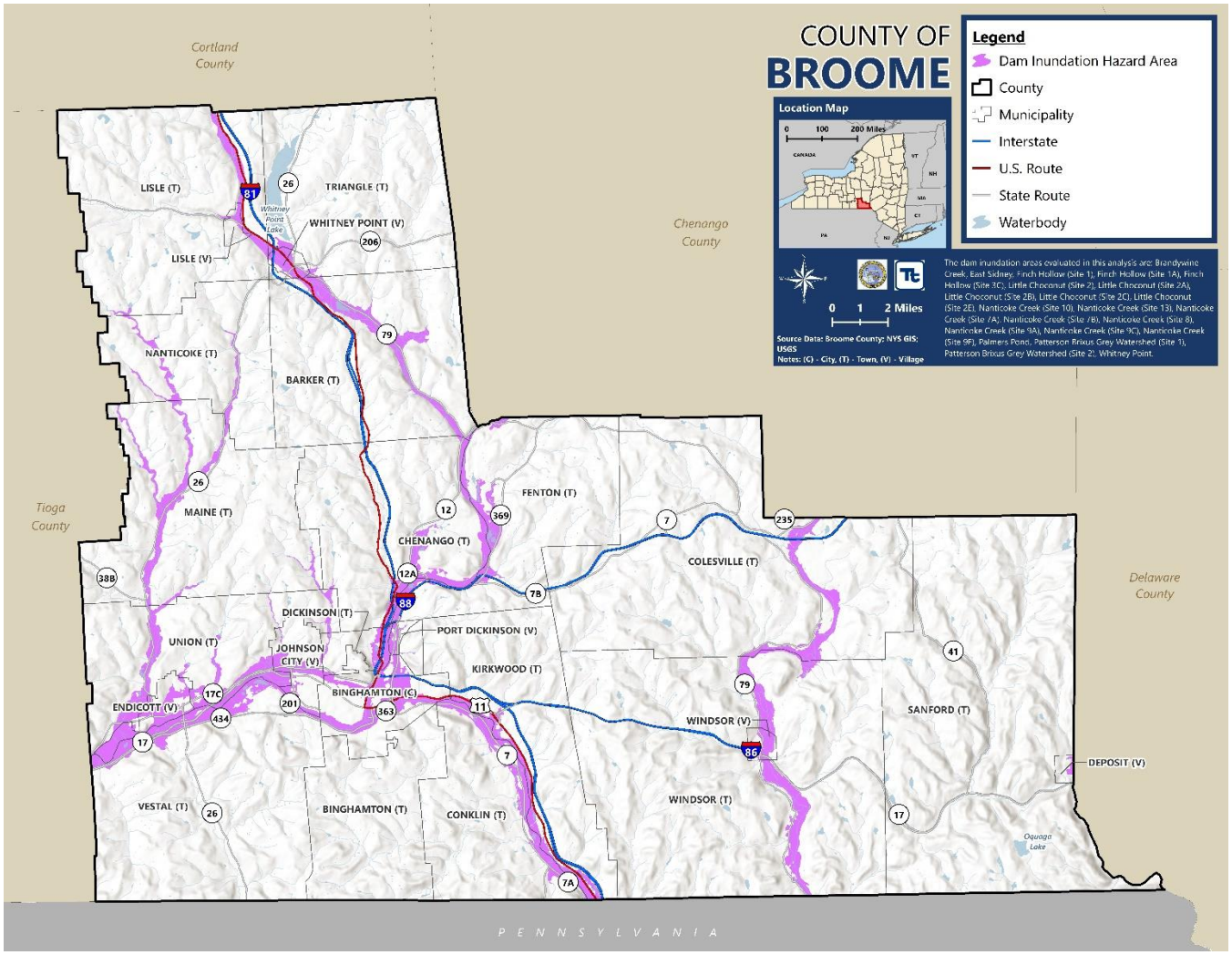
Table 4.3.1-1. High Hazard Dams in Broome County

Dam Name	Location	Hazard Category
Brandywine Creek Site 1 Dam	Village of Port Dickinson	High Hazard
Broome Corporate Park Pond Dam #2	Town of Conklin	High Hazard
Finch Hollow Site 1 Dam	Village of Johnson City	High Hazard
Finch Hollow Site 2 Dam	Town of Dickinson	High Hazard
Finch Hollow Site 3C Dam	City of Binghamton	High Hazard
Little Choconut Site 1A Dam	Town of Maine	High Hazard
Little Choconut Site 2a Dam	Town of Union	High Hazard
Little Choconut Site 2b Dam	Town of Maine	High Hazard
Little Choconut Site 2c Dam	Town of Maine	High Hazard
Little Choconut Site 2e Dam	Town of Maine	High Hazard
Nanticoke Creek Site 10 Dam	Town of Nanticoke	High Hazard

Nanticoke Creek Site 13 Dam	Town of Maine	High Hazard
Nanticoke Creek Site 3 Dam	Town of Lisle	High Hazard
Nanticoke Creek Site 7a Dam	Town of Maine	High Hazard
Nanticoke Creek Site 8 Dam	Town of Nanticoke	High Hazard
Nanticoke Creek Site 9a Dam	Town of Lisle	High Hazard
Nanticoke Creek Site 9c Dam	Town of Lisle	High Hazard
Nanticoke Creek Site 9e Dam	Town of Nanticoke	High Hazard
Oquaga Creek State Park Dam	Town of Sanford	High Hazard
Palmers Pond Dam	Village of Deposit	High Hazard
Patterson Brixius Grey Watershed 1 Dam	Town of Union	High Hazard
Patterson Brixius Grey Watershed 2 Dam	Town of Union	High Hazard
Whitney Point Dam	Town of Triangle	High Hazard

Source: Office of the New York State Comptroller 2017

Figure 4.3.1-1. Dam Inundation Areas in Broome County



Levee Failure

Upwards of 100,000 miles of levees stretch across the United States, and over 85 percent are thought to be locally owned. The remaining 15 percent are overseen by USACE or other federal or state agencies.

FEMA has estimated that levees are located in approximately 22 percent of the counties in the United States, and 43 percent of the population lives in counties with levees.

A comprehensive listing regarding the types and locations of levees across NYS and Broome County is not available. This is mostly because many of the levee systems were not built through formal processes, and therefore never fully documented. Table 4.3.1-2 lists the locations of levee systems in Broome County as reported in the USACE National Levee Database. These systems represent the major structures in which the USACE has provided some degree of assistance or oversight during development. The table includes levees that are owned federally, by the State, or locally. According to USACE, Broome County has twelve levees, most of which are sponsored, monitored, or maintained by NYSDEC. The following table provides details about those levees. Figure 4.3.1-2 through Figure 4.3.1-5 display the levee systems in Broome County.

Table 4.3.1-2. Number of Levees in Broome County

Sponsor (s)	System Name	Total Levee Miles	Accredited?	Flood Source	Primary Purpose
NYSDEC Region 7	Lisle	0.57	Yes	Tioughnioga River & Dudley Creek	Flood Risk Reduction
NYSDEC Region 7	Whitney Point Village	1.23	Yes	Tioughnioga River	Flood Risk Reduction
NYSDEC Region 7; Town of Union	Endicott Northeast	0.55	Yes	Nanticoke Creek	Flood Risk Reduction
NYSDEC Region 7	Endicott	2.84	Yes	Susquehanna River	Flood Risk Reduction
NYSDEC Region 7	Vestal	2.02	Yes	Big Chococut Creek, Susquehanna River, Susquehanna River & Willow Run	Flood Risk Reduction
Town of Union	Fairmont Park Flood Control Project	0.46	No	Susquehanna River	Flood Risk Reduction
NYSDEC Region 7	Johnson City	1.19	Yes	Finch Hollow Creek, Little Choconut Creek, Susquehanna River	Flood Risk Reduction
Not Available	Johnson City East	0.48	Yes	Susquehanna River	Flood Risk Reduction
NYSDEC Region 7	Northwest Binghamton	0.23	Yes	Chenango River	Flood Risk Reduction
Not Available	Binghamton Lourdes Hospital	Not Available	No	Susquehanna River	Flood Risk Reduction
NYSDEC Region 7	South Binghamton	0.99	Yes	Susquehanna River	Flood Risk Reduction
NYSDEC Region 7	Northeast Binghamton	1.69	Yes	Susquehanna River, Chamberlin Creek, Chenango River	Flood Risk Reduction

Source: (USACE 2024)

Figure 4.3.1-2. Binghamton-Port Dickinson Levee

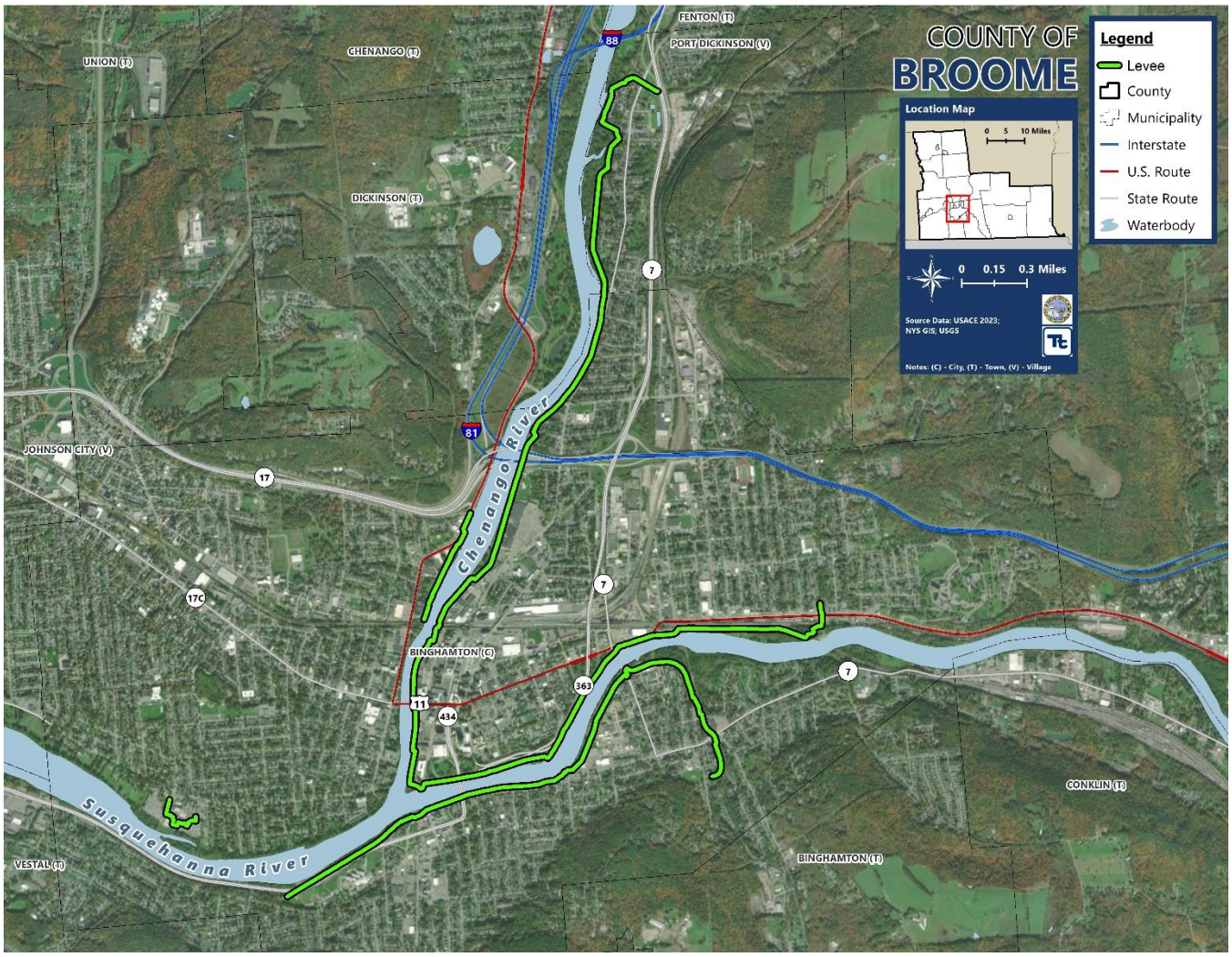


Figure 4.3.1-3. Endicott-Vestal-Union Levee

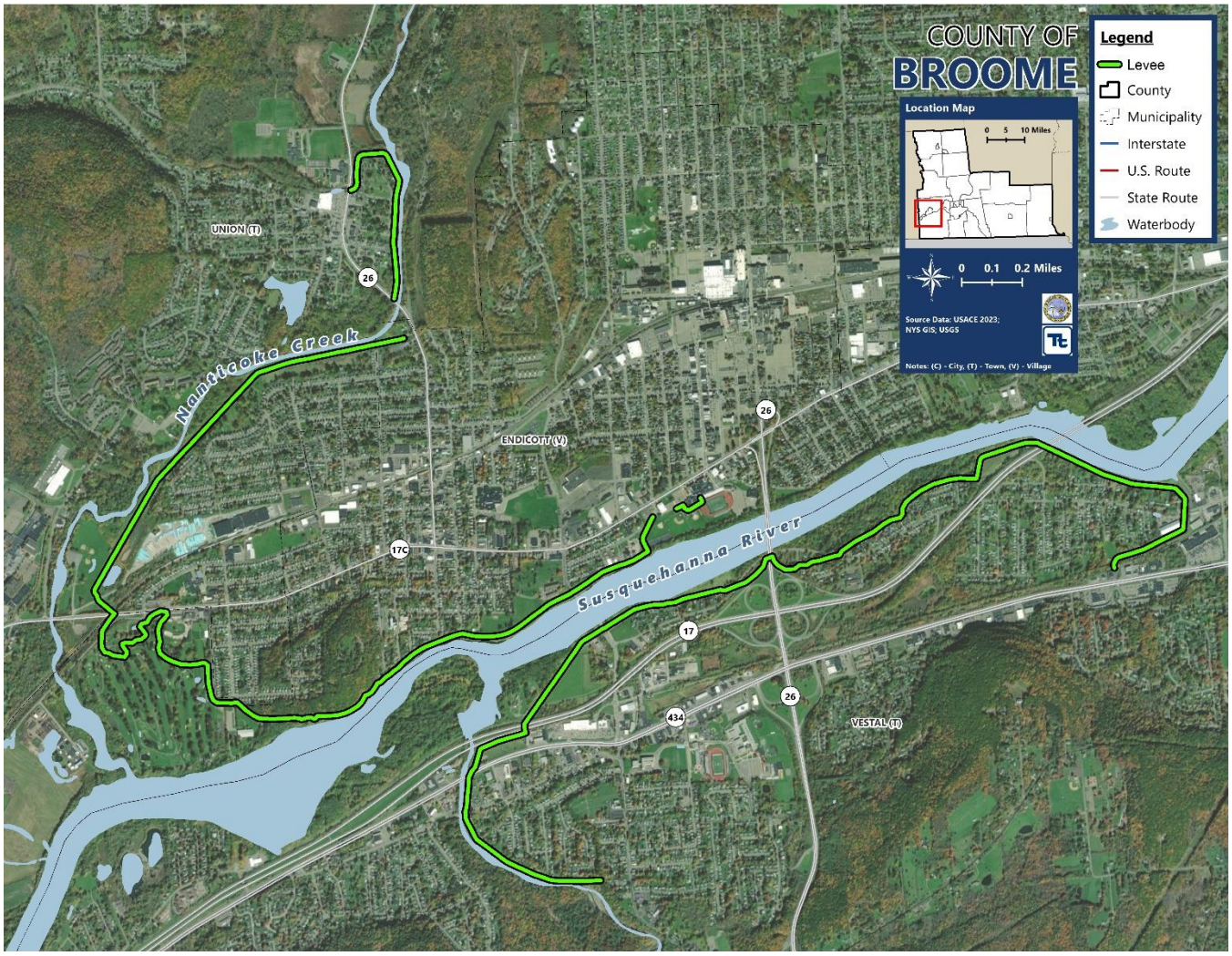
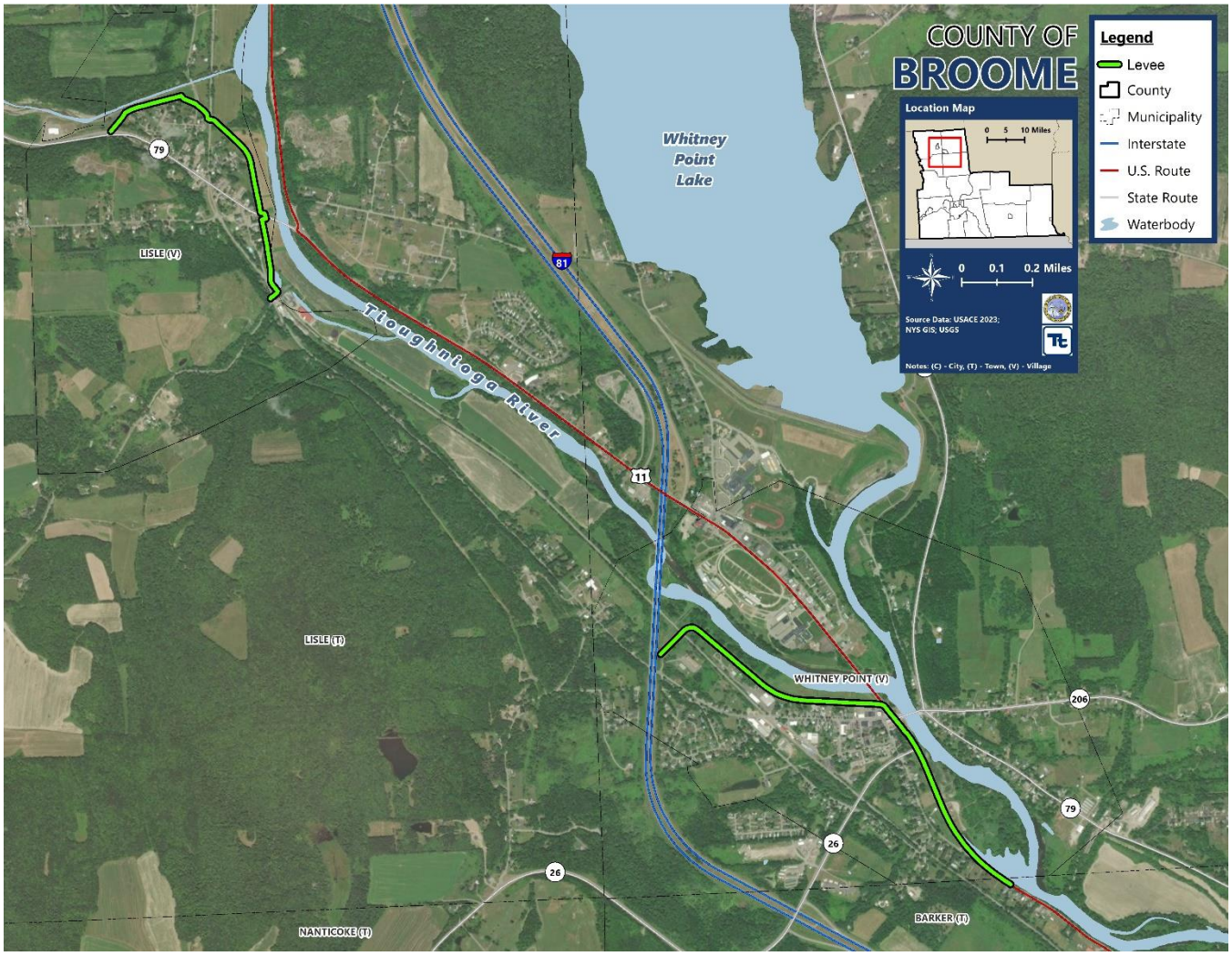


Figure 4.3.1-4. Johnson City-Union Levee

Figure 4.3.1-5. Lisle-Whitney Point Levee



FEMA Accredited Levees

FEMA has never remapped many levees shown on the effective FIRMs since their original mapping in the 1970s and 1980s. Originally, FIRMs showed levees as protecting from the base flood as long as they were designed and constructed in accordance with sound engineering practices. Beginning in 1986, levees have been shown as accredited on FIRMs only when they meet the requirements of Title 44, Chapter 1, Code of Federal Regulations (44 CFR) Section 65.10, "Mapping Areas Protected by Levee Systems," including certification by a registered professional engineer or a federal agency with responsibility for levee design.

Since 1986, levees that do not meet the requirements of 44 CFR 65.10 cannot be shown as accredited on a FIRM. Furthermore, floodplain areas behind unaccredited levees are mapped as high-risk areas subject to FEMA's minimum floodplain management regulations and mandatory flood insurance purchase requirements.

In 2004, as it initiated work under the Flood Map Modernization Initiative (Map Mod), FEMA determined that analysis of the role of levees in flood risk reduction would be an important part of the mapping efforts. A 2005 report noted significant documentation gaps on the status of the nation's levees and that the condition of many levees and floodwalls had not been addressed since their original inclusion in the NFIP. As a result, FEMA established policies to address existing levees.

FEMA Accredited Levees are now generally discussed in two main types: those mapped on Digital Flood Insurance Rate Maps (DFIRM) since Map Mod, and those that were mapped prior to the initiative and not mapped on DFIRMs (FEMA 2021).

FEMA-Accredited Levees Mapped on DFIRMS

As DFIRMs are developed, levees fall under one of the three following categories: Accredited Levee, Provisionally Accredited Levee (PAL), and De-Accredited Levee. Accredited levees are documented to protect from at least the 1-percent-annual-chance flood, and therefore the area behind it will be mapped as a moderate risk except for areas of residual flooding (interior drainage). The purchase of flood insurance is not mandated in a moderate-risk area, but flood insurance is strongly recommended.

A levee for which data and documentation are not readily available, and no known deficiency precludes meeting requirements of 44 CFR 65.10, may be deemed a PAL. FEMA will allow the party seeking recognition up to two years to compile and submit full documentation to show compliance with 44 CFR 65.10. The area behind a provisionally accredited levee will be mapped as a moderate risk with no mandatory flood insurance purchase requirement.

A levee for which data and documentation are not readily available and is not eligible for the PAL designation will be de-accredited by FEMA. FEMA evaluates the level of risk associated with each non-accredited levee through its Levee Analysis Mapping Procedures (LAMP) criteria to consider how to map the floodplain and determine which areas on the dry side of the levee will be shown as high risk. The mapping will then be updated to reflect this risk (FEMA 2021) .

Extent

Dam Failure

Dam failures can occur suddenly without warning during normal operating conditions (this is referred to as a sunny day failure). Dam failures can 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.

FEMA classifies dams according to their potential to cause harm (low, significant, high). The hazard potential classification system should be used with the understanding that failure of any dam or water-retaining structure could represent a danger to downstream life and property (FEMA 2021). The following list describes FEMA's classification system:

- Low-hazard potential dams are those where failure or misoperation would result in no probable loss of human life and low economic or environmental losses. Losses are principally limited to the owner's property.
- Significant-hazard potential dams are those where failure or misoperation would result in no probable loss of human life but could cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. Significant-hazard potential dams are often located in predominantly rural or agricultural areas.
- High-hazard potential dams are those where failure or mis-operation will probably cause loss of human life.

Levee Failure

In the event of a levee failure, floodwaters may ultimately inundate the protected area landward of the levee. The extent of inundation depends on the flooding intensity – failure of a levee during a 1-percent annual chance flood will inundate the approximate 100-year floodplain previously protected by the levee. The structures closest to the levee overtopping or breach location will suffer the most damage from the initial embankment failure flood wave, and other buildings landward of the breach area will be damaged by inundation (FEMA 2018).

Levees require maintenance to continue to provide the level of protection they were designed and built to offer. The responsibility for conducting routine maintenance and inspections belongs to a variety of coordinating entities including local, state, and federal government and private landowners. Well-maintained levees may obtain certification through independent inspections. However, levee owners must maintain the levee and pay for an independent inspection to be certified for maintaining flood protection. Not surprisingly, uncertified levees have a higher risk of failure. In addition, insurance rates may increase for properties located in the inundation area of uncertified levees as identified on FEMA Flood Insurance Rate Maps (FIRM) because FEMA notes that the structures are not certified to protect from a 1-percent annual chance flood event (FEMA 2018).

Like dam failures, warning time depends on the cause of the failure. Despite warnings regarding the structural integrity of the system, a levee failure caused by structural failure can be sudden and perhaps with little to no warning. If heavy rains impact a levee system, communities in the immediate danger zone can be evacuated before a failure occurs. If the levee failure is caused by overtopping, the community may or may not be able to recognize the impending failure and evacuate. If a levee failure occurs suddenly, evacuation may not be possible.

Previous Occurrences and Losses

This section presents the best available information on previous dam failure occurrences, impacts, and monetary losses in Broome County. Where multiple information sources were available, the results presented here were judged to be the most accurate and reliable. Citations are provided for each information source used.

FEMA Major Disasters and Emergency Declarations

Broome County did not experience any FEMA Major Disaster or Emergency Declarations for dam or levee failure between 2019 and 2024 (NPDP 2018).

U.S. Department of Agriculture Disaster Declarations

There have been no U.S. Department of Agriculture (USDA) disaster declarations associated with dam or levee failure in Broome County.

Previous Events

There have been no previous dam or levee failure events recorded in Broome County.

Probability of Future Occurrence

Dam failure events are infrequent and usually coincide with trigger events, such as earthquakes, landslides, and excessive rainfall and snowmelt. However, the risk of such an event increases for each dam as the dam's age increases or the frequency of maintenance decreases. "Residual risk" to dams remains after the implementation of safeguards. Residual risk to dams is associated with events beyond those that the facility was designed to withstand. The probability of any type of dam or levee failure is low in today's dam safety regulatory and oversight environment.

Table 4.3.1-3 shows the future occurrence of dam and levee failure events in Broome County, based on historical information. Broome County has a 0 percent probability of dam failure or levee failure events occurring in any given year. Even though the statistical probability based on past events is zero, dam and levee failure is rated as an *occasional* hazard for Broome County based on the risk ranking methodology used for this HMP (see Section 4.4). This is because of the estimated population and property within the dam and levee inundation hazard areas, frequency of heavy rains, and projected climate change impacts.

Table 4.3.1-3. Future Occurrence of Dam Failure Events in Broome County

Hazard Type	Number of Occurrences Between 2019 and 2023	% Chance of Occurrence in Any Given Year
Dam Failure	0	0
Levee Failure	0	0

Source: NPDP 2018

Climate Change Impacts

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 hygrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. Loss of the 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.

Regional precipitation in central and southwestern New York is anticipated to increase over the next half century (Horton, et al. 2014). Increased precipitation can occur in the form of heavy rainfall events, which

have the potential to increase the risk of dam failures. Increases in precipitation may stress dam walls. Existing dams 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 areas adjacent to currently mapped inundation areas. However, the probable maximum flood assumed in the design of each dam may be able to accommodate climate changes.

Levees in Broome County may be affected by the impacts of climate change. Of particular concern may be the stress that an increase in the intensity and frequency of precipitation events could have on levee systems. With an increased volume of stormwater entering waterways, the levee systems may have to retain more water from storms themselves.

Vulnerability Assessment

Dam and levee failures are a hazard of concern for Broome County because 179 dams are present across the County, 23 of which are identified as high hazard; furthermore, there are twelve levees present across the County (NYS Department of Environmental Conservation 2023). Dam and levee 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. The direct and indirect losses associated with dam and levee failures include injury and loss of life, damage to structures and infrastructure, agricultural losses, utility failure, and stress on community resources. The warning time for a dam or levee failure event is often limited, which contributes to direct and indirect losses. To assess the County's risk from dam and levee failure, a qualitative review was implemented.

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 structure.

Overall Population

The entire population residing within a dam or levee 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. Dam and levee failure can displace persons if flooding of structures occurs. Dam and levee failure impacts on populations may be similar to those of flood events, depending on the size of the dam reservoir and breach. Understanding the potential outcomes of flooding for each dam in Broome County would require intensive hydraulic modeling.

Often, warning time for dam or levee failure is limited. These events are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event are highly vulnerable to this hazard. Ongoing mitigation efforts, including dissemination and early warning systems noted in

Section 6 (Mitigation Strategies) of this plan update, should help avoid the most likely cause of injury: persons trying to cross flooded roadways or channels during a dam or levee failure-induced flood.

Dam Failure

USACE information was used to estimate population exposure for maximum high pool breaches of high-hazard dams. Based on the analysis, there are an estimated 60,198 residents living in the Aggregated Dam Inundation Hazard Area, or 9.3 percent of the County's total population. The City of Binghamton has the greatest number of residents living in the Aggregated Dam Inundation Hazard Area, with an estimated 6,018 residents. Table 4.3.1-4 summarizes the population exposed to the dam failure hazard by jurisdiction.

Table 4.3.1-4. Estimated Population Located Within the Aggregated Dam Inundation Hazard Area

Jurisdiction	Total Population (ACS)	Estimated Population Located Within the Aggregated Dam Inundation Hazard Area	
		Total Population in the Hazard Area	Percent of Total
Barker (T)	2,509	220	8.8%
Binghamton (C)	47,969	6,018	12.5%
Binghamton (T)	4,617	0	0.0%
Chenango (T)	10,959	1,045	9.5%
Colesville (T)	4,868	193	4.0%
Conklin (T)	5,008	513	10.2%
Deposit (V)	721	159	22.1%
Dickinson (T)	3,401	340	10.0%
Endicott (V)	13,667	2,498	18.3%
Fenton (T)	6,429	398	6.2%
Johnson City (V)	15,343	1,408	9.2%
Kirkwood (T)	5,481	166	3.0%
Lisle (T)	2,343	53	2.3%
Lisle (V)	348	76	21.8%
Maine (T)	5,168	238	4.6%
Nanticoke (T)	1,581	136	8.6%
Port Dickinson (V)	1,699	367	21.6%
Sanford (T)	1,518	0	0.0%
Triangle (T)	1,849	9	0.5%
Union (T)	27,128	3,081	11.4%
Vestal (T)	29,313	1,049	3.6%
Whitney Point (V)	960	304	31.7%
Windsor (T)	4,897	134	2.7%
Windsor (V)	907	30	3.3%
Broome County (Total)	**198,683**	**18,435**	**9.3%**

Source: U.S. Census, American Community Survey 5-Year Estimates 2017-2021; FEMA 2010

Levee Failure

There are twelve levee systems in Broome County. **Error! Reference source not found.** provides details on the twelve systems including what is at risk (population, buildings, and property value). The overall risk in Broome County is as follows (USACE 2024):

- 34,320 is the estimated population in Broome County located within the leveed area. This is not a life-loss projection.
- 10,143 is the estimated number of buildings in Broome County located within the leveed area.
- $4 trillion is the estimated total of structure value, structure contents, and vehicles located in the leveed area. This total does not include land value, economic productivity loss, or transportation infrastructure values (e.g., bridges, roads, etc.).

Table 4.3.1-5. Broome County Levee Systems

System Name	Total Levee Miles	Population at Risk	Buildings at Risk	Property Value
Lisle	0.57	202	88	$7.080 million
Whitney Point Village	1.23	351	204	$51.550 million
Endicott Northeast	0.55	253	82	$46.870 million
Endicott	2.84	7,470	2,355	$398 million
Vestal	2.02	2,191	879	$198 million
Fairmont Park Flood Control Project	0.46	157	44	$18.960 million
Johnson City	1.19	1,014	354	$59.470 million
Johnson City East	0.48	462	170	$117 million
Northwest Binghamton	0.23	2,034	815	$226 million
Binghamton Lourdes Hospital	Not Available	1,248	3	$57.820 million
South Binghamton	0.99	4,195	1,599	$569 million
Northeast Binghamton	1.69	14,743	3,550	$2.260 trillion
Total	**12.25**	**34,320**	**10,143**	**$4 trillion**

Source: (USACE 2024)

Socially Vulnerable Populations

According to Census data, Broome County's population includes 37,752 persons over the age of 65, 10,142 persons under the age of 5, 3,165 non-English speakers, 30,857 persons with a disability, and 35,372 persons living in poverty (refer to Table 4.3.1-6). These populations are more at risk during a dam or levee failure event because economically disadvantaged populations are more likely to decide to evacuate based on the net economic impact on their family, and 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 or levee failure event. Populations without adequate warning of the event are highly vulnerable. Individuals who may not receive adequate warning include those who lack an internet connection, do not speak English proficiently, and/or do not regularly use a communication tool used for warnings, like a cellphone or social media account. Figure 4.3.1-6 displays

the FEMA National Risk Inventory's Social Vulnerability Index for the County of Broome, which is identified as "relatively high."

Table 4.3.1-6. Broome County Socially Vulnerable Populations by Municipality

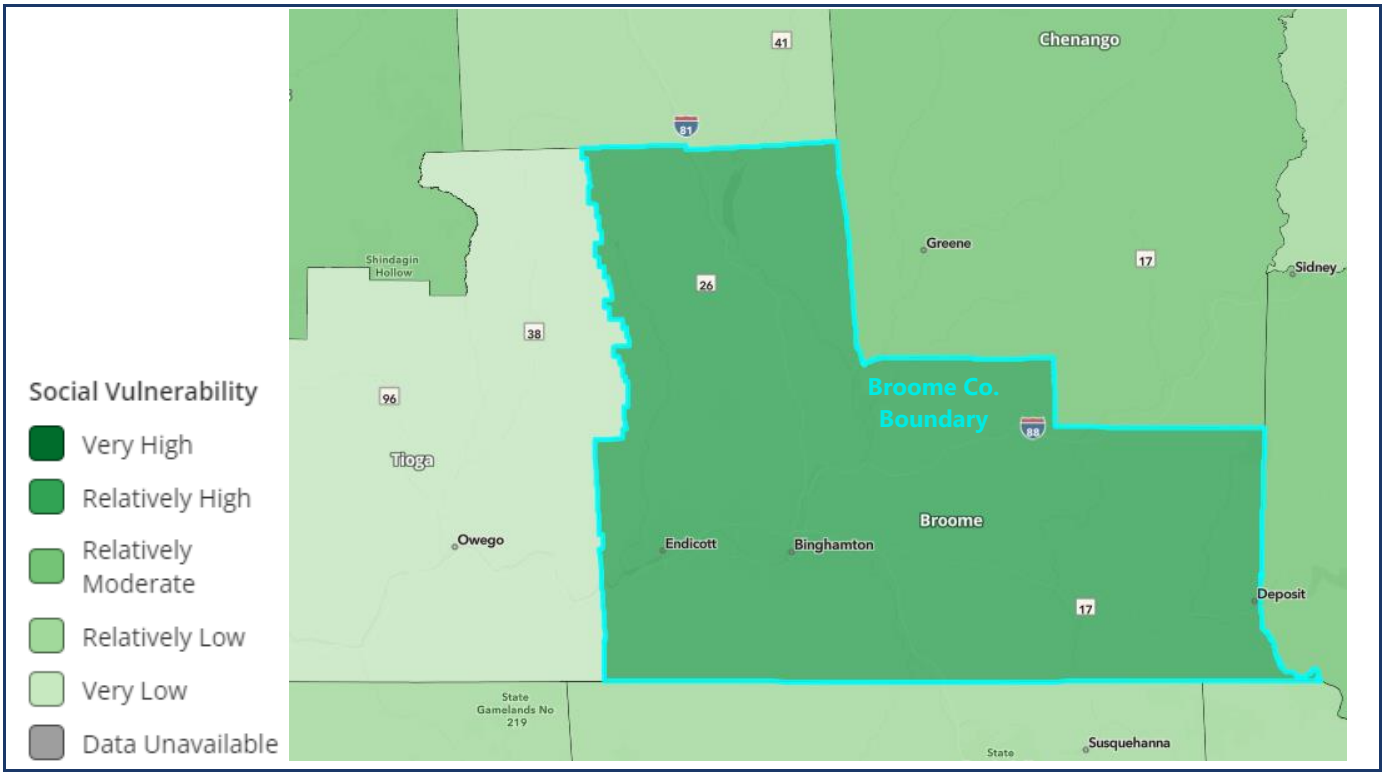
Jurisdiction	American Community Survey 5-Year Population Estimates (2021)									
	Over 65	Percent of Jurisdiction Total	Under 5	Percent of Jurisdiction Total	Non-English Speaking	Percent of Jurisdiction Total	Disability	Percent of Jurisdiction Total	Poverty Level	Percent of Jurisdiction Total
Barker (T)	465	18.5%	142	5.7%	49	2.0%	342	13.6%	537	21.4%
Binghamton (C)	7,642	15.9%	2,588	5.4%	1,051	2.2%	9,632	20.1%	14,894	31.0%
Binghamton (T)	822	17.8%	206	4.5%	5	0.1%	710	15.4%	454	9.8%
Chenango (T)	2,236	20.4%	861	7.9%	37	0.3%	1,359	12.4%	1,292	11.8%
Colesville (T)	1,299	26.7%	161	3.3%	0	0.0%	812	16.7%	345	7.1%
Conklin (T)	1,116	22.3%	227	4.5%	182	3.6%	637	12.7%	584	11.7%
Deposit (V)*	110	15.3%	49	6.8%	0	0.0%	123	17.1%	153	21.2%
Dickinson (T)	829	24.4%	32	0.9%	63	1.9%	611	18.0%	345	10.1%
Endicott (V)*	2,337	17.1%	664	4.9%	107	0.8%	2,544	18.6%	3,535	25.9%
Fenton (T)	1,223	19.0%	518	8.1%	49	0.8%	828	12.9%	962	15.0%
Johnson City (V)*	2,864	18.7%	821	5.4%	356	2.3%	2,718	17.7%	2,938	19.1%
Kirkwood (T)	1,045	19.1%	116	2.1%	61	1.1%	736	13.4%	768	14.0%
Lisle (T)	373	15.9%	157	6.7%	0	0.0%	405	17.3%	207	8.8%
Lisle (V)*	48	13.8%	4	1.1%	0	0.0%	45	12.9%	23	6.6%
Maine (T)	1,141	22.1%	311	6.0%	0	0.0%	927	17.9%	873	16.9%
Nanticoke (T)	384	24.3%	68	4.3%	0	0.0%	265	16.8%	123	7.8%
Port Dickinson (V)*	235	13.8%	77	4.5%	26	1.5%	208	12.2%	223	13.1%
Sanford (T)	469	30.9%	27	1.8%	0	0.0%	243	16.0%	91	6.0%
Triangle (T)	300	16.2%	40	2.2%	0	0.0%	298	16.1%	251	13.6%
Union (T)	6,306	23.2%	1,300	4.8%	301	1.1%	3,358	12.4%	2,549	9.4%
Vestal (T)	5,068	17.3%	1,261	4.3%	876	3.0%	3,025	10.3%	3,318	11.3%
Whitney Point (V)*	221	23.0%	32	3.3%	0	0.0%	168	17.5%	340	35.4%
Windsor (T)	1,002	20.5%	452	9.2%	0	0.0%	713	14.6%	458	9.4%
Windsor (V)*	217	23.9%	28	3.1%	2	0.2%	150	16.5%	109	12.0%
Broome County (Total)	**37,752**	**19.0%**	**10,142**	**5.1%**	**3,165**	**1.6%**	**30,857**	**15.5%**	**35,372**	**17.8%**

Source: American Community Survey 5-Year Estimates 2017-2021

Note: Persons per household = 2.33; Number used to calculate Non-English Speaking population.

* *The following villages are contained with towns, so the population totals were adjusted based on the average population and the count of residential structures from the general building stock data. Deposit (V) is 52% within Sanford (T); Endicott (V) & Johnson City (V) are 100% within Union (T); Lisle (V) is 100% within Lisle (T); Port Dickinson (V) is 100% within Dickinson (T); Whitney Point (V) is 100% within Triangle (T); Windsor (V) is 100% within Windsor (T).*

Figure 4.3.1-6. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA 2019

Impact on General Building Stock

Buildings located downstream of a dam or levee are at risk of damage should there be a failure. Downstream inundation areas were not available to quantify any potential losses to structures. Properties located closest to the dam or levee inundation area have the greatest potential to experience the largest, most destructive surge of water. The overall impact of flooding damage caused by a dam or levee failure will vary depending on the depth of flooding and the velocity of the surge.

Dam Failure

Table 4.3.1-7 summarizes the number of structures in the Aggregated Dam Inundation Hazard Area by jurisdiction. Countywide, there are 21,052 buildings in the Aggregated Dam Inundation Hazard Area with an estimated $31.5 billion of replacement cost value (building and content replacement costs). This represents approximately 22.1 percent of the County's total general building stock inventory.

Table 4.3.1-7. Estimated Number and Total Replacement Cost Value of Structures Located Within the Aggregated Dam Inundation Hazard Area by Jurisdiction

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Number and Total Replacement Cost Value of Structures Located Within the Aggregated Dam Inundation Hazard Area			
			Number of Buildings in the Aggregated Dam Inundation Hazard Area	Percent of Total	Total Replacement Cost of Buildings in the Aggregated Dam Inundation Hazard Area	Percent of Total
Barker (T)	1,265	$458,008,966	240	19.0%	$107,598,701	23.5%
Binghamton (C)	25,243	$25,457,379,910	6,740	26.7%	$9,577,973,156	37.6%
Binghamton (T)	2,121	$819,770,287	1	<0.1%	$1,294,635	0.2%
Chenango (T)	5,183	$3,461,760,757	1,266	24.4%	$1,673,088,894	48.3%
Colesville (T)	2,476	$1,191,537,444	214	8.6%	$81,750,741	6.9%
Conklin (T)	2,520	$1,512,740,573	614	24.4%	$481,688,681	31.8%
Deposit (V)	468	$264,974,793	183	39.1%	$121,679,254	45.9%
Dickinson (T)	1,447	$1,107,438,719	393	27.2%	$360,864,515	32.6%
Endicott (V)	7,011	$5,891,635,188	2,770	39.5%	$2,692,552,519	45.7%
Fenton (T)	3,166	$1,276,510,649	464	14.7%	$204,962,084	16.1%
Johnson City (V)	7,904	$17,304,375,644	1,674	21.2%	$9,684,732,755	56.0%
Kirkwood (T)	2,628	$2,560,128,948	215	8.2%	$320,254,300	12.5%
Lisle (T)	1,108	$396,905,321	59	5.3%	$36,947,143	9.3%
Lisle (V)	135	$62,277,436	92	68.1%	$47,573,405	76.4%
Maine (T)	2,431	$1,346,741,610	259	10.7%	$120,574,891	9.0%
Nanticoke (T)	762	$278,505,563	145	19.0%	$49,165,751	17.7%
Port Dickinson (V)	845	$315,481,120	374	44.3%	$134,207,635	42.5%
Sanford (T)	1,399	$483,498,227	0	0.0%	$0	0.0%
Triangle (T)	915	$437,291,241	15	1.6%	$108,590,018	24.8%
Union (T)	13,013	$15,447,295,551	3,470	26.7%	$3,596,768,899	23.3%
Vestal (T)	9,532	$13,318,921,679	1,322	13.9%	$1,677,119,592	12.6%
Whitney Point (V)	439	$397,093,693	362	82.5%	$368,198,521	92.7%
Windsor (T)	2,685	$956,635,388	139	5.2%	$45,176,831	4.7%

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Number and Total Replacement Cost Value of Structures Located Within the Aggregated Dam Inundation Hazard Area			
			Number of Buildings in the Aggregated Dam Inundation Hazard Area	Percent of Total	Total Replacement Cost of Buildings in the Aggregated Dam Inundation Hazard Area	Percent of Total
Windsor (V)	435	$420,256,617	41	9.4%	$41,157,071	9.8%
Broome County (Total)	**95,131**	**$95,167,165,323**	**21,052**	**22.1%**	**$31,533,919,989**	**33.1%**

Source: Broome County GIS & Mapping Services; RS Means 2022; FEMA 2010

Levee Failure

Structures located in leveed areas are more at risk of damage as a result of a levee breach or failure. In Broome County, twelve levee systems contain 10,143 buildings in the leveed areas with a property value of over $4 trillion. Refer to Table 4.3.1-5 for the number of buildings located within each levee system.

Impact on Critical Facilities and Community Lifelines

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

Table 4.3.1-8 lists the number of community lifelines within the Aggregated Dam Inundation Hazard Area. Of the 568 critical facilities located in the Aggregated Dam Inundation Hazard Area, the greatest number are transportation facilities.

For all other dams and all levees in Broome County, it is assumed all critical facilities and lifelines located within the dam inundation areas or the leveed areas are exposed and at risk to the impacts of dam and levee failures.

Table 4.3.1-8. Lifelines in the Aggregated Dam Inundation Hazard Area

FEMA Lifeline Category	Total Number of Lifelines in Jurisdiction	Number of Lifelines in the Aggregated Dam Inundation Hazard Area
Communications	60	8
Energy	0	0
Food, Water, Shelter	161	43
Hazardous Material	210	105
Health and Medical	41	23
Safety and Security	243	91
Transportation	516	230
Water Systems	197	68
Broome County (Total)	**1,428**	**568**

Source: Broome County 2023

Impact on the Economy

Severe flooding that follows a dam or levee failure can cause extensive structural damage and impede essential services. The cost to recover from flood damage will vary depending on the hazard risk of each dam.

Severe flooding from a dam or levee failure also can cause extensive damage to public utilities and disruptions to the 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 to levels similar to those from 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 or levee failure can include significant water quality and debris disposal issues or severe erosion that can impact local ecosystems. Flood waters can back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate 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.

Cascading Impacts on Other Hazards

Dam or levee failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential secondary hazards of dam or levee failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat. Dam or levee failures can occur because of structural failures, such as progressive erosion of an embankment or overtopping and breaching by a severe flood. (FEMA 2013).

Levee failures can also cause secondary hazards including severe downstream, landslides, bank erosion, and destruction of habitat. Environmental incidents may ensue due to hazardous materials released when floodwaters infiltrate facilities that store these types of materials.

Future Changes that May Impact Vulnerability

Understanding future changes that may impact vulnerability in the County can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place.

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 could be impacted by a dam or levee failure event if the structures are located within the dam failure inundation 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 and levee 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

According to the U.S. Census Bureau, the County's population decreased by 0.95 percent between 2010 and 2020 (US Census 2023). Cornell University's Program on Applied Demographics projects that Broome County will have a population of 186,950 by 2030 and 183,176 by 2040 (Cornell University 2018). These trends indicate a gradual longer-term population decline.

Any changes in the density of the population can impact the number of persons exposed to the probable maximum flood inundation hazard areas. A decrease in density can resolve issues for residents during evacuation of a dam failure event and affect commuters that travel into and out of the County for work, particularly during a dam or levee failure 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.

Climate Change

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 of dam or levee failures. Increases in precipitation may stress the structures. 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. The individual vulnerability of each dam, however, depends on the probable maximum flood specifications used to design the structure. These variations may be able to accommodate changes in climate for some dams or levees up to a certain extent.

Change of Vulnerability Since 2019 HMP

Overall, the County's vulnerability to the dam and levee failure hazard has not changed since the previous HMP, and the County will continue to be exposed and vulnerable to dam and levee failure events. 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 and levee failure 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.

SECTION 4. RISK ASSESSMENT

4.3 HAZARD PROFILES

4.3.2 Disease Outbreak

This 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 disease outbreaks in Broome County.

Hazard Profile

Hazard Description

A global outbreak of disease 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).

Broome 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 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.

Between 2019 and 2023, there were 6,048 confirmed cases of influenza A in Broome County (NYSDOH 2023).

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 the 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).

West Nile Virus

West Nile Virus (WNV) is the leading cause of mosquito-borne disease in the United States. It is mostly 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* or 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).

Location

The location of disease outbreaks depends on the preferred habitat of species that can spread the disease, as well as the species' ease of movement and establishment. The presence of disease-carrying mosquitoes and ticks has been reported throughout most of the state and Broome County.

Extent

The extent of disease outbreaks depends 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.

According to the Broome County Comprehensive Emergency Management Plan (CEMP), the Broome County Department of Public Health, in the event of an emergency, in addition to regular duties, will do the following (Broome County 2008):

- Enforce health, environmental and sanitary codes
- Issue health advisories
- Assist with health and environmental evaluations
- Waive or restrict health or environmental codes
- Monitor water supply, sewage control, hazardous materials, decontamination, disease/pest control, and food sanitation
- Liaise with nursing assistance and provide referral information
- Determine radiation levels, decontamination, treatment, and care
- Coordinate health facility evacuations and determine new treatment centers
- Supervise identification and disposition of dead.

The CDC uses the Pandemic Severity Assessment Framework (PSAF) to determine how "bad" the pandemic will be. The framework uses two factors to determine pandemic severity:

- Clinical severity, or how serious the illness is
- Transmissibility, or how easily the disease spreads from person to person

The framework guides the CDC's recommendations and decision-making at a given time during a pandemic by assessing the disease at different stages. The CDC uses these assessments to compare pandemics (or even seasonal influenza epidemics), creating a quick comparative snapshot of the potential impacts. For example, using the PSAF, the 1918 pandemic can be characterized as one with very high transmissibility and very high clinical severity, whereas the 2009 swine flu (H1N1) pandemic had moderate transmissibility and clinical severity. The results help public health officials and healthcare professionals make timely and informed decisions and take appropriate actions (CDC 2016).

The World Health Organization (WHO) has identified six phases of a global pandemic (World Health Organization 2009) as outlined in Table 4.3.2-1. The State of New York uses the WHO classification system guidance to inform its activities during a pandemic.

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 reassortment virus has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks.
Containment	
Phase 4	Human-to-human transmission of an animal or human-animal influenza reassortment 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	The level of pandemic influenza activity in most countries with adequate surveillance rising again.
Post-Pandemic Period	Levels of influenza activity have returned to the levels seen for seasonal influenza in most countries with adequate surveillance.

Source: (WHO 2009)

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).

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.

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).

Previous Occurrences and Losses

This section presents the best available information on previous disease outbreak occurrences, impacts, and monetary losses in Broome County. Where multiple information sources were available, the results presented here were deemed to be the most accurate and reliable. Citations are provided for each information source used.

FEMA Major Disasters and Emergency Declarations

Between 1953 and 2023, Broome County was included in three disaster (DR) or emergency (EM) declarations for disease outbreak-related events. Generally, these disasters cover a wide region of the State and affect several counties at the same time (FEMA 2023).

Table 4.3.2-2. FEMA Disease Outbreak Disaster Declarations in Broome County (1953 to 2023)

Date of Event	Event Type	FEMA Declaration Number	Broome County included in the Declaration?	Description
May 22 – November 1, 2000	Biological, WNV	EM-3155-NY	Yes	Virus Threat, WNV
January 20, 2020 – May 11, 2023	Biological, Coronavirus	EM-3434-NY	Yes	Covid-19
January 20, 2020 – May 11, 2023	Biological, Coronavirus	DR-4480-NY	Yes	Covid-19 Pandemic

Source: FEMA 2023

U.S. Department of Agriculture Disaster Declarations

The Secretary of 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 contiguous counties. Between 2012 and 2023, Broome County was not included in any disease outbreak-related USDA disaster declarations.

Previous Events

Table 4.3.2-3 summarizes disease outbreak events that affected Broome County between January 2018 and June 2023.

Table 4.3.2-3. Flood Events in Broome County (2018 to 2023)

Date of Event	Event Type	Declaration Number	County Designated?	Event Details
January 1 – December 31, 2018	Biological, WNV	—	Not applicable	Two cases of WNV were reported in Broome County.
September 29, 2019 – April 11, 2020	Biological, Influenza A	—	Not applicable	The 2019-2020 flu season resulted in 1,316 cases of influenza A in Broome County.
September 27, 2020 – May 22, 2021	Biological, Influenza A	—	Not applicable	The 2020-2021 flu season resulted in 6 cases of influenza A in Broome County.
October 3, 2021 – June 25, 2022	Biological, Influenza A	—	Not applicable	The 2021-2022 flu season resulted in 1,170 cases of influenza A in Broome County.
October 3, 2021 – May 20, 2023	Biological, Influenza A	—	Not applicable	The 2022-2023 flu season resulted in 3,556 cases of influenza A in Broome County as of June 19, 2023.
January 1 – December 31, 2018	Biological, Lyme Disease	—	Not applicable	56 cases of Lyme disease were reported in Broome County.
January 1 – December 31, 2019	Biological, Lyme Disease	—	Not applicable	76 cases of Lyme disease were reported in Broome County.
January 1 – December 31, 2020	Biological, Lyme Disease	—	Not applicable	43 cases of Lyme disease were reported in Broome County.
January 20, 2020 – May 11, 2023 [a]	Biological, Coronavirus	EM-3434-NY, DR-4480-NY	Yes	Broome County reported 593 cases of the COVID-19 virus in 2024, as of January 14, 2024. In 2023, 9,010 cases were reported; in 2022, 23,469 cases were reported; 25,625 cases were reported in 2021;

Date of Event	Event Type	Declaration Number	County Designated?	Event Details
				8,301 cases were reported in 2020, beginning on March 1, 2020.

Sources: NYSDOH 2023; CDC 2022; NYSDOH 2023; CDC 2023

a. Coronavirus statistics began on March 1, 2020, and were last updated on January 14, 2024

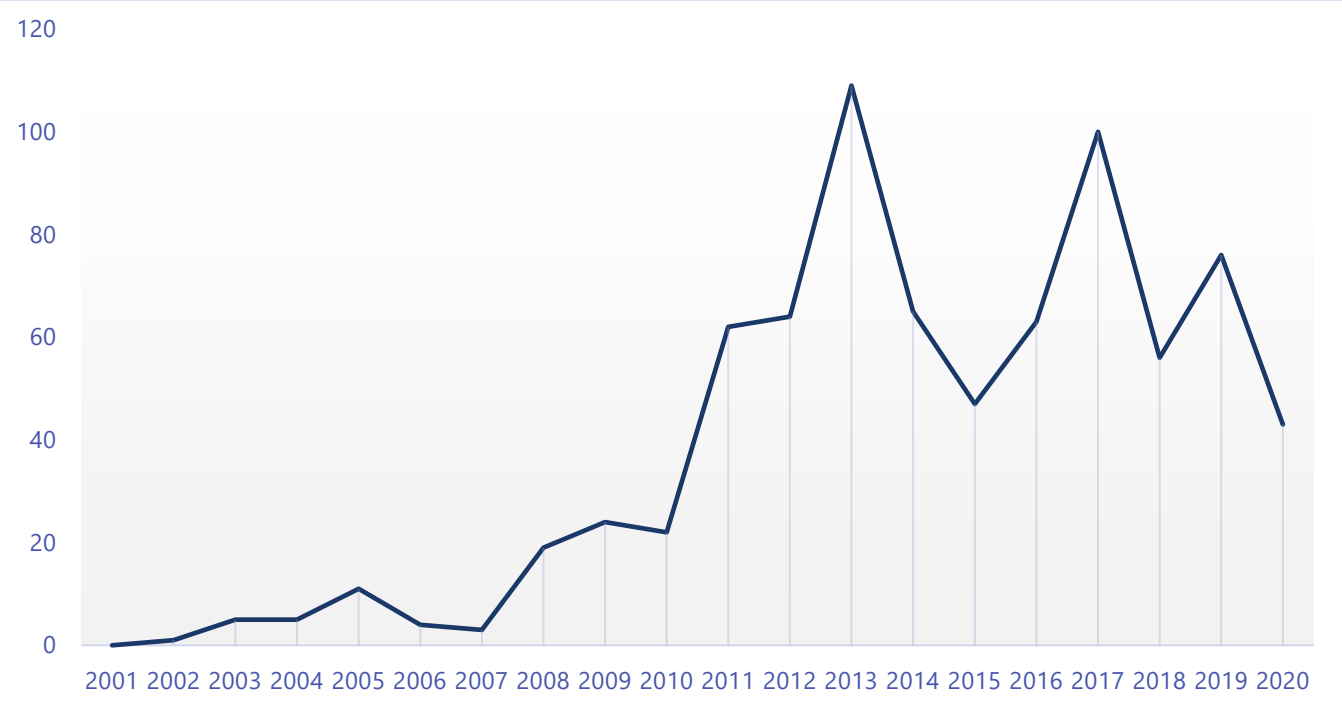
Probability of Future Occurrence

In Broome County, the probability of 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 Broome 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 Broome 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 Broome County. However, vaccines are currently being developed for Lyme Disease, which may assist in slowing the contraction rates (CDC 2022).

In New York, the ticks that carry Lyme disease include the deer tick, American dog tick, and the lone star tick (NYSDOH 2023). As shown in Figure 4.3.2-1, there were 779 confirmed cases of Lyme disease in Broome County between 2001 and 2020, including 109 cases in 2013, the highest number of reported cases in a given year (TickCheck 2023).

Figure 4.3.2-1. Yearly Breakdown of Lyme Cases in Broome County, 2001-2020



Source: CDC 2022

The CDC and New York State DOH retain counts of reported cases of diseases. Between 1999 and June 2023, according to the CDC and New York State DOH, Broome County has had:

- 6,048 reported cases of Influenza,
- 60,064 reported cases of Coronavirus,
- 10 reported cases of the West Nile Virus, and
- 784 reported cases of Lyme disease.

In Section 4.4, the identified hazards of concern for Broome County are 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 of disease outbreak in the County is considered 'occasional'.

Climate Change Impacts

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 of the 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 Broome County, it is estimated temperatures will increase by 3.5 °F to 5.5 °F by the 2050s and 4.5 °F to 8.5 °F by the 2080s (baseline of 46.0 °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 5 to 10 percent by the 2080s (baseline of 38.0 inches, mid-range projection). Table 4.3.2-4 displays the projected seasonal precipitation change for Region 3 (NYSERDA 2014).

Table 4.3.2-4. Projected Seasonal Precipitation Change in Region 2, 2050s (% change)

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

Source: NYSERDA 2014

The relationship between climate change and an 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 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 to the identified hazard. Due to a lack of quantifiable loss information for disease outbreaks, a qualitative assessment was conducted to evaluate the assets exposed to this hazard and the potential impacts associated with it. The following sections qualitatively describe Broome County's vulnerability to the disease outbreak hazard.

Impact on Life, Health, and Safety

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

Overall Population

The entire population of Broome County (198,683) 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.

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.

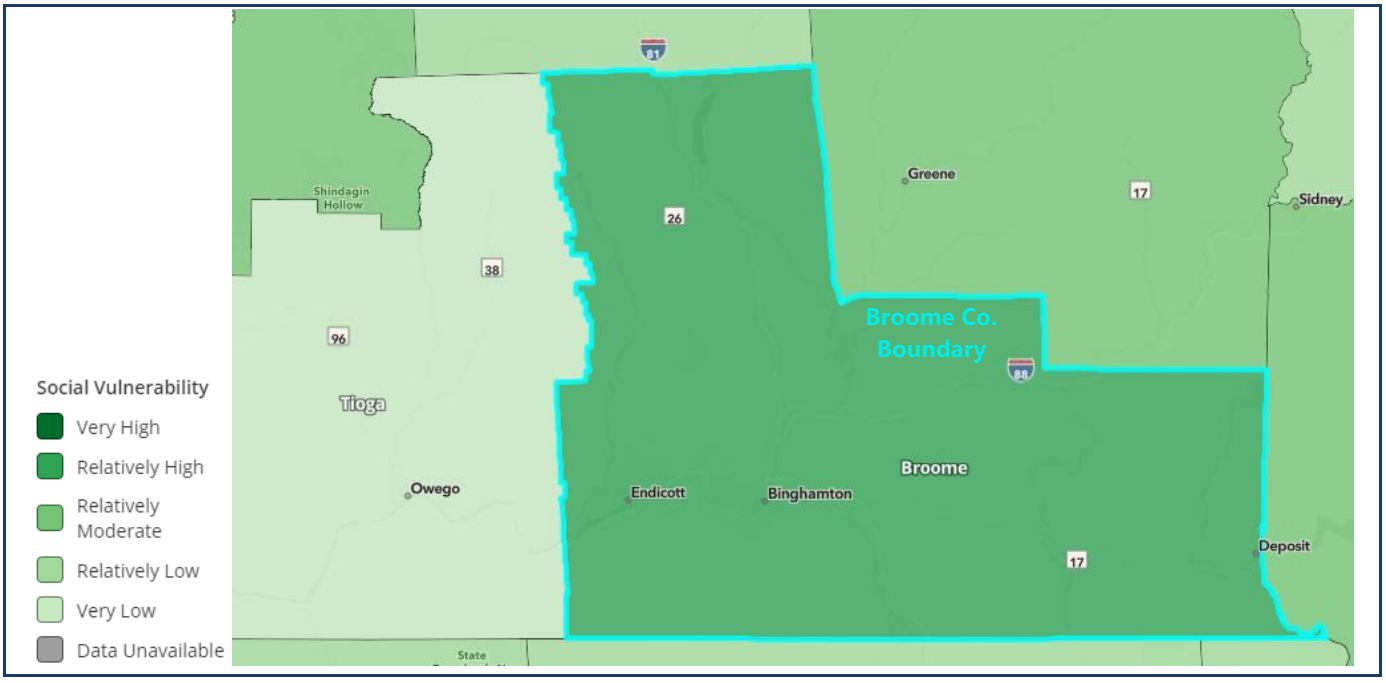
Socially Vulnerable Populations

Socially vulnerable populations are most susceptible based on many factors, including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Economically disadvantaged populations are more likely to make decisions based on the major economic impact on their family and may not have funds to evacuate.

The CDC has indicated that persons 65 years and older, persons living in a nursing home or long-term care facility, and persons with underlying medical conditions such as diabetes, severe obesity, serious heart conditions, etc. are at a higher risk of getting severely ill with COVID-19 (CDC 2020). While the statistics of this virus are subject to change during the publication of this HMP, the New York Department of Health dashboard shows that there is a higher percentage of COVID cases within this age group.

Figure 4.3.2-2 displays the FEMA National Risk Inventory's Social Vulnerability Index for Broome County, which is identified as "relatively high."

Figure 4.3.2-2. FEMA Social Vulnerability Index for Natural Hazards



Source: (FEMA 2019)

According to the 2017-2021 American Community Survey, there are 37,752 persons over the age of 65 years, 10,142 persons under the age of five years, 3,165 non-English speakers, 30,857 persons with a disability, and 35,372 living in poverty (refer to Table 4.3.2-5).

Table 4.3.2-5. Broome County Socially Vulnerable Populations by Municipality

Jurisdiction	American Community Survey 5-Year Population Estimates (2021)									
	Over 65	Percent of Jurisdiction Total	Under 5	Percent of Jurisdiction Total	Non-English Speaking	Percent of Jurisdiction Total	Disability	Percent of Jurisdiction Total	Poverty Level	Percent of Jurisdiction Total
Barker (T)	465	18.5%	142	5.7%	49	2.0%	342	13.6%	537	21.4%
Binghamton (C)	7,642	15.9%	2,588	5.4%	1,051	2.2%	9,632	20.1%	14,894	31.0%
Binghamton (T)	822	17.8%	206	4.5%	5	0.1%	710	15.4%	454	9.8%
Chenango (T)	2,236	20.4%	861	7.9%	37	0.3%	1,359	12.4%	1,292	11.8%
Colesville (T)	1,299	26.7%	161	3.3%	0	0.0%	812	16.7%	345	7.1%
Conklin (T)	1,116	22.3%	227	4.5%	182	3.6%	637	12.7%	584	11.7%
Deposit (V)*	110	15.3%	49	6.8%	0	0.0%	123	17.1%	153	21.2%
Dickinson (T)	829	24.4%	32	0.9%	63	1.9%	611	18.0%	345	10.1%
Endicott (V)*	2,337	17.1%	664	4.9%	107	0.8%	2,544	18.6%	3,535	25.9%
Fenton (T)	1,223	19.0%	518	8.1%	49	0.8%	828	12.9%	962	15.0%
Johnson City (V)*	2,864	18.7%	821	5.4%	356	2.3%	2,718	17.7%	2,938	19.1%
Kirkwood (T)	1,045	19.1%	116	2.1%	61	1.1%	736	13.4%	768	14.0%
Lisle (T)	373	15.9%	157	6.7%	0	0.0%	405	17.3%	207	8.8%
Lisle (V)*	48	13.8%	4	1.1%	0	0.0%	45	12.9%	23	6.6%
Maine (T)	1,141	22.1%	311	6.0%	0	0.0%	927	17.9%	873	16.9%
Nanticoke (T)	384	24.3%	68	4.3%	0	0.0%	265	16.8%	123	7.8%
Port Dickinson (V)*	235	13.8%	77	4.5%	26	1.5%	208	12.2%	223	13.1%
Sanford (T)	469	30.9%	27	1.8%	0	0.0%	243	16.0%	91	6.0%
Triangle (T)	300	16.2%	40	2.2%	0	0.0%	298	16.1%	251	13.6%
Union (T)	6,306	23.2%	1,300	4.8%	301	1.1%	3,358	12.4%	2,549	9.4%
Vestal (T)	5,068	17.3%	1,261	4.3%	876	3.0%	3,025	10.3%	3,318	11.3%
Whitney Point (V)*	221	23.0%	32	3.3%	0	0.0%	168	17.5%	340	35.4%
Windsor (T)	1,002	20.5%	452	9.2%	0	0.0%	713	14.6%	458	9.4%
Windsor (V)*	217	23.9%	28	3.1%	2	0.2%	150	16.5%	109	12.0%
Broome County (Total)	**37,752**	**19.0%**	**10,142**	**5.1%**	**3,165**	**1.6%**	**30,857**	**15.5%**	**35,372**	**17.8%**

Sources: U.S. Census, American Community Survey 5-Year Estimates 2017-2021

Note: Persons per household = 2.33; Number used to calculate Non-English Speaking population.

* *The following villages are contained with towns; the population totals were adjusted based on the average population based on the count of residential structures from the general building stock data. Deposit (V) is 52% within Sanford (T); Endicott (V) & Johnson City (V) are 100% within Union (T); Lisle (V) is 100% within Lisle (T); Port Dickinson (V) is 100% within Dickinson (T); Whitney Point (V) is 100% within Triangle (T); Windsor (V) is 100% within Windsor (T).*

Impact on General Building Stock

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

Impact on Critical Facilities and Community Lifelines

While the physical structures of County and municipal buildings, critical facilities, and infrastructure will not be impacted by a pandemic or disease outbreak, the effect of worker absenteeism will impact local government services. The most significant impact on critical facilities would be the increase in hospitalization and emergency room visits that would take place because of the outbreak. This would create a greater demand for these critical facilities, their staff, and resources.

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

The healthcare system will be severely taxed, if not overwhelmed, by the large number of illnesses and complications from influenza requiring hospitalization and critical care. Ventilators will be the most critical shortage if an outbreak were to occur (Homeland Security Council 2006).

Impact on the Economy

The impact disease outbreaks will have on the economy and estimated dollar losses are difficult to measure and quantify. Costs associated with the activities and programs implemented to conduct surveillance and address disease outbreaks have not been quantified in the available documentation. Activities and programs implemented by the County to address this hazard could impact the local economy.

Smaller-scale disease outbreaks can also cause negative economic impacts, though the extent of the impact is variable. For example, an outbreak of mosquito or tick-borne diseases can impact Broome County's local economies associated with tourism and the use of parks and waterbodies.

The COVID-19 pandemic had significant economic impacts across the State of New York. Over the course of two months, the State lost nearly 2 million jobs as businesses were forced to close their doors and residents entered a period of quarantine. This sudden halt of business activity forced the closure of schools, emptied the State's typically busy roads, and disrupted a previously healthy economy.

Every industry sector in the State of New York declined by at least some margin. As sectors return to pre-pandemic employment levels, only the information, professional and technical services, and healthcare and social assistance sectors, have fully recovered by the end of 2022. The retail, wholesale, leisure, hospitality, and other service sectors lag the most in their recoveries and are not projected to recover before 2026. From the start of the recovery in May 2020, New York City recovered 53.6 percent of its job

losses as of November 2021, the State regained 60.4 percent, and the nation regained 83.1 percent (NYS Division of Budget 2023).

Impact on the Environment

Disease outbreaks may have an impact on the environment if they are caused by invasive species. Invasive species tend to be competitive with native species and their habitat. One study has shown invasive mosquitos such as the Asian tiger mosquito, a common invasive mosquito found in New York, 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 diseases such as 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 such as mosquitos have been reviewed by the Environmental Protection Agency (EPA) and the U.S. Department of Health. If these sprays are applied in large concentrations, they could leach into waterways and harm nearby terrestrial species. The NYSDEC Bureau of Pest Management's pesticide laws, regulations, and policies ensure that pesticides are used and sold in compliance with the state's Environmental Conservation Law (NYSDEC 2014).

The threat of disease outbreaks on the environment is typically intensified when the ecosystem or host species is already stressed, such as during periods of drought. The already weakened state of an ecosystem causes it to more easily be impacted by an infestation.

Cascading Impacts on Other Hazards

There are no known cascading impacts that disease outbreaks can cause to other hazards of concern for Broome County.

Future Changes That May Impact Vulnerability

Understanding future changes that impact vulnerability in the County can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place.

Projected Changes in Development

As discussed in Section 3 (County Profile), areas targeted for future growth and development have been identified across the County. Any areas of growth could be impacted by the disease outbreak hazard because the entire planning area is exposed and vulnerable. Additional development of structures in areas with high population density is at an increased risk. Specific areas of development are indicated in tabular form and/or on hazard maps in the jurisdictional annexes in Volume II of this plan.

Projected Changes in Population

According to the U.S. Census Bureau, the County's population increased by 0.95 percent between 2010 and 2020 (US Census 2023). Cornell University's Program on Applied Demographics projects that the County will have a population of 186,950 by 2030 and 183,176 by 2040 (Cornell University 2018).

A decrease in population will expose fewer people to the pandemic hazard. Population density changes when households move throughout the Planning Area could influence the number of persons exposed to disease outbreaks. The anticipated decrease in density for the County suggests a reduction in exposure to disease outbreaks, but lessening impacts on available basic services provided by critical facilities such as hospitals and emergency facilities.

Climate Change

The relationship between infectious disease occurrence and climate change is difficult to project with certainty. The projected warming temperatures and increase in precipitation for New York State's Region 3, which contains Broome County, may create a more desirable habitat for vectors carrying disease (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. A warming climate is also likely to increase the length of the insect season, increasing the potential rates of transmission of insect-borne disease.

Other factors, such as expanded rapid travel and the 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 2019 HMP

Disease outbreak is a newly identified hazard for the 2024 Broome County hazard mitigation plan, so no change in vulnerability can be identified.

SECTION 4. RISK ASSESSMENT

4.3 HAZARD PROFILES

4.3.1 Drought

This 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 drought in Broome County.

Hazard Profile

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). It 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 classified as one or more of the following four types (National Weather Service n.d.):

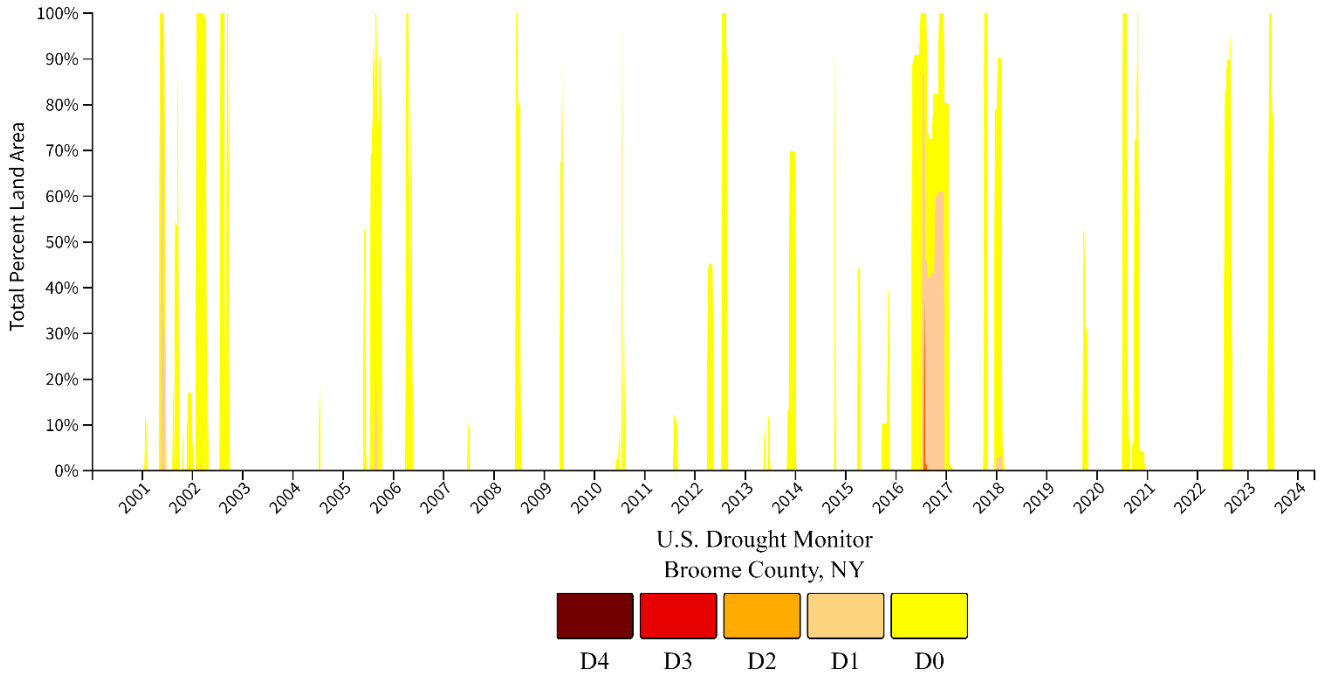
- **Meteorological Drought** is characterized by the degree of dryness or precipitation deficits from the expected average or typical amounts based on monthly, seasonal, and annual time scales. Typically, dry weather patterns affect the entirety of a region.
- **Agricultural Drought** is characterized by impacts on crops and other agricultural products, specifically through changes to precipitation, such as rainfall deficits, soil water deficits, reduced groundwater, or reduced reservoir levels available for irrigation. Typically, crop yield is negatively affected.
- **Hydrological Drought** is characterized by the impacts of rainfall deficits on water supply, such as stream flow, reservoir/lake levels, and the groundwater table. Typically, low water supply becomes evident to the human eye during a hydrological drought.
- **Socioeconomic Drought** is characterized by the impacts of drought conditions (meteorological, agricultural, or hydrological) on the supply and demand of economic goods that depend on precipitation, such as fruits, vegetables, grains, and meat. Socioeconomic drought occurs when demand for the economic good exceeds supply because of weather-related deficits in the water supply.

Location

Droughts can occur in all parts of the United States and at 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).

According to the FEMA National Risk Index, Broome County rarely experiences abnormally dry conditions in comparison to the rest of New York State. Figure 4-4 illustrates low drought risk across the county. Historically, the County has experienced little (D0) to mild (D1) dry conditions across the entire planning areas. Figure 4-1 illustrates drought conditions from 2000 to 2004 for the entire County. From 2016 to 2017 mild (D1) drought conditions were recorded county-wide (NOAA-NIDIS 2024).

Figure 4-1. Historical County-Wide Drought Conditions from 2000 to 2024



Source: NOAA-NIDIS 2024

Figure 4-2. National Risk Index, Drought Risk Index Score Using the County Scale

Source: FEMA 2019

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). Moderate to severe drought events normally have short-term impacts and typically last less than six months. They primarily affect agriculture and grasslands. Extreme to exceptional drought events normally have long-term impacts, typically last over six months, and affect the hydrology and ecology of the affected area.

The U.S. Drought Monitor (USDM) classifies droughts into one of five stages: normal conditions, abnormally dry (D0), moderate drought (D1), severe drought (D2), extreme drought (D3), and exceptional drought (D4) (USDM 2023). Table 4.3.3- provides more details on this drought classification system.

Table 4.3.3-1. Drought Severity Classifications and Palmer Drought Severity Index

Classification	Impacts	Palmer Drought Severity Index
Normal Conditions	No impacts from drought affect the area.	--
Abnormally Dry (D0)	Crop growth is stunted, and planting is delayed. Fire danger is elevated, and spring fire season starts early. Lawns will brown early, and gardens will start. Surface water levels will decline.	-1.0 to -1.9
Moderate Drought (D1)	Honey production will decline. Irrigation uses increase, as hay and grain yields are lower than normal. Trees and landscaping are stressed. Voluntary water conservation will take place. Reservoirs and lakes will be below normal capacity. An increase in Wildfires and ground fires will occur.	-2.0 to -2.9
Severe Drought (D2)	Fish kills will occur, and wildlife damaging crops in search of food will increase. Gold courses will begin to conserve water. Hay prices will rise. Specialty crop yield and fruit size are impacted. Trees will become brittle and susceptible to insects and disease. Air quality will become poor due to particles in the air. Warnings will be issued on outdoor burns. Water quality will also be poor as the groundwater declines. Irrigation ponds will dry out and outdoor water restrictions will be implemented.	-3.0 to -3.9
Extreme Drought (D3)	Crop loss will be widespread. Christmas tree farms will be stressed, and dairy farmers will struggle financially. River temperatures will be warm as there is a reduction in water flow. The well will run dry, resulting in people digging deeper in search of water. Water recreating and hunting will be altered, and wildlife disease outbreaks will occur. Well drillers and bulk water haulers will see an increase in business.	-4.0 to -4.9
Exceptional Drought (D4)	Exceptional and widespread crop and pasture loss. Shortages of water reservoirs, streams, and wells. Water emergencies will occur.	-5.0 or less

Sources: USDM, 2023; NOAA, n.d.

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 levels 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 level 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. At 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 New York State Division of Homeland Security and Emergency Services, based on the 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 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 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). Table 4.3.3- provides details on the PDSI.

The second methodology used by the state is the State Drought Index (SDI), developed by the NYSDEC. The SDI evaluates drought conditions on a more comprehensive basis by measuring whether numerous indicators reach defined thresholds. The data collected is compared against defined threshold values to show short- and long-term drought conditions. 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 any of the 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 on agriculture within the state (NYSDEC 2023). The PDSI and SPEI are monitored to help the state understand the potential impacts of drought on agricultural conditions (NYSDEC 2023).

Previous Occurrences and Losses

This section presents the best available information on previous drought occurrences, impacts, and monetary losses in Broome County. Where multiple information sources were available, the results presented here were judged to be the most accurate and reliable. Citations are provided for each information source used.

FEMA Major Disaster and Emergency Declarations

Broome County has not experienced any FEMA major disaster and emergency declarations since 2018 for severe drought hazard events.

U.S. Department of Agriculture Disaster Declarations

The Secretary of 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 contiguous counties. From 2018 to 2024, Broome County has not experienced any USDA declarations for drought events that resulted in crop failure.

Previous Events

According to the NOAA Storms Event Database, there have been no drought events recorded from 2018 to 2024 that impacted Broome County (NOAA-NCEI 2024).

Probability of Future Occurrence

For the 2024 HMP update, the 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, and FEMA were used to identify the number of events that occurred between 1950 and 2023. Table 4.3.3-1 provides the calculated probability of future drought events in Broome County. Broome County has an 8.3 percent probability of drought events occurring in any given year.

Table 4.3.3-1. Future Occurrence of Drought Events in Broome County

Hazard Type	Number of Occurrences Between 1950 and 2023	% Chance of Occurrence in Any Given Year
Drought	6	8.3%

Source: NOAA-NCEI, 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 1950 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 Broome 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 of drought in the County is considered 'unlikely'.

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 increased occurrence of extreme weather

events (World Economic Forum 2020). Since 1970, average annual temperatures in the State have increased by 0.6°F per decade (NYSERDA 2023).

Anticipated impacts from climate change in the Southern Tier (Region 3) of New York State, where Broome County is located (refer to Figure 4-3) include higher year-round temperatures and more frequent and intense summer water deficits by the mid-to-late century (NYSERDA 2023). Table 4.3.3-2estimates that there will be an average of 23 days over 90°F and up to 5 days of prolonged heat waves per year. This rise in temperatures and water deficits have the potential to lead to more frequent and severe drought conditions.

Table 4.3.3-2. Climate Change Impacts, Extreme Temperature Events in Broome County

		Future		
Event Type	**2020s**	**Low Estimate (10th Percentile)**	**Middle Range (25th to 75th Percentile)**	**High Estimate (90th Percentile)**
Days over 90 degrees Fahrenheit (°F)	8 days	12	17-21	23
# of Heat Waves	0.7 heat waves	2	2 to 3	3
Duration of Heat Waves	4 days	4	4 to 5	5

Source: (Horton, et al. 2014)

Figure 4-3. Climate Regions of New York State

Source: (NYSERDA 2014)

Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. The following is a qualitative discussion of Broome County's vulnerability to the drought hazard.

Impact on Life, Health, and Safety

The entire population of Broome County (198,683) is exposed to this hazard. Drought conditions can affect people's health and safety, including health problems related to low water flows poor water quality, and health problems related to dust. Droughts also can lead to the 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. The health implications of drought are numerous. Some drought-related health effects are short-term while others can be long-term (CDC 2012).

Overall Population

The health implications of drought are numerous. Some drought-related health effects are short-term while others can be long-term. Public health impacts may include an increase in heat-related illnesses, waterborne illnesses, recreational risks, and limited food availability. Other possible impacts on health due to drought include increased recreational risks, such as lack of potable water during athletic or community events; 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 (CDC 2021).

Socially Vulnerable Populations

According to Census data, there are 37,752 persons over the age of 65 years, 10,142 persons under the age of five years, 3,165 non-English speakers, 30,857 persons with a disability, and 35,372 living in poverty in Broome County (refer to Table 4.3.3-). Vulnerable populations could be particularly susceptible to the drought hazard and cascading impacts due to age, health conditions, and limited ability to access safe potable water (NOAA-NIDIS 2024). displays the FEMA National Risk Inventory's Social Vulnerability Index for the County of Broome, which is identified as overall "relatively high."

Table 4.3.3-3 Broome County Socially Vulnerable Populations by Municipality

Jurisdiction	American Community Survey 5-Year Population Estimates (2021)									
	Over 65	Percent of Jurisdiction Total	Under 5	Percent of Jurisdiction Total	Non-English Speaking	Percent of Jurisdiction Total	Disability	Percent of Jurisdiction Total	Poverty Level	Percent of Jurisdiction Total
Barker (T)	465	18.5%	142	5.7%	49	2.0%	342	13.6%	537	21.4%
Binghamton (C)	7,642	15.9%	2,588	5.4%	1,051	2.2%	9,632	20.1%	14,894	31.0%
Binghamton (T)	822	17.8%	206	4.5%	5	0.1%	710	15.4%	454	9.8%
Chenango (T)	2,236	20.4%	861	7.9%	37	0.3%	1,359	12.4%	1,292	11.8%
Colesville (T)	1,299	26.7%	161	3.3%	0	0.0%	812	16.7%	345	7.1%
Conklin (T)	1,116	22.3%	227	4.5%	182	3.6%	637	12.7%	584	11.7%
Deposit (V)*	110	15.3%	49	6.8%	0	0.0%	123	17.1%	153	21.2%
Dickinson (T)	829	24.4%	32	0.9%	63	1.9%	611	18.0%	345	10.1%
Endicott (V)*	2,337	17.1%	664	4.9%	107	0.8%	2,544	18.6%	3,535	25.9%
Fenton (T)	1,223	19.0%	518	8.1%	49	0.8%	828	12.9%	962	15.0%
Johnson City (V)*	2,864	18.7%	821	5.4%	356	2.3%	2,718	17.7%	2,938	19.1%
Kirkwood (T)	1,045	19.1%	116	2.1%	61	1.1%	736	13.4%	768	14.0%
Lisle (T)	373	15.9%	157	6.7%	0	0.0%	405	17.3%	207	8.8%
Lisle (V)*	48	13.8%	4	1.1%	0	0.0%	45	12.9%	23	6.6%
Maine (T)	1,141	22.1%	311	6.0%	0	0.0%	927	17.9%	873	16.9%
Nanticoke (T)	384	24.3%	68	4.3%	0	0.0%	265	16.8%	123	7.8%
Port Dickinson (V)*	235	13.8%	77	4.5%	26	1.5%	208	12.2%	223	13.1%
Sanford (T)	469	30.9%	27	1.8%	0	0.0%	243	16.0%	91	6.0%
Triangle (T)	300	16.2%	40	2.2%	0	0.0%	298	16.1%	251	13.6%
Union (T)	6,306	23.2%	1,300	4.8%	301	1.1%	3,358	12.4%	2,549	9.4%
Vestal (T)	5,068	17.3%	1,261	4.3%	876	3.0%	3,025	10.3%	3,318	11.3%

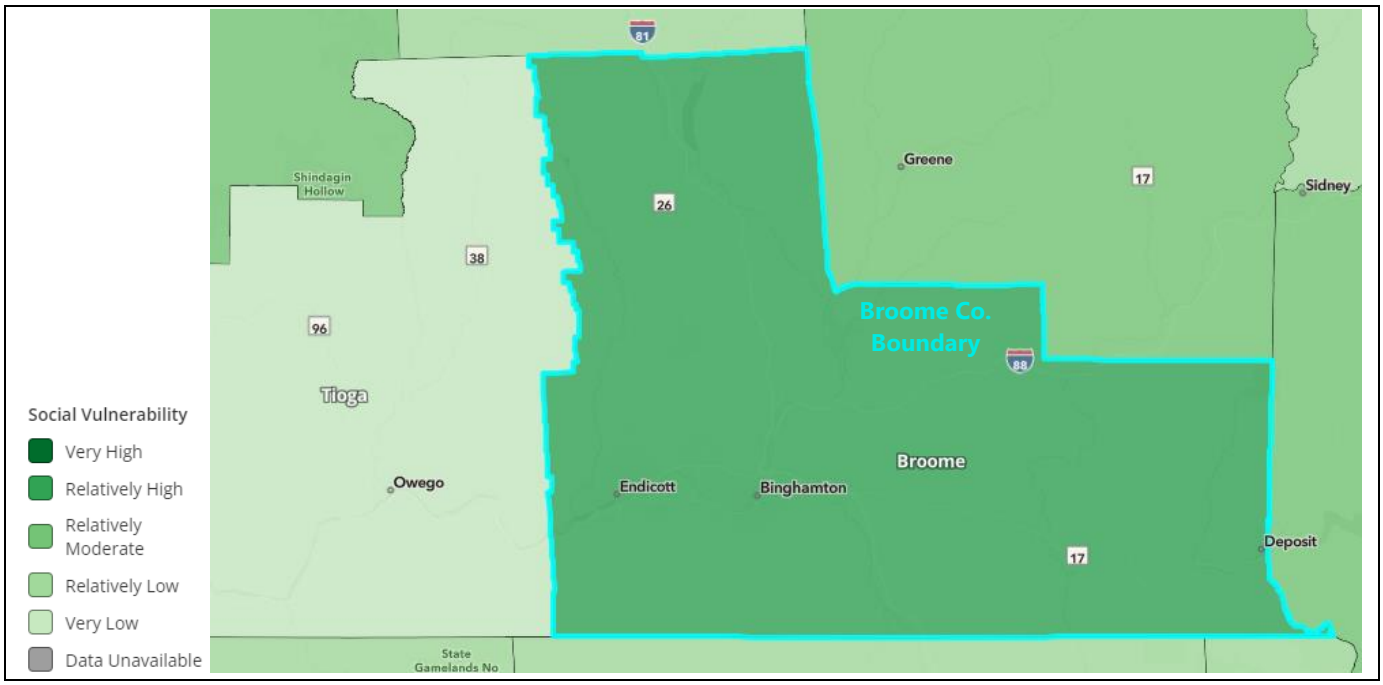
Jurisdiction	American Community Survey 5-Year Population Estimates (2021)									
	Over 65	Percent of Jurisdiction Total	Under 5	Percent of Jurisdiction Total	Non-English Speaking	Percent of Jurisdiction Total	Disability	Percent of Jurisdiction Total	Poverty Level	Percent of Jurisdiction Total
Whitney Point (V)*	221	23.0%	32	3.3%	0	0.0%	168	17.5%	340	35.4%
Windsor (T)	1,002	20.5%	452	9.2%	0	0.0%	713	14.6%	458	9.4%
Windsor (V)*	217	23.9%	28	3.1%	2	0.2%	150	16.5%	109	12.0%
Broome County (Total)	**37,752**	**19.0%**	**10,142**	**5.1%**	**3,165**	**1.6%**	**30,857**	**15.5%**	**35,372**	**17.8%**

Sources: U.S. Census, American Community Survey 5-Year Estimates 2017-2021

Note: Persons per household = 2.33; Number used to calculate Non-English Speaking population.

* *The following Villages were contained with Towns; the Population totals were adjusted based on the average population based on the count of Residential structures from the General Building Stock data. Deposit (V) is 52% within Sanford (T); Endicott (V) & Johnson City (V) are 100% within Union (T); Lisle (V) is 100% within Lisle (T); Port Dickinson (V) is 100% within Dickinson (T); Whitney Point (V) is 100% within Triangle (T); Windsor (V) is 100% within Windsor (T)*

Figure 4-4. FEMA Social Vulnerability Index for Natural Hazards



Source: (FEMA 2019)

Impact on General Building Stock

No structures are anticipated to be directly affected by a drought event. However, droughts contribute to conditions conducive to wildfires and reduce fire-fighting capabilities. Refer to Section 4.3.10 for the wildfire risk assessment.

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. Critical facilities in and adjacent to the wildfire hazard areas are considered vulnerable to wildfire, which can be triggered by a prolonged severe drought event.

Drought affects groundwater sources, but generally not as quickly as it affects 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 the snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest.

Water withdrawals are used not only for potable water but also for use in the commercial/industrial/mining sectors and power generation through thermoelectric power water use. Thermoelectric power water use is the process of generating electricity with steam-driven turbine generators (USGS 2019). Thermoelectric power utilizes both fresh and saline surface or groundwater. However, freshwater sources from groundwater are the most common (USGS 2019). Eastern states, including New York State, account for 84 percent of the total thermoelectric power withdraws in the U.S. and produce 70 percent of the net power generation. New York State is one of the top five states in the U.S., with 33 percent of cumulative total withdraws for thermoelectric power (USGS 2019). Droughts' negative impact on groundwater recharge can lead to less availability for water withdraws to support thermoelectric power supply in the state.

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 used not only for potable water but also for use in the commercial/industrial/mining sectors and power generation.

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 lawn watering, car washing, or any other recreational or commercial outdoor use of water supplies. In exceptional drought conditions, watering of lawns may be prohibited (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 in another area could impact the food supply and price of food for residents within the county.

Impact on the Environment

Droughts can impact the environment because these events can produce more favorable conditions for wildfires, insect infestations, and the spread of disease (IPCC 2016). Droughts 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 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.

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

Cascading Impacts on Other Hazards

Drought can lead to increasing temperatures and faster evaporation of moisture, leaving dead and dying trees and grasses, which are ideal dry conditions for wildfire events to occur. Dry, hot, and windy weather combined with dry vegetation makes some areas more susceptible to wildfires when met with a spark created by humans or natural events, including lightning. Additionally, droughts can lead to the following (NIDIS 2019):

- Insect infestation leading to crop losses and reduced tree canopy.
- Reduction in the ability to perform outdoor activities, which could result in loss of tourism and recreation opportunities.

Future Changes That May Impact Vulnerability

Understanding future changes that affect vulnerability can assist in planning for future development and ensure the establishment of appropriate mitigation, planning, and preparedness measures.

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 in the County could be susceptible to drought due to changes in the water demand.

Projected Changes in Population

Broome County has experienced a 1.67 percent decrease in its population from 2010 to 2022 estimates (U.S. Census 2023). It is also projected that populations are projected to decrease moving forward. Cornell University's Program on Applied Demographics projects that Broome County will have a population of 186,950 by 2030 and 183,176 by 2040 (Cornell University 2018). A decrease in population can impact drought conditions by lessening the demand for water and other resources influenced by water supply.

Climate Change

As discussed in section Climate Change Projections, most studies project that the State of New York will see an increase in average annual temperatures. Additionally, the state is projected to experience more frequent droughts, which may affect the availability of water supplies, primarily placing an increased stress on available potable water. A decrease in water supply, or increase in water supply demand, may increase the County's vulnerability to structural fire and wildfire events through lack of available water for firefighter and EMS emergency response. Critical water-related service sectors may need to adjust management practices and actively manage resources to accommodate future changes.

Change of Vulnerability Since 2019 HMP

When examining the change in the County's vulnerability to drought events from the 2018 HMP to this update, it is important to look at each entity that is exposed and vulnerable. The total population across

the County has experienced a very small decrease over a decade timespan, which can lessen the stress on the water supply during a drought event.

SECTION 4. RISK ASSESSMENT

4.3 HAZARD PROFILES

4.3.4 Earthquake

This 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 earthquakes in Broome County.

Hazard Profile

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 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. 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 include 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 groundwater 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 submarine 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). Three general regions in New York State have a higher seismic risk than other parts of the state:

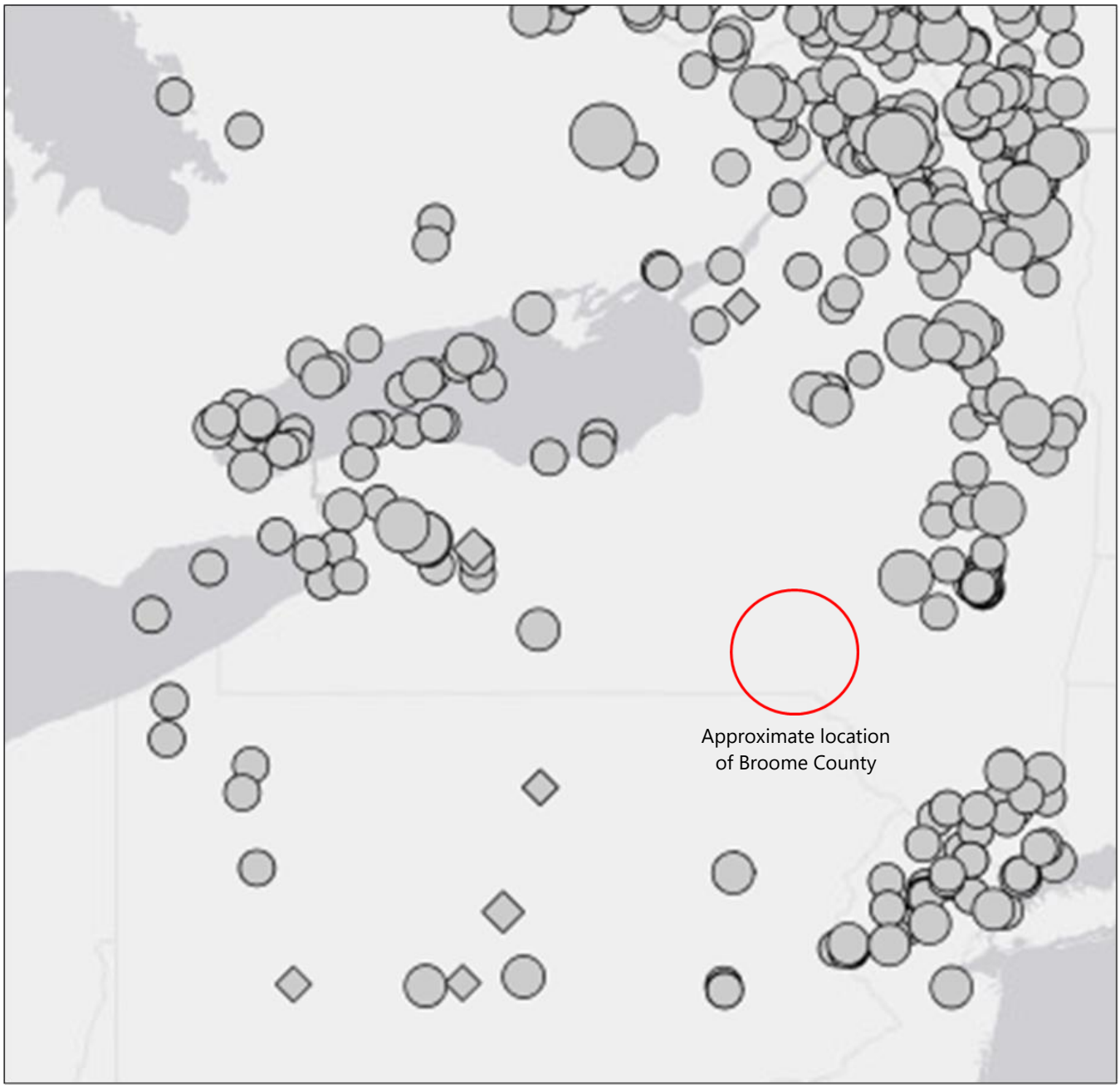
- The north and northeast third of the state, which includes the North Country/Adirondack region and a portion of the greater Albany-Saratoga region
- The southeast corner, which includes the greater New York City area and western Long Island
- The northwest corner, which includes Buffalo and its surrounding area.

These three regions are the most seismically active areas of the state, with the north-northeast portion having the higher seismic risk, and the northwest corner of the state having the lower seismic risk (NYS DHSES 2014). Broome County is not included in any of these high seismic-risk locations.

The closest plate boundary to the East Coast is the Mid-Atlantic Ridge, which is approximately 2,000 miles off the coast. Over 200 million years ago, when the continent Pangaea rifted apart forming the Atlantic Ocean, the northeast coast of America was a plate boundary. Being at the plate boundary, many faults were formed in the region.

Figure 4-1 shows historic earthquake epicenters across the northeast United States and in New York State between 1914 and 2022. Multiple earthquakes originating outside New York's borders have been felt within the state. These quakes have come from Quebec and Massachusetts. According to the NYS HMP, such events are considered significant for hazard mitigation planning because they could produce damage in the state in certain situations.

Figure 4-1. Earthquake Epicenters in the Northeast U.S., 1914-2022



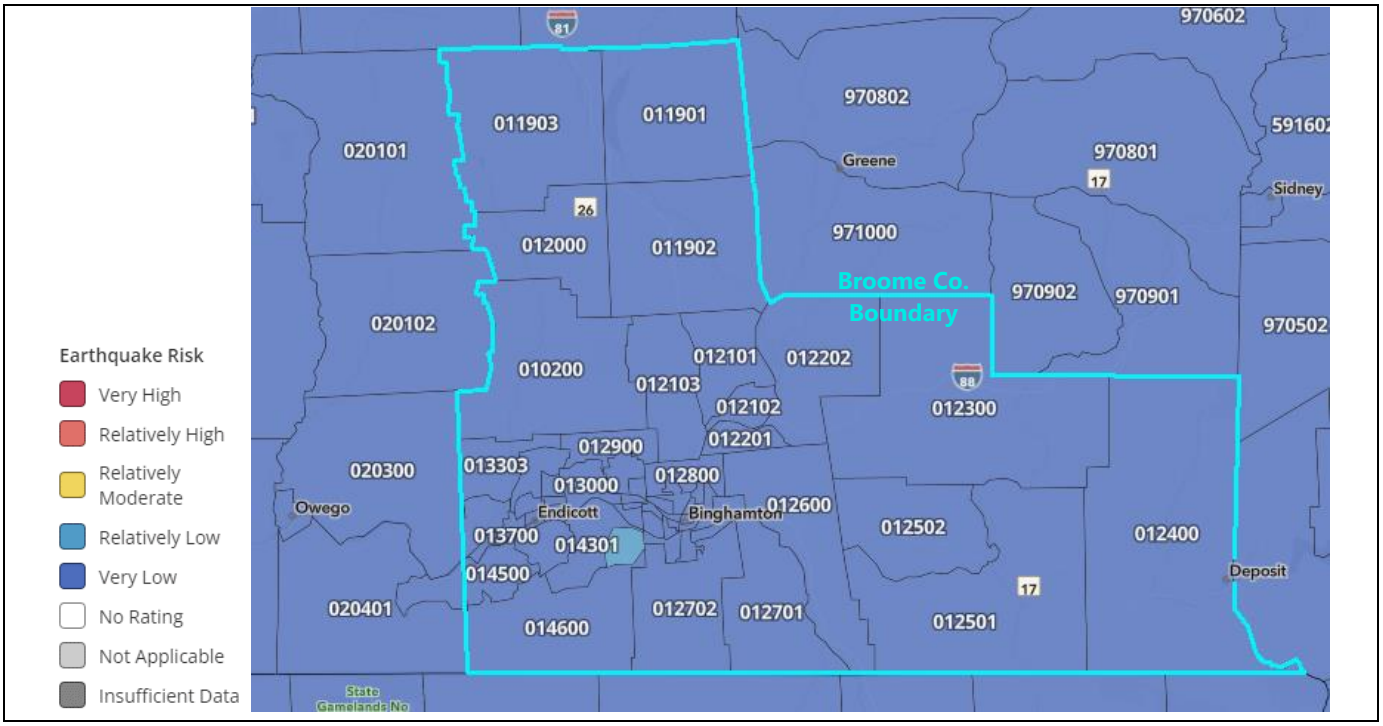
Source: USGS 2022

Figure 4-2 and Figure 4-3 show the Earthquake Risk Index for Broome County on the county and census tract scales, respectively. According to the National Risk Index, on the county scale, the County has a very low risk of earthquakes; on the census tract scale, the County ranges from a very low risk to a relatively low risk (FEMA 2019).

Figure 4-2. National Risk Index, Earthquake Risk Index Score Using the County Scale

Source: FEMA 2019

Figure 4-3. National Risk Index, Earthquake Index Score Using the Census Tract Scale



Source: FEMA 2019

Extent

An earthquake's magnitude and intensity are used to describe the size and severity of the event. Magnitude describes the size of 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. presents the Richter scale magnitudes. The Richter Scale is no longer commonly used but is often referred to when discussing 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	A great earthquake can 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 the upper floors of buildings.
III	Weak	Felt quite noticeable by persons indoors, especially on the upper floors of buildings. Many people do not recognize it as an earthquake. Standing automobiles may rock slightly. Vibrations are similar to the passing of a truck. Duration estimated.
IV	Light	Felt indoors by many, and outdoors by few during the day. At night, some awakened. Dishes, windows, and doors are disturbed; walls make a cracking sound. Sensation like a heavy truck striking a building. Standing automobiles rocked noticeably.
V	Moderate	Felt by nearly everyone; many awakened. Some dishes and windows are 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	Felt by all. Damage is negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; and considerable in poorly built or badly designed structures. Some chimneys are broken.
VIII	Severe	Felt by all. Damage is slight in specially designed structures; and considerable in ordinary substantial buildings with partial collapse. Damage is great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned.
IX	Violent	Felt by all. Damage is considerable in specially designed structures; well-designed frame structures are thrown out of plumb. Damage is great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Extreme	Felt by all. Some well-built wooden structures are destroyed; most masonry and frame structures are destroyed with foundations. Rails bent.

Source: USGS 2014

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

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

Source: NJOEM 2011

Note: %g = Peak ground acceleration as a percent of the acceleration due to gravity

Table 4.3.4-4. Modified Mercalli Intensity (MMI) and PGA Equivalents

Modified Mercalli Intensity	**PGA** (%g)	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 et al. (Purdue University) 2004
Note: PGA = Peak Ground Acceleration; %g = percent of the acceleration due to gravity

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.

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 the 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 is 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 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 soil 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 4.3.4-4 illustrates the NEHRP soils located throughout Broome County. The data was available from the NYS DHSES. The available NEHRP soil information is incorporated into the Hazus earthquake model for the risk assessment (discussed in further detail later in this section). According to this figure, Broome County is predominately underlain by Type B soils.

Figure 4.3.4-4. NEHRP Soils in Broome County

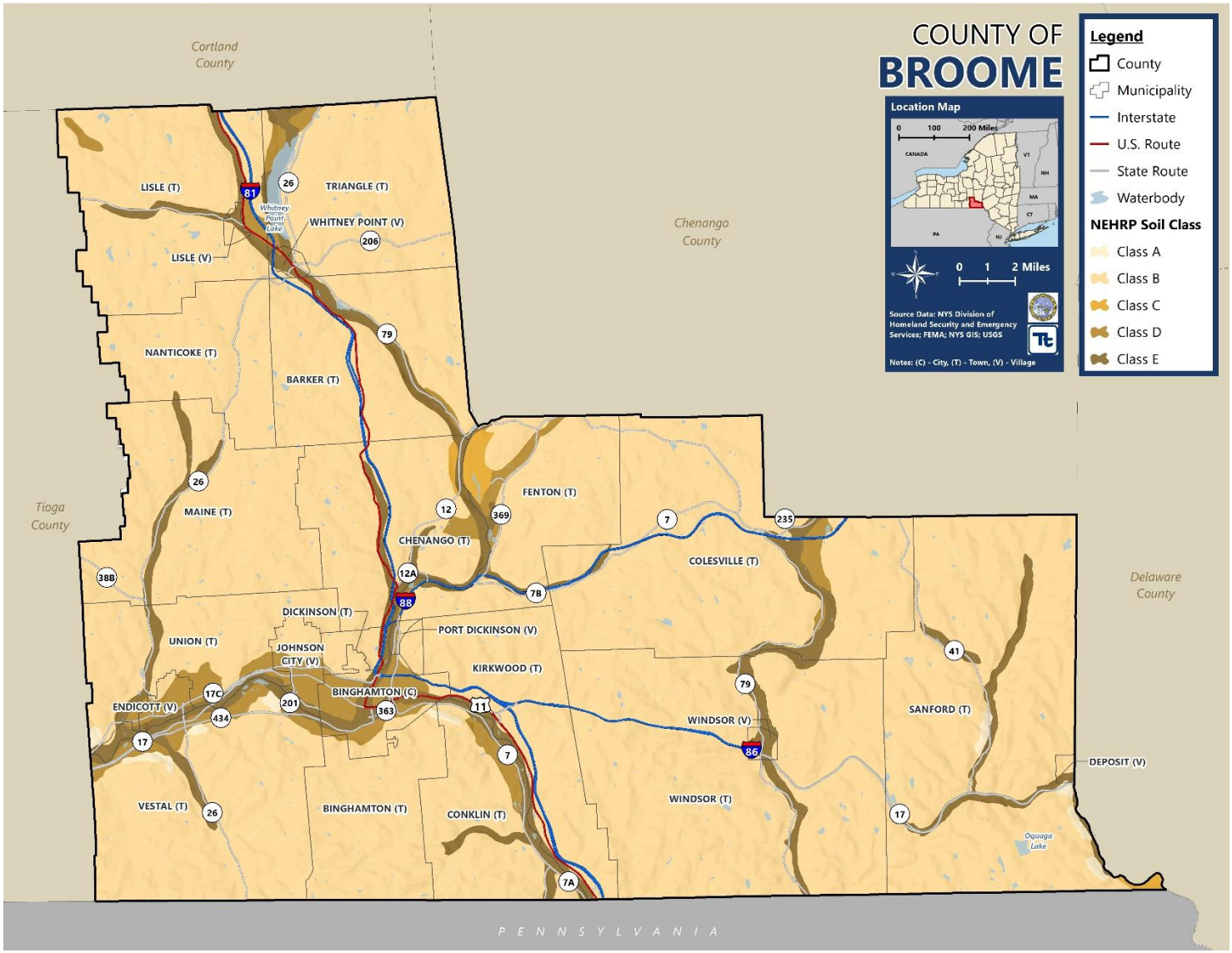
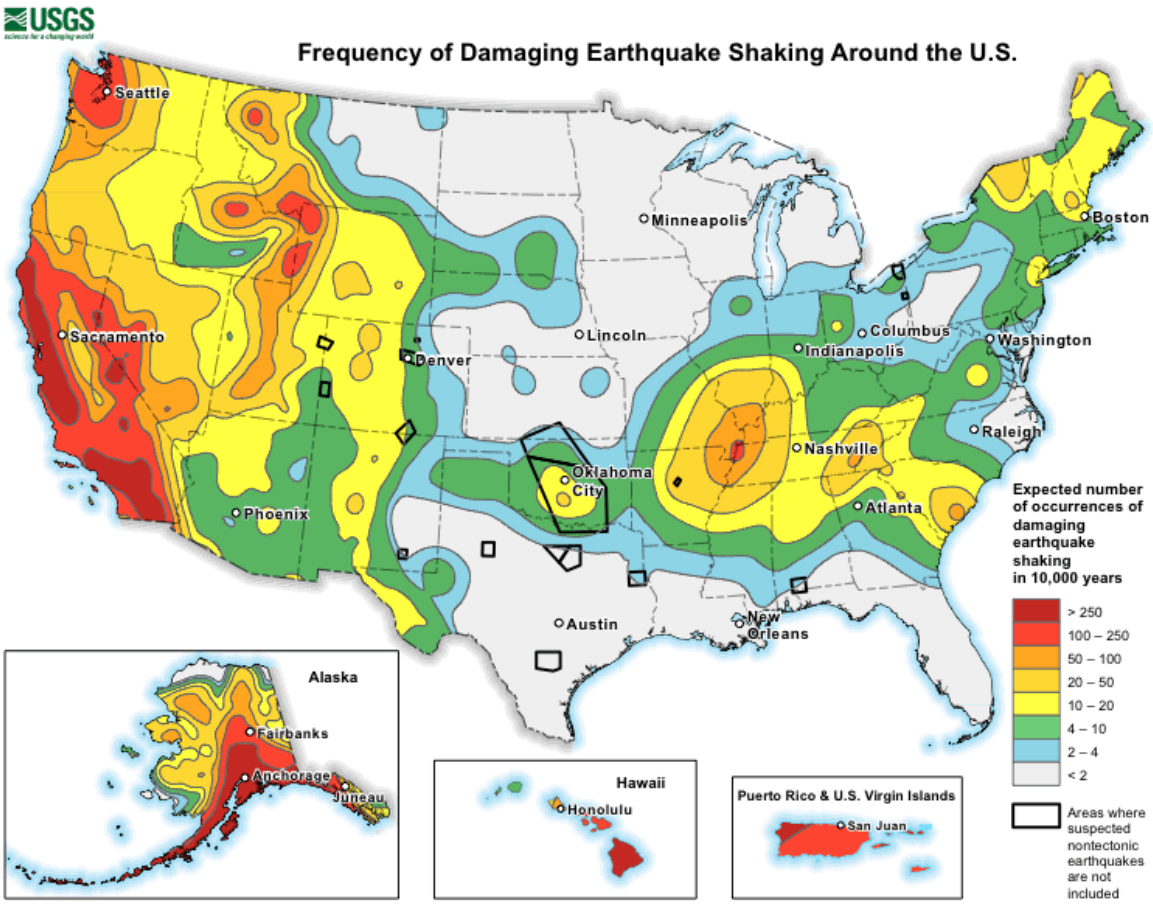


Figure 4.3.4-4 illustrates the number of occurrences of damaging earthquake shaking in 10,000 years. Broome County is expected to experience two to four damaging earthquakes in the next 10,000 years.

Figure 4.3.4-5. Frequency of Damaging Earthquake Shaking Around the U.S.



Source: USGS 2022

Previous Occurrences and Losses

This section presents the best available information on previous earthquake occurrences, impacts, and monetary losses in Broome County. Where multiple information sources were available, the results presented here were judged to be the most accurate and reliable. Citations are provided for each information source used.

FEMA Major Disasters and Emergency Declarations

Between 2019 and 2023, Broome County was not included in any earthquake disaster (DR) or emergency (EM) declarations for earthquake-related events.

U.S. Department of Agriculture Disaster Declarations

The Secretary of 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 contiguous counties. Between 2019 and 2023, Broome County was not included in any earthquake-related agricultural disaster declarations.

Previous Events

Since 2019, there have been no earthquake-related events in Broome County. Refer to the previous County HMP for events before 2019.

Probability of Future Occurrence

No earthquake events have been recorded in Broome County. This prohibits the calculation of the probability of future occurrence based on a historical record. Based on this lack of historical records and input from the Planning Partnership, the probability of occurrence of 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 the 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).

The 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. Broome County is expected to experience extreme rises in temperature, increases in precipitation, and increases in sea level (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 the proximity of activity in surrounding states. Coupled with climate change impacts, the County could face elevated risks related to earthquakes.

Vulnerability Assessment

A probabilistic assessment was conducted for Broome County for the 500 and 2,500-year mean return periods (MRPs), which are estimated reoccurrence intervals. A Level 2 analysis in Hazus (v6.0) analyzed the earthquake hazard to provide a range of loss estimates. The probabilistic method uses information from locations and magnitudes of historic earthquakes and inferred faults to compute the probable ground shaking levels that could be experienced by the Census tract. The PGA for these two events is shown in Figure 4-6 and Figure 4-7.

An exposure analysis also was conducted for the County's assets (population, building stock, critical facilities, historic assets, and new development) using the NEHRP soil data. 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.

Impact on Life, Health, and Safety

The entire County may experience an earthquake. However, the degree of impact is dependent on many factors including the age and type of construction of the structures that people live in, the soil type that 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

According to the 2020 U.S. Census, Broome County had a population of 198,683 people. Overall, the 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 ornamentations and chimneys that may be shaken loose and fall because of an earthquake. As shown in Table 4.3.4-6, 104,428 persons live within the NEHRP Soils Class D and E Hazard Areas. The City of Binghamton has the greatest population in the hazard area, with 43,260 persons.

Whether directly or indirectly impacted, the entire population will have to deal with the consequences of earthquakes to some degree. Further, the time of day exposes different sectors of the community to the hazard. Hazus assesses the time when residential occupancy is likely at its maximum (2:00 a.m.), when the educational, commercial, and industrial sectors are likely at their maximum (2:00 p.m.), and when the commute is likely at its peak (5:00 p.m.). Business interruption could prevent people from getting to work. Road closures could isolate the population. Loss of function at utilities could impact populations that suffered no direct damage from an event itself. Overall, as shown on Table 4.3.4-7, Hazus estimates no hospitalizations or casualties as a result of the 500-year MRP event, but a total of three injuries. For the 2,500-year MRP event, Hazus estimates zero causalities, three hospitalizations, and 30 injuries. For both events, the 2:00 p.m. time of day has the greatest impact on the County's population.

Figure 4-6 PGA 500-Year Mean Return Period for Broome County

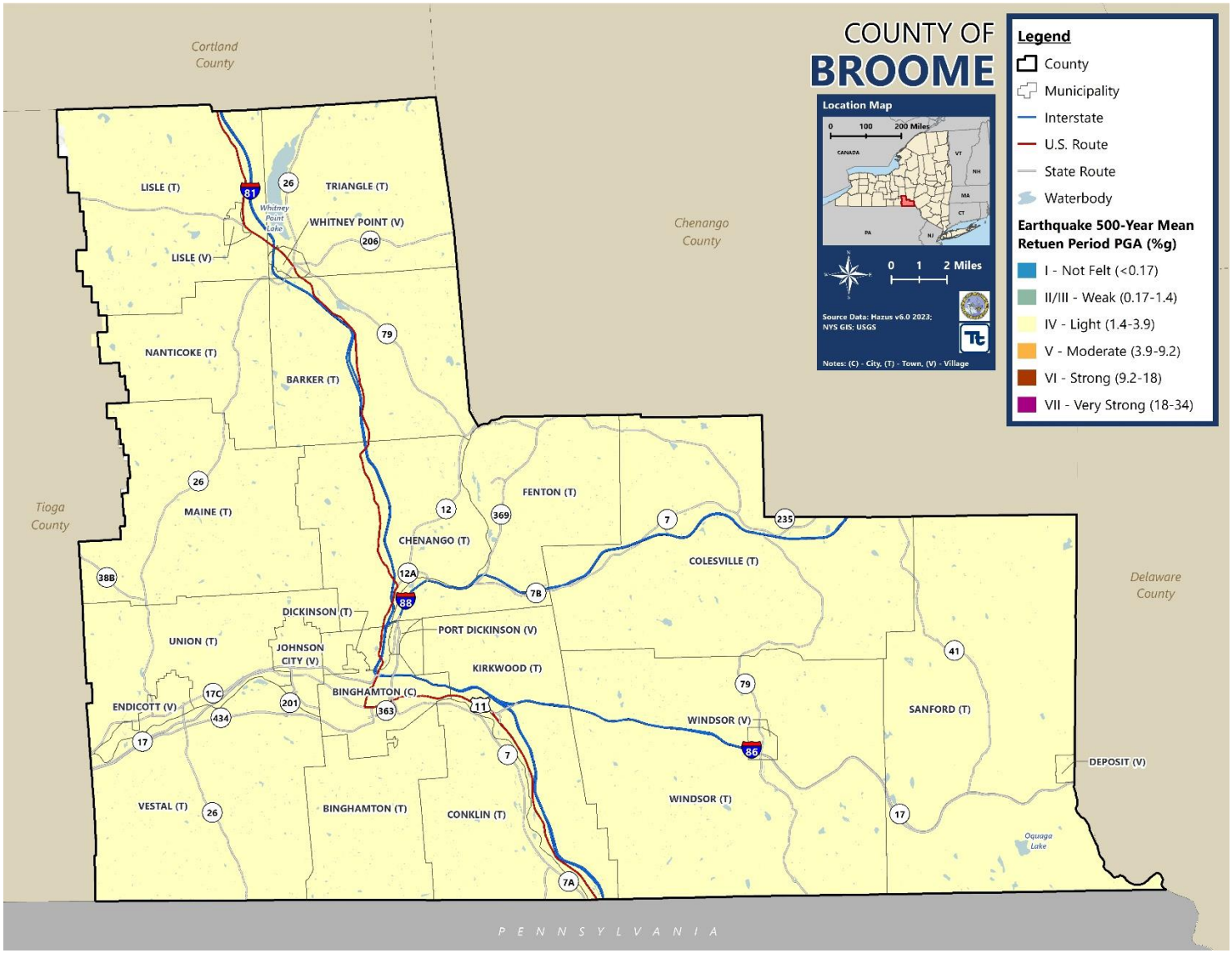


Figure 4-7 PGA 2,500-Year Mean Return Period for Broome County

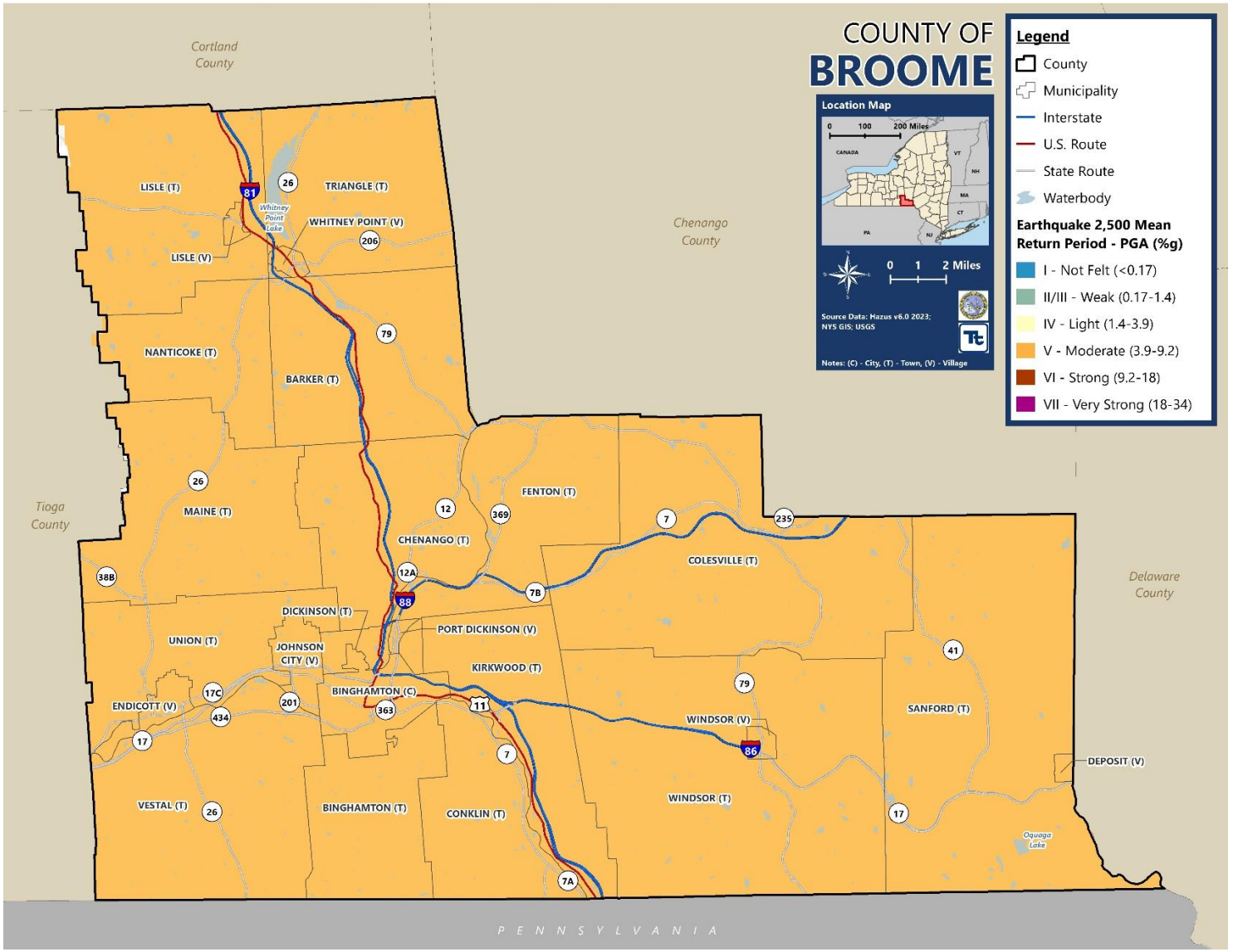


Table 4.3.4-6. Estimated Population Living in the NEHRP Soils Class D and E Hazard Areas

Jurisdiction	Total Population	Estimated Population Located Within the NEHRP Soils Class D and E Hazard Areas	
		Number of People	Percent of Total
Barker (T)	2,509	371	14.8%
Binghamton (C)	47,969	43,260	90.2%
Binghamton (T)	4,617	157	3.4%
Chenango (T)	10,959	3,716	33.9%
Colesville (T)	4,868	843	17.3%
Conklin (T)	5,008	2,546	50.8%
Deposit (V)	721	137	19.0%
Dickinson (T)	3,401	824	24.2%
Endicott (V)	13,667	12,022	88.0%
Fenton (T)	6,429	1,164	18.1%
Johnson City (V)	15,343	11,075	72.2%
Kirkwood (T)	5,481	183	3.3%
Lisle (T)	2,343	815	34.8%
Lisle (V)	348	286	82.2%
Maine (T)	5,168	1,091	21.1%
Nanticoke (T)	1,581	2	0.1%
Port Dickinson (V)	1,699	1,195	70.3%
Sanford (T)	1,518	212	14.0%
Triangle (T)	1,849	115	6.2%
Union (T)	27,128	10,716	39.5%
Vestal (T)	29,313	11,972	40.8%
Whitney Point (V)	960	846	88.1%
Windsor (T)	4,897	364	7.4%
Windsor (V)	907	516	56.9%
Broome County (Total)	**198,683**	**104,428**	**52.6%**

Sources: U.S. Census, American Community Survey 5-Year Estimates 2017-2021; NYS DHSES 2014

Table 4.3.4-7. Earthquake Population Impacts Based on Time of Day

	500-Year Mean Return Period			2,500-Year Mean Return Period		
	2:00 AM	2:00 PM	5:00 PM	2:00 AM	2:00 PM	5:00 PM
Injuries	0	2	1	5	20	10
Hospitalizations	0	0	0	0	2	1
Casualties	0	0	0	0	0	0

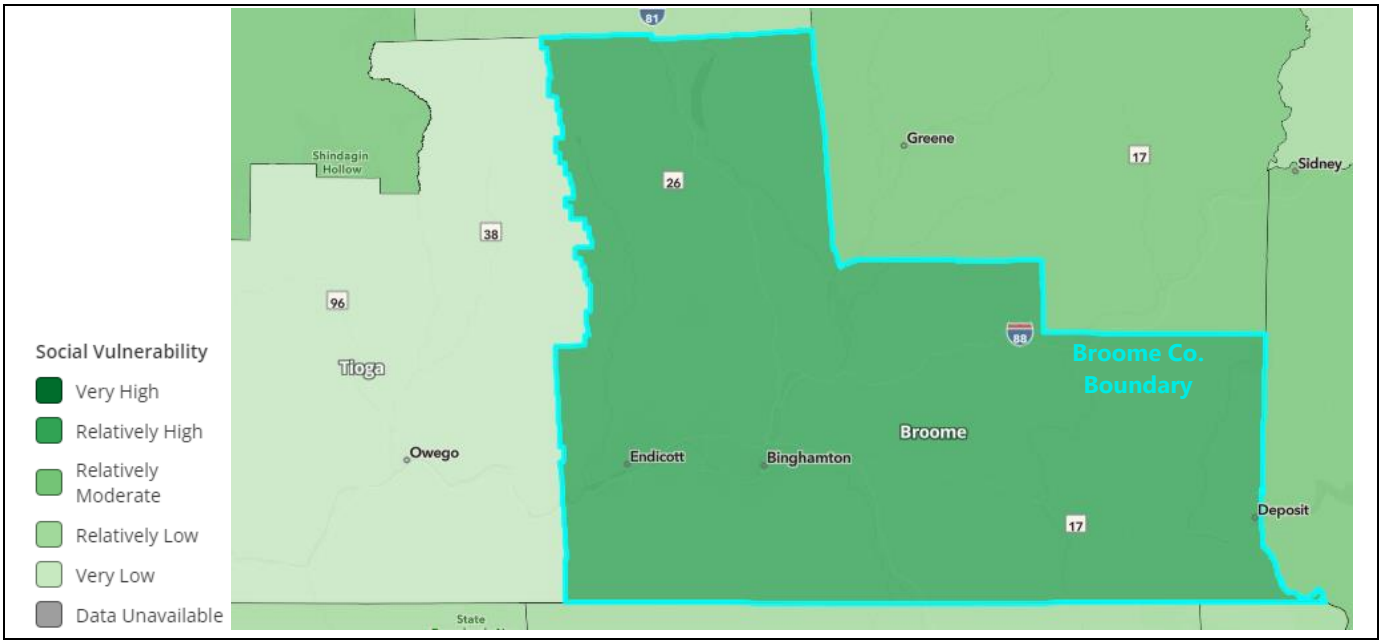
Source: Hazus v6.0

Earthquakes can cause residents to 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 be zero displaced households and zero persons seeking short-term sheltering following the 500-year and 2,500-year MRP events.

Socially Vulnerable Populations

Socially vulnerable populations, including persons over age 65 and individuals living below the poverty threshold, are most susceptible to adverse impacts of an earthquake. 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. According to the 2017-2021 American Community Survey, there are 37,752 persons over the age of 65 years, 10,142 persons under the age of five years, 3,165 non-English speakers, 30,857 persons with a disability, and 35,372 living in poverty in Broome County. Figure 4-8 displays the FEMA National Risk Inventory's Social Vulnerability Index for the County of Broome, which is identified as "relatively high."

Figure 4-8. FEMA Social Vulnerability Index for Natural Hazards



Source: (FEMA 2019)

Table 4.3.4-8 presents the estimated socially vulnerable populations located within the NEHRP Soils Class D and E Hazard Areas. There are 18,742 persons over the age of 65 years, 5,368 persons under the age of 5 years, 1,927 non-English speakers, 17,644 persons with a disability, and 23,071 living in poverty located in these areas.

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

Jurisdiction	Vulnerable Population (ACS 5-Year Estimates 2021)					Estimated Vulnerable Persons Located Within the NEHRP Soils Class D and E Hazard Areas									
	Over 65	Under 5	Non-English Speaking	Disability	Poverty Level	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
Barker (T)	465	142	49	342	537	68	14.6%	21	14.8%	7	14.3%	50	14.6%	79	14.7%
Binghamton (C)	7,642	2,588	1,051	9,632	14,894	6,891	90.2%	2,333	90.1%	947	90.1%	8,686	90.2%	13,431	90.2%
Binghamton (T)	822	206	5	710	454	28	3.4%	7	3.4%	0	0.0%	24	3.4%	15	3.3%
Chenango (T)	2,236	861	37	1,359	1,292	758	33.9%	292	33.9%	12	32.4%	460	33.8%	438	33.9%
Colesville (T)	1,299	161	0	812	345	225	17.3%	27	16.8%	0	0.0%	140	17.2%	59	17.1%
Conklin (T)	1,116	227	182	637	584	567	50.8%	115	50.7%	92	50.5%	323	50.7%	296	50.7%
Deposit (V)	110	49	0	123	153	20	18.2%	9	18.4%	0	0.0%	23	18.7%	29	19.0%
Dickinson (T)	829	32	63	611	345	201	24.2%	7	21.9%	15	23.8%	148	24.2%	83	24.1%
Endicott (V)	2,337	664	107	2,544	3,535	2,055	87.9%	584	88.0%	94	87.9%	2,237	87.9%	3,109	87.9%
Fenton (T)	1,223	518	49	828	962	221	18.1%	93	18.0%	8	16.3%	150	18.1%	174	18.1%
Johnson City (V)	2,864	821	356	2,718	2,938	2,067	72.2%	592	72.1%	256	71.9%	1,962	72.2%	2,120	72.2%
Kirkwood (T)	1,045	116	61	736	768	35	3.3%	3	2.6%	2	3.3%	24	3.3%	25	3.3%
Lisle (T)	373	157	0	405	207	129	34.6%	54	34.4%	0	0.0%	140	34.6%	72	34.8%
Lisle (V)	48	4	0	45	23	39	81.3%	3	75.0%	0	0.0%	37	82.2%	18	78.3%
Maine (T)	1,141	311	0	927	873	240	21.0%	65	20.9%	0	0.0%	195	21.0%	184	21.1%
Nanticoke (T)	384	68	0	265	123	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Port Dickinson (V)	235	77	26	208	223	165	70.2%	54	70.1%	18	69.2%	146	70.2%	156	70.0%
Sanford (T)	469	27	0	243	91	65	13.9%	3	11.1%	0	0.0%	34	14.0%	12	13.2%
Triangle (T)	300	40	0	298	251	18	6.0%	2	5.0%	0	0.0%	18	6.0%	15	6.0%
Union (T)	6,306	1,300	301	3,358	2,549	2,490	39.5%	513	39.5%	118	39.2%	1,326	39.5%	1,006	39.5%
Vestal (T)	5,068	1,261	876	3,025	3,318	2,069	40.8%	515	40.8%	357	40.8%	1,235	40.8%	1,355	40.8%
Whitney Point (V)	221	32	0	168	340	194	87.8%	28	87.5%	0	0.0%	148	88.1%	299	87.9%

Jurisdiction	Vulnerable Population (ACS 5-Year Estimates 2021)					Estimated Vulnerable Persons Located Within the NEHRP Soils Class D and E Hazard Areas									
	Over 65	Under 5	Non-English Speaking	Disability	Poverty Level	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
Windsor (T)	1,002	452	0	713	458	74	7.4%	33	7.3%	0	0.0%	53	7.4%	34	7.4%
Windsor (V)	217	28	2	150	109	123	56.7%	15	53.6%	1	50.0%	85	56.7%	62	56.9%
Broome County (Total)	**37,752**	**10,142**	**3,165**	**30,857**	**35,372**	**18,742**	**49.6%**	**5,368**	**52.9%**	**1,927**	**60.9%**	**17,644**	**57.2%**	**23,071**	**65.2%**

Source: U.S. Census, American Community Survey 5-Year Estimates 2017-2021; NYS DHSES 2014

Note: Persons per household = 2.33. Number used to calculate non-English speaking population.

Impact on General Building Stock

The entire County's general building stock is considered at risk and exposed to this hazard. However, soft soils can amplify ground shaking to damaging levels even during a moderate earthquake. Buildings located on these types of soils may be more vulnerable to damage.

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

National maps of earthquake-shaking hazards have been produced since 1948. They provide information essential to creating and updating the seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities, and land use planning used in the U.S. Based on a review of the studies, professional organizations of engineers update the seismic-risk maps and seismic design requirements used in building codes (Brown 2001). Scientists frequently revise these maps to reflect new information and knowledge. Buildings, bridges, highways, and utilities built to meet modern seismic design requirements are typically able to withstand earthquakes better, with less damage and disruption (USGS 2008).

The potential damage from an earthquake is the modeled loss that could occur to the exposed inventory measured by the structural and content replacement cost value. There are an estimated 52,016 buildings within the NEHRP Soils Class D and E Hazard Areas, representing 56.7 percent of the County's total general building stock inventory replacement cost value. The City of Binghamton has the greatest number of its buildings located in the earthquake hazard area (22,842 buildings or 90.5 percent of its total building stock). Refer to Table 4.3.4-9 for the estimated exposure of the earthquake hazard area by jurisdiction.

The Hazus model evaluates the best available earthquake science and takes into account an earthquake's PGA. The Hazus probabilistic earthquake model was applied to analyze the effects of the earthquake hazard on general building stock in Broome County.

A building's construction determines how well it can withstand the force of an earthquake. Additional attributes that affect a building's capability to withstand an earthquake's force include its age, number of stories, and quality of construction. Hazus considers building construction and the age of the building as part of the analysis. Because a custom general building stock was used for this Hazus analysis, the building ages and building types from the inventory were incorporated into the Hazus model.

Table 4.3.4-9. 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	Estimated Number and Total Replacement Cost Value of Structures Located in the NEHRP Soils Class D and E Hazard Areas			
			Number of Buildings	Percent of Total	Total Replacement Cost Value	Percent of Total
Barker (T)	1,265	$458,008,966	194	15.3%	$86,499,878	18.9%
Binghamton (C)	25,243	$25,457,379,910	22,842	90.5%	$23,357,209,889	91.8%
Binghamton (T)	2,121	$819,770,287	71	3.3%	$31,260,239	3.8%
Chenango (T)	5,183	$3,461,760,757	1,865	36.0%	$2,048,447,450	59.2%
Colesville (T)	2,476	$1,191,537,444	439	17.7%	$190,259,420	16.0%
Conklin (T)	2,520	$1,512,740,573	1,316	52.2%	$909,370,080	60.1%
Deposit (V)	468	$264,974,793	114	24.4%	$109,085,052	41.2%
Dickinson (T)	1,447	$1,107,438,719	349	24.1%	$201,767,006	18.2%
Endicott (V)	7,011	$5,891,635,188	6,215	88.6%	$5,613,335,988	95.3%
Fenton (T)	3,166	$1,276,510,649	595	18.8%	$294,069,187	23.0%
Johnson City (V)	7,904	$17,304,375,644	5,814	73.6%	$6,553,457,607	37.9%
Kirkwood (T)	2,628	$2,560,128,948	114	4.3%	$338,629,291	13.2%
Lisle (T)	1,108	$396,905,321	385	34.7%	$156,865,480	39.5%
Lisle (V)	135	$62,277,436	114	84.4%	$56,428,535	90.6%
Maine (T)	2,431	$1,346,741,610	521	21.4%	$204,930,562	15.2%
Nanticoke (T)	762	$278,505,563	1	0.1%	$249,295	0.1%
Port Dickinson (V)	845	$315,481,120	589	69.7%	$226,705,787	71.9%
Sanford (T)	1,399	$483,498,227	197	14.1%	$67,602,917	14.0%
Triangle (T)	915	$437,291,241	58	6.3%	$109,709,611	25.1%
Union (T)	13,013	$15,447,295,551	5,306	40.8%	$4,807,440,783	31.1%
Vestal (T)	9,532	$13,318,921,679	4,075	42.8%	$7,885,419,385	59.2%
Whitney Point (V)	439	$397,093,693	391	89.1%	$378,511,256	95.3%
Windsor (T)	2,685	$956,635,388	204	7.6%	$75,370,837	7.9%
Windsor (V)	435	$420,256,617	247	56.8%	$291,353,125	69.3%
Broome County (Total)	**95,131**	**$95,167,165,323**	**52,016**	**54.7%**	**$53,993,978,659**	**56.7%**

Sources: Broome County GIS & Mapping Services; RS Means 2022; NYS DHSES 2014

Potential building damage was evaluated by Hazus across the following damage categories: none, slight, moderate, extensive, and complete. Table 4.3.4-10 provides definitions of the categories of damage for a light wood-framed building. Definitions for other building types are included in the Hazus technical manual documentation.

Table 4.3.4-10. 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	A 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; and large foundation cracks.

Source: FEMA 2022

The Hazus estimates of potential damage states for buildings in Broome County categorized by general occupancy classes (i.e., residential, commercial, industrial, etc.) are summarized in Table 4.3.4-11 for the 500-year MRP event. Hazus estimates that there will be $6,588,800 in damage to structures caused by the 500-year MRP event, with the estimated residential damage being the most expensive at $3,147,569, or 47.8 percent of the total damage. Table 4.3.4-12 summarizes the damage to structures for the 2,500-year MRP event. It estimates that there will be $115,662,544 in damage to structures caused by the 2,500-year MRP event, with the estimated commercial damage being the most expensive at $57,937,888, or roughly 50 percent of the total damage.

Building damage due to the 500-year and 2,500-year MRP earthquakes was estimated for each municipality using Hazus. Table 4.3.4-13 summarizes estimated total building and content losses caused by the 500-year MRP event by building occupancy class. No buildings will be destroyed or severely damaged by the 500-year MRP event; however, up to 35 will be moderately damaged. Most of the damage is estimated to the residential occupancy class. Table 4.3.4-14 summarizes estimated total building and content losses caused by the 2,500-year MRP event by occupancy class. No buildings will be destroyed by the 2,500-year MRP event; however, up to 15 will be severely damaged, and up to 470 will be moderately damaged. Most of the damage is estimated to the residential occupancy class.

Table 4.3.4-11. Estimated Building Damage by General Occupancy for a 500-Year MRP Earthquake Event

Jurisdiction	Total Replacement Cost Value	500-Year Mean Return Period				
		Estimated Total Damage	Percent of Total Replacement Cost	Estimated Residential Damage	Estimated Commercial Damage	Estimated Damage for All Other Occupancies
Barker (T)	$458,008,966	$20,629	<0.1%	$16,263	$1,281	$3,085
Binghamton (C)	$25,457,379,910	$1,793,054	<0.1%	$1,017,532	$475,628	$299,894
Binghamton (T)	$819,770,287	$37,117	<0.1%	$23,626	$2,824	$10,667
Chenango (T)	$3,461,760,757	$126,944	<0.1%	$50,000	$52,408	$24,536
Colesville (T)	$1,191,537,444	$65,681	<0.1%	$41,650	$3,959	$20,071
Conklin (T)	$1,512,740,573	$76,873	<0.1%	$34,254	$19,359	$23,259
Deposit (V)	$264,974,793	$8,117	<0.1%	$5,488	$1,053	$1,576
Dickinson (T)	$1,107,438,719	$46,570	<0.1%	$13,558	$2,467	$30,545
Endicott (V)	$5,891,635,188	$664,513	<0.1%	$413,865	$120,372	$130,275
Fenton (T)	$1,276,510,649	$70,709	<0.1%	$41,183	$5,318	$24,209
Johnson City (V)	$17,304,375,644	$1,448,032	<0.1%	$728,035	$552,023	$167,973
Kirkwood (T)	$2,560,128,948	$94,137	<0.1%	$33,901	$31,584	$28,653
Lisle (T)	$396,905,321	$25,538	<0.1%	$19,652	$912	$4,974
Lisle (V)	$62,277,436	$3,105	<0.1%	$2,392	$110	$603
Maine (T)	$1,346,741,610	$63,970	<0.1%	$33,262	$16,744	$13,964
Nanticoke (T)	$278,505,563	$19,502	<0.1%	$17,017	$1,005	$1,479
Port Dickinson (V)	$315,481,120	$26,635	<0.1%	$7,439	$1,287	$17,908
Sanford (T)	$483,498,227	$24,325	<0.1%	$16,437	$3,135	$4,753
Triangle (T)	$437,291,241	$47,702	<0.1%	$26,949	$3,376	$17,378
Union (T)	$15,447,295,551	$622,578	<0.1%	$294,347	$130,617	$197,614
Vestal (T)	$13,318,921,679	$1,208,967	<0.1%	$253,112	$519,164	$436,692
Whitney Point (V)	$397,093,693	$22,918	<0.1%	$12,943	$1,622	$8,353
Windsor (T)	$956,635,388	$61,768	<0.1%	$38,742	$2,549	$20,477
Windsor (V)	$420,256,617	$9,416	<0.1%	$5,919	$433	$3,064
Broome County (Total)	**$95,167,165,323**	**$6,588,800**	**<0.1%**	**$3,147,569**	**$1,949,231**	**$1,492,000**

Source: Hazus v6.0

Table 4.3.4-12. Estimated Building Damage by General Occupancy for the 2,500-Year MRP Earthquake Event

Jurisdiction	Total Replacement Cost Value	2,500-Year Mean Return Period				
		Estimated Total Damage	Percent of Total Building and Contents	Estimated Residential Damage	Estimated Commercial Damage	Estimated Damage for All Other Occupancies
Barker (T)	$458,008,966	$365,261	0.1%	$270,933	$33,142	$61,187
Binghamton (C)	$25,457,379,910	$31,152,521	0.1%	$19,262,856	$8,040,850	$3,848,815
Binghamton (T)	$819,770,287	$738,506	0.1%	$562,968	$62,152	$113,385
Chenango (T)	$3,461,760,757	$2,825,864	0.1%	$1,207,208	$1,297,186	$321,470
Colesville (T)	$1,191,537,444	$1,098,763	0.1%	$754,616	$91,460	$252,687
Conklin (T)	$1,512,740,573	$1,396,365	0.1%	$535,002	$469,453	$391,910
Deposit (V)	$264,974,793	$172,621	0.1%	$122,220	$24,648	$25,753
Dickinson (T)	$1,107,438,719	$885,520	0.1%	$354,165	$55,857	$475,499
Endicott (V)	$5,891,635,188	$10,177,591	0.2%	$6,799,279	$1,867,549	$1,510,764
Fenton (T)	$1,276,510,649	$1,154,106	0.1%	$638,166	$124,645	$391,295
Johnson City (V)	$17,304,375,644	$25,163,036	0.1%	$11,578,023	$11,667,249	$1,917,764
Kirkwood (T)	$2,560,128,948	$2,218,381	0.1%	$845,836	$754,346	$618,199
Lisle (T)	$396,905,321	$374,432	0.1%	$254,428	$22,463	$97,541
Lisle (V)	$62,277,436	$45,526	0.1%	$30,957	$2,722	$11,847
Maine (T)	$1,346,741,610	$1,165,084	0.1%	$537,276	$452,288	$175,520
Nanticoke (T)	$278,505,563	$253,065	0.1%	$195,792	$25,456	$31,817
Port Dickinson (V)	$315,481,120	$497,825	0.2%	$193,726	$29,575	$274,523
Sanford (T)	$483,498,227	$516,088	0.1%	$365,259	$73,398	$77,431
Triangle (T)	$437,291,241	$666,028	0.2%	$371,465	$73,491	$221,071
Union (T)	$15,447,295,551	$14,258,872	0.1%	$6,846,001	$2,462,200	$4,950,671
Vestal (T)	$13,318,921,679	$18,967,567	0.1%	$5,162,218	$8,970,746	$4,834,603
Whitney Point (V)	$397,093,693	$319,947	0.1%	$178,399	$35,315	$106,233
Windsor (T)	$956,635,388	$1,066,875	0.1%	$739,557	$60,954	$266,364
Windsor (V)	$420,256,617	$182,701	<0.1%	$131,539	$10,573	$40,589
Broome County (Total)	**$95,167,165,323**	**$115,662,544**	**0.1%**	**$57,937,888**	**$36,707,720**	**$21,016,936**

Source: Hazus v6.0

Table 4.3.4-13. Estimated Building Structure and Contents Damage from the 500-Year MRP Earthquake Event

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	500-Year Mean Return Period	
			Building Count	Percent Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	88,871	None	88,574	99.7%
		Minor	271	0.3%
		Moderate	27	0.0%
		Severe	0	0.0%
		Destruction	0	0.0%
Commercial Buildings	4,431	None	4,405	99.4%
		Minor	22	0.5%
		Moderate	4	0.1%
		Severe	0	0.0%
		Destruction	0	0.0%
Industrial Buildings	508	None	505	99.6%
		Minor	2	0.4%
		Moderate	0	0.0%
		Severe	0	0.0%
		Destruction	0	0.0%
Government, Religion, Agricultural, and Education Buildings	1,321	None	1,303	98.6%
		Minor	14	1.1%
		Moderate	4	0.3%
		Severe	0	0.0%
		Destruction	0	0.0%

Source: Hazus v6.0

Table 4.3.4-14. Estimated Building Structure and Contents Damage from the 2,500-Year MRP Earthquake Event

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	2,500-Year Mean Return Period	
			Building Count	Percent Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	88,871	None	86,150	96.9%
		Minor	2,351	2.6%
		Moderate	362	0.4%
		Severe	8	<0.1%
		Destruction	0	0.0%
Commercial Buildings	4,431	None	4,176	94.2%
		Minor	178	4.0%
		Moderate	74	1.7%
		Severe	3	0.1%
		Destruction	0	0.0%
Industrial Buildings	508	None	482	95.0%
		Minor	18	3.6%

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	2,500-Year Mean Return Period	
			Building Count	Percent Buildings in Occupancy Class
		Moderate	7	1.4%
		Severe	0	0.0%
		Destruction	0	0.0%
Government, Religion, Agricultural, and Education Buildings	1,321	None	1,215	92.0%
		Minor	75	5.7%
		Moderate	27	2.0%
		Severe	4	0.3%
		Destruction	0	0.0%

Source: Hazus v6.0

Impact on Critical Facilities and Community Lifelines

All critical facilities and community lifelines in Broome County may be exposed to earthquakes, but those located in NEHRP Soils Class D and E Hazard Areas are more vulnerable to adverse impacts. Table 4.3.4-15 summarizes the number of community lifelines exposed to the earthquake hazard. Of the 790 community lifelines located in the earthquake hazard area, Transportation has the most facilities exposed (285). Section 3 (County Profile) of this HMP provides a complete inventory of critical facilities in Broome County.

Table 4.3.4-15. 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
Communications	60	12
Energy	0	0
Food, Water, Shelter	161	96
Hazardous Material	210	149
Health and Medical	41	29
Safety and Security	243	119
Transportation	516	285
Water Systems	197	100
Broome County (Total)	**1,428**	**790**

Source: Broome County 2023; NYS DHSES 2014

The Hazus earthquake model was used to assign the range or average probability of each damage state category to the critical facilities and lifelines in Broome County for the 500-year and 2,500-year MRP events. In addition, Hazus estimates the time to restore critical facilities to fully functional use. Results are presented as a probability of being functional at specified time increments (days after the event). For example, Hazus might estimate that a facility has a 5 percent chance of being fully functional on Day 3

and a 95 percent chance of being fully functional on Day 90. For the percent probability of sustaining damage, the minimum and maximum damage estimated value for that facility type is presented.

For both the 500-year MRP and 2,500-year MRP earthquake events, Hazus estimates that critical facilities will be nearly 100 percent functional, with negligible damage. Therefore, the impact on critical facilities is not significant for either event. Table 4.3.4-16 and Table 4.3.4-17 summarize the damage state probabilities for critical facilities during the 500-year and 2,500-year MRP events, respectively.

Table 4.3.4-16. Estimated Damage and Loss of Functionality for Critical Facilities and Utilities in Broome County for the 500-Year MRP Earthquake Event

Name	Percent Probability of Sustaining Damage 500-year MRP					Percent Functionality			
	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Essential Facilities									
Medical Facilities	99.7% - 99.9%	0.0% - 0.3%	0.0% - <0.1%	0.0%	0.0%	99.6% - 99.9%	99.9%	99.9%	99.9%
Emergency Operations Center	99.5%	0.4%	0.1%	0.0%	0.0%	99.4%	99.8%	99.9%	99.9%
Police Stations	97.9% - 99.5%	0.4% - 1.6%	0.1% - 0.4%	0.0% - <0.1%	0.0%	97.9%	99.4% - 99.8%	99.9%	99.9%
Fire Stations	97.2% - 99.5%	0.4% - 2.1%	0.1% - 0.6%	0.0% - 0.1%	0.0%	97.1% - 99.5%	99.2% - 99.8%	99.9%	99.9%
Schools	97.2% - 99.5%	0.4% - 2.1%	0.1% - 0.6%	0.0% - 0.1%	0.0%	97.1% - 99.5%	99.2% - 99.8%	99.9%	99.9%
Utilities									
Communications	99.3% - 99.9%	0.1% - 0.7%	0.0% - <0.1%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%
Potable Water	97.9% - 99.6%	0.2% - 1.2%	0.1% - 0.7%	<0.1% - 0.1%	0.0%	99.2% - 99.8%	99.9%	99.9%	99.9%
Waste Water	97.9% - 99.6%	0.2% - 1.2%	0.1% - 0.7%	<0.1% - 0.1%	0.0%	98.4 - 99.6%	99.8% - 99.9%	99.8% - 99.9%	99.9%
Transportation									
Highway Bridges	99.9% - 100%	0.0%	0.0%	0.0%	0.0%	99.9% - 100%	99.9% - 100%	99.9% - 100%	99.9% - 100%
Rail Facility	99.9%	0.1%	0.0%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%

Source: Hazus v6.0

Table 4.3.4-17. Estimated Damage and Loss of Functionality for Critical Facilities and Utilities in Broome County for the 500-Year MRP Earthquake Event

Name	Percent Probability of Sustaining Damage 2,500-year					Percent Functionality			
	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Essential Facilities									
Medical Facilities	94.5% - 99.5%	0.4% - 4.1%	0.1% - 1.3%	0.0% - 0.1%	0.0% - <0.1%	94.4% - 99.4%	98.4% - 99.9%	99.9%	99.9%
Emergency Operations Center	95.1%	3.6%	1.2%	0.1%	0.0%	95.0%	98.5%	99.8%	99.9%
Police Stations	88.2% - 95.2%	3.5% - 8.0%	1.1% - 3.2%	0.1% - 0.5%	0.0% - <0.1%	88.2% - 95.2%	96.0% - 98.6%	99.4% - 99.8%	99.7% - 99.9%
Fire Stations	85.9% - 95.4%	3.4% - 9.4%	1.1% - 4.0%	0.1% - 0.6%	0.0% - 0.1%	85.9% - 95.3%	95.0% - 98.6%	99.2% - 99.8%	99.6% - 99.9%
Schools	85.9% - 95.3%	3.4% - 9.4%	1.1% - 4.0%	0.1% - 0.6%	0.0% - 0.1%	85.9% - 95.3%	95.0% - 98.6%	99.2% - 99.8%	99.6% - 99.9%
Utilities									
Communications	94.4% - 98.7%	1.3% - 5.3%	<0.1% - 0.4%	0.0%	0.0%	99.7% - 99.9%	99.9%	99.9%	99.9%
Potable Water	88.6% - 96.5%	2.1% - 5.9%	1.3% - 4.4%	0.2% - 1.0%	0.0%	95.2% - 98.6%	99.2% - 99.8%	99.7% - 99.9%	99.9%
Waste Water	88.6% - 96.5%	2.0% - 5.9%	1.3% - 4.4%	0.2% - 1.0%	0.0%	91.0% - 97.2%	98.6% - 99.7%	99.1% - 99.9%	99.8% - 99.9%
Transportation									
Highway Bridges	99.9%	0.0%	0.0%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%
Rail Facility	98.3%	1.7%	0.1%	0.0%	0.0%	99.9%	99.9%	99.9%	99.9%

Source: Hazus v6.0

Impact on the Economy

Earthquake impacts on the economy include 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). Economic losses estimated by Hazus are summarized in Table 4.3.4-18. Hazus estimates inventory losses for the 500-year MRP event of $169,800, which is 2.9 percent of the 2,500-year MRP event's $5,706,900 inventory losses. Similarly, wage losses for the 500-year MRP event are $345,900, or 7.5 percent of the 2,500-year MRP event's $4,627,900 wage losses.

Table 4.3.4-18. Economic Losses for the 500-Year and 2,500 Mean Return Period (MRP) Earthquake Event

Mean Return Period (MRP)	Inventory Loss	Relocation Loss	Building and Content Losses	Wages Losses	Rental Losses	Capital-Related Loss
500-year	$169,800	$790,400	$2,258,000	$345,900	$359,600	$147,800
2,500-year	$5,706,900	$10,694,300	$43,467,600	$4,627,900	$5,437,800	$2,523,700

Source: Hazus v6.0

Although the Hazus analysis did not compute damage estimates for individual roadway segments and railroad tracks, it is assumed these features would undergo damage due to ground failure, resulting in interruptions of regional transportation and distribution of materials. Losses to the community that would result from damage to lifelines could exceed the costs of repair.

Earthquake events can also significantly affect road 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 the degree of vulnerability is the age of facilities and infrastructure, which correlates with standards in place at times of construction.

Hazus also estimates the volume of debris that may be generated because of an earthquake event to enable the study region to prepare and rapidly and efficiently manage debris removal and disposal. Debris estimates are divided into two categories: (1) reinforced concrete and steel that require special equipment to break it up before it can be transported, and (2) brick, wood, and other debris that can be loaded directly onto trucks with bulldozers (FEMA 2022).

For the 500-year MRP event, Hazus estimates that 1,892 tons of debris will be generated. For the 2,500-year MRP event, Hazus estimates a total of 20,934 tons of debris will be generated countywide. Table 4.3.4-19 summarizes the estimated debris generated because of these events, by municipality.

Table 4.3.4-19. Estimated Debris Generated by the 500-Year and 2,500-Year MRP Earthquake Events

Jurisdiction	Estimated Debris Created During the 500-Year Mean Return Period Earthquake Event		Estimated Debris Created During the 2,500-Year Mean Return Period Earthquake Event	
	Brick/Wood (tons)	Concrete/Steel (tons)	Brick/Wood (tons)	Concrete/Steel (tons)
Barker (T)	6	1	49	16
Binghamton (C)	316	95	2,574	1,987
Binghamton (T)	13	2	99	25
Chenango (T)	32	11	275	223
Colesville (T)	26	4	189	53
Conklin (T)	27	8	193	130
Deposit (V)	2	1	19	8
Dickinson (T)	28	3	260	48
Endicott (V)	118	38	860	744
Fenton (T)	30	6	228	82
Johnson City (V)	175	102	1,340	2,497
Kirkwood (T)	23	8	187	170
Lisle (T)	9	2	82	22
Lisle (V)	1	0	10	3
Maine (T)	21	5	157	70
Nanticoke (T)	6	2	51	16
Port Dickinson (V)	16	2	153	27
Sanford (T)	7	2	58	24
Triangle (T)	21	4	154	46
Union (T)	104	53	932	1,193
Vestal (T)	378	134	2,698	2,586
Whitney Point (V)	10	2	74	22
Windsor (T)	29	4	213	49
Windsor (V)	4	1	30	7
Broome County (Total)	**1,404**	**488**	**10,884**	**10,050**

Source: Hazus v6.0

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 of earthquakes that can create wide ruptures in the ground. Ruptures can have a direct impact on the landscape and natural environment because they can tear apart plant roots or disconnect habitats for miles, isolating animal species (USGS n.d.).

Furthermore, ground failure because 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 it is that drainage of groundwater can occur, which depletes water resources. In areas where there is higher pressure of groundwater retention, the pores can build up more pressure and make soil behave

like a fluid rather than a solid, increasing the risk of localized flooding and deposition or accumulation of silt (USGS n.d.).

Cascading Impacts on Other Hazards

Earthquakes can cause large and sometimes disastrous landslides and mudslides. Any steep slope is vulnerable to slope failure, often because of loss of cohesion in clay-rich soils. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people.

Earthen dams and levees are highly susceptible to seismic events. The impacts of their eventual failures can be considered secondary risks for earthquakes. The most common mode of earthquake-induced dam failure is slumping or settlement of earth-fill dams where the fill has not been properly compacted. If the slumping occurs when the dam is full, then overtopping of the dam is possible, with rapid erosion leading to dam failure. Dam failure is also possible if strong ground motions heavily damage concrete dams. Earthquake-induced landslides into reservoirs have also caused dam failures. Dam failures are further discussed in Section 4.3.1 (Dam Failure) of this Plan update.

Another secondary effect of earthquakes that are often observed in low-lying areas near water bodies is ground liquefaction. Liquefaction is the conversion of water-saturated soil into a fluid-like mass. This can occur when loosely packed, waterlogged sediments lose their strength in response to strong shaking.

According to the U.S. Search and Rescue Task Force, tsunamis are formed because of earthquakes, volcanic eruptions, or landslides that occur under the ocean. A large earthquake can lift large portions of the seafloor, which will cause the formation of huge waves (U.S. SAR Task Force n.d).

Future Changes That May Impact Vulnerability

Understanding future changes that impact vulnerability in the County can assist in planning for future development and ensure the establishment of appropriate mitigation, planning, and preparedness measures.

Projected Changes in Development

As discussed in Section 3 (County Profile), areas targeted for future growth and development have been identified across the County. In addition, each community was requested to provide recent and anticipated new development and infrastructure projects, which is summarized in Volume II.

Development 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 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. Persons that move into older buildings may increase their overall vulnerability to earthquakes.

Projected Changes in Population

According to the U.S. Census Bureau, the County's population increased by 0.95 percent between 2010 and 2020 (U.S. Census 2023). Cornell University's Program on Applied Demographics projects that Broome County will have a population of 186,950 by 2030 and 183,176 by 2040 (Cornell University 2018).

Climate Change

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 intensify secondary impacts of earthquakes. As a result of climate change, the County's assets in areas of saturated soils or at the base of steep slopes will be at a higher risk of landslides resulting from seismic activity. With the expectation of more precipitation and more intense cycles of precipitation, this will pose a higher risk of landslides so when earthquakes do occur, conditions are optimal for landslides

Change of Vulnerability Since 2019 HMP

Overall, the entire County continues to be vulnerable to earthquakes. For the 2024 HMP, the building inventory was updated using RS Means 2022 values, which are more current and reflect replacement cost versus the building stock improvement values reported in the 2019 HMP. Additional building stock updates include updates to the critical facility inventory provided by Broome County. Updated hazard areas were used as well. Since the 2019 HMP, an updated version of Hazus (v6) was released, and this updated model includes longer historical records to generate probabilistic events.

SECTION 4. RISK ASSESSMENT

4.3 HAZARD PROFILES

4.3.5 Extreme Temperature

This 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 extreme temperatures in Broome County.

Hazard Profile

Hazard Description

Extreme temperature includes both heat and cold events. Such events can have a significant impact on human health and commercial/agricultural businesses, with primary or secondary effects on infrastructure (e.g., burst pipes and power failure). What constitutes extreme cold or extreme heat varies across the country, based on normal temperatures for a given area.

Extreme Cold

Extreme cold events are when temperatures drop well below normal for the area. In New York State, temperatures at or below 0 ºF for an extended period of time characterize an extreme cold event (NYSDHSES 2019). Health hazards related to extreme cold temperatures include wind chill, frostbite, and hypothermia:

- *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 -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).

The Impact on Life, Health, and Safety Section discusses more on the health impacts of extreme cold events.

Extreme Heat

Extreme heat is defined as weather that is much hotter and/or more humid than average for a particular time and place (EPA and CDC 2016). A period of extreme heat for two or more consecutive days is typically called a heat wave and is often accompanied by high humidity (NWS n.d.). Humid or muggy conditions

occur when a dome of high atmospheric pressure traps hazy, damp air near the ground. Extreme hot days in New York State are defined as individual days with maximum temperatures at or above 90 °F or 95 °F (Horton, et al. 2014). Heat waves in New York State are defined as three or more consecutive days with maximum temperatures above 90 °F (Horton, et al. 2014).

Health hazards related to extreme high temperatures include heat exhaustion and heat stroke:

- *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)

The Impact on Life, Health, and Safety Section discusses more on the health impacts of extreme heat events.

Location

According to the New York State Hazard Mitigation Plan (2019), excessive heat can occur anywhere in New York State. Excessive heat incidents are widespread, even if there are localized cooler areas. The state has varied summers, with warmer conditions in the south and milder conditions elsewhere.

New York State is divided into 10 climate divisions (regions with relatively homogeneous climate): Western Plateau, Eastern Plateau, Northern Plateau, Coastal, Hudson Valley, Mohawk Valley, Champlain Valley, St. Lawrence Valley, Great Lakes, and Central Lakes. Broome County is located within the Eastern Plateau Climate Division (CPC 2005). The Easter Plateau Climate Division is characterized by hot and dry summers with cold overcast winters, and precipitation in late fall to early spring. However, it is important to note that climate conditions can vary from year to year.

Extreme Cold

Extreme cold temperatures occur throughout the winter and generally accompany winter storm events. Under higher-than-normal atmospheric pressures when Arctic air masses are present, extreme winter temperatures hover over Broome County, flowing southward from central Canada or the Hudson Bay (Horton, et al. 2014). Extreme cold temperatures of varying degrees occur throughout the county during the winter. The northern sections of the county (Towns of Lisle, Triangle, Nanticoke, and Barker) and areas with the highest elevations (Town of Sanford, Town of Windsor) typically experience the coldest conditions.

The Midwest Regional Climate Center (MRCC) Application Tools Environment provides access to climate data and tools. This application can be used to look up raw climate data, rankings of climate information,

thresholds, growing season tools, maps, and graphs. As provided by the MRCC, average high and low temperatures during the winter around Broome County are shown in Table 4.3.5-1.

Table 4.3.5-1. High and Low Winter Temperature Range in Broome County, 2019-2023

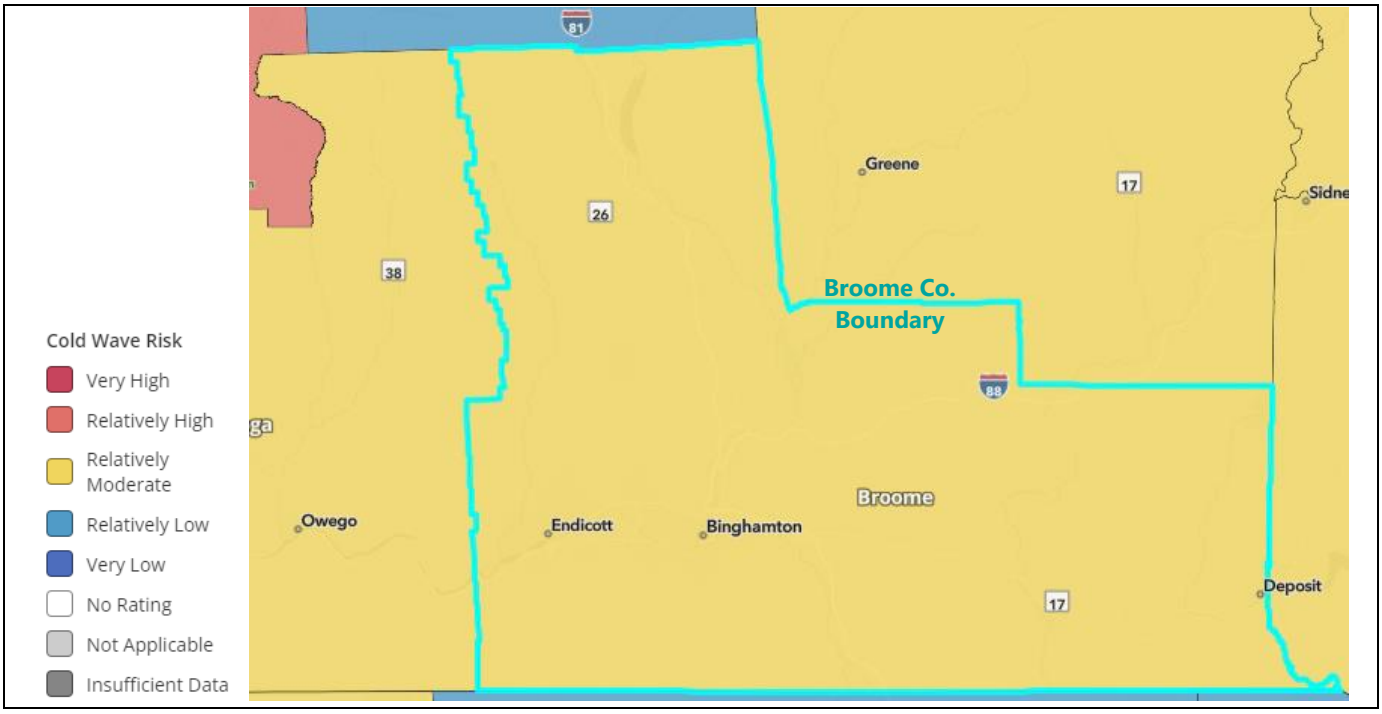
Month	Average High	Average Low	Record Low
November	45.6°F	31.0°F	12°F
December	35.8°F	23.8°F	-5°F
January	31.0°F	17.9°F	-10°F
February	34.4°F	18.8°F	-13°F
March	43.2°F	25.9°F	3°F

Source: (MRCC 2023)

Note: Due to the availability of temperature records, the Binghamton (Greater AP) station was used to demonstrate county temperature averages and record events.

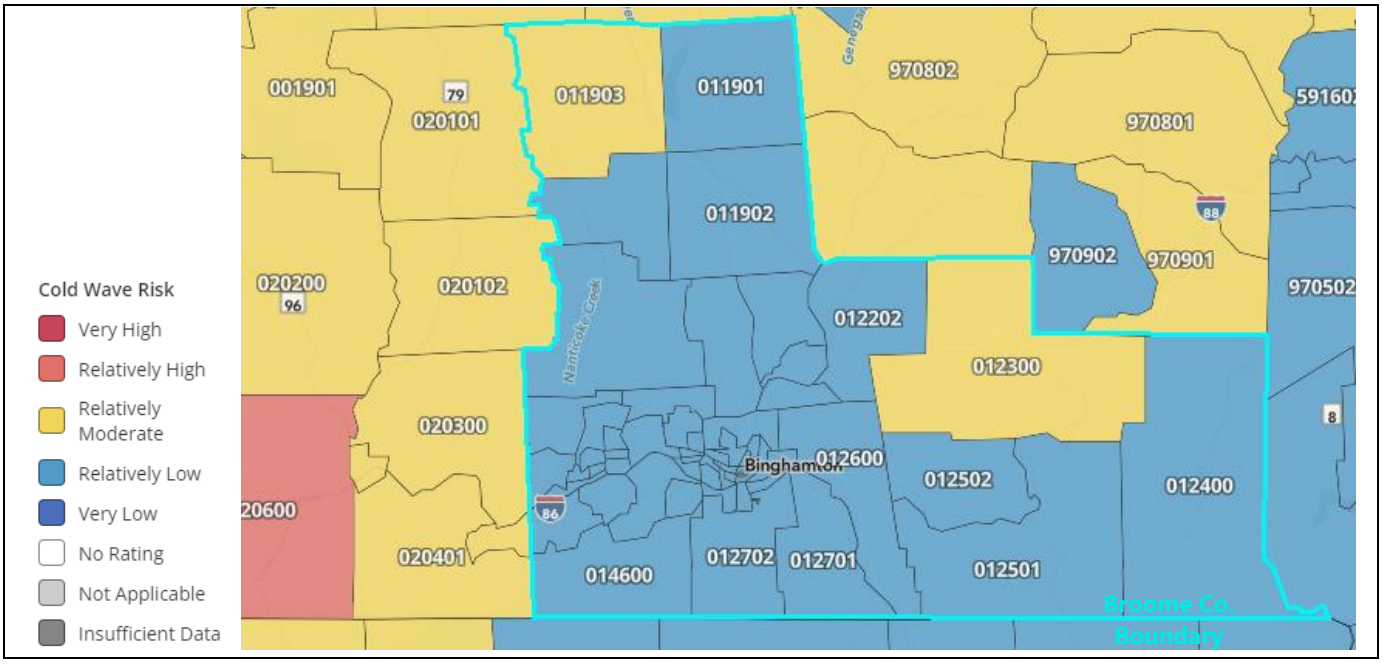
Figure 4.3.5-1 and Figure 4.3.5-2 show the Cold Wave Risk Index for Broome County on the county and census tract scales, respectively. This index indicates the susceptibility of the County to cold temperatures. According to the National Risk Index, on the county scale, the County has a relatively moderate risk of cold temperatures; on the census tract scale, the County ranges from a relatively low risk to a relatively moderate risk (FEMA 2019).

Figure 4.3.5-1. National Risk Index, Cold Wave Risk Index Score Using the County Scale



Source: FEMA 2019

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



Source: FEMA 2019

Extreme Heat

Extreme heat temperatures occur throughout the county for most of the summer, except for areas with high altitudes. High-pressure systems often move just off the Atlantic coast and become stagnant for several days, and then a persistent airflow from the southwest or south affects the weather in the state. This circulation brings the very warm, often humid weather of summer (Horton, et al. 2014). Areas of dense urban development, such as the City of Binghamton, are prone to the urban heat island effect, which can further raise temperatures. As provided by the MRCC, average high and low temperatures during the summer around Broome County are as shown in Table 4.3.5-2.

Table 4.3.5-2. High and Low Temperature Range for Summer Months in Broome County, 2019-2023

Month	Average High	Average Low	Record High
May	66.3°F	45.9°F	88°F
June	74.4°F	55.5°F	91°F
July	80.2°F	61.7°F	93°F
August	77.8°F	59.9°F	92°F
September	69.7°F	52.1°F	88°F

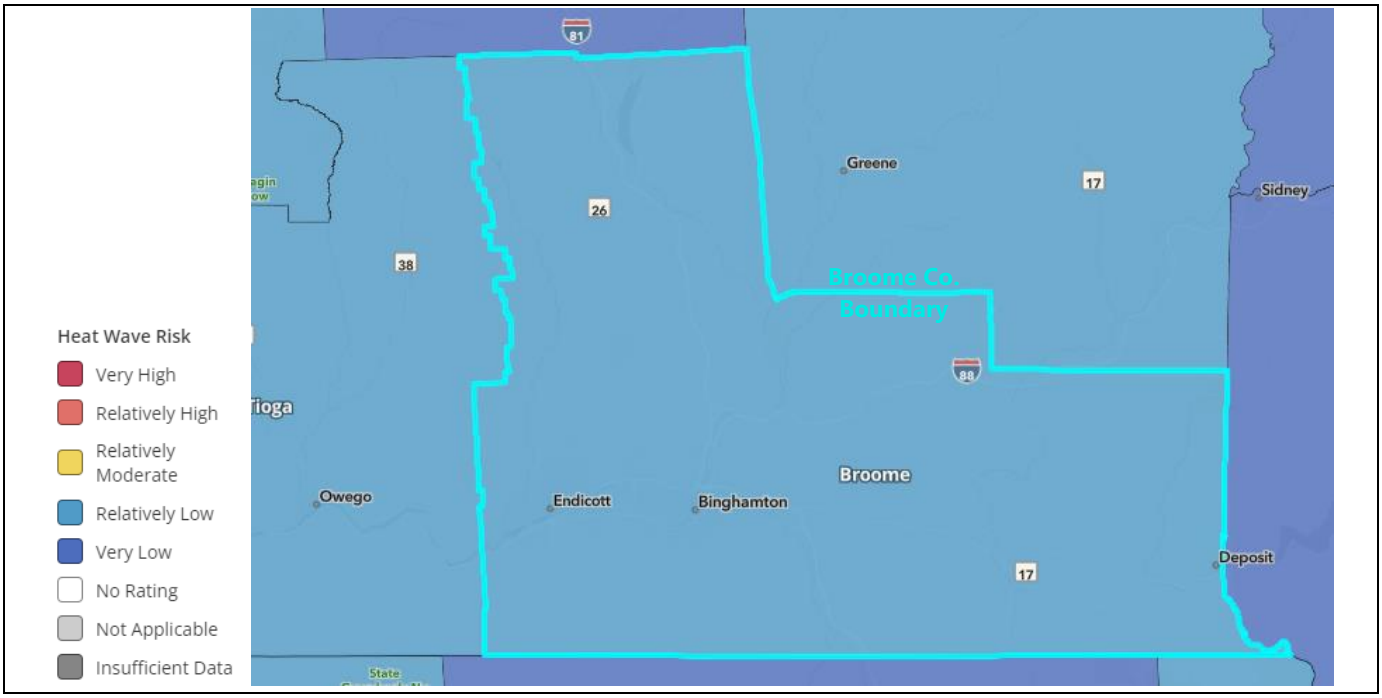
Source: (MRCC 2023)

Note: Due to the availability of temperature records, the Binghamton (Greater AP) station was used to demonstrate county temperature averages and record events.

Figure 4.3.5-3 and Figure 4.3.5-4 show the Heat Wave Risk Index for Broome County on the county and census tract scales, respectively. This index indicates the susceptibility of the County to extreme heat.

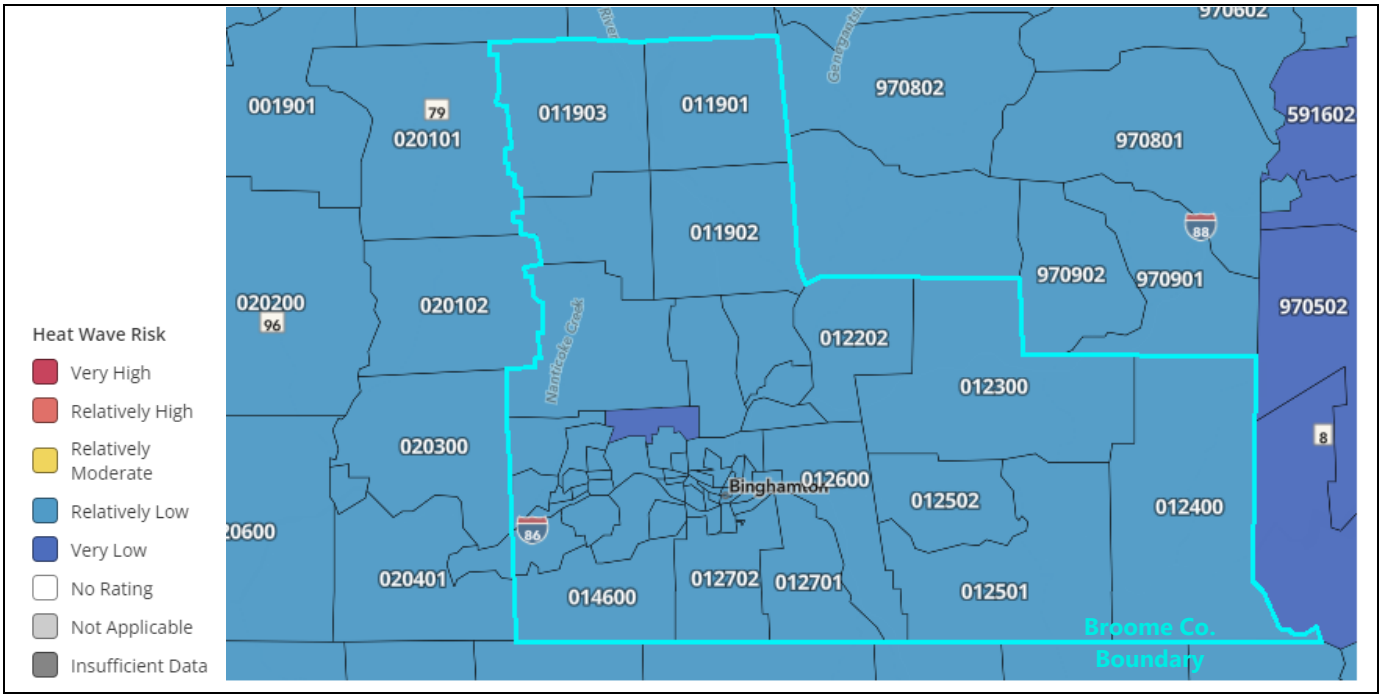
According to the National Risk Index, on the county scale, the County has a relatively moderate risk of extreme heat; on the census tract scale, the County ranges from a relatively low risk to a relatively moderate risk (FEMA 2019).

Figure 4.3.5-3. National Risk Index, Heat Wave Risk Index Score Using the County Scale



Source: FEMA 2019

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



Source: FEMA 2019

Extent

Extreme Cold

The extent (severity or magnitude) of extreme cold temperatures is generally measured through the Wind Chill Temperature (WCT) Index, an approach to calculating the dangers from wind chill. The WCT Index is presented in Figure 4.3.5-5. The National Weather Service (NWS) provides alerts when the index approaches hazardous levels. Table 4.3.5-3 explains these alerts. Additionally, the NWS issues freeze-frost advisories as described in Table 4.3.5-4.

Wind Chill at a Glance

Wind chill is how cold the weather feels on the skin when the wind is factored in. It may also be referred to as the "feels-like" temperature. Bitterly cold wind chills increase the risk of developing frostbite and hypothermia.

Source: The Weather Channel (2019)

Figure 4.3.5-5. NWS WCT Index

WIND CHILL CHART (Source: NWS)

Temperature (°F)

Wind (mph)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times

30 minutes | 10 minutes | 5 minutes

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

Wind Chill (°F) = 35.74 + 0.6215T - 35.75(V0.16) + 0.4275T(V0.16)

Source: NYS DHSES, 2019

Table 4.3.5-3. NWS Alerts for Extreme Cold

Alert	Criteria
Wind Chill Advisory	NWS issues a wind chill advisory when seasonably cold wind chill values, but not extremely cold values, are expected or occurring.
Wind Chill Watch	NWS issues a wind chill watch when dangerously cold wind chill values are possible.
Wind Chill Warning	NWS issues a wind chill warning when dangerously cold wind chill values are expected or occurring.

Source: NWS 2018

Table 4.3.5-4. NWS Alerts for Freezing

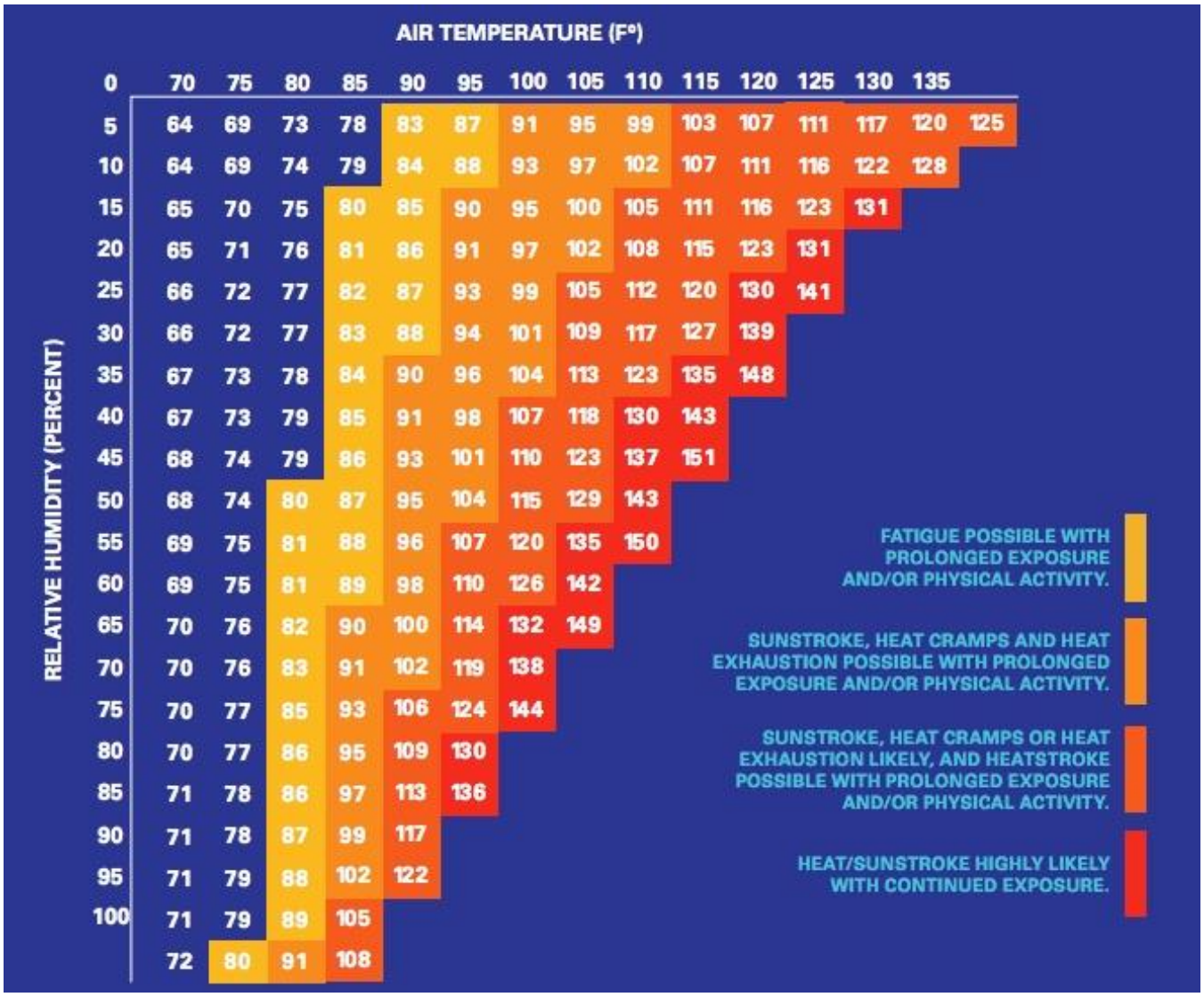
Alert	Criteria
Hard Freeze Warning	NWS issues a hard freeze warning when temperatures are expected to drop below 28°F for an extended period, killing most types of commercial crops and residential plants.
Freeze Warning	When temperatures are forecasted to go below 32°F for a long period of time, NWS issues a freeze warning. This temperature threshold kills some types of commercial crops and residential plants.
Freeze Watch	NWS issues a freeze watch when there is a potential for significant, widespread freezing temperatures within the next 24 to 36 hours. A freeze watch is issued in the autumn until the end of the growing season and in the spring at the start of the growing season.
Frost Advisory	A frost advisory means areas of frost are expected or occurring, posing a threat to sensitive vegetation.

Source: NYS DHSES, 2019

Extreme Heat

The extent of extreme heat temperatures generally is measured through the Heat Index. Created by the NWS, the Heat Index measures the apparent temperature of the air as it increases with relative humidity, as seen in Figure 4.3.5-6. This provides a measure of how temperatures feel. The values are devised for shady, light wind conditions. Exposure to full sun can increase the index by up to 15 degrees (NYSDHSES 2019). NWS provides alerts when the index approaches hazardous levels. Table 4.3.5-5 explains these alerts.

Figure 4.3.5-6. Heat Index Chart



Source: NYS DHSES, 2019

Table 4.3.5-5. NWS Alerts for Heat

Alert	Criteria
Heat Advisory	The criteria for a Heat Advisory in New York is a heat index of 95 to 104 °F. The heat index has to remain at or above this criterion for a minimum of 2 hours. Heat advisories are issued by a county when any location within that county is expected to reach the criterion.
Excessive Heat Watch	Issued when Heat Warning criteria may be achieved (50-79% chance) 1 to 2 days in advance.
Excessive Heat Warning	The criteria for an Excessive Heat Warning is a heat index of 105 °F or greater that will last for 2 hours or more. Excessive Heat Warnings are issued by a county when any location within that county is expected to reach the criterion.

Source: NWS, 2020

Previous Occurrences and Losses

This section presents the best available information on previous extreme temperature occurrences, impacts, and monetary losses in Broome County. Where multiple information sources were available, the results presented here were judged to be the most accurate and reliable. Citations are provided for each information source used.

FEMA Major Disasters and Emergency Declarations

Extreme temperature events occur each year in Broome County. To identify the events in Broome County, the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) Storm Events database was queried. The database records and defines extreme temperature events as follows:

- Cold/Wind Chill is reported in the NOAA-NCEI database when a period of low temperatures or wind chill temperatures reach or exceed locally or regionally defined advisory conditions (typical value is negative 18 °F or colder).
- Excessive Heat is reported in the NOAA-NCEI database whenever heat index values meet or exceed locally or regionally established excessive heat warning thresholds.
- Extreme Cold/Wind Chill is reported in the NOAA-NCEI database when a period of extremely low temperatures or wind chill temperatures reaches or exceeds locally or regionally defined warning criteria (typical value around negative 35 °F or colder).
- Heat is reported in the NOAA-NCEI database whenever heat index values meet or exceed locally or regionally established advisory thresholds.

Between 1954 and October 2023, New York State was not included in any major disaster (DR) or emergency (EM) declarations due to extreme temperatures (heat or cold). However, during the same time period, FEMA included Broome County in four winter storm-related DR or EM declarations classified as one or a combination of the following disaster types: severe winter storm, snowstorm, snow, ice storm, winter storm, and blizzard (Table 4.3.5-6). Extreme cold temperatures are often associated with these disaster types.

Table 4.3.5-6. Extreme Temperature Declarations in Broome County, 1990 to 2023

FEMA Declaration Number	Date(s) of Event	Event Type	Details
EM-3107	March 13–17, 1993	Snow	Severe Blizzard
EM-3173	December 25, 2002–January 4, 2003	Snow	Snowstorms
EM-3184	February 17–18, 2003	Snow	Snow
DR-4322	March 14–15, 2017	Snow	Severe Winter Storms and Snowstorms

Source: FEMA 2018

Note: DR = Major Disaster Declaration (FEMA); EM = Emergency Declaration (FEMA)

USDA Disaster Declarations

The Secretary of 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 contiguous counties. Between 2019 and 2023, Broome County was included in four extreme temperature-related agricultural disaster declarations:

- S5485, May 2023—Freeze and frost
- S5342, July 2022—Drought
- S5360, July 2022—Drought
- S4903, April 2020—Freeze and frost

Previous Events

Many sources provide information on previous extreme temperature occurrences in Broome County and associated losses. The 2019 HMP discussed specific extreme temperature events in the County through 2019. Table 4.3.5-7 lists significant extreme temperature events in Broome County between January 1, 2019, and December 31, 2023. Significant events include those that resulted in losses greater than $5,000 in property or crop damages or fatalities, as reported by the NOAA-NCEI database, those that led to a FEMA disaster declaration, or those that led to a USDA declaration.

Table 4.3.5-7. Extreme Temperature Events in Broome County (2019 to 2023)

Date of Event	Event Type	FEMA or USDA Declaration Number	Broome County Included in Declaration?	Location Impacted	Description
1/15/2022	Extreme Cold/Wind Chill	N/A	N/A	Entire County	High pressure was present over Ontario/Quebec with a tight pressure gradient extending across Central New York. Subzero temperatures and strong, gusty winds brought wind chills as low as 35 below zero in some areas.
1/22/2022	Extreme Cold/Wind Chill	N/A	N/A	Entire County	Arctic high pressure brought significantly cold air to Central New York. Low temperatures were as low as minus 25°F.

Sources: FEMA 2023; U.S. Department of Agriculture 2023; NOAA-NCEI 2023

Probability of Future Occurrence

The probability of occurrence is one parameter used for hazard rankings in this HMP. Based on the history of extreme temperature events, Broome County has a 32 percent chance of experiencing at least one extreme temperature event (of any type) in any given year (see Table 4.3.5-8). Based on these records and input from the Planning Partnership, the probability of occurrence of extreme temperature in the County is considered occasional (hazard event has an annual probability of between 10 and 100 percent).

Table 4.3.5-8. Probability of Future Extreme Temperature Events in Broome County

Hazard Type	Number of Occurrences Between 1950 and 2023	% Chance of Occurring in Any Given Year
Cold/Wind Chill	13	18%
Excessive Heat	2	3%
Extreme Cold/Wind Chill	5	7%
Heat	3	4%
TOTAL	**23**	**32%**

Source: NOAA-NCEI 2023

Note: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act and selected 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.

Climate Change Impacts

With an increase in temperatures, heat waves, defined as three or more consecutive days with maximum temperatures at or above 90 ˚F, will become more frequent and intense, increasing heat-related illness and death, and posing new challenges to the energy system, air quality, and agriculture. In contrast, the annual number of days with extreme cold events, defined both as days with minimum temperature at or below 32 ˚F and those at or below 0 ˚F, is expected to decrease as average temperatures rise. Table 4.3.5-9 lists the projected changes in these events and includes the minimum, central range, and maximum days per year.

Table 4.3.5-9. Climate Change Impacts, Extreme Temperature Events in Broome County

Event Type	2020s	Future		
		Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
Days over 90 degrees Fahrenheit (°F)	8 days	12	17-21	23
# of Heat Waves	0.7 heat waves	2	2 to 3	3
Duration of Heat Waves	4 days	4	4 to 5	5
Days below 32°F	133 days	119	122 to 130	134

Source: (Horton, et al. 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 Broome 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, are vulnerable to the extreme temperature hazard.

Impact on Life, Health, and Safety

Overall Population

For this HMP, the entire population of Broome County (198,683) is exposed to extreme temperature events. Extreme temperature events have potential health impacts including injury and death. Meteorologists can accurately forecast extreme heat and cold event development and the severity of the associated conditions with several days of lead time. These forecasts provide an opportunity for public health and other officials to notify vulnerable populations, implement short-term emergency response actions, and focus on surveillance and relief efforts for those at greatest risk. Adhering to extreme temperature warnings and conducting appropriate mitigation and preparation measures can significantly reduce the risk of temperature-related injuries and deaths. Health hazards related to extreme cold temperatures include wind chill, frostbite, and hypothermia as discussed in the Hazard Profile introduction. Health hazards related to extreme high temperatures include heat exhaustion and heat stroke as discussed in the Hazard Profile introduction.

Table 4.3.5-10 outlines the effects of prolonged exposure to direct sunlight on the human body during extreme heat events.

Table 4.3.5-10. Adverse Effects of Prolonged Exposure to Direct Sunlight

Category	Heat Index	Effects on the Body
Caution	80°F - 90°F	Fatigue is possible with prolonged exposure and/or physical activity
Extreme Caution	90°F - 103°F	Heat stroke, heat cramps, or heat exhaustion is possible with prolonged exposure and/or physical activity
Danger	103°F - 124°F	Heat cramps or heat exhaustion is likely, and heat stroke is possible with prolonged exposure and/or physical activity
Extreme Danger	125°F or higher	Heat stroke is highly likely

Source: (NWS 2023)

Socially Vulnerable Populations

According to the Centers for Disease Control and Prevention (CDC), those most at risk of extreme cold and heat events include the following populations:

- The elderly, who are less able to withstand temperature extremes due to their age, health conditions, and limited mobility to access shelters
- Infants and children up to four years of age, who are less able to withstand temperature extremes due to their age and reliance on parental guardians.
- Individuals with chronic medical conditions (e.g., heart disease, high blood pressure), who are less able to withstand temperature extremes due to their health conditions.

- Low-income persons who cannot afford proper heating and cooling, and who are less able to withstand temperature extremes due to limited access to cooling/heating devices.
- Anyone who overexerts during work or exercise during extreme heat events (CDC 2022, CDC 2005).

According to the 2017-2021 American Community Survey, there are 37,752 persons over the age of 65, 10,142 persons under the age of five, 3,165 non-English speakers, 30,857 persons with a disability, and 35,372 living in poverty (refer to Table 4.3.5-11).

Figure 4.3.5-7 displays the FEMA National Risk Inventory's Social Vulnerability Index for the County of Broome, which is identified as "relatively high."

Table 4.3.5-11. Broome County Socially Vulnerable Populations by Municipality

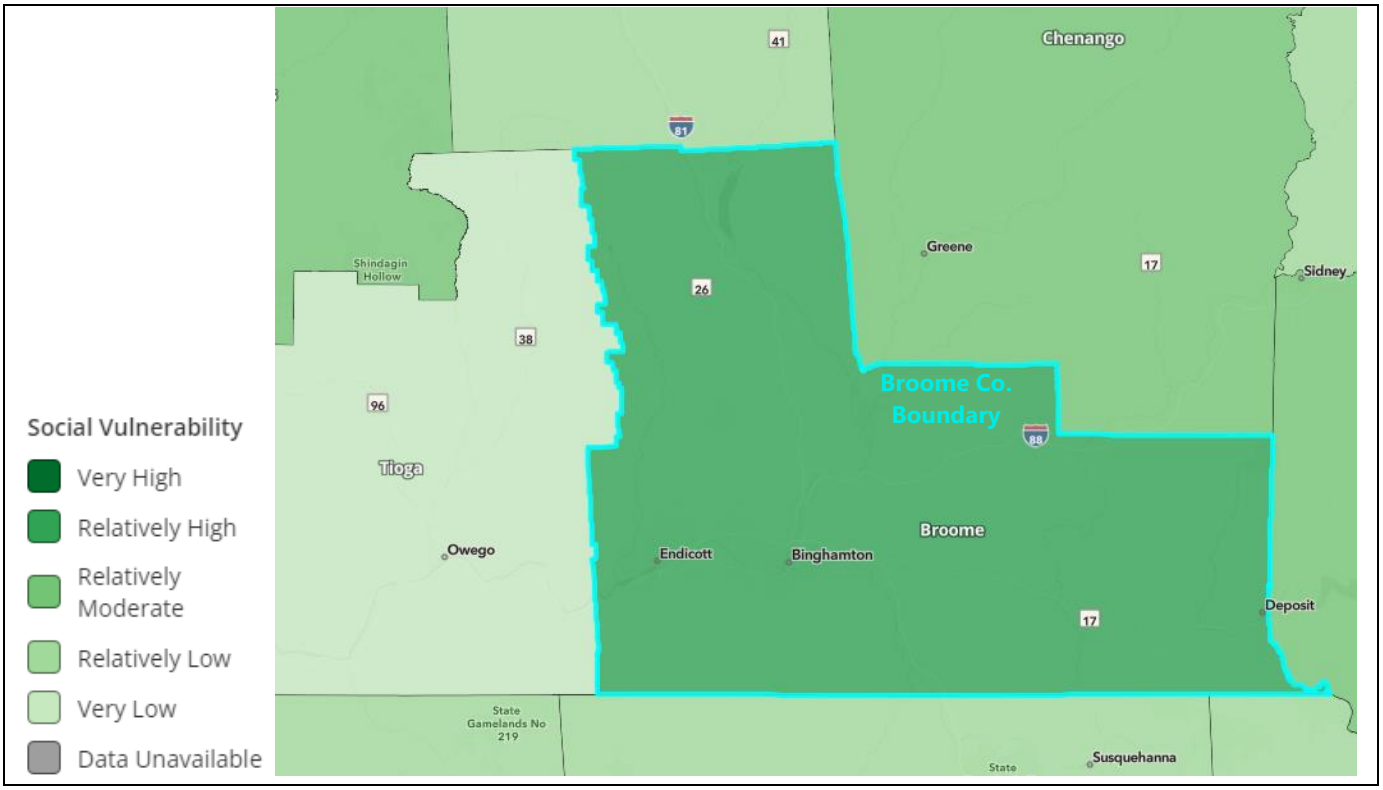
Jurisdiction	American Community Survey 5-Year Population Estimates (2021)									
	Over 65	Percent of Jurisdiction Total	Under 5	Percent of Jurisdiction Total	Non-English Speaking	Percent of Jurisdiction Total	Disability	Percent of Jurisdiction Total	Poverty Level	Percent of Jurisdiction Total
Barker (T)	465	18.5%	142	5.7%	49	2.0%	342	13.6%	537	21.4%
Binghamton (C)	7,642	15.9%	2,588	5.4%	1,051	2.2%	9,632	20.1%	14,894	31.0%
Binghamton (T)	822	17.8%	206	4.5%	5	0.1%	710	15.4%	454	9.8%
Chenango (T)	2,236	20.4%	861	7.9%	37	0.3%	1,359	12.4%	1,292	11.8%
Colesville (T)	1,299	26.7%	161	3.3%	0	0.0%	812	16.7%	345	7.1%
Conklin (T)	1,116	22.3%	227	4.5%	182	3.6%	637	12.7%	584	11.7%
Deposit (V)*	110	15.3%	49	6.8%	0	0.0%	123	17.1%	153	21.2%
Dickinson (T)	829	24.4%	32	0.9%	63	1.9%	611	18.0%	345	10.1%
Endicott (V)*	2,337	17.1%	664	4.9%	107	0.8%	2,544	18.6%	3,535	25.9%
Fenton (T)	1,223	19.0%	518	8.1%	49	0.8%	828	12.9%	962	15.0%
Johnson City (V)*	2,864	18.7%	821	5.4%	356	2.3%	2,718	17.7%	2,938	19.1%
Kirkwood (T)	1,045	19.1%	116	2.1%	61	1.1%	736	13.4%	768	14.0%
Lisle (T)	373	15.9%	157	6.7%	0	0.0%	405	17.3%	207	8.8%
Lisle (V)*	48	13.8%	4	1.1%	0	0.0%	45	12.9%	23	6.6%
Maine (T)	1,141	22.1%	311	6.0%	0	0.0%	927	17.9%	873	16.9%
Nanticoke (T)	384	24.3%	68	4.3%	0	0.0%	265	16.8%	123	7.8%
Port Dickinson (V)*	235	13.8%	77	4.5%	26	1.5%	208	12.2%	223	13.1%
Sanford (T)	469	30.9%	27	1.8%	0	0.0%	243	16.0%	91	6.0%
Triangle (T)	300	16.2%	40	2.2%	0	0.0%	298	16.1%	251	13.6%
Union (T)	6,306	23.2%	1,300	4.8%	301	1.1%	3,358	12.4%	2,549	9.4%
Vestal (T)	5,068	17.3%	1,261	4.3%	876	3.0%	3,025	10.3%	3,318	11.3%
Whitney Point (V)*	221	23.0%	32	3.3%	0	0.0%	168	17.5%	340	35.4%
Windsor (T)	1,002	20.5%	452	9.2%	0	0.0%	713	14.6%	458	9.4%
Windsor (V)*	217	23.9%	28	3.1%	2	0.2%	150	16.5%	109	12.0%
Broome County (Total)	**37,752**	**19.0%**	**10,142**	**5.1%**	**3,165**	**1.6%**	**30,857**	**15.5%**	**35,372**	**17.8%**

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

Note: Persons per household = 2.33; Number used to calculate Non-English Speaking population.

* *The following villages are contained with towns; the population totals were adjusted based on the average population based on the count of residential structures from the general building stock data. Deposit (V) is 52% within Sanford (T); Endicott (V) & Johnson City (V) are 100% within Union (T); Lisle (V) is 100% within Lisle (T); Port Dickinson (V) is 100% within Dickinson (T); Whitney Point (V) is 100% within Triangle (T); Windsor (V) is 100% within Windsor (T).*

Figure 4.3.5-7. FEMA Social Vulnerability Index for Natural Hazards



Source: (FEMA 2019)

The following are key points regarding the vulnerability of specific socially vulnerable populations:

- **Low-Income Populations—**Residents with low incomes might have inconsistent access to housing or their housing can be of lesser quality, making it unable to withstand extreme hot or cold temperatures (e.g., homes with poor insulation and heating). Poor housing conditions, lack of adequate temperature control, and inability to locate cooler/warmer shelters make low-income populations particularly vulnerable to extreme heat and cold and its associated health risks. According to the U.S. Census Bureau's American Housing Survey, about 9 percent of American households lack air conditioning (US Census Bureau 2021). This may result in 9 percent of American's left vulnerable and seeking cooling shelters at times of extreme heat events. Many individuals and families that are low-income and which reside in urban centers are also susceptible to the urban heat island effect. These development patterns [re: less tree canopy, more pavement] result in localized pockets of higher temperature compared to the surrounding areas that are less urbanized. As a result, daytime temperatures are higher, and nighttime cooling is reduced, which contributes to the prevalence of heat-related illnesses in these areas (National Geographic 2023). The City of Binghamton has the greatest population of individuals living in poverty (14,894).
- **Infants and Children—**Infants and children under the age of four are more susceptible to the effects of extreme high and low temperatures. Children often spend a significant amount of time

outside recreationally and are not equipped to independently regulate their activity levels or understand when to rest or seek out hydration and cooling. Their body temperature rises three to five times faster than an adult, and they absorb heat faster due to their increased surface area relative to their mass (Columbia University 2023). The City of Binghamton has the highest population under the age of 5 (2,588).

- **Older Adults—**Adults over the age of 65 are more likely than other subsets of the population to have pre-existing medical conditions and/or take specific medications that can affect their body's ability to control temperature, which can lower their threshold to tolerate heat and cold. Older adults are also more likely to be more socially isolated due to physical disability, lack of transportation, and other factors attributed to age, including dependence on durable medical equipment (AARP 2022). In Broome County, each municipality has areas of high concentration of elderly population, with higher concentrations in the more urban, densely populated areas of the County. The City of Binghamton has the highest population over 65 (7,642).
- **People with Chronic Pre-Existing Health Issues—**Some types of illness can increase an individual's susceptibility to heat or cold-related illness, including but not limited to respiratory disease, cardiovascular disease, mental illness, obesity, and diabetes. Many chronic conditions require medication for treatment, and many of these can cause dysregulation of body temperature that lessens the body's ability to tolerate extreme high or low temperatures (CDC 2017). The City of Binghamton has the largest disabled population in the County (9,632).
- **Those Who Are Pregnant and Breastfeeding—**Pregnancy and breastfeeding cause significant strain on the body. The parent is sharing a blood supply and any water intake with the fetus or baby, and this greatly increases the risk of dehydration or heat exhaustion if the body is not allowed time to cool and hydrate. Overheating during pregnancy can harm a fetus and result in slow growth and premature birth (CDC 2022). Additionally, according to the National Institutes of Health (NIH), exposure to extreme cold during pregnancy can increase the risk of premature birth (occurring before 37 weeks of pregnancy) and increases the likelihood of health issues (NIH 2016).
- **Workers—**Many occupations require work in all types of inclement weather, with extreme heat or cold being one that impacts workers both indoors and outdoors. From construction and agricultural workers to bakers and warehouse managers, heat or cold-related illness while on the job can be attributed to several factors outside of the existing environmental conditions, including wearing of any protective or safety gear and lack of efficient warming/cooling (OSHA 2023).
- **Athletes and People Playing Sports—**Intense exercise causes a rapid rise in body temperature, which is greatly exacerbated by high environmental temperatures. Many activities also require specific equipment or protective gear, such as helmets and pads, which can be heavy and retain a significant amount of heat and moisture that will accelerate the speed at which heat exhaustion may occur (Academy of Nutrition and Dietetics 2022).

Impact on General Building Stock

All the building stock in the County is exposed to the extreme temperature hazard. 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 temperatures can damage buildings through freezing and bursting of 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

Like 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 on critical facilities are the same as were described for the general building stock. Additionally, critical facilities must remain operational during natural hazard events. Extreme heat events can sometimes cause short periods of utility failures, commonly referred to as "brownouts," created by increased usage of air conditioners, appliances, and similar equipment. 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. Designating and developing emergency cooling or heating facilities can also enhance the resilience and safety of communities.

Impact on the Economy

Extreme temperature events can affect the economy, including loss of business function, damage/loss of inventory, and limited travel for consumers. 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. Additionally, extreme cold can freeze and ruin crop production.

Impact on the Environment

Extreme temperatures 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.

Cascading Impacts on Other Hazards

Extreme high-temperature events can exacerbate the drought hazard, increase the potential risk of wildfires, and escalate severe storm events for the County. For example, extreme heat events may accelerate evaporation rates, drying out the air and soils. Extreme heat can also dry out vegetation, making them more susceptible to catching fire. Extreme variation in temperatures could create ideal atmospheric conditions for severe storms or worsen the outcome of severe winter weather during freezing and thawing periods. Refer to Section 4.3.8 (Severe Storm), Section 4.3.9 (Severe Winter Storm), and Section 4.3.10 (Wildfire) for more information about these hazards of concern.

Future Changes That May Impact Vulnerability

Understanding future changes that affect vulnerability can assist in planning for future development and ensure the establishment of appropriate mitigation, planning, and preparedness measures.

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 or on the hazard maps included in the jurisdictional annexes in Volume II of this plan.

Projected Changes in Population

Broome County has experienced a decrease in its population since 2010. Cornell University's Program on Applied Demographics projects that Broome County will have a population of 186,950 by 2030 and 183,176 by 2040 (Cornell University 2018). Refer to Section 3 (County Profile) for a detailed discussion on population changes.

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

Climate Change

As discussed in Climate Change Impacts, most studies project that the State of New York will see an increase in average annual temperatures and precipitation. As the climate warms, extreme cold events might decrease in frequency, while extreme heat events might increase in frequency; the shift in temperatures could also result in hotter extreme heat events. With increased temperatures, vulnerable

populations could face increased vulnerability to extreme heat and its 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 2019 HMP

Overall, the entire County remains vulnerable to extreme temperatures. As existing development and infrastructure continue to age, they can be at increased risk from failed utility systems (e.g., HVAC) if they are not properly maintained. Similarly, an increase in the elderly population remaining in the County increases the vulnerable population (Broome County 2019).

SECTION 4. RISK ASSESSMENT

4.3 HAZARD PROFILE

4.3.6 Flood

This 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 flood in Broome County.

Hazard Profile

Hazard Description

A flood is an overflow of water from oceans, rivers, groundwater, or rainfall that submerges areas that are usually dry. This natural phenomenon can be exacerbated by features of the built environment.

Flood is a natural hazard that can occur during any season. Flooding typically occurs during prolonged rainfalls over several days, intense rainfalls over a short period of time, or when an ice or debris jam causes a river or stream to overflow onto the surrounding area. The most common cause of flooding is rain or snowmelt which accumulates faster than soils can absorb it, or rivers can carry it away. Flooding can also result from the failure of a water control structure (NWS 2019).

Flooding events are a common occurrence in Broome County and are the most frequently occurring hazard in the United States (DHS 2022). A variety of flood types, such as riverine, flash flooding, stormwater, urban, and ice jam flooding can cause widespread damage throughout rural and urban areas, causing loss of life, injury, and severe water damage to residential and commercial buildings, bridge and road closures, transit services, electrical and communication networks, and agriculture.

Floodplains

Floods are one of the most frequent and costly natural hazards in terms of human hardship and economic loss, particularly to communities in the floodplains of a major water source. A floodplain is a flat land adjacent to a river, creek, or stream that is subject to periodic inundation when floodwater exceeds the capacity of the main channel, or water escapes the channel through bank erosion. It is an integral part of a stream system that collects fresh water from the land and carries it to the ocean.

The floodplain is affected by adjustments the system makes to its sediment load and variable flow. During inundation, silt is deposited by retreating floodwater and trapped by vegetation, building up the floodplain. The buildup is greatest near the stream, forming natural levees in areas of stable banks. Floodplain deposits, which are coarsest near the stream, may show vertical size-graded stratification (sorting). Floodplain deposits and floodplain development affect a larger natural structure than might first be appreciated (National Geographic 2022).

Floodplains serve multiple functions. They moderate flooding, maintain water quality, recharge groundwater, reduce erosion, redistribute sand and sediment, and support fish and wildlife habitats.

The boundaries of the floodplains are affected by 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. One measurement of a floodplain is the area inundated by the "100-year" flood, or a flood that has a 1 percent chance in any given year of being equaled or exceeded.

Flooding Types

Flooding is a general and temporary condition of partial or complete inundation on normally dry land. It includes the following:

- Riverine overbank flooding
- Flash floods
- Alluvial fan floods
- Mudflows or debris floods
- Dam- and levee-break floods
- Local drainage backups
- High groundwater flooding
- Flooding from fluctuating lake levels
- Ice jam flooding
- Coastal flooding (NWS 2019)

The Steering Committee for this HMP identified riverine, flash, shallow, and ice jam flooding as the main flood types of concern for Broome County. These types of flooding are further discussed below.

Riverine Flooding

Riverine flooding is when the flow in streams and rivers exceeds the capacity of their natural or constructed channels and water overflows the banks, spilling out into adjacent low-lying, dry land (FEMA 2019).

Flash Flooding

A flash flood is a rapid inundation of low-lying areas caused by heavy rain associated with severe thunderstorms, tropical systems, or melting water from ice or snow. Flash flooding also occurs far away from water bodies when a large volume of water cannot be absorbed by the soil or stormwater systems and travels overland unimpeded (NWS 2019). The National Weather Service defines a flash flood as follows (NWS 2015):

A flood is caused by heavy or excessive rainfall 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 river beds, 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.

Shallow Flooding

Shallow stormwater flooding is caused by local drainage issues and high groundwater levels. Locally, heavy precipitation may produce flooding in areas other than delineated floodplains or along recognizable channels. If local conditions cannot accommodate intense precipitation through a combination of infiltration and surface runoff, water may accumulate and cause flooding problems. During winter and spring, frozen ground and snow accumulations may contribute to inadequate drainage and localized ponding. Flooding 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 (NOAA 2022). Shallow street flooding can occur unless channels have been improved to account for increased flows (FEMA 2006).

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

Urban flooding is the inundation of property in a built environment caused by rain falling on increased amounts of impervious surfaces and overwhelming the capacity of drainage systems. It occurs when stormwater enters buildings through windows, doors, or other openings, pipes and drains back up, or seepage occurs through walls and floors. It includes sewer water backing up into homes, water seeping through foundation walls, clogged street drains, and overflow from sound walls, roads, or other barriers that restrict stormwater runoff. This definition excludes flooding in undeveloped or agricultural areas (University of Maryland and Texas A&M University 2018).

Combined sewer overflows are discharges from a combined sewer system caused by snowmelt or stormwater runoff. Combined sewers are sewer systems that collect stormwater runoff, domestic sewage, and industrial wastewater in the same pipe and bring it to a wastewater treatment facility (USEPA 2023).

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, such as river bends, mouths of tributaries, points where the river slope decreases, dams, and bridges. The water held back by the accumulated ice can cause flooding upstream, and if the jam suddenly breaks, flash flooding can occur as well (NOAA 2023). Ice jam flooding can be unpredictable; it can take several hours from the time an ice jam forms to the start of flooding – or as little as one hour (The Hartford 2016). The ice carried within the flow of a stream or river can very quickly back up the flow of water and cause a flood (Niziol 2020).

The formation of ice jams depends on the weather and physical condition of the river and stream channels. Ice jams are common in locations where the channel slope changes from relatively steep to

mild and where a tributary stream enters a large river. Ice jams and resulting floods can occur during different times of 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).

There are two main types of ice jams: freeze-up and breakup. Freeze-up jams occur when floating ice may slow or stop due to a change in water slope as it reaches an obstruction to movement. Breakup jams occur during periods of thaw, generally in late winter and early spring. The ice cover breakup is usually associated with a rapid increase in runoff and corresponding river flow due to heavy rainfall, snowmelt, or warmer temperatures (FEMA 2018).

Location

Areas subject to flooding include the following (National Geographic 2022) (FEMA 2022):

- Locations that experience greater than the 1-percent annual chance of flood
- Those subject to less extensive, more frequent, or repetitive flooding
- Sites that experience shallow flooding, stormwater flooding, or drainage problems that do not meet National Flood Insurance Program (NFIP) mapping criteria (20 percent of flood insurance claims are from properties in these areas)
- Places affected by flood-related hazards such as riverine erosion

Riverine Flooding

Flooding in Broome County occurs primarily along the bodies of water that flow through it, including the Otselic River, Tioughnioga River, Chenango River, Delaware River (West Branch), Nanticoke Creek, Susquehanna River, Oquga Creek, Trout Brook, Still Creek, Brandywine Creek, Little Choconut Creek, Patterson Creek, Brixius Creek, Denton Creek, Ballyhook Creek, Honey Hollow Creek, and Horton Creek. The Susquehanna River is the largest river that flows through the County, and municipalities along the river are known to sustain extensive damage during flood events. According to the New York State HMP, the Susquehanna River Basin experiences severe riverine flooding.

Locations of flood zones in Broome County as depicted on the most current FEMA preliminary Digital Flood Insurance Rate Map (DFIRM) are illustrated in Figure 4.3.6-1. Preliminary FEMA maps are newer flood maps that are not used for regulatory purposes until they have been officially adopted and made effective. The effective FIRM is the regulatory product used to determine which properties are subject to the NFIP. Figure 4.3.6-2 shows the regulatory flood hazard areas inn Broome County. To leverage the most recently available data, the HMP uses the preliminary DFIRM for the flood analyses in the risk assessment.

The total land area in the floodplain, exclusive of water bodies, is summarized in Table 4.3.6-1. Maps of floodplains in each jurisdiction are included in Volume II. Flood hazard zones occur throughout the county, with the largest areas along the Susquehanna River.

Figure 4.3.6-1. Flood Hazard Area in Broome County

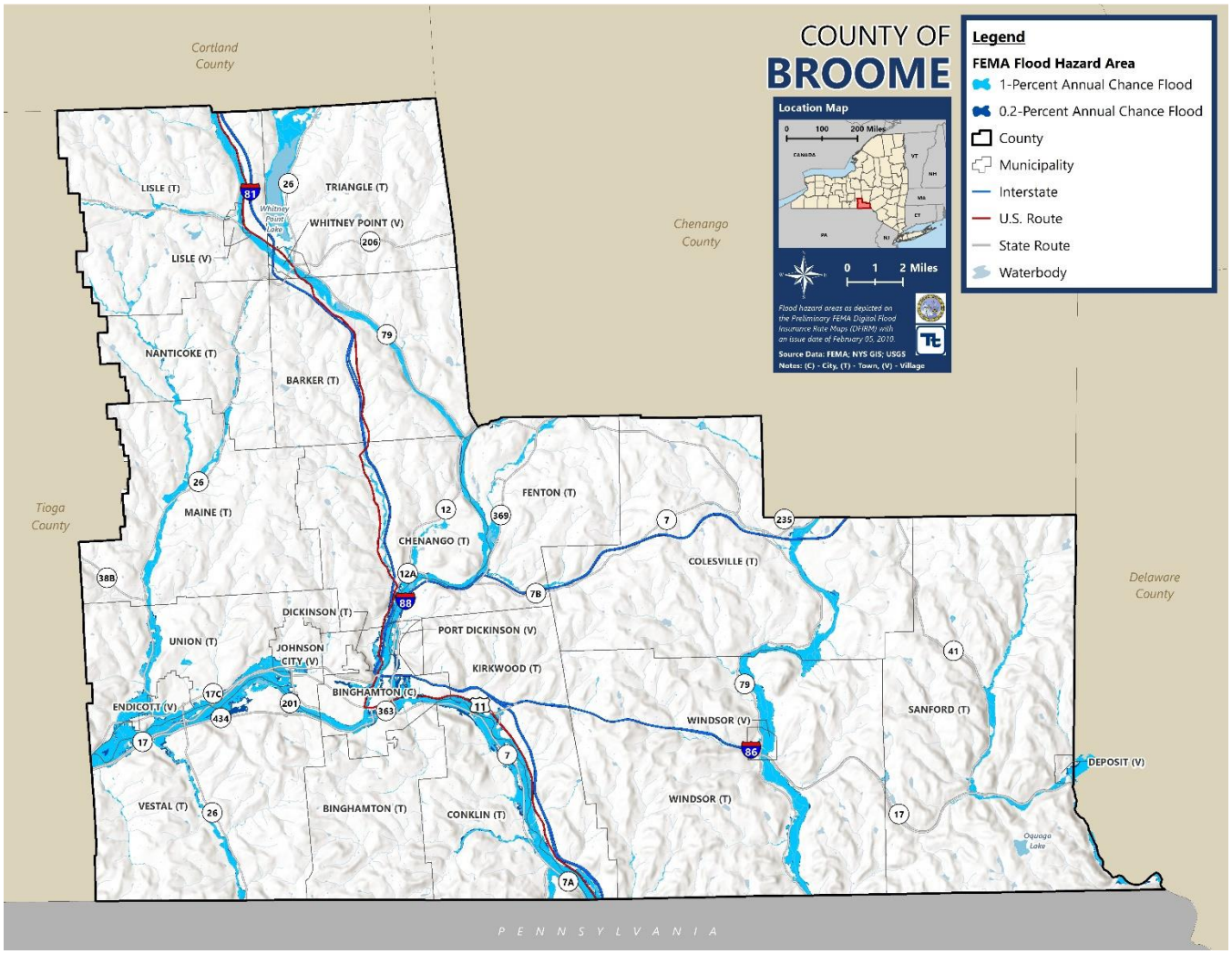


Figure 4.3.6-2. Effective Flood Insurance Rate Map in Broome County

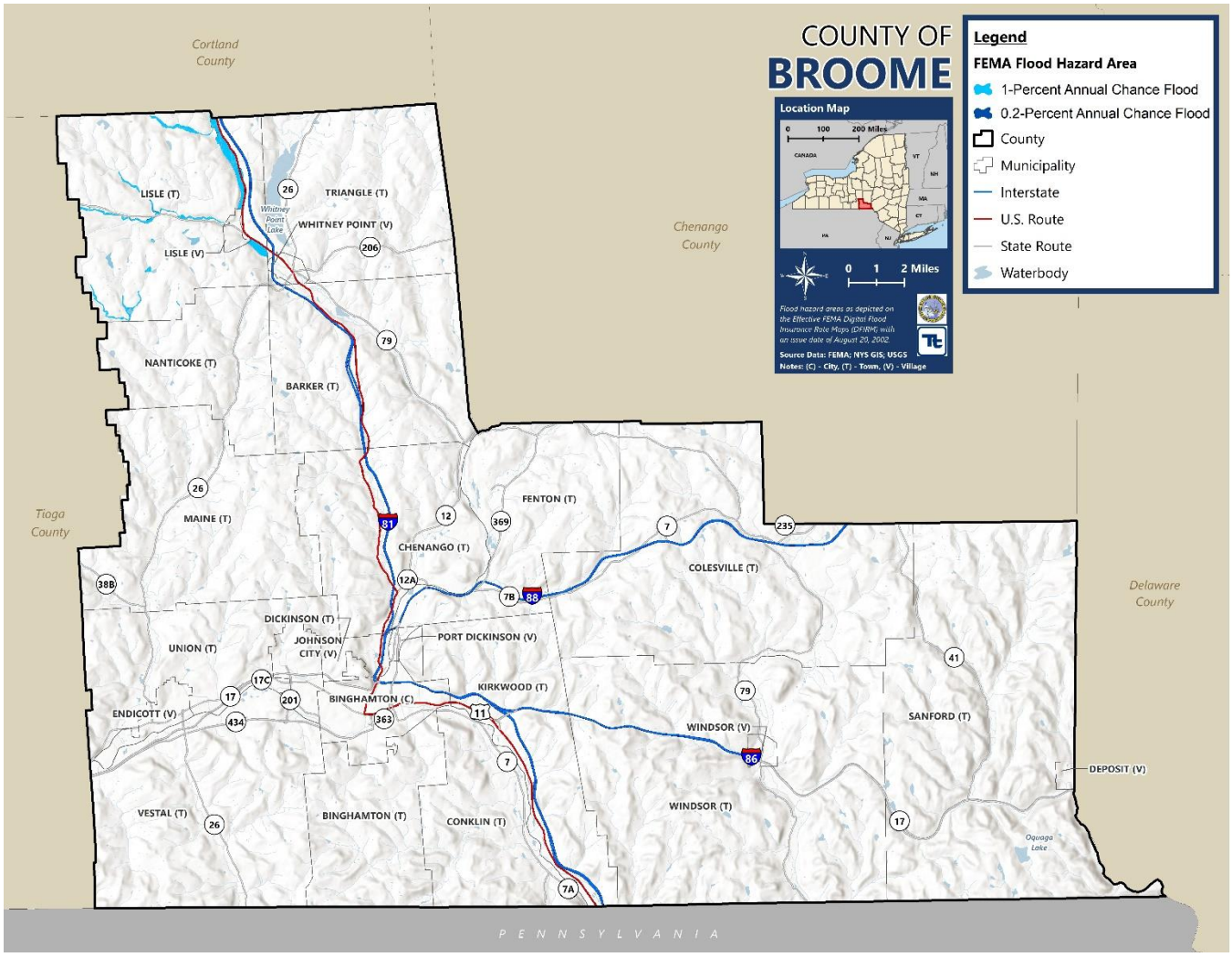


Table 4.3.6-1. Total Land Area in the 1-percent and 0.2-percent Annual Chance Flood Zones

Municipality	Total Area (acres)	1% Flood Event Hazard Area		0.2% Flood Event Hazard Area	
		Area (acres)	Percent of Total	Area (acres)	Percent of Total
Barker (T)	26,496	1,079	4.1%	1,084	4.1%
Binghamton (C)	7,071	1,340	19.0%	1,729	24.5%
Binghamton (T)	16,026	38	0.2%	40	0.2%
Chenango (T)	21,824	1,175	5.4%	1,325	6.1%
Colesville (T)	50,402	1,431	2.8%	1,502	3.0%
Conklin (T)	15,736	1,791	11.4%	2,107	13.4%
Deposit (V)	423	72	17.0%	88	20.8%
Dickinson (T)	2,751	302	11.0%	358	13.0%
Endicott (V)	2,172	882	40.6%	1,019	46.9%
Fenton (T)	21,016	1,225	5.8%	1,337	6.4%
Johnson City (V)	2,966	364	12.3%	437	14.7%
Kirkwood (T)	19,809	1,233	6.2%	1,365	6.9%
Lisle (T)	29,234	1,181	4.0%	1,212	4.1%
Lisle (V)	544	93	17.1%	93	17.1%
Maine (T)	28,801	1,064	3.7%	1,065	3.7%
Nanticoke (T)	15,432	458	3.0%	539	3.5%
Port Dickinson (V)	404	115	28.5%	152	37.6%
Sanford (T)	57,382	1,230	2.1%	1,293	2.3%
Triangle (T)	23,468	1,019	4.3%	1,019	4.3%
Union (T)	17,961	1,847	10.3%	2,027	11.3%
Vestal (T)	33,450	2,202	6.6%	2,590	7.7%
Whitney Point (V)	731	259	35.4%	259	35.4%
Windsor (T)	58,137	2,279	3.9%	2,371	4.1%
Windsor (V)	727	277	38.1%	286	39.3%
Broome County	**452,963**	**22,956**	**5.1%**	**25,297**	**5.6%**

Sources: Broome County 2023; USGS; FEMA 2010

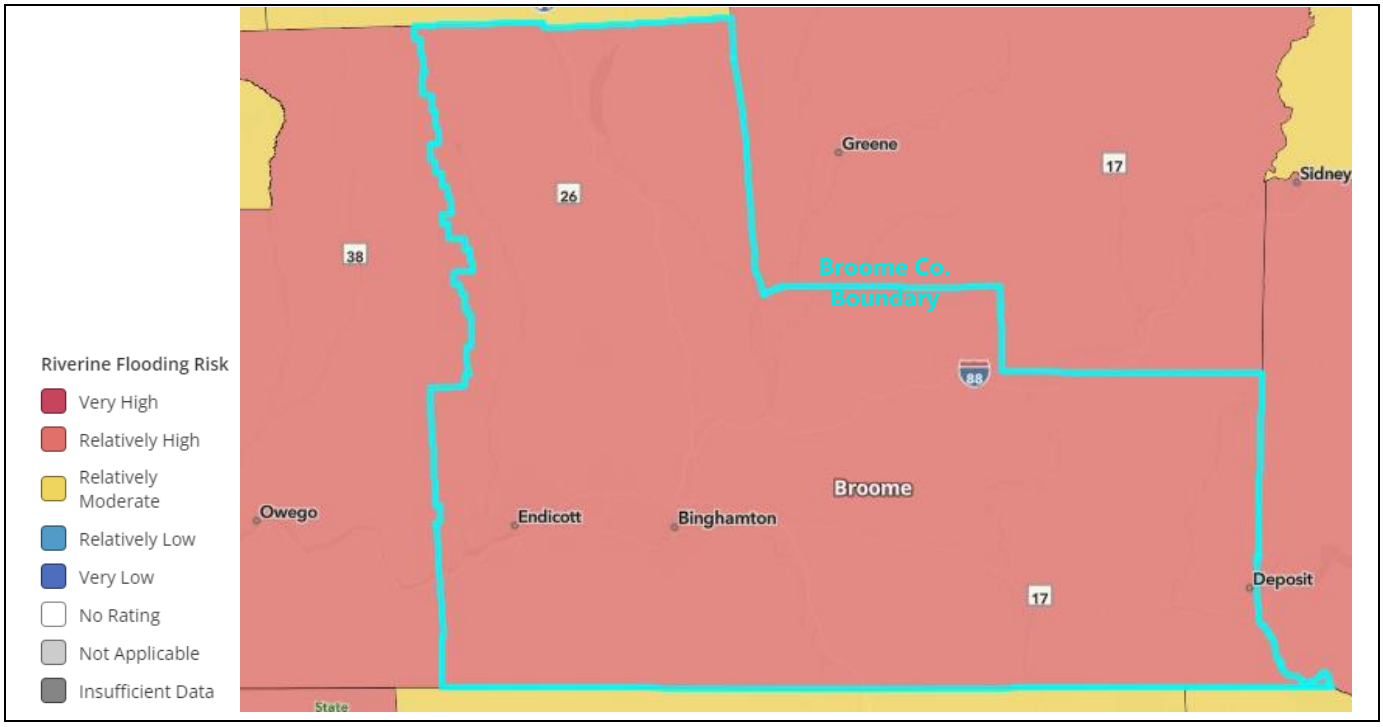
Note: Excludes areas designated as water. Values are rounded to the nearest whole value.

The DFIRM data provided by FEMA for Broome County show the following flood hazard areas:

- 1-Percent Annual Chance Flood Hazard—Areas subject to inundation by the 1-percent-annual-chance flood event. This includes Zone A, Zone AE, and Zone A. Mandatory flood insurance requirements and floodplain management standards apply. Base flood elevations are provided in Zone AE. Zone AO has associated flood depths derived from detailed hydraulic analyses. Zone A has no determined flood depths.
- 0.2-Percent Annual Chance Flood Hazard—Area of minimal flood hazard, usually depicted on FIRMs as the 500-year flood level or Shaded X Zone.

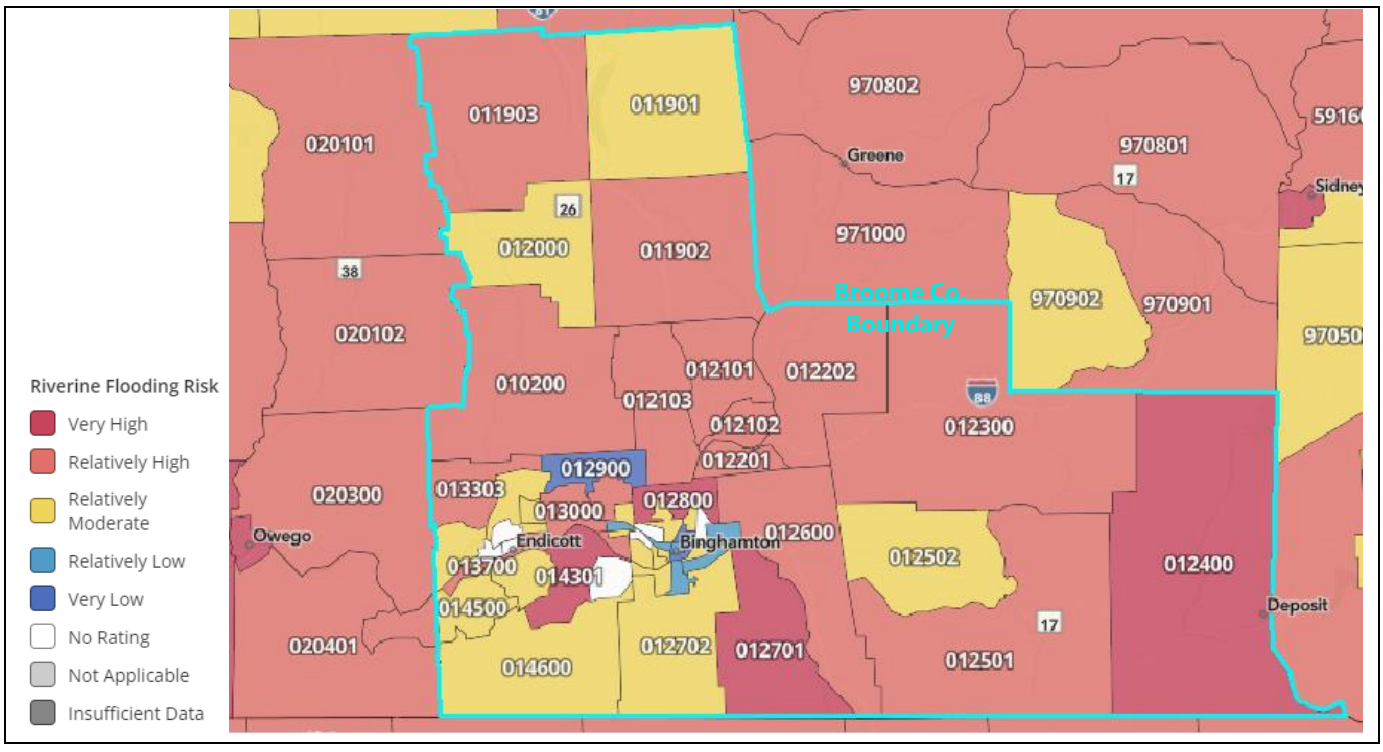
Figure 4.3.6-3 and Figure 4.3.6-4 show the Riverine Flooding Risk Index for Broome County on the county and census tract scales, respectively. This index indicates the susceptibility of the County to riverine flooding. According to the National Risk Index, on the county scale, the County has a relatively high risk of riverine flooding; on the census tract scale, although portions of the County have no rating, most census tracks range from a very low risk to a very high risk (FEMA 2019).

Figure 4.3.6-3. Riverine Flooding National Risk Index Score Using the County Scale



Source: FEMA 2023

Figure 4.3.6-4. Riverine Flooding National Risk Index Score Using the Census Tract Scale



Source: FEMA 2023

Flash Flooding

Flash flooding also occurs primarily along the bodies of water that flow through the County, which includes the Otselic River, Tioughnioga River, Chenango River, Delaware River (West Branch), Nanticoke Creek, Susquehanna River, Oquga Creek, Trout Brook, Still Creek, Brandywine Creek, Little Choconut Creek, Patterson Creek, Brixius Creek, Denton Creek, Ballyhook Creek, Honey Hollow Creek, and Horton Creek. Severe thunderstorms and periods of heavy rainfall can lead to flash floods if these local bodies of water reach and/or surpass their capacity (NWS 2014).

Shallow Flooding

Urbanization increases runoff to amounts two to six times what would occur on natural terrain. During periods of urban flooding, streets can become swift-moving rivers. This type of flooding occurs in the urbanized municipalities of Broome County, such as the City of Binghamton, and particularly in areas with impermeable surfaces, which cause the ground to lose its ability to absorb rainfall (NWS 2014).

Much of the area where urban flooding occurs is not within the 1 percent annual chance floodplain shown in Figure 4.3.6-1. Nationwide, approximately 25 percent of all NFIP claims are submitted by policyholders whose property is outside of the FEMA-defined 1 percent annual chance floodplain, according to a 2018 report by the University of Maryland and Texas A&M University (University of Maryland and Texas A&M University 2018).

Ice Jam Flooding

Ice jam flooding occurs on a body of water, which for Broome County includes the Otselic River, Tioughnioga River, Chenango River, Delaware River (West Branch), Nanticoke Creek, Susquehanna River, Oquga Creek, Trout Brook, Still Creek, Brandywine Creek, Little Choconut Creek, Patterson Creek, Brixius Creek, Denton Creek, Ballyhook Creek, Honey Hollow Creek, and Horton Creek.

Ice jams have formed along the Susquehanna River in Vestal (2002, 2017), Windsor (2011, 1996), Conklin (2009, 1996, 1994, 1992, 979, 1945, 1944, 1943, 1920, 1918), and Binghamton (1945, 1904), the Chenango River in Chenango (2009), Binghamton (2005, 1945) and Dickinson (2005), and the Occanum Creek in Windsor (2018), the Oquaga Creek in Deposit (1957, 1955), and the Tioughnioga River in Lisle (1996).

Extent

Broome County's topographic, climatological, and meteorological features create an environment conducive to year-round flooding. Warm-weather flooding is caused by severe thunderstorms bringing heavy rainfall that leads to flash floods and riverine or overbank flooding. In cold weather, fast-melting snow overwhelms waterways. Bank erosion and sediment deposits exacerbate flooding by blocking and re-directing the natural flow of waterways. Broome County is usually not directly affected by hurricanes or tropical storms; however, the severe storms associated with these systems can result in additional flooding.

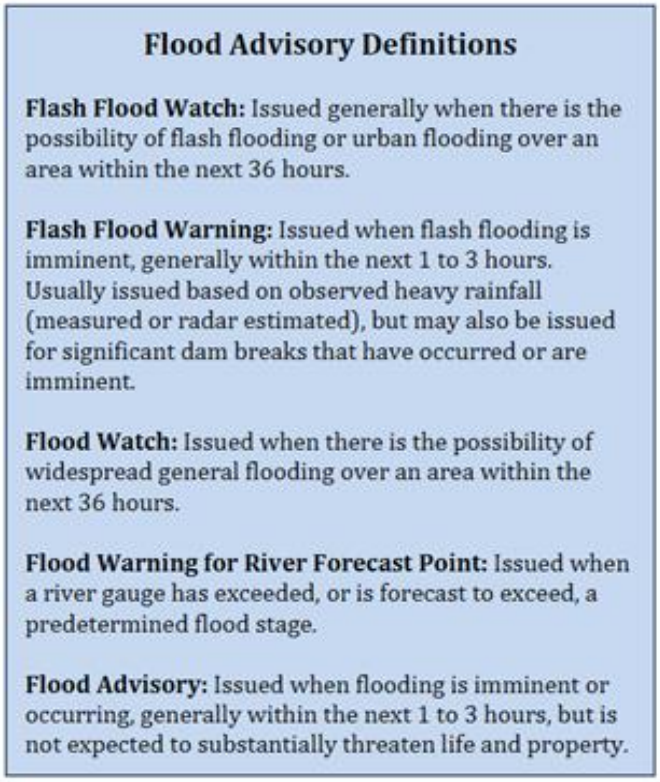
The strength or magnitude of a flood varies based on meteorological, environmental, and geological factors, including latitude, altitude, topography, and atmospheric conditions. Flood severity is also affected by seasonal variation, storm characteristics, warning time, speed of onset, and duration. A flood may last from minutes to days (O'Connor, Grant and Costa 2002). The exact flood location and depth depend on the amount, duration, and location of rainfall.

Most floods are preceded by a warning period that allows emergency managers to communicate the need to prepare for the event (see **Error! R eference source not found.**). Warnings issued through official sources, such as the National Weather Service (NWS) and the Storm Prediction Center, provide the most reliable and timely preparedness information.

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, 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).

Figure 4.3.6-4. Flood Advisory Definitions



Source: NWS 2018

USGS uses stream gages to determine the severity of flood at different points along a body of water. There are nine total gages in Broome County along the Susquehanna, Tioughnioga, and Chenango Rivers. The flood stage is identified at each gage. Broome County and its municipalities rely on these gages to determine the height of the rivers during heavy rain events and to determine whether residents need to evacuate. Table 4.3.6-2 lists the eight gages in the County with the established flood stage and record flood events. Figure 4.3.6-5 displays the locations of the nine stream gages in Broome County. The USGS website provides details about each gage and the gage heights of flooding events (https://waterwatch.usgs.gov/index.php). The NWS provides the flood stages for the gages (https://water.weather.gov/ahps/).

Table 4.3.6-2. Stream Gage Statistics for Broome County

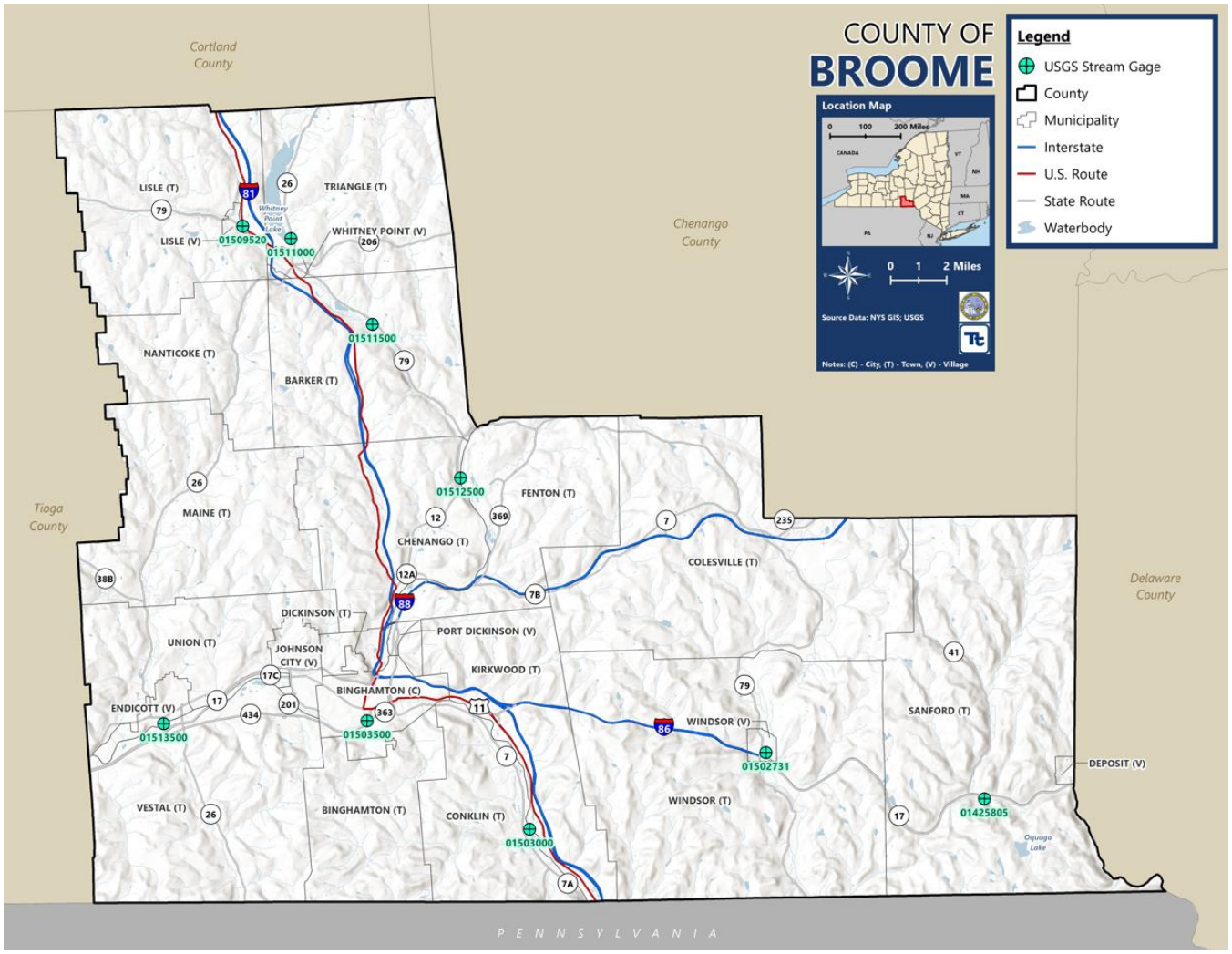
Gage Site Number	Site Name	Action Stage (feet)	Minor Flood Stage (feet)	Moderate Flood Stage (feet)	Major Flood Stage (feet)	Record Flood
1502731	Susquehanna River at Windsor NY	13.0	17.0	19.0	20.5	24.27 feet on June 29, 2006
1503000	Susquehanna River at Conklin NY	10.0	12.0	15.0	20.0	25.02 feet on June 28, 2006
1503500	Susquehanna River at Binghamton NY	12.0	14.0	15.0	18.0	25.73 feet on September 8, 2011
1513500	Susquehanna River at Vestal NY	15.0	18.0	21.0	27.0	35.26 feet on September 8, 2011
1509520	Tioughnioga River at Lisle NY	5.0	9.0	12.0	18.0	10.38 feet on April 2, 2005
1511500	Tioughnioga River at Itaska NY	5.0	7.0	8.0	10.0	16.61 feet on July 8, 1935
1511000	Whitney Point Lake at Whitney Point NY	1,009.0	1,010.0	N/A	N/A	986.18 feet* on May 03, 2023
1512500	Chenango River near Chenango Forks NY	8.0	10.0	12.6	14	20.3 feet on July 8, 1935
1425805	Oquaga Creek at McClure NY	N/A	N/A	N/A	N/A	N/A

Sources: NOAA 2023; USGS 2023

Note: N/A = Not Available

**Recent maximum stage (within the past 365 days)*

Figure 4.3.6-5. Stream Gage Locations in Broome County



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, the 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 (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 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. The water elevation resulting from a given discharge level is one of the most important factors used in estimating flood damage. A structure located within an 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 annual chance 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 X on FIRMs. Flood elevations and depths are not shown for this zone, and insurance purchase is not required in this zone (FEMA 2022).

Previous Occurrences and Losses

This section presents the best available information on previous flood occurrences, impacts, and monetary losses in Broome County. Where multiple information sources were available, the results presented here were judged to be the most accurate and dependable. Citations are provided for each information source used.

FEMA Major Disasters and Emergency Declarations

Between 1953 and 2023, Broome County was included in disaster (DR) or emergency (EM) declarations for flood-related events as listed in Table 4.3.6-3. Generally, these disasters cover a wide region of the state; therefore, they can impact many counties. However, FEMA did not include all counties in the disaster declarations (FEMA 2023).

Table 4.3.6-3. FEMA Flood Disaster Declarations in Broome County (1953 to 2023)

Date of Event	Event Type	FEMA Declaration Number	Broome County Included in Declaration?	Description
July 22, 1970	Flood	DR-290-NY	Yes	Heavy Rains, Flooding
June 23, 1972	Flood	DR-338-NY	Yes	Tropical Storm Agnes
October 2, 1975	Flood	DR-487-NY	Yes	Severe Storms, Heavy Rain, Landslides, Flooding
July 21, 1976	Flood	DR-515-NY	Yes	Severe Storms, Flooding
January 19-30, 1996	Flood	DR-1095-NY	Yes	Severe Storms, Flooding
April 26-May 8, 2011	Flood	DR-1993-NY	Yes	Severe Storms, Flooding, Tornadoes, and Straight-line Winds
June 26-July 10, 2013	Flood	DR-4129-NY	Yes	Severe Storms, Flooding
August 13-15, 2018	Flood	DR-4397-NY	Yes	Severe Storms, Flooding

Source: FEMA 2023

U.S. Department of Agriculture Disaster Declarations

The Secretary of 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 contiguous counties. Table 4.3.6-4 lists designations for Broome County, which was included in two flood-related agricultural disaster declarations between 2012 and 2023.

Table 4.3.6-4. Flood Events in Broome County (2012 to 2022)

Date(s) of Event	Event Type	USDA Declaration Number	Broome County Included in Declaration?	Description
May 1 – July 14, 2015	Flood	S3885	Yes	Excessive Rain, High Winds, Hail, Lightning, and Tornado
July 21, 2018 – continuing	Flood	S4465	Yes	Excessive Rain, Flash Flooding, and Flooding
July 23, 2018 – continuing	Flood	S4479	Yes	Excessive Precipitation
July 21, 2018 – February 28, 2019	Flood	S4516	Yes	Excessive Rain, Flash Flooding, and Flooding

Source: USDA 2023

Previous Events

Known flood events that impacted Broome County between January 2018 and June 2023 are discussed below. For events prior to 2018, refer to the 2018 Broome County HMP. The Ice Jam Database, maintained by the Ice Engineering Group at the U.S. Army Corps of Engineers (USACE) Cold Regions Research and Engineering Laboratory currently consists of over 19,000 records from across the nation. According to the database, Broome County underwent or may have been impacted by 27 ice jam incidents between 1904 and 2022 (USACE 2022).

Table 4.3.6-5. Flood Events in Broome County (2018 to 2023)

Date of Event	Event Type	Declaration Number	County Designated?	Event Details
August 8, 2018	Flash Flood, Flood	—	No	Thunderstorms produced heavy rain during the late afternoon and evening. Several streets were flooded in Kirkwood and surrounding areas. Streams and creeks were out of their banks flooding Route 11 and surrounding areas. $25,000 in property damage was incurred from this event in Broome County.
August 13-15, 2018	Flash Flood, Flood	DR-4397	Yes	Heavy rainfall from slow-moving, severe storms resulted in severe flash flooding and major damage. Roadways were shut down, residents were trapped, and evacuations of homes took place. Local shelters were opened. $250,000 in property damage was incurred from this event in Broome County.
September 18, 2018	Flash Flood	—	No	Slow-moving, heavy rainfall contributed to several areas of flash flooding. Water was flowing over Route 79 and surrounding homes. Evacuation occurred in several locations. Route 26 was closed due to flooding near Glen Aubrey. $40,000 in property damage was incurred from this event in Broome County.

Date of Event	Event Type	Declaration Number	County Designated?	Event Details
October 31, 2019	Flash Flood	—	No	1 to 3 inches of rain fell throughout the region, with localized amounts in the 3- to 5-inch range. Some of this heavy rainfall fell in a short amount of time, producing several areas of flash flooding. Flash flooding was reported on multiple roadways. Park Creek flooded, significantly impacting a bridge; water was near the road deck of the bridge. $43,000 in property damage was incurred from this event in Broome County.
April 30, 2020	Flood	—	No	Heavy rainfall persisted for several hours, triggering rapid and enhanced flooding. Water was covering the roadway on Park Avenue near Carman Road and other locations. Choconut Creek flooded its banks sending water into the Vestal Center Park and other lowland areas. $4,000 in property damage was incurred from this event in Broome County.
August 11, 2020	Flash Flood	—	No	Scattered showers and thunderstorms produced excessive rainfall and areas of flash flooding. Flash flooding was occurring on multiple roadways, including Route 79. $35,000 in property damage was incurred from this event in Broome County.
December 24-25, 2020	Flash Flood, Flood	—	No	Warmer air and windy conditions rapidly melted a substantial snowpack of 20 to 30 inches in the region. This, coupled with heavy rainfall, contributed to rapid stream rises, resulting in major flash flooding. Roadways became impassable. Families were evacuated from nearby neighborhoods and a mobile home park on Route 26. $425,000 in property damage was incurred from this event in Broome County.
July 2, 2021	Flash Flood	—	No	Scattered thunderstorms produced torrential rainfall which led to flash flooding. Roberts and Pierce Creek Roads were flooded and covered with debris. Roads were impassable. Multiple creeks were over their banks. Several roads were flooded and washed out and became impassible. $60,000 in property damage was incurred from this event in Broome County.
July 11-12, 2021	Flash Flood	—	No	Severe thunderstorms with torrential rainfall produced areas of high-impact flash flooding in many parts of Broome County. Evacuations were taking place on the Chenango Bridge. Several roads were flooded and washed out. Vehicles were reported to be stuck in flowing water above the wheels. $660,000 in property damage was incurred from this event in Broome County.
July 17, 2021	Flash Flood	—	No	Locally heavy rainfall produced areas of flash flooding and related damage in the region. Flooding occurred on multiple local roadways and the Vestal Parkway. $15,000 in property damage was incurred from this event in Broome County.
July 20, 2021	Flash Flood	—	No	Slow-moving thunderstorms produced pockets of 1.5 to 3.5 inches of rain in a short amount of time during the early evening. Isolated areas of flash flooding resulted from torrential downpours. Flash flooding over several roads occurred. $10,000 in property damage was incurred from this event in Broome County.
October 26, 2021	Flash Flood, Flood	—	No	Moderate to heavy rainfall led to widespread flash flooding across the Southern Tier and Finger Lakes region. Oquaga and Nanticoke Creek were reported to be flooding onto roadways. State Route 26 was closed due to flash flooding. $41,000 in property damage was incurred from this event in Broome County.

Source: NOAA 2023

Probability of Future Hazard Events

For the 2024 HMP update, the 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 was used to identify the number of events that occurred between 1904 and 2023. Table 4.3.6-6 provides the calculated probability of future flood events in Broome County.

Table 4.3.6-6. Probability of Future Flood Events

Hazard Type	Number of Occurrences Between 1904 and 2022	% Chance of Occurring in Any Given Year
Flood	48	40%
Flash Flood	63	53%
Urban [a]	-	-
Ice Jam	27	22%
Total	**138**	**100**

Sources: NOAA 2023; USACE 2022; FEMA 2023

There is no official reporting system for the collection of data related to stormwater/urban flooding. Although this type of flooding certainly occurs, there is no determined number of occurrences

Climate Change Impacts

The climate of Broome County is already changing and will continue to change in the future. Climate change is beginning to affect both people and resources of the County and the impacts will continue. Impacts related to increasing temperatures are already being felt in the County. ClimAID: the Integrated Assessment for Effective Climate Change in New York State was used to provide decision-makers with information on the State's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge.

Anticipated impacts from climate change in the Southern Tier (Region 3) of New York State, where Broome County is located (refer to Figure 4.3.6-6), including higher year-round temperatures, increased frequency of heavy rainfall events, and more frequent and intense summer water deficits by the mid-to-late century (NYSERDA 2014).

Temperatures in New York State 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 New York State 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.

Regional precipitation across New York State is projected to increase by 1 to 8 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.

In Region 3, it is estimated that temperatures will increase by 3.5 ºF to 5.5 ºF by the 2050s and 4.5 ºF to 8.5 ºF by the 2080s (baseline of 46 ºF). Precipitation totals will increase by 0 percent to 10 percent by the 2050s and 5 percent to 10 percent by the 2080s (baseline of 38 inches) (NYSERDA 2014).

Figure 4.3.6-6. Climate Regions of New York State

Source: (NYSERDA 2014)

Climate change affects flooding more than other hazards because the frequency of extreme precipitation events in the Northeast has increased in recent years. Severe storms projected in the 1950s to occur only once in 100 years are now expected to occur once every 60 years. Other climate change influences include the following:

- Spring breakup, snowmelt, and winter rains—Warmer spring temperatures that lead to earlier and more rapid snow melt; more late-winter precipitation likely to fall as rain, rather than as snow
- Cyclonic disturbances—Increasing frequency of severe cyclonic events, which may permit more northward tracking of hurricanes
- Localized summer outburst events—Increased formation of conditions conducive to summer outbursts and flash flooding (New York State 2019).

Vulnerability Assessment

To assess Broome County's risk to the flood hazard, an analysis was conducted using the best available spatially delineated flood hazard areas. The 1 and 0.2 percent annual chance flood events were examined using the 2010 FEMA preliminary DFIRM to determine assets located in the hazard areas and to estimate potential loss using the Hazus. The results are summarized below. Refer to Section 4.2 for additional details on the methodology used.

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. Injuries and deaths generally are not anticipated if proper warning and precautions are in place. Ongoing mitigation efforts should help avoid the most likely cause of injury, which results from persons trying to cross flooded roadways or channels during a flood.

Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur, as well as everyone who may be affected by the hazard event. This includes people traveling in flooded areas and people whose access to emergency services is compromised during an event. The degree of that impact will vary and is not strictly measurable.

Overall Population

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 14,777 residents living in the 1-percent annual chance floodplain, or 7.4 percent of the County's total population (refer to Table 4.3.6-7). The City of Binghamton has the greatest number of residents living in the 1 percent annual chance floodplain, at 4,771 residents. Based on the same analysis, there are an estimated 22,597 residents living in the 0.2 percent annual chance floodplain, or 11.4 percent of the County's total population. The City of Binghamton has the greatest number of residents living in the floodplain, at 7,442 residents.

Table 4.3.6-7. Estimated Number of Persons in Broome County Living in the 1-Percent and 0.2-Percent Annual Chance Floodplains

Jurisdiction	Total Population	Estimated Population Located in the Flood Hazard Area			
		Number of Persons Located in the 1 Percent Annual Chance Floodplain	Percent of Total	Number of Persons Located in the 0.2 Percent Annual Chance Floodplain	Percent of Total
Barker (T)	2,509	101	4.0%	114	4.5%
Binghamton (C)	47,969	4,771	9.9%	7,442	15.5%
Binghamton (T)	4,617	0	0.0%	0	0.0%
Chenango (T)	10,959	274	2.5%	581	5.3%
Colesville (T)	4,868	196	4.0%	257	5.3%
Conklin (T)	5,008	870	17.4%	1,306	26.1%

Jurisdiction	Total Population	Estimated Population Located in the Flood Hazard Area			
		Number of Persons Located in the 1 Percent Annual Chance Floodplain	Percent of Total	Number of Persons Located in the 0.2 Percent Annual Chance Floodplain	Percent of Total
Deposit (V)	721	115	16.0%	230	31.9%
Dickinson (T)	3,401	20	0.6%	91	2.7%
Endicott (V)	13,667	2,159	15.8%	3,148	23.0%
Fenton (T)	6,429	124	1.9%	193	3.0%
Johnson City (V)	15,343	488	3.2%	1,096	7.1%
Kirkwood (T)	5,481	276	5.0%	439	8.0%
Lisle (T)	2,343	50	2.1%	57	2.4%
Lisle (V)	348	84	24.1%	84	24.1%
Maine (T)	5,168	204	3.9%	204	3.9%
Nanticoke (T)	1,581	56	3.5%	129	8.2%
Port Dickinson (V)	1,699	165	9.7%	447	26.3%
Sanford (T)	1,518	22	1.4%	45	3.0%
Triangle (T)	1,849	4	0.2%	4	0.2%
Union (T)	27,128	1,969	7.3%	2,739	10.1%
Vestal (T)	29,313	2,384	8.1%	3,502	11.9%
Whitney Point (V)	960	234	24.4%	234	24.4%
Windsor (T)	4,897	189	3.9%	219	4.5%
Windsor (V)	907	22	2.4%	36	4.0%
Broome County (Total)	**198,683**	**14,777**	**7.4%**	**22,597**	**11.4%**

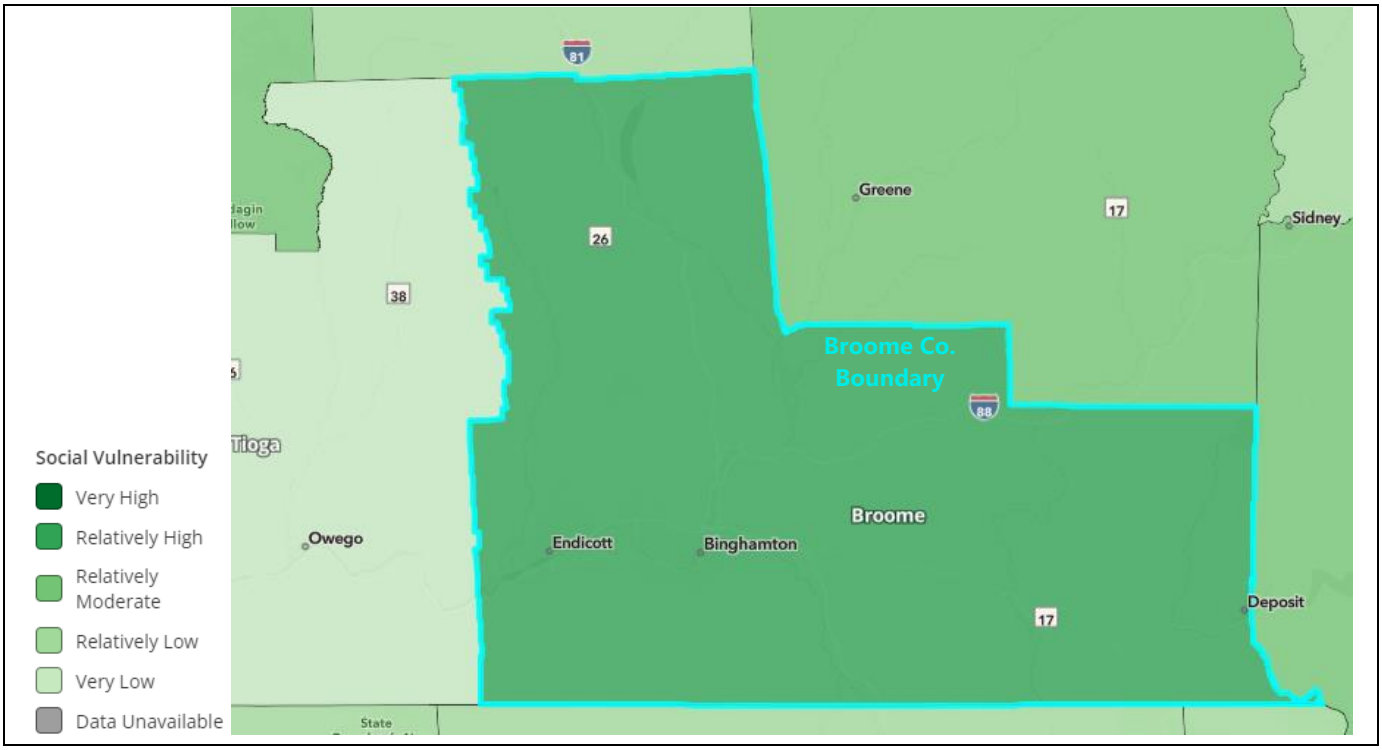
Sources: U.S. Census, American Community Survey 5-Year Estimates 2017-2021; FEMA 2010
Note: Values are rounded down.

Socially Vulnerable Populations

Research has shown that some populations, while they may not have more hazard exposure, may experience exacerbated impacts and prolonged recovery if/when impacted. This is due to many factors, including their physical and financial ability to react or respond during a hazard. Of the population exposed, the most vulnerable include the economically disadvantaged and the population over age 65. Economically disadvantaged populations may be more vulnerable because they are likely to make decisions to evacuate based on net economic impacts on their families. The population over age 65 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 flood event, and they may have more difficulty evacuating.

Figure 4.3.6-7 displays the FEMA National Risk Inventory's Social Vulnerability Index for Broome County, which is identified as "relatively high."

Figure 4.3.6-7. FEMA Social Vulnerability Index for Natural Hazards



Source: (FEMA 2019)

As shown in Table 4.3.6-7, there are 37,374 persons located in the mapped flood hazard areas: 14,777 in the 1 percent annual chance floodplain and 22,597 in the 0.2 percent annual chance floodplain. Table 4.3.6-8 presents the estimated socially vulnerable populations in the 1 percent annual chance floodplain. Of the 14,777 persons located in the 1 percent annual chance floodplain, there are 2,708 persons over the age of 65, 724 persons under the age of 5,260 non-English speakers, 2,355 persons with a disability, and 3,006 living in poverty. Table 4.3.6-9 presents the estimated socially vulnerable populations located in the 0.2 percent annual chance floodplain. Of the 22,597 persons located in the 0.2 percent annual chance floodplain, there are 4,119 persons over the age of 65, 1,117 persons under the age of 5, 408 non-English speakers, 3,622 persons with a disability, and 4,616 living in poverty.

Table 4.3.6-8. Estimated Vulnerable Persons Located Within the 1-Percent Annual Chance Flood Hazard Area

Jurisdiction	Vulnerable Population					Estimated Vulnerable Persons Located Within the 1 Percent Flood Hazard Area									
	Over 65	Under 5	Non-English Speaking	Disability	Poverty Level	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
Barker (T)	465	142	49	342	537	18	3.9%	5	3.5%	1	2.0%	13	3.8%	21	3.9%
Binghamton (C)	7,642	2,588	1,051	9,632	14,894	760	9.9%	257	9.9%	104	9.9%	958	9.9%	1,481	9.9%
Binghamton (T)	822	206	5	710	454	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Chenango (T)	2,236	861	37	1,359	1,292	56	2.5%	21	2.4%	0	0.0%	34	2.5%	32	2.5%
Colesville (T)	1,299	161	0	812	345	52	4.0%	6	3.7%	0	0.0%	32	3.9%	13	3.8%
Conklin (T)	1,116	227	182	637	584	194	17.4%	39	17.2%	31	17.0%	110	17.3%	101	17.3%
Deposit (V)	110	49	0	123	153	17	15.5%	7	14.3%	0	0.0%	19	15.4%	24	15.7%
Dickinson (T)	829	32	63	611	345	4	0.5%	0	0.0%	0	0.0%	3	0.5%	2	0.6%
Endicott (V)	2,337	664	107	2,544	3,535	369	15.8%	104	15.7%	16	15.0%	401	15.8%	558	15.8%
Fenton (T)	1,223	518	49	828	962	23	1.9%	10	1.9%	0	0.0%	16	1.9%	18	1.9%
Johnson City (V)	2,864	821	356	2,718	2,938	91	3.2%	26	3.2%	11	3.1%	86	3.2%	93	3.2%
Kirkwood (T)	1,045	116	61	736	768	52	5.0%	5	4.3%	3	4.9%	37	5.0%	38	4.9%
Lisle (T)	373	157	0	405	207	8	2.1%	3	1.9%	0	0.0%	8	2.0%	4	1.9%
Lisle (V)	48	4	0	45	23	11	22.9%	0	0.0%	0	0.0%	10	22.2%	5	21.7%
Maine (T)	1,141	311	0	927	873	45	3.9%	12	3.9%	0	0.0%	36	3.9%	34	3.9%
Nanticoke (T)	384	68	0	265	123	13	3.4%	2	2.9%	0	0.0%	9	3.4%	4	3.3%
Port Dickinson (V)	235	77	26	208	223	22	9.4%	7	9.1%	2	7.7%	20	9.6%	21	9.4%
Sanford (T)	469	27	0	243	91	7	1.5%	0	0.0%	0	0.0%	3	1.2%	1	1.1%
Triangle (T)	300	40	0	298	251	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Union (T)	6,306	1,300	301	3,358	2,549	457	7.2%	94	7.2%	21	7.0%	243	7.2%	185	7.3%
Vestal (T)	5,068	1,261	876	3,025	3,318	412	8.1%	102	8.1%	71	8.1%	246	8.1%	269	8.1%
Whitney Point (V)	221	32	0	168	340	54	24.4%	7	21.9%	0	0.0%	41	24.4%	83	24.4%
Windsor (T)	1,002	452	0	713	458	38	3.8%	17	3.8%	0	0.0%	27	3.8%	17	3.7%
Windsor (V)	217	28	2	150	109	5	2.3%	0	0.0%	0	0.0%	3	2.0%	2	1.8%
Broome County (Total)	**37,752**	**10,142**	**3,165**	**30,857**	**35,372**	**2,708**	**7.2%**	**724**	**7.1%**	**260**	**8.2%**	**2,355**	**7.6%**	**3,006**	**8.5%**

Sources: U.S. Census, American Community Survey 5-Year Estimates 2017-2021; FEMA 2010

Note: Persons per household = 2.33. The number used to calculate the non-English speaking population. Values are rounded down.

Table 4.3.6-9. Estimated Vulnerable Persons Located Within the 0.2-Percent Annual Chance Flood Hazard Area

Jurisdiction	Vulnerable Population					Estimated Vulnerable Persons Located Within the 0.2 Percent Flood Hazard Area									
	Over 65	Under 5	Non-English Speaking	Disability	Poverty Level	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
Barker (T)	465	142	49	342	537	21	4.5%	6	4.2%	2	4.1%	15	4.4%	24	4.5%
Binghamton (C)	7,642	2,588	1,051	9,632	14,894	1,185	15.5%	401	15.5%	163	15.5%	1,494	15.5%	2,310	15.5%
Binghamton (T)	822	206	5	710	454	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Chenango (T)	2,236	861	37	1,359	1,292	118	5.3%	45	5.2%	1	2.7%	72	5.3%	68	5.3%
Colesville (T)	1,299	161	0	812	345	68	5.2%	8	5.0%	0	0.0%	42	5.2%	18	5.2%
Conklin (T)	1,116	227	182	637	584	291	26.1%	59	26.0%	47	25.8%	166	26.1%	152	26.0%
Deposit (V)	110	49	0	123	153	35	31.8%	15	30.6%	0	0.0%	39	31.7%	48	31.4%
Dickinson (T)	829	32	63	611	345	22	2.7%	0	0.0%	1	1.6%	16	2.6%	9	2.6%
Endicott (V)	2,337	664	107	2,544	3,535	538	23.0%	152	22.9%	24	22.4%	586	23.0%	814	23.0%
Fenton (T)	1,223	518	49	828	962	36	2.9%	15	2.9%	1	2.0%	24	2.9%	28	2.9%
Johnson City (V)	2,864	821	356	2,718	2,938	204	7.1%	58	7.1%	25	7.0%	194	7.1%	210	7.1%
Kirkwood (T)	1,045	116	61	736	768	83	7.9%	9	7.8%	4	6.6%	59	8.0%	61	7.9%
Lisle (T)	373	157	0	405	207	9	2.4%	3	1.9%	0	0.0%	9	2.2%	5	2.4%
Lisle (V)	48	4	0	45	23	11	22.9%	0	0.0%	0	0.0%	10	22.2%	5	21.7%
Maine (T)	1,141	311	0	927	873	45	3.9%	12	3.9%	0	0.0%	36	3.9%	34	3.9%
Nanticoke (T)	384	68	0	265	123	31	8.1%	5	7.4%	0	0.0%	21	7.9%	10	8.1%
Port Dickinson (V)	235	77	26	208	223	61	26.0%	20	26.0%	6	23.1%	54	26.0%	58	26.0%
Sanford (T)	469	27	0	243	91	14	3.0%	0	0.0%	0	0.0%	7	2.9%	2	2.2%
Triangle (T)	300	40	0	298	251	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Union (T)	6,306	1,300	301	3,358	2,549	636	10.1%	131	10.1%	30	10.0%	339	10.1%	257	10.1%
Vestal (T)	5,068	1,261	876	3,025	3,318	605	11.9%	150	11.9%	104	11.9%	361	11.9%	396	11.9%
Whitney Point (V)	221	32	0	168	340	54	24.4%	7	21.9%	0	0.0%	41	24.4%	83	24.4%
Windsor (T)	1,002	452	0	713	458	44	4.4%	20	4.4%	0	0.0%	31	4.3%	20	4.4%
Windsor (V)	217	28	2	150	109	8	3.7%	1	3.6%	0	0.0%	6	4.0%	4	3.7%
Broome County (Total)	**37,752**	**10,142**	**3,165**	**30,857**	**35,372**	**4,119**	**10.9%**	**1,117**	**11.0%**	**408**	**12.9%**	**3,622**	**11.7%**	**4,616**	**13.0%**

Sources: U.S. Census, American Community Survey 5-Year Estimates 2017-2021; FEMA 2010
Note: Persons per household = 2.33. The number used to calculate the non-English speaking population. Values are rounded down.

Hazus estimates the potential sheltering needs if a 1 percent annual chance flood event were to occur. Using 2021 American Community Survey data for Broome County, Hazus estimates 15,917 individuals will be displaced and 2,935 people will seek short-term sheltering. These statistics, by jurisdiction, are presented in Table 4.3.6-10.

Table 4.3.6-10. Estimated Population Displaced or Seeking Short-Term Shelter from the 1-Percent Annual Chance Floodplain

Jurisdiction	1-Percent Annual Chance Flood Event	
	Displaced Population	Persons Seeking Short-Term Sheltering
Barker (T)	118	7
Binghamton (C)	5,330	1,316
Binghamton (T)	8	3
Chenango (T)	326	46
Colesville (T)	146	22
Conklin (T)	1,015	98
Deposit (V)	125	23
Dickinson (T)	68	25
Endicott (V)	2,371	404
Fenton (T)	165	57
Johnson City (V)	601	82
Kirkwood (T)	323	33
Lisle (T)	86	0
Lisle (V)	101	18
Maine (T)	223	84
Nanticoke (T)	57	16
Port Dickinson (V)	256	40
Sanford (T)	72	11
Triangle (T)	12	4
Union (T)	2,230	291
Vestal (T)	1,804	213
Whitney Point (V)	283	34
Windsor (T)	108	82
Windsor (V)	89	27
Broome County (Total)	**15,917**	**2,935**

Source: Hazus v6.0

Impact on General Building Stock

Exposure to the flood hazard includes buildings located in the mapped flood zone or downstream in other flood inundation areas. 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 7,591 buildings exposed to the 1 percent annual flood chance event, representing 8.5 percent of the County's total general building stock inventory replacement cost value. The City of Binghamton has the greatest

number of its buildings in the 1 percent annual chance floodplain (2,658 buildings or 10.5 percent of its total building stock). There are an estimated 11,574 buildings in the 0.2 percent annual chance floodplain, representing 13.5 percent of the County's total general building stock inventory replacement cost value. The City of Binghamton has the greatest number of buildings located in the 0.2 percent annual chance floodplain (4,124 buildings or 16.3 percent of its total building stock). Refer to Table 4.3.6-11 and Table 4.3.6-12 for the estimated exposure of buildings during 1 percent and 0.2 percent annual chance flood events by jurisdiction. Refer to Table 4.3.6-13 for the Hazus' estimated losses by jurisdiction, for residential, commercial, and other occupancy structures.

Table 4.3.6-11. Estimated General Building Stock Located in the 1 Percent Annual Chance Floodplain

Jurisdiction	Number of Buildings	Replacement Cost Value	Estimated Building Stock Located in the 1 Percent Annual Chance Flood Hazard Area			
			Number of Buildings	Percent of Total	Total Replacement Cost of Buildings	Percent of Total
Barker (T)	1,265	$458,008,966	51	4.0%	$14,265,439	3.1%
Binghamton (C)	25,243	$25,457,379,910	2,658	10.5%	$2,833,039,765	11.1%
Binghamton (T)	2,121	$819,770,287	1	0.0%	$1,294,635	0.2%
Chenango (T)	5,183	$3,461,760,757	150	2.9%	$121,034,900	3.5%
Colesville (T)	2,476	$1,191,537,444	108	4.4%	$41,704,622	3.5%
Conklin (T)	2,520	$1,512,740,573	500	19.8%	$425,468,682	28.1%
Deposit (V)	468	$264,974,793	96	20.5%	$96,345,888	36.4%
Dickinson (T)	1,447	$1,107,438,719	9	0.6%	$15,108,257	1.4%
Endicott (V)	7,011	$5,891,635,188	1,133	16.2%	$1,649,080,712	28.0%
Fenton (T)	3,166	$1,276,510,649	66	2.1%	$36,202,651	2.8%
Johnson City (V)	7,904	$17,304,375,644	297	3.8%	$542,513,669	3.1%
Kirkwood (T)	2,628	$2,560,128,948	152	5.8%	$227,269,082	8.9%
Lisle (T)	1,108	$396,905,321	26	2.3%	$18,347,683	4.6%
Lisle (V)	135	$62,277,436	37	27.4%	$18,634,757	29.9%
Maine (T)	2,431	$1,346,741,610	93	3.8%	$18,510,772	1.4%
Nanticoke (T)	762	$278,505,563	28	3.7%	$10,243,197	3.7%
Port Dickinson (V)	845	$315,481,120	82	9.7%	$26,817,664	8.5%
Sanford (T)	1,399	$483,498,227	20	1.4%	$5,210,909	1.1%
Triangle (T)	915	$437,291,241	2	0.2%	$730,453	0.2%
Union (T)	13,013	$15,447,295,551	1,009	7.8%	$1,094,205,032	7.1%
Vestal (T)	9,532	$13,318,921,679	836	8.8%	$673,698,194	5.1%
Whitney Point (V)	439	$397,093,693	119	27.1%	$192,727,992	48.5%
Windsor (T)	2,685	$956,635,388	103	3.8%	$32,128,019	3.4%
Windsor (V)	435	$420,256,617	15	3.4%	$6,893,286	1.6%
Broome County (Total)	**95,131**	**$95,167,165,323**	**7,591**	**8.0%**	**$8,101,476,260**	**8.5%**

Source: Broome County GIS & Mapping Services; RS Means 2022; FEMA 2010

Table 4.3.6-12. Estimated General Building Stock Located in the 0.2-percent Annual Chance Floodplain

Jurisdiction	Number of Buildings	Replacement Cost Value	Estimated Building Stock Located in the 0.2 Percent Annual Chance Floodplain			
			Number of Buildings	Percent of Total	Total Replacement Cost of Buildings	Percent of Total
Barker (T)	1,265	$458,008,966	58	4.6%	$22,381,184	4.9%
Binghamton (C)	25,243	$25,457,379,910	4,124	16.3%	$5,383,727,693	21.1%
Binghamton (T)	2,121	$819,770,287	1	0.0%	$1,294,635	0.2%
Chenango (T)	5,183	$3,461,760,757	330	6.4%	$416,458,571	12.0%
Colesville (T)	2,476	$1,191,537,444	138	5.6%	$52,365,969	4.4%
Conklin (T)	2,520	$1,512,740,573	720	28.6%	$522,767,266	34.6%
Deposit (V)	468	$264,974,793	167	35.7%	$151,022,050	57.0%
Dickinson (T)	1,447	$1,107,438,719	54	3.7%	$82,910,954	7.5%
Endicott (V)	7,011	$5,891,635,188	1,665	23.7%	$1,923,832,873	32.7%
Fenton (T)	3,166	$1,276,510,649	114	3.6%	$81,141,272	6.4%
Johnson City (V)	7,904	$17,304,375,644	602	7.6%	$663,186,816	3.8%
Kirkwood (T)	2,628	$2,560,128,948	246	9.4%	$355,287,377	13.9%
Lisle (T)	1,108	$396,905,321	30	2.7%	$22,231,866	5.6%
Lisle (V)	135	$62,277,436	37	27.4%	$18,634,757	29.9%
Maine (T)	2,431	$1,346,741,610	93	3.8%	$18,510,772	1.4%
Nanticoke (T)	762	$278,505,563	63	8.3%	$24,491,165	8.8%
Port Dickinson (V)	845	$315,481,120	217	25.7%	$71,385,176	22.6%
Sanford (T)	1,399	$483,498,227	40	2.9%	$9,734,911	2.0%
Triangle (T)	915	$437,291,241	2	0.2%	$730,453	0.2%
Union (T)	13,013	$15,447,295,551	1,391	10.7%	$1,337,127,424	8.7%
Vestal (T)	9,532	$13,318,921,679	1,220	12.8%	$1,438,073,551	10.8%
Whitney Point (V)	439	$397,093,693	119	27.1%	$192,727,992	48.5%
Windsor (T)	2,685	$956,635,388	119	4.4%	$37,086,255	3.9%
Windsor (V)	435	$420,256,617	24	5.5%	$10,633,547	2.5%
Broome County (Total)	**95,131**	**$95,167,165,323**	**11,574**	**12.2%**	**$12,837,744,528**	**13.5%**

Sources: Broome County GIS & Mapping Services; RS Means 2022; FEMA 2010

Table 4.3.6-13. Estimated General Building Stock Potential Loss to the 1 Percent Annual Chance Floodplain

Jurisdiction	Estimated Loss for All Occupancies	Estimated Loss for Residential Properties	Estimated Loss for Commercial Properties	Estimated Loss for All Other Occupancies
Barker (T)	$2,649,409	$2,628,390	$17,395	$3,624
Binghamton (C)	$605,683,770	$366,172,621	$139,354,492	$100,156,657
Binghamton (T)	$686,829	$0	$686,829	$0
Chenango (T)	$9,150,299	$4,881,614	$4,268,685	$0
Colesville (T)	$5,166,701	$3,241,175	$1,177,451	$748,075
Conklin (T)	$107,066,463	$30,129,287	$55,863,845	$21,073,331
Deposit (V)	$10,572,130	$4,136,201	$3,660,677	$2,775,251
Dickinson (T)	$431,174	$167,862	$0	$263,312
Endicott (V)	$388,727,403	$293,821,524	$61,182,841	$33,723,038
Fenton (T)	$2,187,811	$1,035,703	$1,152,108	$0
Johnson City (V)	$130,217,903	$9,392,459	$85,044,635	$35,780,809
Kirkwood (T)	$18,524,491	$7,758,384	$7,850,420	$2,915,688
Lisle (T)	$3,095,812	$1,127,044	$0	$1,968,768
Lisle (V)	$4,295,583	$1,886,025	$473,950	$1,935,608
Maine (T)	$3,537,390	$3,464,714	$72,676	$0
Nanticoke (T)	$475,773	$449,532	$26,241	$0
Port Dickinson (V)	$3,358,590	$2,755,351	$603,240	$0
Sanford (T)	$352,927	$352,927	$0	$0
Triangle (T)	$113,930	$113,930	$0	$0
Union (T)	$350,483,445	$64,196,009	$72,242,395	$214,045,041
Vestal (T)	$247,001,620	$53,619,693	$154,035,672	$39,346,255
Whitney Point (V)	$19,616,602	$5,573,655	$10,658,362	$3,384,586
Windsor (T)	$3,423,167	$2,917,613	$505,553	$0
Windsor (V)	$1,076,896	$462,335	$92,658	$521,903
Broome County (Total)	**$1,917,896,119**	**$860,284,048**	**$598,970,125**	**$458,641,946**

Source: Hazus v6.0

NFIP Statistics

This risk assessment included an analysis of available data on flood policies, claims, and repetitive loss (RL) properties. FEMA Region 2 provided a list of residential properties with NFIP policies, past claims, and multiple claims. A property is considered a repetitive loss property when there are two or more losses reported that were paid more than $1,000 for each loss. The two losses must be within 10 years of each other and be at least 10 days apart. Only losses since 1978 that are closed are considered.

Counts of severe repetitive loss (SRL) properties in Broome County were not available for review during this planning process. The National Flood Insurance Act (42 *United States Code* (U.S.C.) 4102a, Section 1361A as amended) defines an SRL property as a residential property covered under an NFIP flood insurance policy that satisfies either of the first two conditions listed below and the third condition:

1) At least four NFIP claim payments for the property (including building and contents) over $5,000 each have occurred, and the cumulative amount of such claim payments exceeded $20,000.

2) At least two separate claims payments for the property (building payments only) have occurred, and the cumulative amount of the building portion of such claims exceeded the market value of the building.
3) For either of the above, at least two of the referenced claims must have occurred within any 10-year period and must have occurred more than 10 days apart.

Table 4.3.6-14 summarizes NFIP policies, claims, and repetitive loss statistics for Broome 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 (i.e., some locations were more accurate than others). Source: FEMA 2023
Note: Statistics are current as of October 2023.

Figure 4.3.6-8 displays the general area of NFIP repetitive and severe repetitive loss locations.

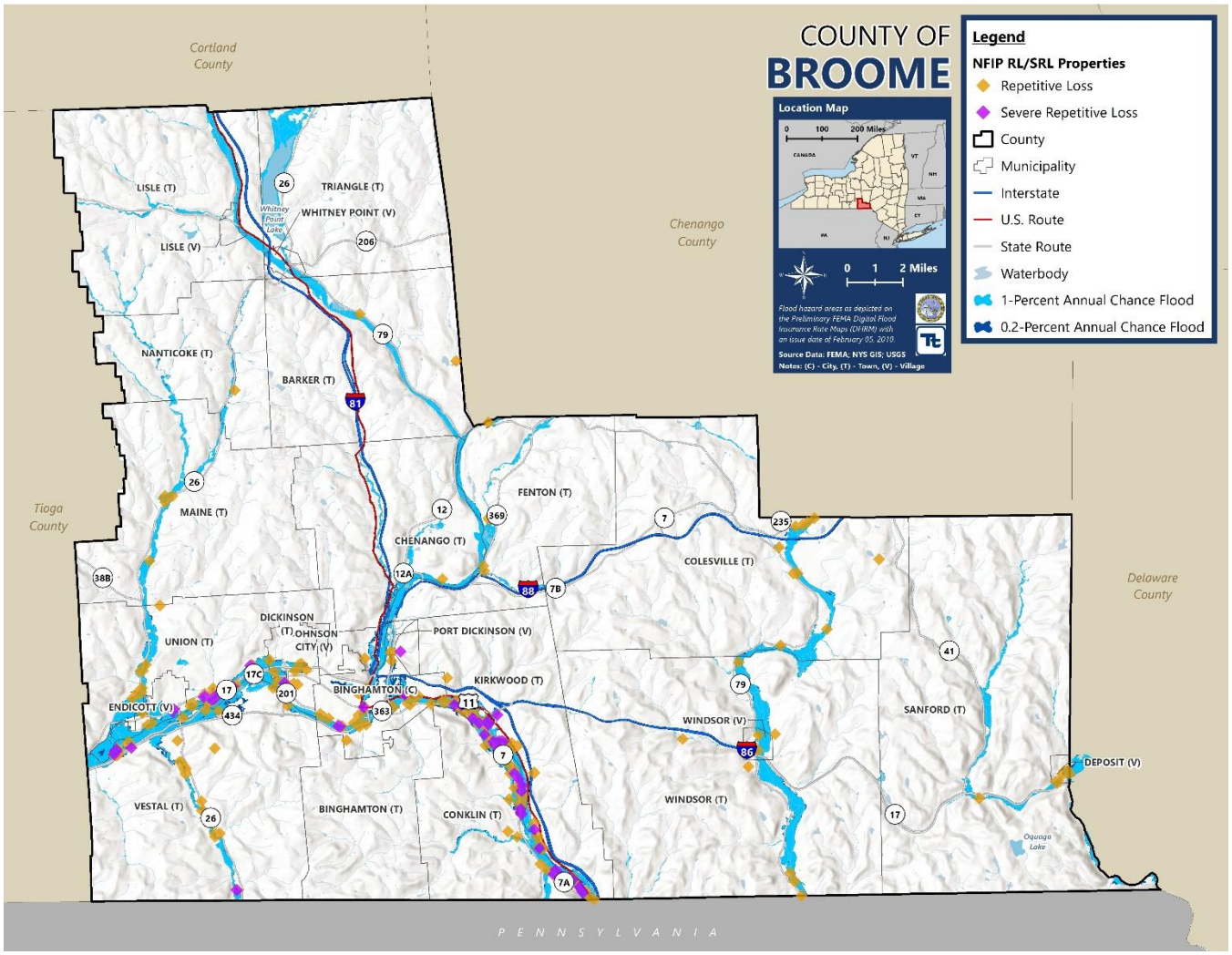
Table 4.3.6-14. NFIP Policies, Claims, and Repetitive Loss Statistics

Jurisdiction	Number of Policies	Claims	Payments	Number of NFIP RL Properties
Barker (T)	4	4	$4,034	0
Binghamton (C)	255	255	$313,164	45
Binghamton (T)	4	4	$12,210	2
Chenango (T)	0	0	$0	0
Colesville (T)	42	72	$1,753,810	14
Conklin (T)	198	764	$35,419,259	152
Deposit (V)	48	116	$2,867,481	9
Dickinson (T)	0	0	$0	0
Endicott (V)	53	85	$3,926,585	8
Fenton (T)	22	47	$546,088	7
Johnson City (V)	186	201	$14,838,944	29
Kirkwood (T)	55	220	$8,349,045	38
Lisle (T)	8	7	$159,822	0
Lisle (V)	1	1	$7,958	0
Maine (T)	27	33	$1,248,563	6
Nanticoke (T)	9	3	$64,297	1
Port Dickinson (V)	24	14	$363,306	0
Sanford (T)	21	17	$232,683	2
Triangle (T)	0	1	$-0	0
Union (T)	276	548	$23,158,435	90
Vestal (T)	347	487	$24,216,989	71
Whitney Point (V)	4	3	$35,416	1
Windsor (T)	17	54	$1,380,155	8
Windsor (V)	10	12	$113,624	2
Broome County (Total)	**1,611**	**2,948**	**$119,011,868**	**485**

Source: FEMA 2023

Note: Statistics are current as of October 2023.

Figure 4.3.6-8. NFIP Repetitive Loss and Severe Repetitive Loss Locations



Impact on Critical Facilities and Community Lifelines

Critical services during and after a flood event may not be available if facilities are directly damaged or transportation routes to access them are impacted. Roads that are blocked or damaged can isolate residents and prevent access throughout the planning area for 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 a surge of water from a flash flood. Loss of these utilities could create additional isolation issues for the inundation zones.

Issues associated with flooding of community lifelines include 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 4.3.6-15 summarizes the number of community lifelines exposed to the flood hazard by jurisdiction.

Table 4.3.6-15. Lifelines and Critical Facilities Located in the 1 Percent and 0.2 Percent Annual Chance Floodplains

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines Located in the 1 Percent Annual Chance Floodplain	Number of Lifelines Located in the 0.2 Percent Annual Chance Floodplain
Communications	60	2	5
Energy	0	0	0
Food, Water, Shelter	161	12	16
Hazardous Materials	210	41	72
Health and Medical	41	7	13
Safety and Security	243	19	35
Transportation	516	166	199
Water Systems	197	50	61
Broome County (Total)	**1,428**	**297**	**401**

Sources: Broome County 2023; FEMA 2010

The Transportation lifeline has the majority of facilities (166) in the 1 percent (166) and 0.2 percent (199) annual floodplains. Major roadways that may be impacted by the 1 percent annual chance flood event include I-88, I-81, I-86, NY-17, NY-17C, NY-12A, NY-7, NY-7A, NY-363, NY-3639, NY-434, and US-11.

Impact on the Economy

Flood events can significantly impact the local and regional economy. This includes but is not limited to general building stock damage, associated tax loss, impacts on utilities and infrastructure, agricultural losses, business interruption, and effects on tourism. Flooding can result in standing water which blocks transportation corridors and public transit for days or causes damages that take weeks to repair. Flooding may also prevent individuals from traveling to school, work, shopping centers, services, etc. Table 4.3.6-16 lists building-related economic losses due to the 1 percent annual chance of flood events. In areas that are directly flooded, renovations of commercial and industrial buildings may be necessary, disrupting associated services.

Table 4.3.6-16. Building-Related Economic Loss Estimates from the 1-Percent Annual Chance Flood Event

Flood Hazard	Total Business Interruption Loss				
	Inventory Loss	Relocation Loss	Wage Loss	Rental Loss	Income Loss
1-Percent Annual Chance Flood Event	$341,200,000	$284,950,000	$744,300,000	$241,310,000	$323,690,000

Source: Hazus v6.0

Debris management may also be a large expense after a flood event. Hazus estimates the amount of structural debris generated during a flood event. The model breaks down debris into three categories: finishes (drywall, insulation, etc.), structural (wood, brick, etc.), and foundations (concrete slab and block, rebar, etc.). These distinctions are necessary because of the different types of equipment needed to handle debris. Table 4.3.6-17 summarizes the Hazus debris estimates for the 1 percent annual chance floodplain. Overall, Hazus estimates that there will be 78,579 tons of debris generated during the 1 percent annual chance flood event in Broome County.

Table 4.3.6-17. 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)
Barker (T)	252	118	74	60
Binghamton (C)	26,326	24,107	1,131	1,088
Binghamton (T)	12	11	0	1
Chenango (T)	2,011	1,224	477	310
Colesville (T)	394	184	117	93
Conklin (T)	3,235	1,666	857	713
Deposit (V)	448	415	19	14
Dickinson (T)	124	113	7	4
Endicott (V)	17,908	12,180	3,086	2,643
Fenton (T)	383	178	116	89
Johnson City (V)	2,114	1,321	447	346
Kirkwood (T)	1,761	690	641	431
Lisle (T)	70	37	14	19
Lisle (V)	50	38	5	8
Maine (T)	352	116	84	152
Nanticoke (T)	54	16	14	24
Port Dickinson (V)	693	452	133	107
Sanford (T)	97	57	22	19
Triangle (T)	153	46	52	55
Union (T)	10,380	5,242	3,049	2,089
Vestal (T)	10,345	5,929	2,410	2,007
Whitney Point (V)	910	854	23	32
Windsor (T)	277	106	95	76
Windsor (V)	228	192	21	15
Broome County (Total)	**78,579**	**55,292**	**12,894**	**10,392**

Source: Hazus v6.0

Note: 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.

Impact on the Environment

As Broome 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 Broome 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.

Cascading Impacts on Other Hazards

Public Health

Flood impacts may 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 mildew are not the only public health risks 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:

- Unsafe food
- Contaminated drinking and washing water and poor sanitation
- Mosquitos and animals
- Carbon monoxide poisoning
- Secondary hazards associated with entering and cleaning flooded structures
- Mental stress and fatigue (FEMA 2022)

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.

Utility Disruption

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. The following are potential harmful effects of flooding on the water supply:

- **Water Supply Contamination**—Excess floodwater can contaminate private drinking water sources, such as wells and springs. Floodwater picks up debris, increasing the amount of bacteria, sewage, and other industrial waste and chemicals in a water source. Excess water also makes it more difficult for water treatment plants to treat the water efficiently and effectively. If there is contamination at any step of the water flow process, it 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 their homes until 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 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 or low on water supply (Andrew 2021).

Floodwaters can also damage buildings' mechanical equipment, resulting in service interruptions, if the service panel, generator, meter, or other device is not elevated above the base flood elevation. 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 impact vulnerability in the county can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place.

Projected Changes in Development

Section 3 (County Profile) identifies areas targeted for future growth and development across the County. Any areas of growth located in the SFHA could be impacted by flooding. Areas outside of the SFHA can also be impacted by urban flooding and less frequent and more severe flooding events. Specific areas of

recent and new development for each jurisdiction are indicated in tabular form or on hazard maps in Volume II.

Projected Changes in Population

According to the U.S. Census Bureau, the County's population decreased by 0.95 percent between 2010 and 2020 (US Census 2023). Cornell University's Program on Applied Demographics projects Broome County will have a population of 186,950 by 2030 and 183,176 by 2040 (Cornell University 2018).

While the geographic and topographic areas most vulnerable to the flood hazard will remain the same, the overall population exposed will decrease. However, groups most vulnerable to the hazard, including those over 65 years old, will increase as the County's population ages, increasing their risk of the flood hazard.

Climate Change

As discussed earlier in Climate Change Impacts, 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 of flash flooding and riverine flooding and flood critical transportation corridors and infrastructure (NYSERDA 2014). Increases in precipitation may alter and expand the floodplain boundaries and runoff patterns, resulting in the exposure of populations, buildings, critical facilities, and infrastructure that were previously outside the floodplain. This increase in exposure would result in an increased risk to life and health, an increase in structural losses, a diversion of additional resources to response and recovery efforts, and an increase in business closures affected by future flooding events due to loss of service or access.

It is anticipated Broome 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 (FEMA n.d.).

Change of Vulnerability Since 2019 HMP

Overall, the vulnerability assessment presented uses a more accurate and updated building inventory, which provides more accurate exposure and potential loss estimates for Broome County. Broome County and its municipalities continue to be vulnerable to the flood hazard. Mitigation measures undertaken by each jurisdiction are described in the jurisdictional annexes in Volume II of this HMP.

SECTION 4. RISK ASSESSMENT

4.3 HAZARD PROFILES

4.3.7 Invasive Species

This 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 invasive species in Broome County.

Hazard Profile

Hazard Description

The U.S. Department of Agriculture (USDA) defines an invasive species as a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (USDA 2016). Invasive species can be plants, animals, and other organisms (e.g., microbes). Human actions are the primary means of invasive species introductions (USDA 2016). Invasive species may come from anywhere in the world, and as international trade increases, so does the rate of invasive species introductions. Invasive species threaten nearly every aspect of the world and are one of the greatest threats to the State of New York's biodiversity (NYSDEC 2018). The State of New York is home to nearly 500 invasive plant and animal species tracked and managed by experts with universities and the New York State Department of Environmental Conservation (NYSDEC). According to NYSDEC (2018), invasive species in the state cause or contribute to the following phenomena:

- Habitat degradation and loss
- The loss of native fish, wildlife, and tree species
- The loss of recreational opportunities and income
- Crop damage and diseases in humans and livestock
- Risks to public safety

The Finger Lakes Partnership for Regional Invasive Species Management (PRISM)—a partnership of stakeholders throughout 17 counties in central New York State, including Broome County—identifies species with very high or high impact and high difficulty of eradication due to being established or widespread in the area as Tier 4 species. Local control of these species is the recommended course of action, as eradication is not feasible due to their widespread nature. A focus on localized management over time can contain, exclude, or suppress the species. The following are examples of Finger Lakes PRISIM Tier 4 species (New York Invasive Species Network (NYIS) 2018):

- Terrestrial species:
  - Norway maple (*Acer plantanoides*)
  - Emerald ash borer (*Agrilus planipennis*)
  - Tree of heaven (*Ailanthus altissima*)
  - Garlic mustard (*Alliaria petiolata*)
  - Yellow iris (*Iris pseudacorus*)
  - Purple loosestrife (*Lythrum salicaria*)
  - Callery pear (*Pyrus calleryana*)
  - Multiflora rose (*Rosa multiflora*).
- Aquatic species:
  - Alewife (*Alosa pseudoharengus*)
  - Goldfish (*Carassius auratus*)
  - Asian clam (*Corbicula fluminea*)
  - Mute swan (*Cygnus olor*)
  - Common carp (*Cyprinus carpio*)
  - Zebra mussel (*Dreissena polymorpha*)
  - Quagga mussel (Dreissena rostriformis bugensis)
  - Ruffe (Gymnocephalus cernuus)
  - Rainbow smelt (*Osmerus mordax*)
  - Curvy leaved pondweed (*Potamogeton crispus*)
  - Rudd (*Scardinius erythrophthalmus*)

In addition to Tier 4 species, the following are identified as species of concern for low to high impact in New York State (New York Invasive Species Network (NYIS) 2018):

- Terrestrial invasive species of concern:
  - Emerald ash borer *(Agrilus planipennis*)
  - Giant hogweed (*Heracleum mantegazzianum*)
  - Hemlock woolly adelgid (*Adelges tsugae*)
  - Japanese knotweed (*Polygonum cuspidatum*)
  - Oriental bittersweet (*Celastrus orbiculatus*)
  - Swallow-wort (pale and black) (*Cynanchum spp.*)
  - Japanese stiltgrass (*Microstegium vimineum*)
  - Mile-a-minute vine (*Persicaria perfoliate*)
  - Slender falsebrome (*Brachypodium sylvaticum*)
- Aquatic invasive species of concern:
  - Hydrilla (*Hydrilla verticillata*)
  - Water chestnut (*Trapa natans*)
  - Macroalgae starry stonewort (*Nitellopsis obtuse*)
  - Bloody red shrimp (*Hemimysis*)
  - Round goby fish (*Neogobius melanostomus*)
  - Oriental weatherfish (*Misgurnus anguillicaudatus*)

The State of New York has been impacted by various past and present infestations of invasive insects, including high populations of invasive mosquito species and invasive tick species, which can cause Lyme disease, West Nile virus (WNV), Eastern equine encephalitis (EEE), La Crosse encephalitis, Powassan virus, St. Louis encephalitis, and Western equine encephalitis. Other insect species, such as emerald ash borer, Asian long-horned beetles, Sirex woodwasp, and hemlock woolly adelgid, destroy trees and other

vegetation. Not all of these invasive species have been found in Broome County, but they have been noted regionally and could spread into Broome County.

Invasive Plants and Fungi

An invasive plant can thrive and spread aggressively outside its native range. A naturally aggressive plant can be especially invasive when it is introduced to a new habitat (USDA 2016). Invasive aquatic plants are introduced plants that have adapted to living in, on, or next to water, and can grow either submerged or partially submerged in water (USDA 2017). Invasive plants often are introduced to a new area for ornamental gardening.

Common Reed/Phragmites

Common reed or **phragmites** grow in dense thickets that make habitats unsuitable for local animals (Cornell University Cooperative Extension; New York Sea Grant 2019). It outcompetes and replaces native plants, and produces mesoxalic acid, a toxin that is harmful to many plants. Common reed has been found in North America for thousands of years, but it is spread when soil is disturbed in upland areas or when introduced into previously unimpacted wetlands (Cornell University Cooperative Extension; New York Sea Grant 2019).

Source: NYIS (2019)

Dutch Elm Disease

Dutch elm disease is an elm tree pathogen caused by two fungi species, Ophiostoma ulmi and O. novo-ulmi (Smith 2017). The fungi can spread via elm bark beetles or root grafts in adjacent trees, eventually leading to tree death over a period ranging from weeks to years. The disease entered North America in 1930 and has since killed most of the American elm trees in the northeastern United States. However, it is still possible to find mature elm trees within Broome County (Sprague and Blum 2020).

Eurasian Watermilfoil

Eurasian watermilfoil is an underwater aquatic plant that has become a major invader across much of North America (Cornell University Cooperative Extension; New York Sea Grant 2019). Plants are rooted at the lake bottom and grow rapidly, creating dense beds and canopies. Eurasian watermilfoil reduces native plants by reducing light penetration into water bodies and can have negative impacts on wildlife and fish populations in water bodies, causing cascading economic impacts for property values and development along lakefront areas (Cornell University Cooperative Extension; New York Sea Grant 2019).

Source: NYIS (2019)

Giant Hogweed

Giant hogweed is a large invasive plant species that is classified as a noxious weed. Originally from Europe, giant hogweed is an identified giant, reaching a height of 14 feet or more, with large leaves up to 5 feet wide and large white flower heads up to 2.5 feet in diameter. The sap of the giant hogweed, when combined with moisture and sunlight, can cause severe skin and eye irritation, painful blistering, permanent scarring, and blindness. The sap can encounter the skin by brushing against the bristles on the stem or breaking the stem and leaves (NYSDEC 2018).

Source: NYIS (2019)

Hydrilla

Hydrilla, also commonly called water thyme, is a submersed perennial herb (Cornell University Cooperative Extension; New York Sea Grant 2019). The plant is rooted in the bed of water bodies and has long stems (up to 25 feet in length) that branch at the surface where growth forms dense mats. Hydrilla can be found infesting freshwater lakes, ponds, rivers, impoundments, and canals. Hydrilla can invade deep, dark waters where most native plants cannot grow. The plant's aggressive growth (hydrilla's 20 to 30-foot stems can add up to an inch per day) can spread into shallow water areas and form thick mats that block sunlight to native plants below, effectively displacing the native vegetation of a water body (Cornell University Cooperative Extension; New York Sea Grant 2019).

Source: NYIS (2019)

Japanese Knotweed

Japanese knotweed, originally introduced as an ornamental and erosion control species, can grow from 3 to 15 feet tall and has bamboo-like stems. It is sometimes called Japanese bamboo (Cornell University Cooperative Extension; Sea Grant New York 2019). As with many invasive plants, knotweed thrives in disturbed areas and once established can spread rapidly, creating monoculture stands that threaten native plant communities. Japanese knotweed can tolerate deep shade, high temperatures, high soil salinity, and drought. It is commonly found along streams and rivers, in low-lying areas, in disturbed areas such as rights-of-way, and around old homes and farmsteads. Japanese knotweed spreads rapidly,

Source: NYIS (2019)

forming dense thickets that crowd and shade out native vegetation. This reduces species diversity, alters natural ecosystems, and negatively impacts wildlife habitat (Cornell University Cooperative Extension; Sea Grant New York 2019).

Tree of Heaven

Tree of heaven is a deciduous tree that can grow up to 100 feet tall. Infestations are most found in disturbed urban landscapes, including beneath powerlines and along rights of way. It is also found in riparian zones, open areas, forest edges, and forest openings (WNY PRISM n.d.). Tree of Heaven grows and spreads rapidly, posing a threat to native plant communities and tree species. It also produces allelopathic chemicals that leach into the soil and prevent the establishment of other plants while its robust root system damages pavement and infrastructure (WNY PRISM n.d.). Critically, it is the preferred host of the highly destructive invasive species spotted lanternfly (WNY PRISM n.d.).

Source: WNY PRISM

Wild Parsnip

Wild parsnip is an herbaceous plant that can grow from 4 to 5 feet tall. It is commonly found growing along roadsides, in pastures, abandoned fields, or any place where the soil has been disturbed and native vegetation has yet to become fully established (Cornell University Cooperative Extension; Sea Grant New York 2019). It is like giant hogweed, as its sap contains chemicals that can cause a severe burn within 48 hours. It can cause skin discoloration that can lead to years of light sensitivity. Wild parsnip invades and modifies disturbed open habitats. Well-established fields and meadows are not likely to be invaded, but parsnip can become well-established along the edges and in disturbed areas. Once an infestation begins, it can spread into adjacent areas and form dense stands in high-quality fields and meadows. Wild parsnip is also very persistent on sites that remain disturbed or bare, such as paths, roadsides, and utility rights of way (Cornell University Cooperative Extension; Sea Grant New York 2019).


Source: NYIS (2019)

Invasive Animals and Insects

An invasive animal or insect can thrive and spread aggressively outside its native range. Invasive animal and insect species can cause harm to the environment, the economy, and/or human health (NYSDEC 2018).

Elm Zigzag Sawfly

The **elm zigzag sawfly** is an invasive insect that feeds exclusively on elm trees. Although the sawfly has not yet been shown to cause tree mortality, the elm zigzag sawfly can contribute to defoliation, branch dieback, and crown thinning on infested elm trees (St. Lawrence Eastern Lake Ontario PRISM n.d.). Infested trees are also more vulnerable to other tree pests and pathogens, causing a cascading impact on forest ecology.

In August 2022, the elm zigzag sawfly was confirmed for the first time in New York State in St. Lawrence County. Currently, sawfly populations appear to be at low levels and causing only minor damage in the St. Lawrence County area. However, once introduced to an area, the elm zigzag sawfly can fly up to 56 miles in a year and even further when assisted by wind currents, creating the potential for further spread across the state (NYSDEC 2022).

Emerald Ash Borer

Emerald ash borer (EAB) is an Asian beetle that infests and kills North American ash species *(Fraxinus* sp.) including green, white, black, and blue ash. Thus, all native ash trees are susceptible. Adult beetles leave distinctive D-shaped exit holes in the outer bark of the branches and the trunk. Adults are roughly three-eighths to five-eighths inches long, with metallic green wing covers and a coppery red or purple abdomen. They can be present from late May through early September but are most common in June and July. Signs of infection include tree canopy dieback, yellowing, and browning of leaves (NYSDEC n.d.).

Source: NYIS (2019)

EAB affects black and white ash trees, which are valuable commercially and used for the manufacture of flooring, furniture, shipping pallets, and baseball bats. Approximately 114 million board-feet of ash lumber is grown annually in the eastern United States (approximately $25 billion value) (Gould, et al. 2021). Hedgerows composed of ash trees help protect fields from drying and eroding from winds. These hedgerows also provide shelter to plants, animals, and humans.

The City of Binghamton has an Emerald Ash Borer Preparedness Plan that outlines sections from ordinances that allow the city to combat the EAB problem, establishes priorities for treatment and removal of impacted trees, determines replacement methods, identifies EAB educational programs, and provides a budget for the plan (City of Binghamton, Department of Planning, Housing & Community Development n.d.).

Hemlock Wooly Adelgid

Hemlock woolly adelgid is native to parts of Asia and was first discovered in the state in 1985. It is in the family Adelgidae, which is related to aphids. The adelgid uses long mouth parts to extract sap and nutrients from hemlock foliage, preventing tree growth and causing needles to discolor from deep green to grayish green and to drop prematurely. Loss of new shoots and needles seriously impairs tree health. Infestation is usually fatal to the tree after several years. Wind, birds, other wildlife, and movement of infested host material (wood) by humans are all factors in the dispersion of the adelgid (NYSDEC n.d.).

Source: NYIS (2019)

Hemlock wood is commonly used in barns and on farm building projects. Groves of hemlock trees provide habitat and cover for deer, ruffed grouse, turkey, rabbit, and snowshoe hare. Loss of hemlock groves can result in loss of cool, damp, and shaded microclimates that support terrestrial plant communities. Losses can result in warmer stream temperatures for fish and other aquatic species, thus harming them. Declines in hemlock can result in losses of unique plant and animal assemblages and drastic changes to the ecosystem (Cornell University Cooperative Extension; New York Sea Grant 2019).

Spotted Lanternfly

The **spotted lanternfly** is native to China and was first detected in the United States in Pennsylvania in 2014. It was originally thought to have a low risk of spreading across the northern United States due to an inability to survive cold winters (Cornell University Cooperative Extension; New York Sea Grant 2019). However, the spotted lanternfly has recently been spotted in New York and has the potential to become a significant agricultural pest. Spotted lanternflies feed on over 65 species of plants, preferring plants that have high sugar content and toxic metabolites (Cornell University Cooperative Extension; New York Sea Grant 2019). These include many agricultural species such as fruit vines (grapes), fruit trees (apples, cherries, peaches, pears, plums), and maple trees. Ornamental plants and forestry species including dogwoods, lilacs, and pines are also susceptible (Cornell University Cooperative Extension; New York Sea Grant 2019).

Source: Lawrence Barringer, Pennsylvania Department of Agriculture, bugwood.org

True Armyworm

True armyworm, also known as the common armyworm, is primarily a pest of plants in the grass family: forage, pasture, lawns, small grains, and corn. Young larvae are smooth, cylindrical, and pale green to brownish. Mature larvae are smooth and marked with two orange, white-bordered strips on each side. Larvae range from an eighth inch to 1.5 inches long. The insect spends winters in the south and flies up to the State of New York in the spring (Cornell Cooperative Extension 2021).

Source: Russ Ottens, University of Georgia

Brown Marmorated Stinkbug

Brown marmorated stink bug is an invasive species that made its way from Asia to North America (Cornell University College of Agriculture and Life Sciences n.d.). The species was first documented in New York State in the Hudson Valley region in 2008 (Friedland 2011). These insects can impact fruit and vegetable crops (peaches, apples, tomatoes, soybeans, sweet corn, berries, apricots, grapes, cherries, nectarines, lima beans, peppers, and ornamentals). Severe damage from these insects can render crops unusable for processed products.

Source: Cornell University CALS

Ticks

Many ticks are native to Broome County, but several species are invasive in the county. Asian longhorned tick is invasive. Lone Star Tick is not native to the state and is expanding its range farther north from the south. Broome County Health Department has observed an increase in reported tickborne illnesses (Broome County 2021).

Regulations

New York State Invasive Species Program

The New York State Invasive Species Program is made up of the following components:

- **Environmental Protection Fund**—The invasive species line item is the lifeline supporting the infrastructure of the statewide invasive species program. Many of the components are administered as contracts through NYSDEC.
- **New York State Invasive Species Council**—Nine state agencies, co-chaired by NYSDEC and the Department of Agriculture and Markets (NYSDAM).
- **New York State Invasive Species Advisory Committee**—Twenty-five representative stakeholders, including environmental, academic, and industry groups.

- **Invasive Species Coordination Unit**—Two coordinating staff at the NYSDEC, housed within the Division of Lands and Forests.
- **Partnerships for Regional Invasive Species Management (PRISMs)**—Eight regional public-private partnerships across New York that coordinate invasive species prevention and management and deliver on-the-ground programming. Broome County is part of the Finger Lakes PRISM.
- **iMapInvasives**—Web-based database and mapping system that stores and displays statewide invasive species occurrence, treatment, and assessment information for agencies and citizens.
- **New York Invasive Species Clearinghouse**—Web-based gateway to access timely, accurate, scientific, and policy information and information on upcoming invasive species events and invasive species news of interest.
- **New York Invasive Species Education Program**—Education program integrated within the Cornell Cooperative Extension Network that provides science-based educational programs and research-based information regarding invasive species of major concern.
- **New York Invasive Species Research Institute**—Virtual institute that serves the scientific research community, natural resource and land managers, and state offices by promoting information-sharing and developing recommendations and implementation protocols for research, funding, and management to improve the scientific basis of invasive species management.
- **Additional Components**—The State of New York's invasive species program leads special projects as needed and as resources and capacity allow, such as offering an Invasive Species Eradication Grant Program; preparing a state invasive species management strategy; coordinating and streamlining regulatory processes; implementing regulatory and encouraging non-regulatory approaches to prevention; supporting invasive species research; and responding to new species introductions to the state.

New York State Invasive Species Council

The New York State Invasive Species Council is a statutory body created in 2008 by Title 17, Section 9 of the state's Environmental Conservation Law. The Council coordinates among multiple state entities and partners to address the environmental and economic threats of invasive species. The legislation defines invasive species as a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely causing economic or environmental harm or harm to human health. The council is co-led by the NYSDEC and NYSDAM and consists of nine members: Commissioners of the NYSDEC, the NYSDAM, Transportation, Education, and the Office of Parks, Recreation, and Historic Preservation; the Secretary of State; the Chair of the New York State Thruway Authority; the Director of the New York State Canal Corporation; and the Chair of the Adirondack Park Agency (Cornell University Cooperative Extension; New York Sea Grant n.d.).

Proposed New State Regulations

The NYSDEC, in cooperation with NYSDAM, has proposed new invasive species regulations (6 New York Codes Rules and Regulations, Part 575) that include the following elements:

- A list of prohibited species, possession of which shall be unlawful with intent to sell, import, purchase, transport, or introduce
- A list of regulated species that shall be legal to possess, sell, purchase, propagate, and transport but may not be knowingly introduced into a free-living state
- Requirement of a permit for education, research, and other approved activities involving prohibited species and release of regulated species into a free-living state
- Criteria for imposing these classifications and a means for future classification of species
- Establishment of grace periods for certain prohibited species to allow businesses to plan management of existing stock

Location

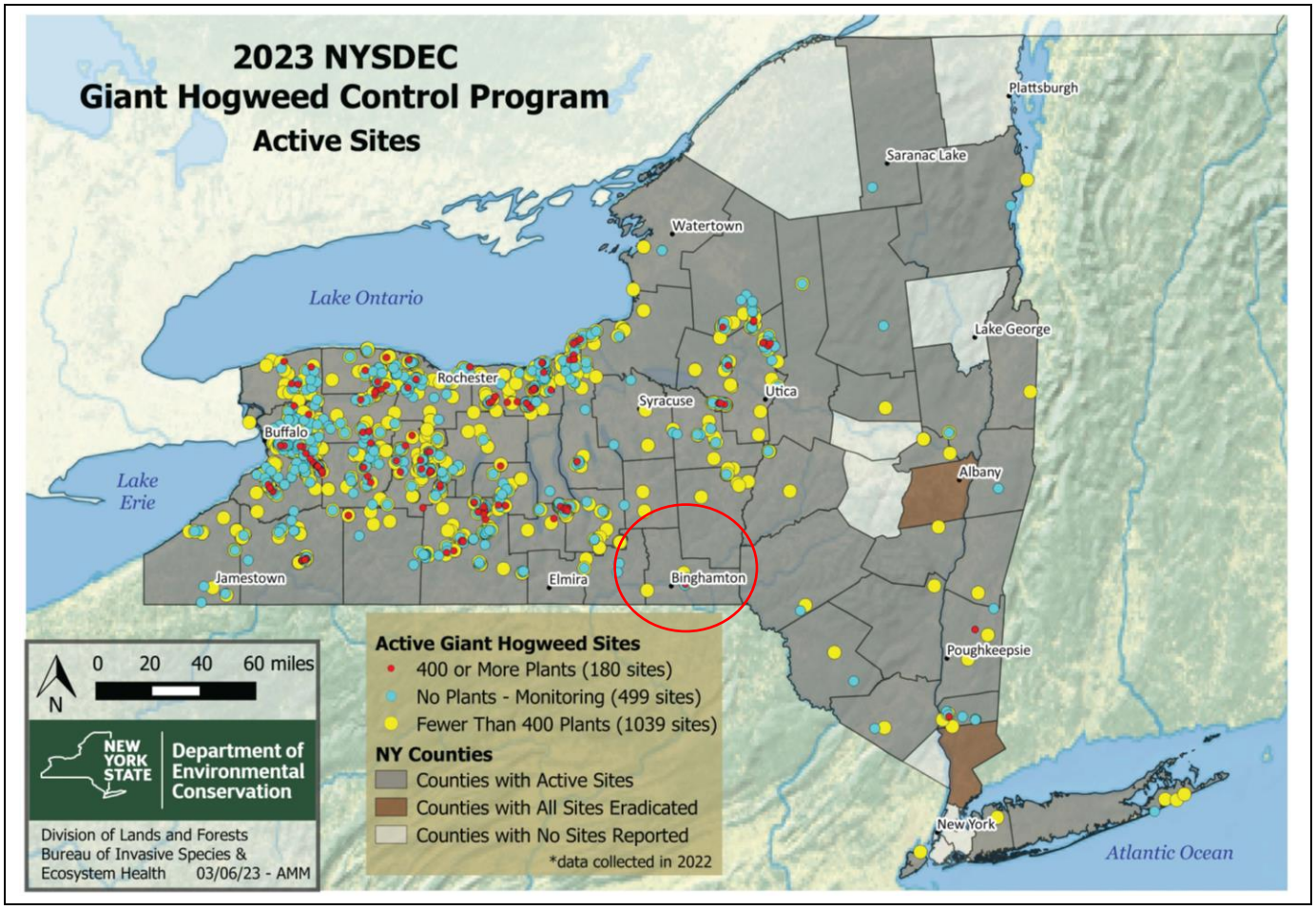
The location of invasive species depends on the preferred habitat of the species, as well as the species' ease of movement and establishment. Each threat can impact most areas of New York State, including Broome County. Levels of threat from invasive species range from nuisance to widespread.

Some invasive species, such as mosquitoes and ticks, are found countywide. Others are limited to specific locations. Examples of known locations of invasive species within Broome County are described below.

Giant Hogweed

The NYSDEC runs a giant hogweed control program. Figure 4.3.7-1 indicates active giant hogweed locations (more than 400 plants) identified by the program in Broome County.

Figure 4.3.7-1. Giant Hogweed Control Program Active Sites for 2023

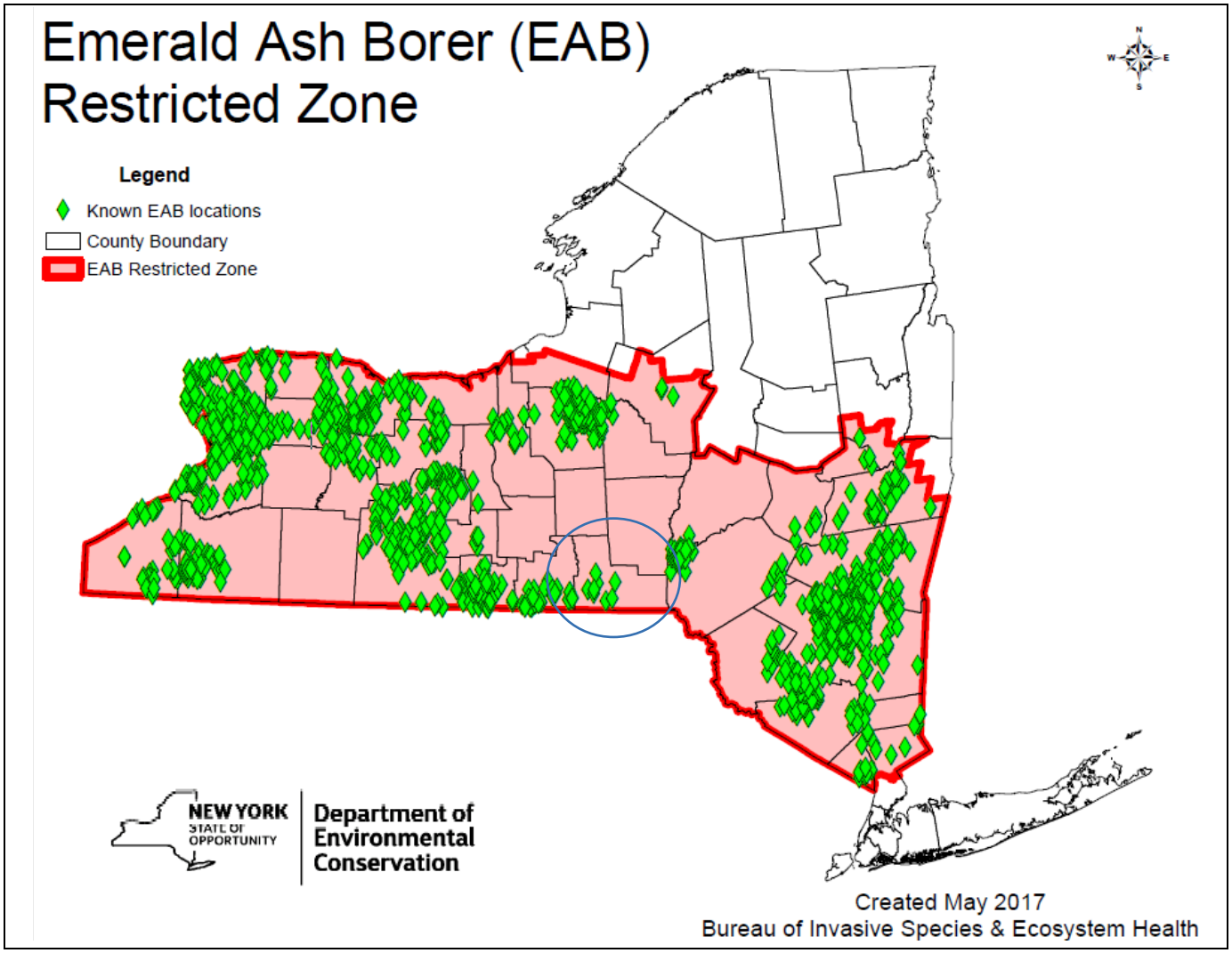


Source: NYS Department of Environmental Conservation, 2023.
Note: The red circle indicates Broome County

Emerald Ash Borer

Figure 4.3.7-2 shows the known locations of EAB documented by NYSDEC. EAB is found in the center and southwestern portion of Broome County. Dead, infested ash trees were found in the Towns of Conklin, Kirkwood, Vestal, and Union and the City of Binghamton. EAB was detected in a County Park (Otsiningo). The NYSDEC has found that ash trees of all species comprise approximately 10 percent of Broome County's forests.

Figure 4.3.7-2. Emerald Ash Borer Locations and the Restricted Zone



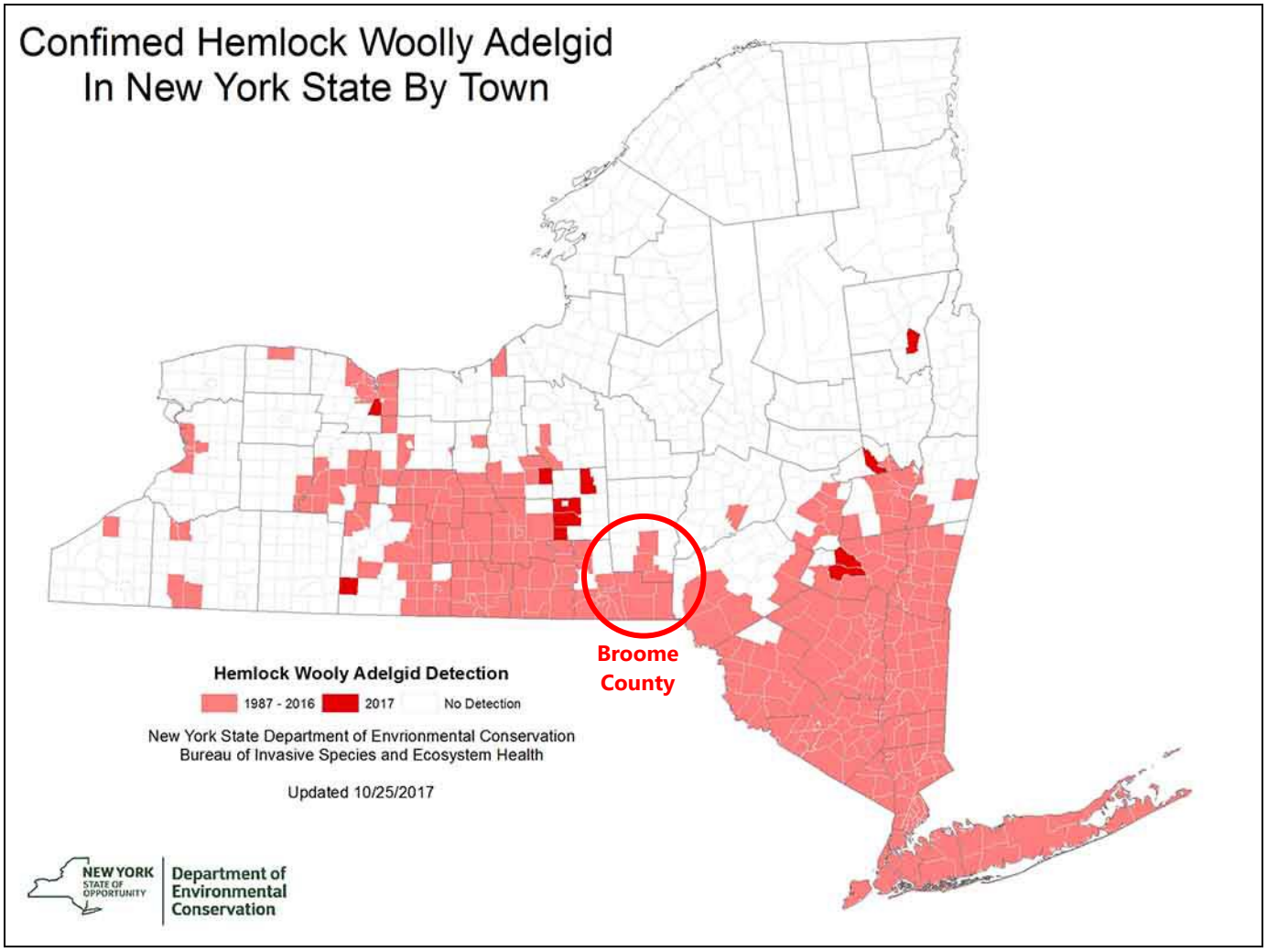
Source: NYSDEC 2017

Note: The blue circle indicates Broome County.

Hemlock Woody Adelgid

Figure 4.3.7-3 shows locations of hemlock wooly adelgid documented by NYSDEC. Hemlock wooly adelgid is found in the center and southwestern portion of Broome County. It has been found in numerous locations in Broome County from the Pennsylvania state line to the Town of Triangle.

Figure 4.3.7-3. Confirmed Hemlock Wooly Adelgid in New York State by Town



Source: NYSDEC 2017

Additional mapping for a wide range of invasive species in Broome County can be found at iMapInvasives, New York State's online, all-taxa invasive species database and mapping tool. The comprehensive database can be used for the following (iMapInvasives 2020):

- Documenting and sharing invasive species observation, survey, assessment, and treatment data
- Coordinating early detection and rapid response efforts through email alerts
- Data analysis and summaries in the web interface and GIS

Extent

The extent and location of invasive species depend on the preferred habitat of the species, as well as the species' ease of movement and establishment. However, each of these threats can impact many areas of Broome County. The magnitude of invasive species impacts ranges from nuisance to widespread. 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 invasive species.

Previous Occurrences and Losses

This section presents the best available information on previous invasive species occurrences, impacts, and monetary losses in Broome County. Where multiple information sources were available, the results presented here were judged to be the most accurate and reliable. Citations are provided for each information source used.

FEMA Disaster Declarations

The Federal Emergency Management Agency (FEMA) has not had any invasive species disaster declarations between the last plan update in 2019 and 2024.

U.S. Department of Agriculture Disaster Declarations

Nearby counties have previously been included in a USDA agricultural disaster declaration (S3411) for invasive insects; however, Broome County has not been included in any USDA disasters related to invasive species, and sources did not reveal the impacts of invasive insects in Broome County.

Previous Events

Table 4.3.7-1 summarizes invasive species events that have been reported to have affected Broome County since 1999.

Table 4.3.7-1. Invasive Species Events in Broome County, 1999 to 2023

Date of Event	Event Type	FEMA and/or USDA Declaration Number	Broome County Included in Declaration?	Description
1999	Eurasian milfoil	N/A	N/A	Eurasian Milfoil was first identified in Broome County.
2008	Brown marmorated stink bug	N/A	N/A	Brown marmorated stink bug was first identified in the Hudson Valley.
2011	Hydrilla	N/A	N/A	Hydrilla identified and targeted for management in the region.
2014	Emerald ash borer	N/A	N/A	The EAB was first identified in Broome County.
2015	Wild parsnip	N/A	N/A	Wild Parsnip was identified at several locations in Broome County.
2018	Giant hogweed	N/A	N/A	NYSDEC reported giant hogweed at one site in the county.
2020	Spotted lanternfly	N/A	N/A	Finger Lakes PRISM reported Spotted Lanternfly in the region.

Sources: EDD MapS 2018; USDA 2018; NYSDOH 2015; CDC 2017

Note: Many sources were consulted to update previous occurrences and losses; event details and loss/impact information may vary and have been summarized in the above table. CDC = Centers for Disease Control; EAB = Emerald Ash Borer; N/A = Not applicable

Probability of Future Occurrence

Based on historical documentation and given the overall impact of the changing climate, the State of New York is expected to undergo increased incidences of invasive species. Broome County and all its jurisdictions will continue to be under threat of invasive species that may induce secondary hazards and health threats to the county population if infestations are not prevented, controlled, or eradicated.

Based on historical records and input from the Planning Partnership, the probability of occurrence of invasive species in Broome County is considered occasional. It is difficult to determine the percentage of occurrence for invasive species due to a lack of reporting and monitoring, as well as the ongoing fluctuations of climate impacts.

Climate Change Impacts

Climate change and the globalization of trade, travel, and transport are greatly increasing the number and type of species moved around the world, as well as the rate of movement. Changes in land use and climate are also rendering some habitats more susceptible to the establishment of nonnative species and may amplify the adverse impacts of biological invasion (National Invasive Species Council (NISC) 2016). According to the New York State Energy Research and Development Authority (NSYRDA), the entire state is projected to have an increase in the frequency and severity of heat days. Table 4.3.7-1 estimates there will be on average 23 days per year where temperatures will climb above 90°F. This shift in climate temperatures will not only impact the native species and vegetation within the state but also provide a suitable climate for invasive species.

Warmer temperatures and changing rainfall patterns provide an environment where mosquitos can remain active longer, greatly increasing the risk for animals and humans (e.g., West Nile Virus). Lyme disease could expand throughout the United States as temperatures warm, allowing ticks to move into new areas of the country. The changes in climate can also allow tropical and subtropical insects to move from regions where diseases thrive into new places (Ginty 2018). Armyworms die in colder temperatures; warmer spring and winter temperatures allow them to continue to reproduce—a factor contributing to an outbreak in 2012. Mosquitoes capable of carrying and transmitting diseases now live in at least 28 states. Warmer temperatures, heavy rainfall, and high humidity have reportedly increased the rate of WNV infections in humans (Ginty 2018). As temperatures increase and rainfall patterns change, these insects can remain active for longer seasons and within wider areas.

Table 4.3.7-1. Climate Change Impacts, Extreme Temperature Events in Broome County

		Future		
Event Type	2020s	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
Days over 90 degrees Fahrenheit (°F)	8 days	12	17-21	23
# of Heat Waves	0.7 heat waves	2	2 to 3	3
Duration of Heat Waves	4 days	4	4 to 5	5
Days below 32°F	133 days	119	122 to 130	134

Source: (Horton, et al. 2014)

As climate change continues to take place, it is anticipated that the occurrence of invasive species is likely to increase in Broome County, particularly by species acclimated to warmer climates that expand their range to the north as temperatures warm.

Vulnerability Assessment

A qualitative assessment was conducted for invasive species infestations in Broome County. The following discusses the County's vulnerability to this hazard. Refer to Section 4.2 (Methodology and Tools) for additional details on the methodology used to assess the infestation and invasive species risk.

Impact on Life, Health, and Safety

Overall Population

The entire population of Broome County (1,323,807) is exposed to invasive species (U.S. Census 2020); however, those living in areas more impacted by invasive species may be more at risk. For example, homes surrounded by ash trees may be more susceptible to falling trees due to the impacts EABs have on the trees.

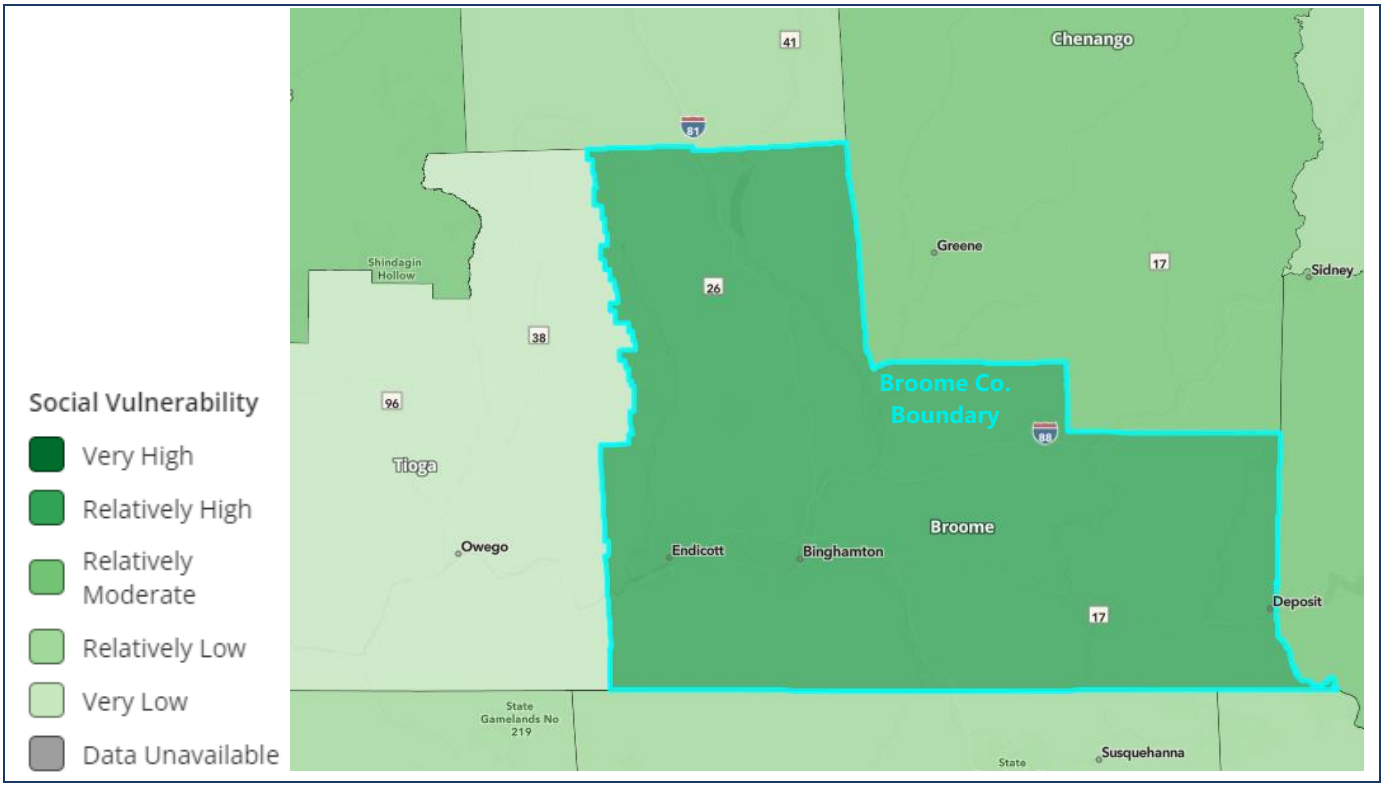
The impacts of HAB on life, health, and safety depend on several factors, including the severity of the event and whether citizens and tourists have become exposed to waters suspected of containing toxins associated with cyanobacteria. Routes of exposure include consumption, inhalation, and dermal exposure. The population living near or visiting water bodies is at risk for exposure as well as those that use those water bodies for water supply. Contact with water containing HAB can cause various health effects including diarrhea, nausea, or vomiting; skin, eye, or throat irritation; and allergic reactions or breathing difficulties (CDC 2022).

Socially Vulnerable Populations

Of Broome County's total population, the elderly population and individuals with suppressed immune systems are most susceptible to the effects of infestations, due to secondary impacts such as the spread of diseases that can be transmitted through invasive species. The 2017-2021 American Community Survey indicates that there are 37,752 persons over the age of 65 in Broome County. Figure 4.3.7-4 displays the

FEMA National Risk Inventory's Social Vulnerability Index for Broome County, which is identified as "relatively high."

Figure 4.3.7-4. FEMA Social Vulnerability Index for Natural Hazards



Source: (FEMA 2019)

Impact on General Building Stock

Structures are not anticipated to be directly affected by infestation of invasive species. However, EAB may cause an extreme loss of ash trees throughout Broome County, which could result in stream bank instability, erosion, and increased sedimentation, impacting ground stabilization and possibly causing foundation issues for nearby structures. Additionally, with an increased number of dead trees, there is an elevated risk of trees falling on roadways, power lines, and buildings.

Some invasive plants can destabilize soil due to high densities and shallow root systems, negatively impacting nearby buildings and septic systems. Other invasive plant species have been known to clog culverts and streams, which increases flooding risk.

Impact on Critical Facilities and Community Lifelines

Water treatment plants could be impacted by infestation by invasive species because of issues similar to those that the general building stock may experience. Water that becomes polluted due to increased sedimentation and erosion will require additional treatment. If the system becomes clogged with these

pollutants, the ability of water treatment plants to operate may become impaired. Additionally, soil that becomes unstable due to decaying vegetation can impact critical facilities that are built on or around these soils.

Impact on the Economy

Direct economic impacts resulting from invasive species include identification and management costs, research and monitoring program costs, and job and wage losses. Impacts of infestation and invasive species on the economy and estimated dollar losses are difficult to measure and quantify. Crops and agriculture tend to be the largest problem when discussing the impacts of invasive species in terms of job and wage losses. As well, invasive species can cause tourism and recreation to decline through infestations and health risks, impacting economic tourism in the County.

Impact on the Environment

Environmental impacts from invasive species can include reduced or complete loss of ecosystem services, which then must be provided through human-created mechanisms. Reduced biodiversity, resource production, and property values can also be economic impacts resulting from invasive species. Management of an invasive species is an ongoing expense unless an affordable method of eradication with minimal effects on the ecosystem is more cost-effective (Centre n.d.).

EAB is responsible for placing all three of New York's ash species in serious decline. Ashwood is the primary wood for baseball bats. Ash is the most common tree planted in parks and city streets and has a long history of positive impact on several wildlife species. The cost of removal for ash trees can be upwards of $1 million depending on the number of trees for removal and their location.

Broome County's parks, forests, landscaping, and agricultural areas are vulnerable to spotted lanternflies, hemlock woolly adelgid, and EAB. Species that cause eventual destabilization of soil, such as invasive insects that destroy plants or invasive plants that outcompete native vegetation but have less effective root systems, can increase runoff into water bodies. Soil destabilization can also increase the likelihood of mudslides in areas with a steep slope.

Cascading Impacts on Other Hazards

Species that result in damage and death to trees can increase the risk of wildfire. Soil destabilization can increase the likelihood of mudslides in areas with a steep slope.

Future Changes that May Impact Vulnerability

Understanding future changes that impact vulnerability in the County can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place.

Potential or Projected Development

Section 3 (County Profile) identifies areas targeted for future growth and development across the County. Any areas of growth in Broome County could be impacted by invasive species and infestation. Areas of recent and new development in individual jurisdictions are indicated in tabular form or on the hazard maps included in Volume II.

Projected Changes in Population

Although Broome County has experienced a decrease in its population since 2010, Cornell University's Program on Applied Demographics projects that the County will have a population of 186,950 by 2030 and 183,176 by 2040 (Cornell University 2018).

Changes in the density of the population and increased construction throughout the County to support future projected populations could lead to increased vulnerability of homes and other structures. Especially the increase of development near wetlands, forested areas, or agricultural lands. This can increase the risks of dying and decaying native trees and foliage. Once a tree is infested and decays, it is at risk of falling over or losing limbs which can damage homes and structures, ultimately impacting the health and safety of the population. Refer to Section 3 (County Profile), which includes a discussion on population trends for the County.

Climate Change

Climate change and invasive species are two of the top four drivers of global biodiversity loss, affecting production landscapes, crop yields, and the provision of ecosystem services (Masters and Norgrove 2010). Climate-induced stress in an ecosystem will facilitate invasive species infestations. As new species enter regions due to climate change, species hierarchy in ecosystems will begin to shift, leading to new dominants (Masters and Norgrove 2010). Invasive species infestations also can facilitate climate stress by increasing the ecosystems' susceptibility to climatic disturbance, through reducing the number of species and their functional types within an ecosystem.

Change of Vulnerability Since 2019 HMP

Overall, the County's vulnerability to invasive species has not changed since the 2019 HMP, and exposure and vulnerability to invasive species will continue throughout Broome County.

SECTION 4. RISK ASSESSMENT

4.3 HAZARD PROFILES

4.3.8 Severe Storm

This 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 severe storms in Broome County.

Hazard Profile

Hazard Description

For the 2024 plan update, the severe storm hazard include thunderstorms, lightning, hailstorms, high winds, tornadoes, and tropical cyclones. These types of severe storm events are discussed in the following section.

Thunderstorms

A thunderstorm is a local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder (NWS 2021). 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 from the equator to as far north as Alaska. Thunderstorms generally affect a small area when they occur, but they can become dangerous due to their ability to generate tornadoes, hailstorms, strong winds, flash flooding, and lightning. The National Weather Service (NWS) considers a thunderstorm severe only if it produces damaging wind gusts of 58 miles per hour (mph) or higher, large hail one inch in diameter or larger, or tornadoes (NWS 2021).

Lightning

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 are capable of producing lightning. Lightning ranks as one of the top weather killers in the nation, killing approximately 50 people and injuring hundreds each year. Lightning can occur anywhere there is a thunderstorm. Lightning can be cloud-to-air, cloud-to-cloud, or cloud to ground (NOAA 2014).

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 degrees Fahrenheit (°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 it

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

High winds, other than tornadoes, are experienced in all parts of the United States. The 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 with other severe storm events such as thunderstorms, tornadoes, hurricanes, and tropical storms (NWS 2012).

Tornadoes

A tornado is a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 300 mph. Damage paths can be greater than a mile in width and 50 miles in length. Tornadoes typically develop from either a severe thunderstorm or hurricane as cool air rapidly overrides a layer of warm air. The average speed of a tornado is 30 mph but may vary from nearly stationary to 70 mph. The lifespan of a tornado is rarely longer than 30 minutes (NOAA-NSSL n.d.).

Tropical Cyclones

Tropical cyclones are storm systems fueled by a heating mechanism such that, at any height in the atmosphere, the center of the cyclone is warmer than its surroundings—a phenomenon called "warm core" storm systems (NOAA 2011). This distinguishes tropical cyclones from other cyclonic windstorms, such as nor'easters and polar lows. Tropical cyclones strengthen when water evaporated from the ocean is released as the saturated air rises, resulting in condensation of water vapor from the moist air.

Tropical cyclones begin as disturbed areas of weather. As the storm organizes, it is designated as a tropical depression. When sustained winds in the cyclone reach 39 mph, it is designated as a tropical storm, which is characterized by a low-pressure center and numerous thunderstorms that produce strong winds and heavy rain. A tropical cyclone attains hurricane status when its wind speed reaches 74 mph or higher.

Tropical cyclones may develop in the Atlantic between the Lesser Antilles and the African coast or in the warm tropical waters of the Caribbean and Gulf of Mexico. These storms may move up the Atlantic coast of the United States and impact the eastern seaboard or move into the United States through the states along the Gulf Coast, bringing wind and rain as far north as New England before moving offshore and heading east (NOAA n.d.).

Location

All of Broome County is equally exposed to thunderstorms, lightning, hailstorms, high winds, tornadoes, and tropical cyclones. Despite Broome County's inland location, coastal storms, such as hurricanes and tropical storms, can impact the County from June to November, the official hurricane season of the eastern United States. However, they are most likely to occur during late July to early October when North

Atlantic Ocean waters are warmest (NOAA 2015). Although one of the most severe impacts associated with hurricanes is storm surge, due to Broome County's location, storm surge is not a concern for the County and is not detailed in this profile.

According to the Federal Emergency Management Agency (FEMA) Winds Zones of the United States map, Broome County is located in Wind Zone III where wind speeds can reach up to 200 mph. The information on the map is based on 40 years of tornado data and 100 years of hurricane data collected by FEMA.

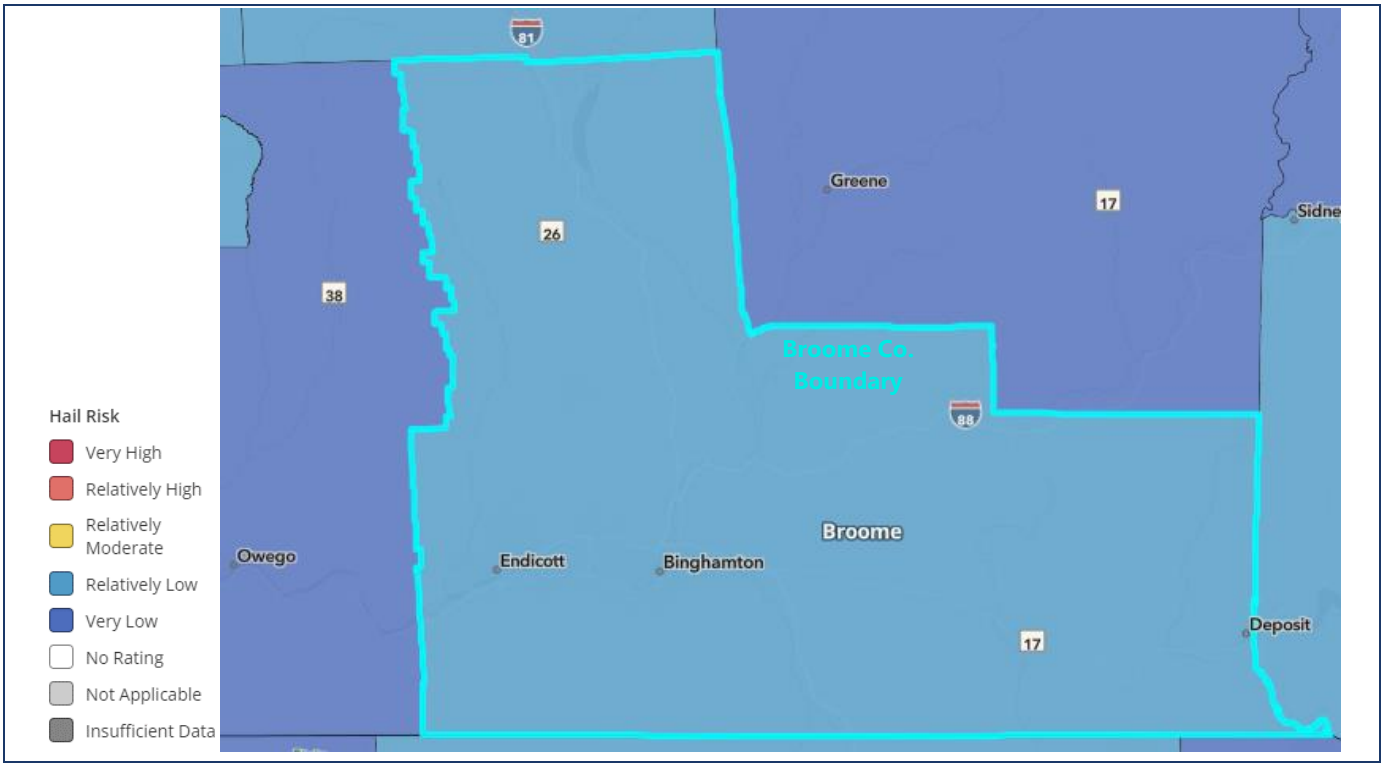
Figure 4.3.8-1 and Figure 4.3.8-2**Error! Reference source not found.** and **Error! Reference source not found.** show the Hail Risk Index for Broome County at the county and census tract scales, respectively. This index indicates the susceptibility of the County to hail. At the county scale, Broome County has a relatively low risk of hail; at the census tract scale, the County ranges from a very low risk to a relatively low risk (FEMA 2019).

Figure 4.3.8-3 and Figure 4.3.8-4 show the Strong Wind Risk Index for Broome County at the county and census tract scales, respectively. This index indicates the susceptibility of the County to strong winds. At the county scale, Broome County has a relatively low risk of strong winds; at the census tract scale, the County ranges from a very low risk to a relatively low risk (FEMA 2019).

Figure 4.3.8-5 and Figure 4.3.8-6 show the Tornado Risk Index for Broome County at the county and census tract scales, respectively. This index indicates the susceptibility of the County to tornadoes. At the county scale, Broome County has a relatively moderate risk of tornadoes; at the census tract scale, the County ranges from a relatively low risk to a relatively high risk (FEMA 2019).

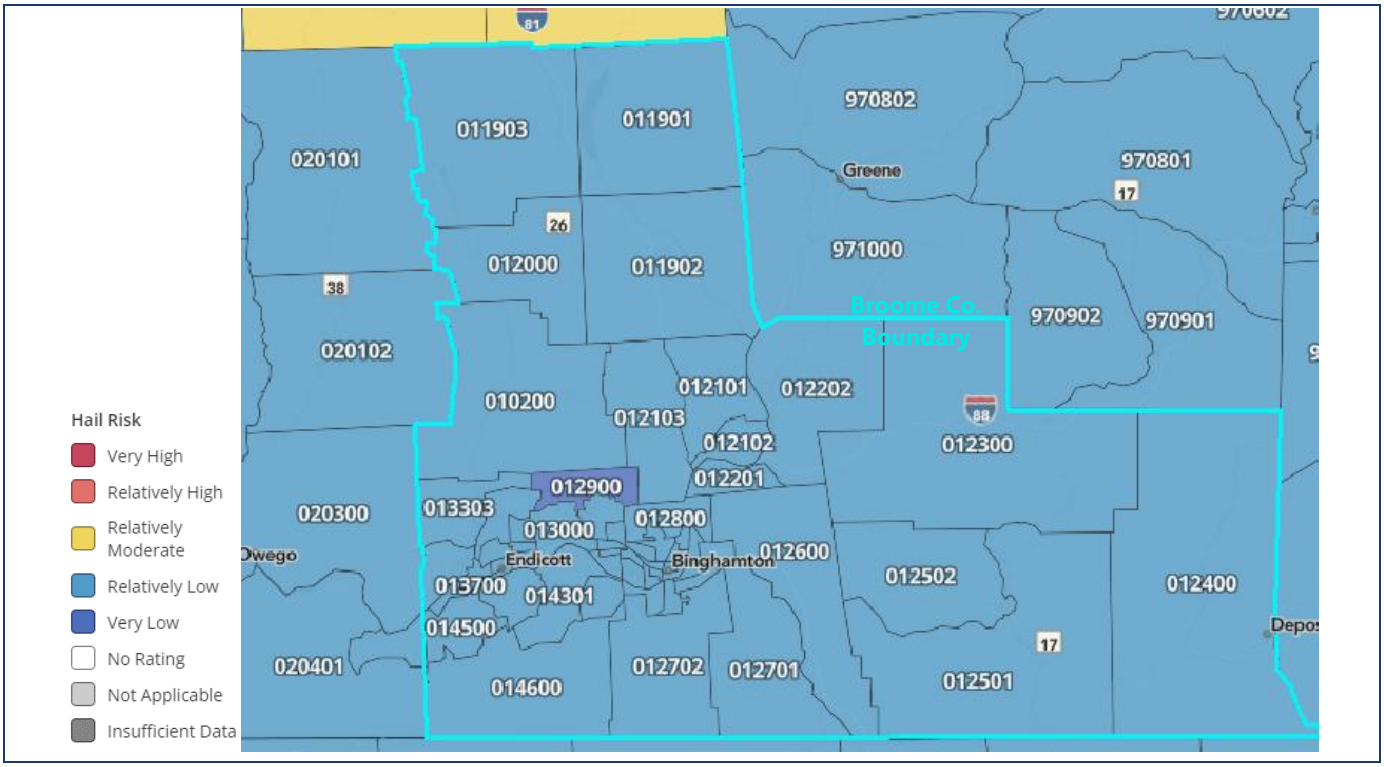
Figure 4.3.8-7 and Figure 4.3.8-8 show the Hurricane Risk Index for Broome County at the county and census tract scales, respectively. This index indicates the susceptibility of the County to hurricanes. At the county scale, Broome County has a relatively low risk of hurricanes; at the census tract scale, the County ranges from a very relatively low risk to a relatively moderate risk (FEMA 2019).

Figure 4.3.8-1. National Risk Index Hail Risk Index Score at the County Scale



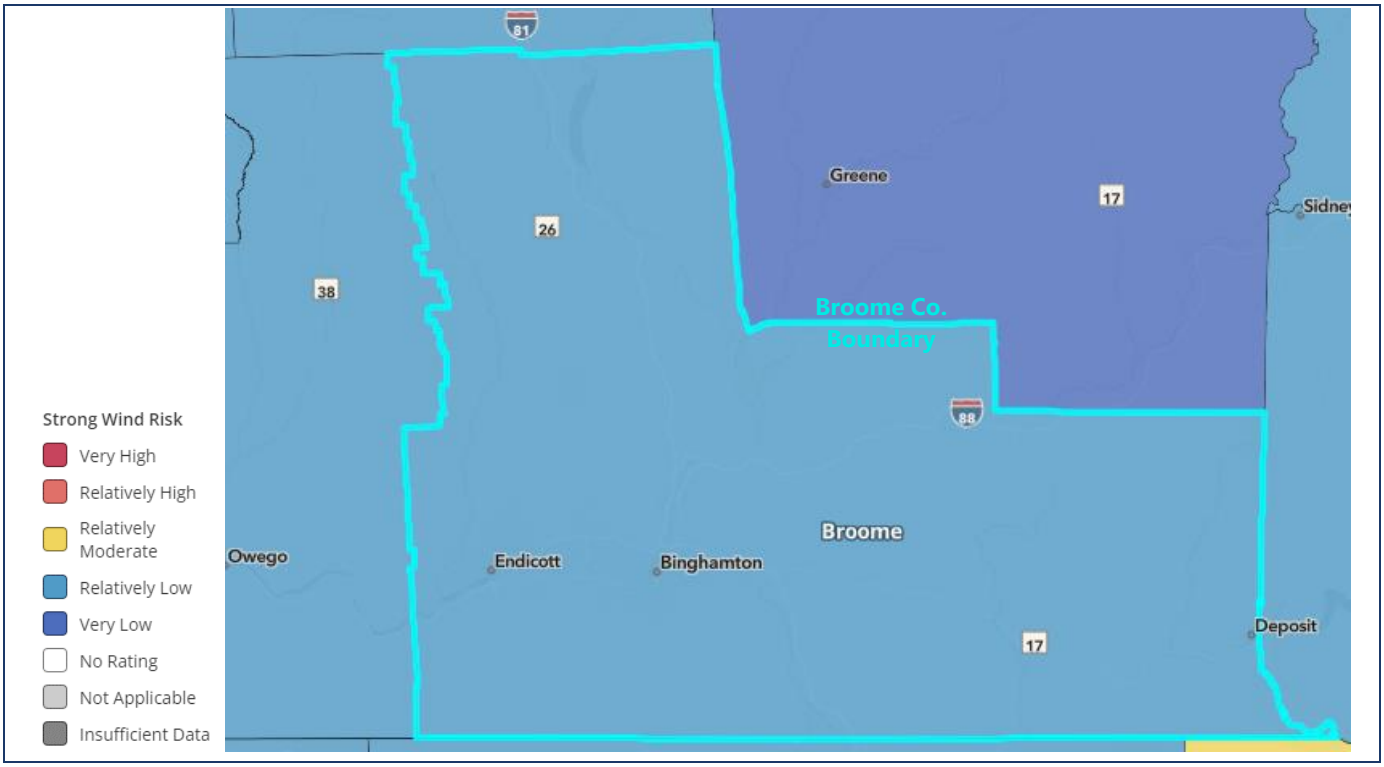
Source: FEMA 2019

Figure 4.3.8-2. National Risk Index Hail Risk Index Score at the Census Tract Scale



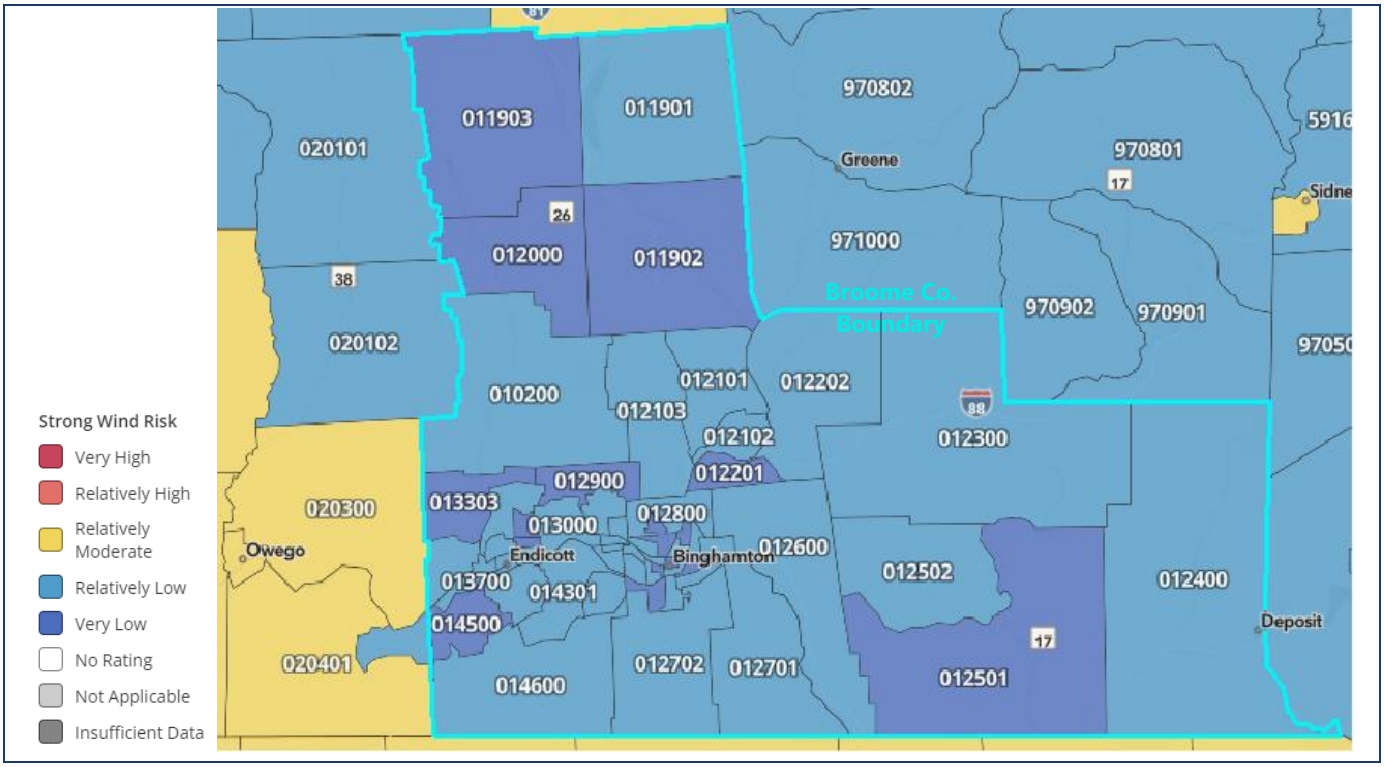
Source: FEMA 2019

Figure 4.3.8-3. National Risk Index Strong Wind Risk Index Score at the County Scale



Source: FEMA 2019

Figure 4.3.8-4. National Risk Index Strong Wind Risk Index Score at the Census Tract Scale

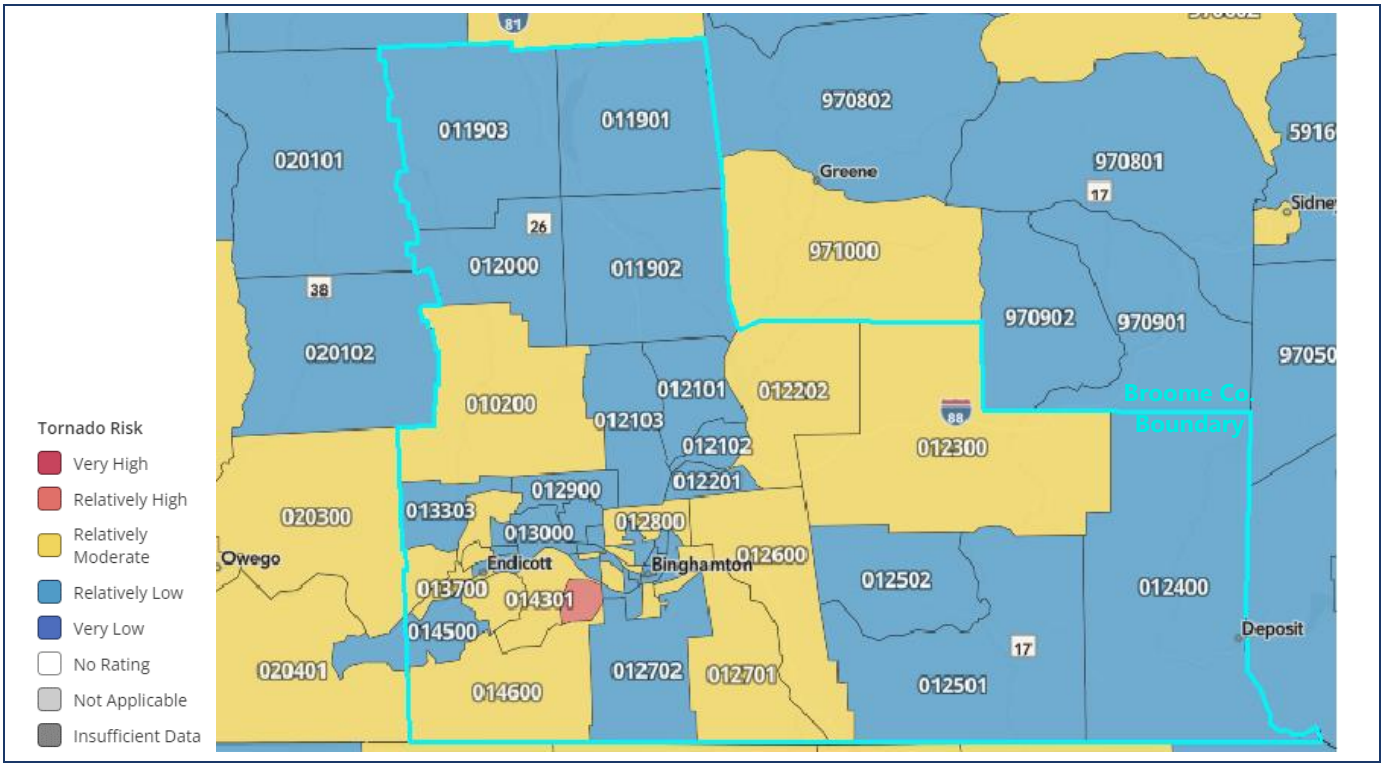


Source: FEMA 2019

Figure 4.3.8-5. National Risk Index Tornado Risk Index Score at the County Scale

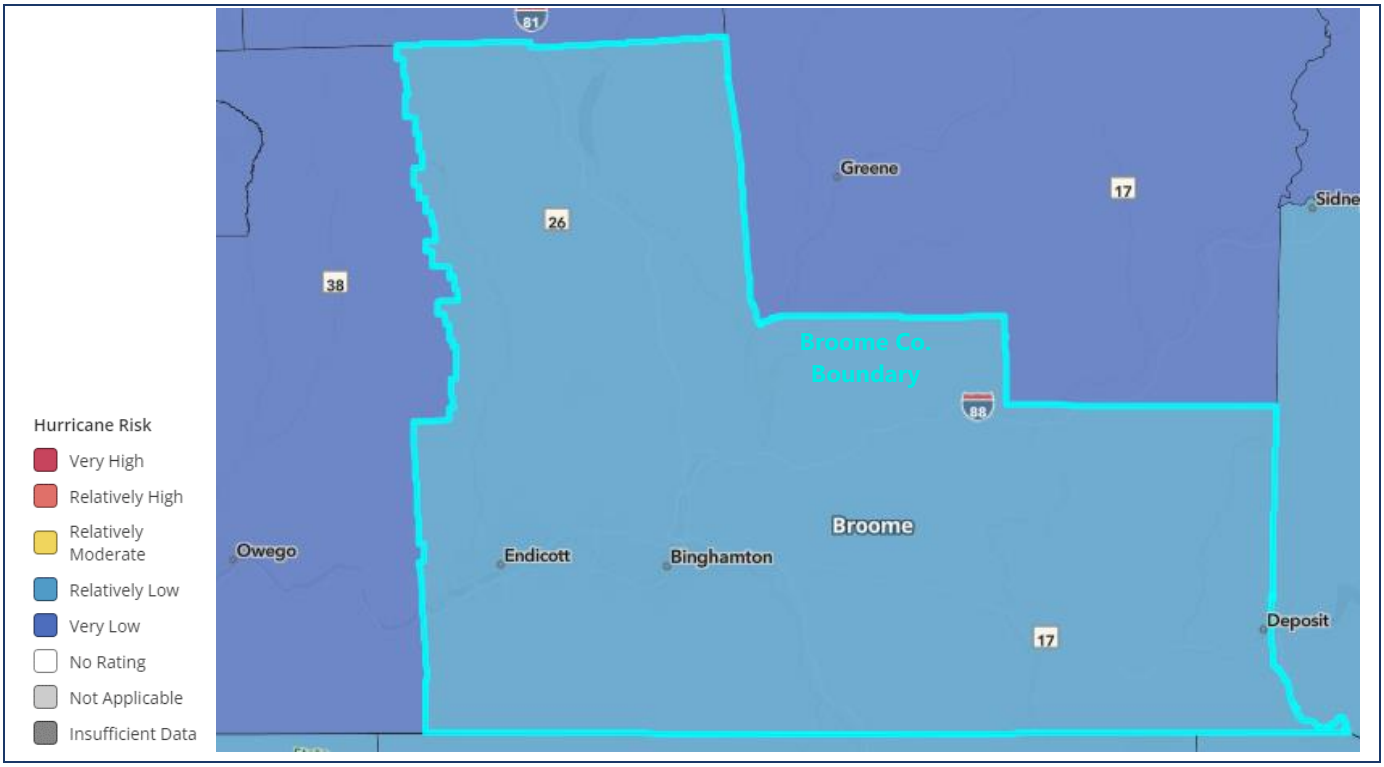
Source: FEMA 2019

Figure 4.3.8-6. National Risk Index Tornado Risk Index Score at the Census Tract Scale



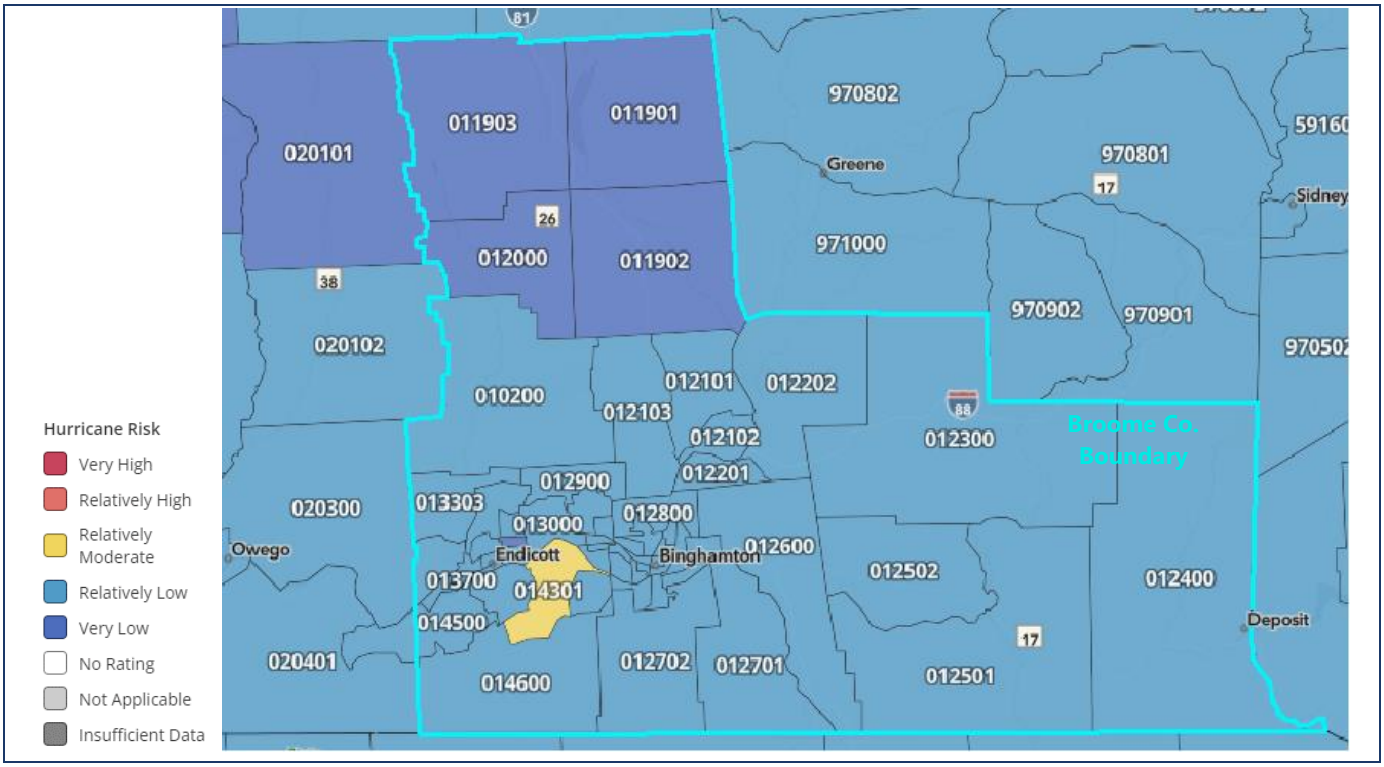
Source: FEMA 2019

Figure 4.3.8-7. National Risk Index Hurricane Risk Index Score at the County Scale



Source: FEMA 2019

Figure 4.3.8-8. National Risk Index Hurricane Risk Index Score at the Census Tract Scale



Source: FEMA 2019

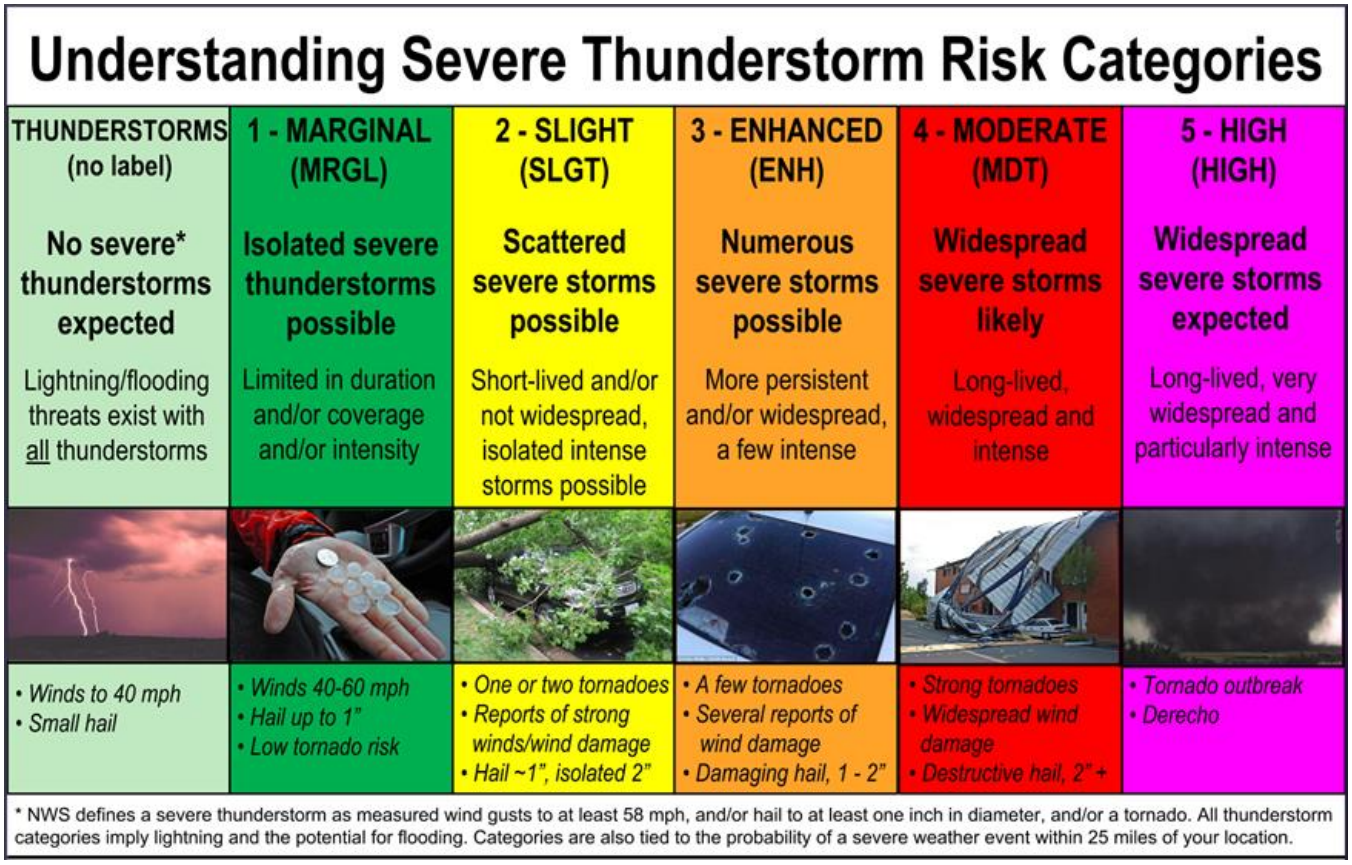
Extent

The extent (severity or magnitude) of a severe storm depends on the most damaging aspects of each type of severe storm. This section describes the extent of thunderstorms, lightning, hail, windstorms, tornadoes, and tropical cyclones in Broome County.

Thunderstorms

Severe thunderstorm watches and warnings are issued by the local NWS office and the Storm Prediction Center (SPC). **Error! Reference source not found.** describes the severe thunderstorm risk categories provided by the SPC.

Figure 4.3.8-9. Severe Thunderstorm Risk Categories



Source: NOAA SPC 2017

The NWS and SPC update their watches and warnings and notify the public when they are no longer in effect. NWS issues the following statements, watches, and warnings for thunderstorms (NWS 2020):

- **A Special Weather Statement** is issued for strong storms that are below severe levels but may have impacts. Usually reserved for the threat of wind gusts of 40 to 58 mph or small hail <1 inch.

- **Severe Thunderstorm Watch** is issued when severe thunderstorms with large hail, damaging winds, and/or tornadoes are possible, but the exact time and location of storm development is still uncertain. A watch means being prepared for storms.
- **Severe Thunderstorm Warning** is issued when a severe thunderstorm is imminent or occurring; it is either detected by weather radar or reported by storm spotters. A severe thunderstorm produces winds 58 mph or stronger and/or hail 1 inch in diameter or larger. A warning means to take shelter.

Lightning

Lightning is associated with moderate to severe thunderstorms. Lightning severity is determined by the frequency of lightning strikes during a storm. The New York City Office of Emergency Management notes that lightning strikes occur with moderate frequency in the State of New York, with 3.8 strikes occurring per square mile each year. Multiple devices are available to track and monitor the frequency of lightning (NYC Emergency Management 2023).

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 risks to people (DHSES 2019). The size of hail is estimated by comparing it to a known object, as shown on Figure 4.3.8-10. The Tornado and Storm Research Organization (TORRO) Hailstorm Intensity Scale (H0 to H10) relates typical damage and hail sizes.

High Winds

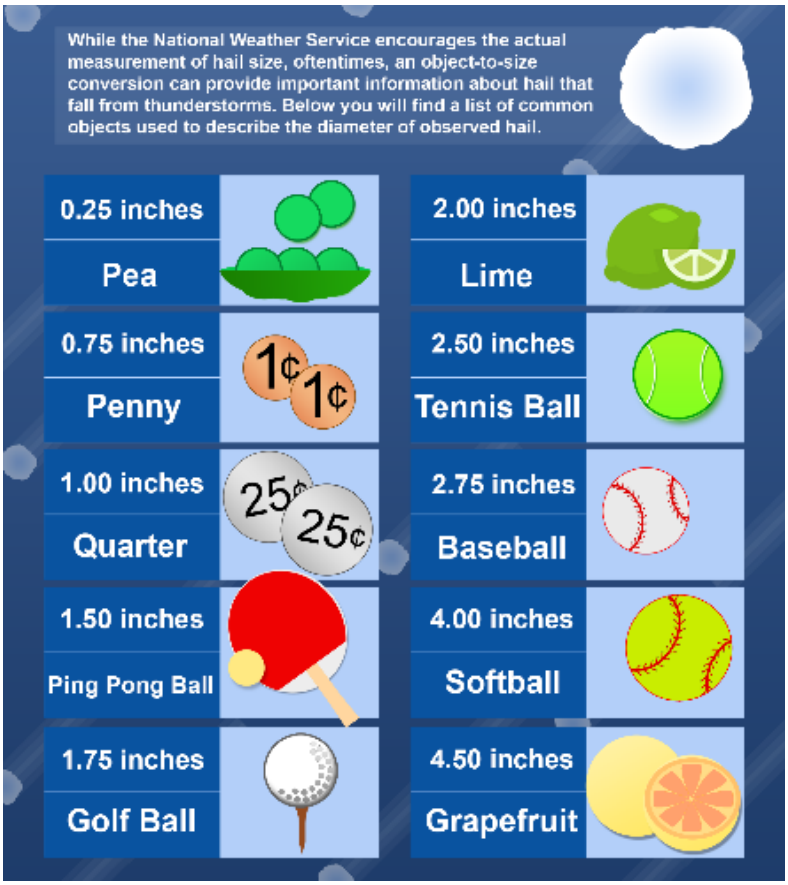
Table 4.3.8-1 provides the descriptions of winds and their associated sustained wind speed used by the NWS during wind-producing events. The Beaufort wind scale, developed in 1805, is still used today to classify wind conditions.

Table 4.3.8-1. NWS Wind Descriptions

Descriptive Term	Sustained Wind Speed (mph)
Strong, dangerous, or damaging	≥40
Very Windy	30-40
Windy	20-30
Breezy, brisk, or blustery	15-25
None	5-15 or 10-20
Light or light and variable wind	0-5

Source: NWS 2010

Figure 4.3.8-10. Hail Size Chart



The NWS issues site-specific high-wind advisories, watches, and warnings when wind speeds can pose a hazard or are life-threatening. The criteria vary from state to state. According to the NWS, wind warnings and advisories for New York State are as follows (NWS 2020):

- **High Wind Warnings** are issued when sustained wind speeds of 40 mph or greater lasting for one hour or longer or winds of 58 mph or greater for any duration or widespread damage are possible.
- **Wind Advisories** are issued when sustained winds of 30 to 39 mph for one hour or longer, or wind gusts of 46 to 57 mph for any duration are forecast.

Tornadoes

The magnitude or severity of a tornado is categorized using the Enhanced Fujita Tornado Intensity Scale (EF Scale). This scale determines tornado ratings by comparing wind speed and actual damage. Figure 4.3.8-11 illustrates the relationship between EF ratings, wind speed, and expected tornado damage.

Figure 4.3.8-11. Explanation of Enhanced Fujita Scale Ratings

EF Rating	Wind Speeds	Expected Damage	
EF-0	65-85 mph	'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.	
EF-1	86-110 mph	'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.	
EF-2	111-135 mph	'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.	
EF-3	136-165 mph	'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.	
EF-4	166-200 mph	'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.	
EF-5	> 200 mph	'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.	

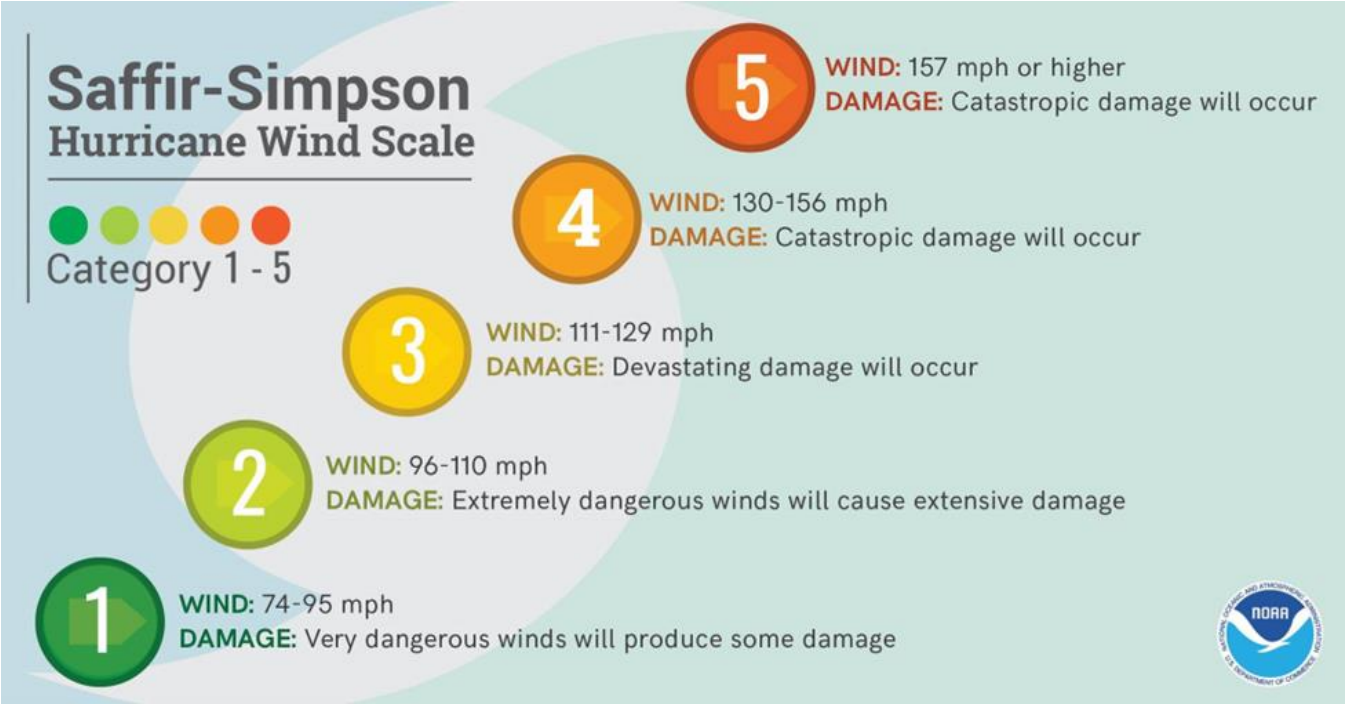
Source: NOAA 2020

Tornado watches and warnings are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar. The current average lead time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly that little, if any, advance warning is possible (FEMA n.d.).

Tropical Cyclones

Most tropical cyclones that impact Broome County are remnants of former tropical storms or hurricanes. Once a tropical cyclone becomes a hurricane, its severity is approximated using the Saffir-Simpson Hurricane Wind Scale (see Figure 4.3.8-12). The scale assigns a hurricane category rating of 1 to 5 based on a hurricane's sustained wind speed. It is used to estimate potential property damage and flooding expected when a hurricane makes landfall. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Tropical storms and Category 1 and 2 storms are still dangerous and require preventative measures (NOAA n.d.).

Figure 4.3.8-12. The Saffir-Simpson Scale



Source: NOAA 2020

Figure 4.3.8-13 and Figure 4.3.8-14 show the estimated maximum three-second gust wind speeds that can be anticipated in the study area associated with the 100- and 500-year mean return period (MRP) events. These peak wind speed projections were generated using FEMA's Hazus model for the 100- and 500-year wind event. The maximum 3-second gust wind speeds for Broome County range from 74 to 95 mph for both the 100-year and 500-year MRP event.

Previous Occurrences and Losses

This section presents the best available information on previous severe storm occurrences, impacts, and monetary losses in Broome County. Where multiple information sources were available, the results presented here were judged to be the most accurate and reliable. Citations are provided for each information source used.

FEMA Major Disasters and Emergency Declarations

Between 1953 and 2023, Broome County was included in 12 disaster (DR) or emergency (EM) declarations for severe storm-related events (see Table 4.3.8-2). These declarations can cover a wide region of the State and can apply to multiple counties at once. Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

Figure 4.3.8-13. Wind Speeds for the 100-Year Mean Return Period Event

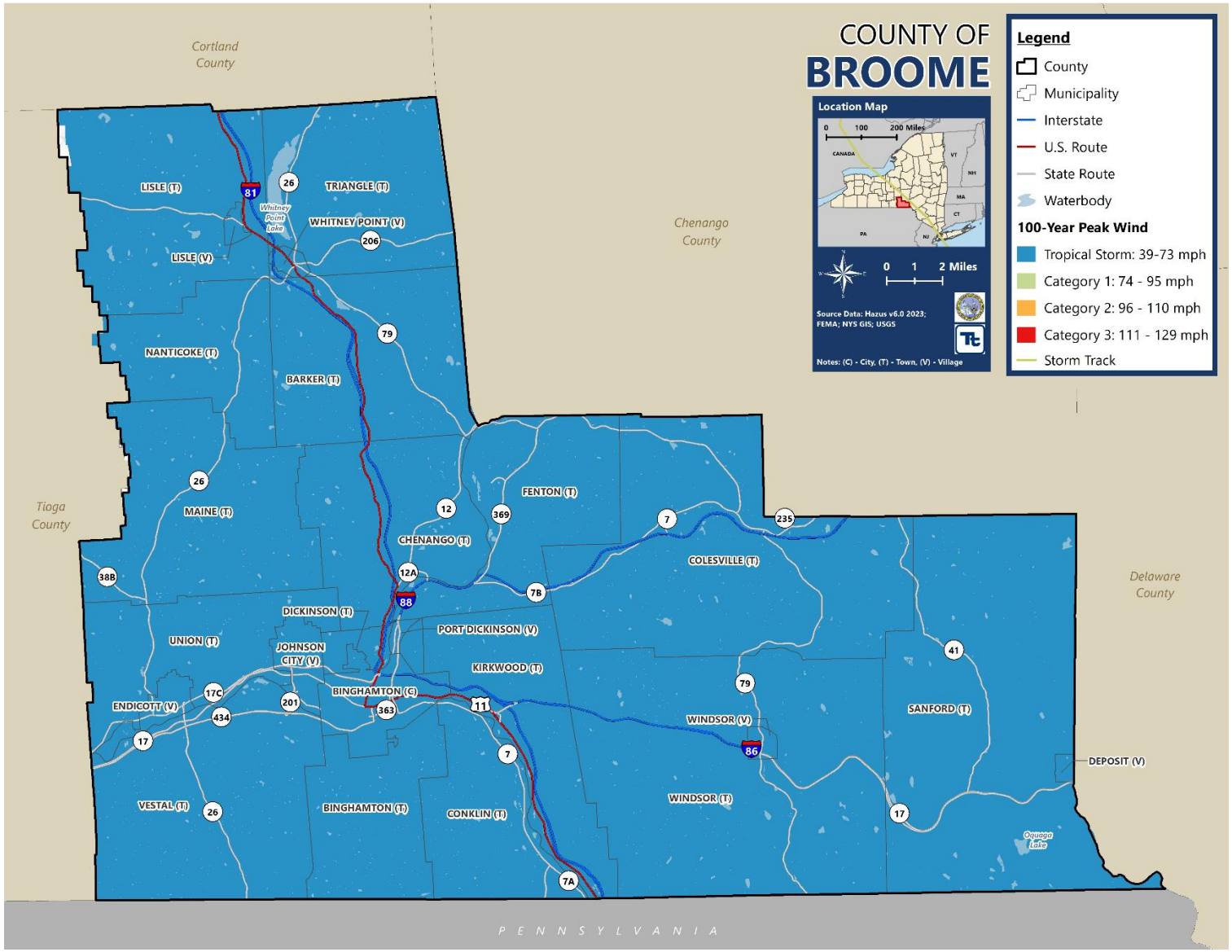


Figure 4.3.8-14. Wind Speeds for the 500-Year Mean Return Period Event

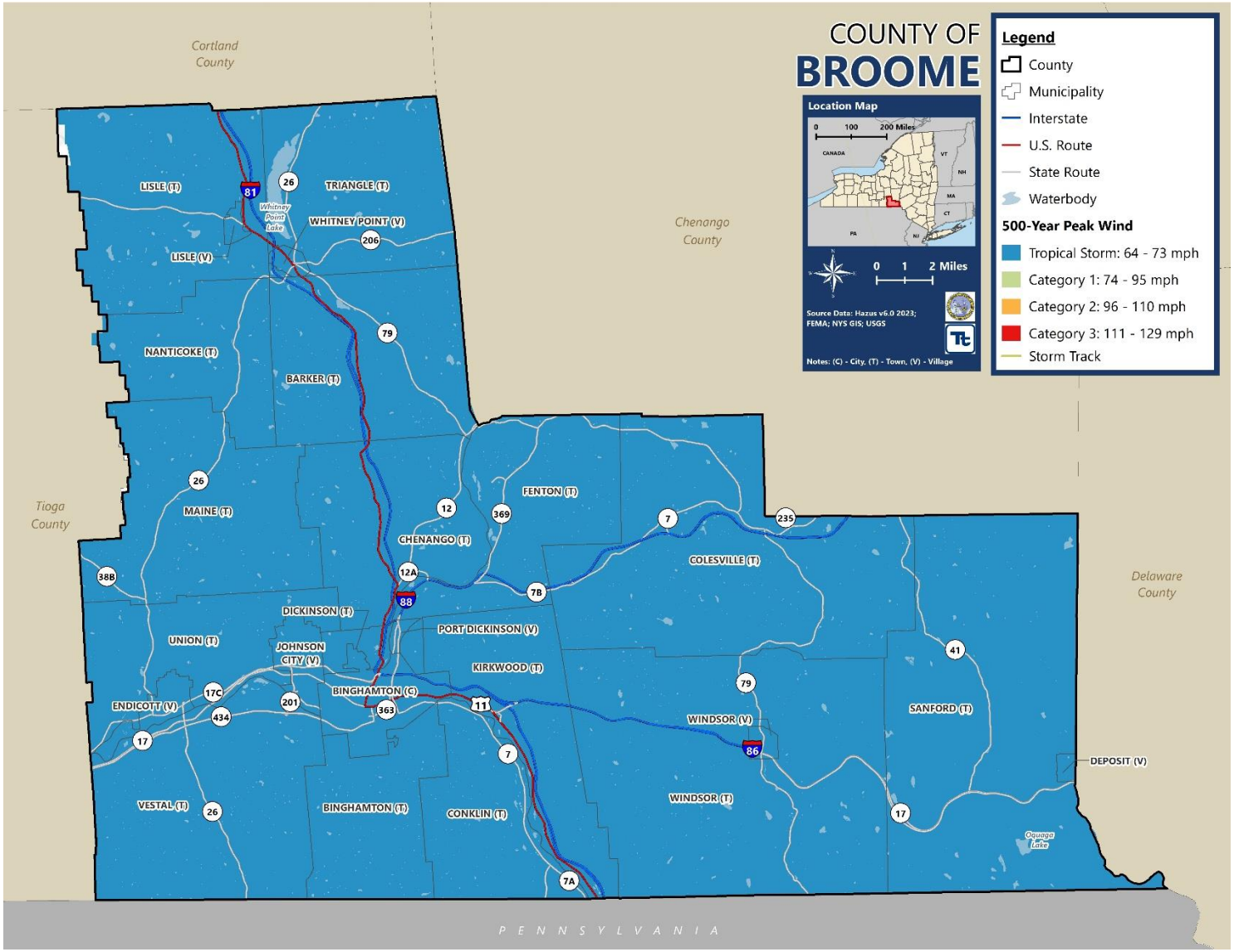


Table 4.3.8-2. FEMA Severe Storm Disaster Declarations in Broome County (1953 to 2023)

Date of Event	Event Type	FEMA Declaration Number	Broome County Included in Declaration?	Description
May 31 – June 2, 1998	Severe Storm	DR-1222-NY	Yes	Severe Storms and Tornados
May 13 – June 17, 2004	Severe Storm	DR-1534-NY	Yes	Severe Storms and Flooding
August 13 – September 16, 2004	Severe Storm	DR-1564-NY	Yes	Severe Storms and Flooding
September 16 – 24, 2004	Severe Storm	DR-1565-NY	Yes	Tropical Depression Ivan
April 2 – 4, 2005	Severe Storm	DR-1589-NY	Yes	Severe Storms and Flooding
August 29 – October 1, 2005	Hurricane	EM-3262-NY	Yes	Hurricane Katrina Evacuation
June 26 – July 10, 2006	Severe Storm	DR-1650-NY	Yes	Severe Storms and Flooding
September 16 – 17, 2006	Severe Storm	DR-1670-NY	Yes	Severe Storms and Flooding
September 7 – 11, 2011	Severe Storm	DR-4031-NY	Yes	Remnants of Tropical Storm Lee
September 7 – 11, 2011	Severe Storm	EM-3341-NY	Yes	Remnants of Tropical Storm Lee
October 27 – November 8, 2012	Hurricane	EM-3351-NY	Yes	Hurricane Sandy
August 21 – 24, 2021	Hurricane	EM-3565-NY	Yes	Hurricane Henri

Source: FEMA 2023

U.S. Department of Agriculture Declarations

The Secretary of 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 contiguous counties. Between 2019 and 2023, Broome County was not included in any severe storm-related agricultural disaster declarations.

Previous Events

Many sources provide information on previous occurrences and losses associated with severe storm events in Broome County. The 2019 HMP discussed specific severe storm events that occurred in the County through 2019. For this 2024 HMP update, severe storm events were summarized between January 1, 2019, and December 31, 2023, as listed in Table 4.3.8-3. Significant events include those that resulted in losses greater than $5,000 in property or crop damage or fatalities, as reported by the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI), events that led to a FEMA disaster declaration, and events that led to a USDA declaration.

Table 4.3.8-3. Severe Storm Events in Broome County (2019 to 2023)

Date of Event	Event Type	FEMA or USDA Declaration Number	Broome County Included in Declaration?	Location Impacted	Description
April 15, 2019	Thunderstorm/ Tornado	N/ A	N/ A	Entire County	Several thunderstorms came through the area and produced an EF1 tornado in the Port Crane/ Fenton/ Colesville area. Numerous trees and structures were knocked over and damaged. Property damage was documented at $110,000.
June 20, 2019	Thunderstorm Wind	N/ A	N/ A	Entire County	A thunderstorm uprooted several trees and snapped numerous branches along County Route 8 and Bull Hill Road. Maximum wind speeds were estimated to be 65 mph. Property damage was estimated to be $15,000.
July 19, 2019	Thunderstorm Wind	N/ A	N/ A	Entire County	Severe storms moved across the County and winds brought down trees and wires. Property damage was estimated to be $30,000.
August 8, 2019	Thunderstorm Wind	N/ A	N/ A	Entire County	Severe thunderstorms moved across the County and brought down trees and wires. Property damage was estimated to be $55,000.
August 15, 2019	Hail/ Thunderstorm Wind	N/ A	N/ A	Entire County	Severe thunderstorms moved across the County and produced hail up to ¾ of an inch in diameter. Property damage was estimated to be $20,000.
August 18, 2019	Thunderstorm Wind	N/ A	N/ A	Entire County	Severe thunderstorms moved across the County and winds knocked trees and wires down, damaging numerous houses. Property damage was estimated to be $50,000.
October 31, 2019	Thunderstorm Wind	N/ A	N/ A	Entire County	Severe thunderstorms and strong showers moved across the County and winds knocked over trees and wires, blocking off numerous roads. Property damage was estimated to be $25,000.
April 13, 2020	Thunderstorm Wind	N/ A	N/ A	Entire County	Severe thunderstorms and strong winds caused many trees and powerline damage. Property damage was estimated to be $30,000.
May 29, 2020	Thunderstorm Wind	N/ A	N/ A	Conklin, West Windsor	Severe thunderstorms brought down trees and wires along Carlin and Frost roads. Property damage was estimated to be $20,000.
June 18, 2020	Lightning	N/ A	N/ A	Binghamton, West Endicott	Lightning strikes caused a tree to catch fire in Binghamton and a house to catch fire in West Endicott. Property damage was estimated to be $15,000.

Date of Event	Event Type	FEMA or USDA Declaration Number	Broome County Included in Declaration?	Location Impacted	Description
July 19, 2020	Thunderstorm Wind	N/ A	N/ A	Maine, Castle Creek, Stella, Vestal, Binghampton, Sanitaria Springs	Severe thunderstorms brought down trees and wires along roads and on a car in Vestal. Property damage was estimated to be $50,000.
July 23, 2020	Thunderstorm Wind/ Lightning	N/ A	N/ A	Entire County	Strong thunderstorms produced tree and wire damage and lightning struck a tree and wires, which caused a fire off Old Vestal Road. Property damage was estimated to be $40,000.
August 11, 2020	Thunderstorm Wind	N/ A	N/ A	Windsor	A strong thunderstorm brought down a tree on Brown Road, leading to property damage of $5,000.
August 24-25, 2020	Thunderstorm Winds	N/ A	N/ A	Kettellville, Vestal, Nanticoke, Glen Aubrey	Strong thunderstorms moved through the County and produced severe tree and wire damage. Property damage was estimated to be $25,000.
August 27, 2020	Hail/ Thunderstorm Winds	N/ A	N/ A	Entire County	Strong thunderstorms produced strong winds that knocked down trees and power lines and produced 1-inch-sized hail. Property damage was estimated to be $55,000.
October 7, 2020	Thunderstorm Winds	N/ A	N/ A	Binghamton, Bible School Park	Strong thunderstorm winds brought down trees and powerlines along Martha Road and along Sunset Drive. Property damage was estimated to be $15,000.
July 6-7, 2021	Thunderstorm Winds/ Hail	N/ A	N/ A	Entire County	Strong thunderstorms produced 1-inch-sized hail and damaging winds which knocked down trees and wires. One storm had a microburst with winds estimated to be 80 mph. Property damage was estimated to be $99,500.
July 9, 2021	Thunderstorm Winds	N/ A	N/ A	Lisle, Chenango Bridge, Hinman Corner, Vestal Center	Strong thunderstorm winds knocked down trees and wires along roads, blocking access to some roads. Property damage was estimated to be $9,000.
July 20, 2021	Lightning	N/ A	N/ A	Belden	Lightning struck a house in Belden, setting the house on fire and incurring $20,000 in property damage.
July 27, 2021	Thunderstorm Winds	N/ A	N/ A	Entire County	Thunderstorm winds knocked down trees and wires. Wind gusts were measured at 51 knots. Property damage was documented at $9,250.

Date of Event	Event Type	FEMA or USDA Declaration Number	Broome County Included in Declaration?	Location Impacted	Description
March 7, 2022	Thunderstorm Winds	N/ A	N/ A	Entire County	Thunderstorm winds knocked down numerous trees and powerlines and damaged some personal property. Property damage was documented at $34,500.
May 16, 2022	Thunderstorm Winds/ Hail	N/ A	N/ A	Stella, Binghamton, Park Terrace, Port Crane, McClure	Thunderstorm winds knocked down numerous trees and wires and hail ranging from ¾ of an inch to 1.25 inches was reported. Property damage was estimated to be $6,500.
May 22, 2022	Thunderstorm Winds	N/ A	N/ A	West Corners, Union Center	Thunderstorm winds knocked down trees and uprooted several trees and wires along Farm to Market Road. Property damage was estimated to be $8,000.
June 1, 2022	Thunderstorm Winds/ Hail	N/ A	N/ A	Entire County	Hail sizes were documented to be up to 2.25 inches in diameter and damage was documented on some vehicles. The thunderstorm wind knocked down several trees onto roadways, vehicles, and houses. Property damage was estimated to be $16,000.
July 1, 2022	Thunderstorm Winds	N/ A	N/ A	Entire County	Strong thunderstorm winds knocked down trees onto roads and houses, which led to property damage estimated at $24,500.
July 24, 2022	Thunderstorm Winds	N/ A	N/ A	Whitney, Upper Lisle, Damascus, Gulf Summit	Strong thunderstorm winds knocked down trees along roads, which led to property damage estimated to be $15,200.
August 7, 2023	Tornado	N/A	N/A	Gulf Summit, McClure	An EF1 tornado touched down and moved into the Town of Sanford and resulted in residential damages. Property damage was estimated to be $15,000.

Sources: FEMA 2023; USDA 2023; NCEI 2023

Probability of Future Occurrence

For the 2024 HMP update, the most up-to-date data was collected to calculate the probability of future occurrence of severe storm events for the County. Information from FEMA, the National Hurricane Center, the NOAA-NCEI storm events database, the 2019 New York State HMP, and the 2019 Broome County HMP were used to identify the number of severe summer weather events that occurred between 1954 and 2023.

Based on the County's history of severe storm events, Broome County could experience at least 5 such events (of any type) every year (see Table 4.3.8-4 for more information). Based on these records and input

from the Planning Partnership, the probability of occurrence of the severe storm hazard in the County is considered to be "frequent".

Table 4.3.8-4. Probability of Future Severe Storm Events in Broome County

Hazard Type	Number of Occurrences Between 1954 and 2023	% Chance of Occurring in Any Given Year
Thunderstorm Wind	222	100%
Lightning	15	21.13%
Hailstorms	91	100%
High/Strong Winds	17	23.98%
Tornadoes	10	14.08%
Tropical Cyclones	0	0%
TOTAL	**355**	**100%**

Sources: FEMA 2023; USDA 2023

Note: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act and selected events since 1968. Due to limitations in data, not all severe storm events occurring between 1954 and 2023 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

Climate Change Impacts

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 Broome County, which includes the Southern Tier, is estimated that temperatures will increase by 4.4 to 6.3 ºF by the 2050s and 5.7 to 9.9ºF by the 2080s (baseline of 47.5 ºF, middle range projection). Precipitation totals are estimated to increase by 4 to 10 percent by the 2050s and 6 to 14 percent by the 2080s (baseline of 35.0 inches, middle range projection) (NYSERDA 2023).

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 to 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.

Impacts on Life, Health, and Safety

The entire population of Broome County (198,683) is exposed to this hazard; however, the impact these events can have on life, health, and safety is 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).

Overall Population

Lightning can be responsible for deaths, injuries, and property damage. Lightning-based deaths and injuries typically involve heart damage, inflated lungs, or brain damage, as well as loss of consciousness, amnesia, paralysis, and burns, depending on the severity of the strike. Most people struck by lightning survive, although they may have severe burns and internal damage. People located outdoors (i.e., recreational activities and farming) are considered most vulnerable to hailstorms, thunderstorms, and tornadoes because there is little to no warning, and shelter might not be available. Downed trees, damaged buildings, and debris carried by high winds from hurricanes, tropical storms, or tornadoes can lead to injury or loss of life.

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 and 500-year MRP events.

Socially Vulnerable Populations

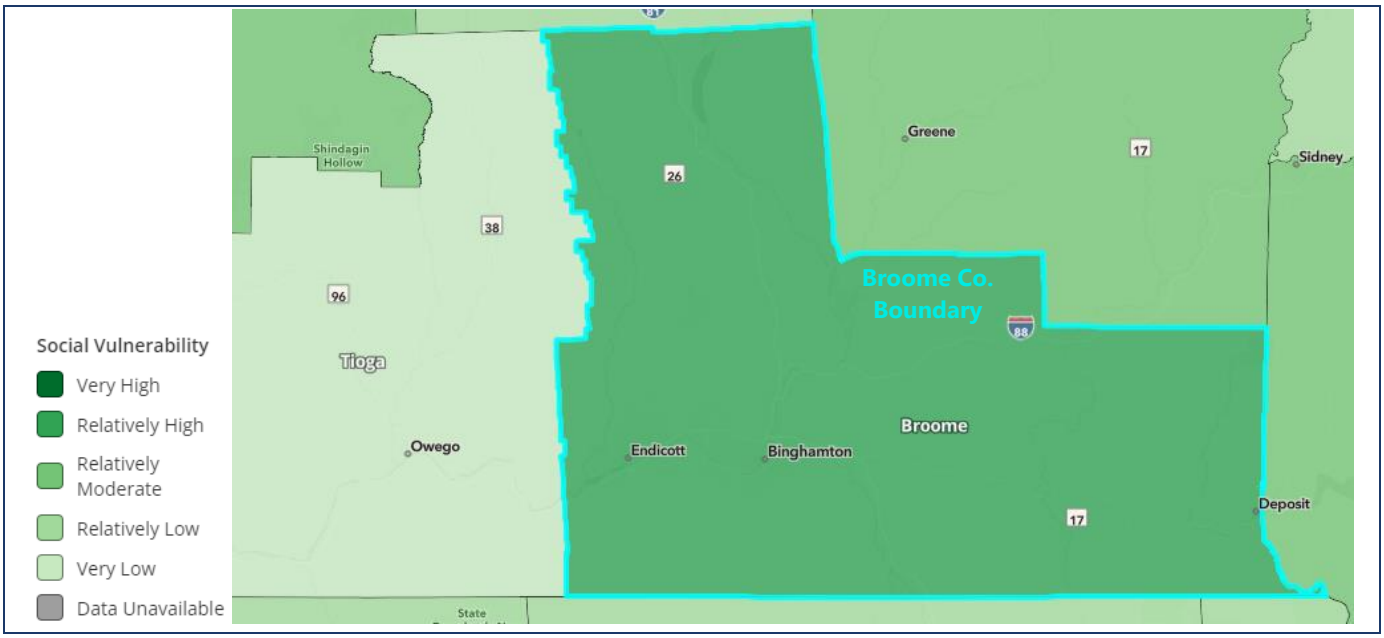
Socially vulnerable populations are most susceptible due to their physical and financial ability to react and respond during extremely severe summer weather. This population includes the elderly, young, and individuals with disabilities or access or functional needs who may be unable to evacuate in the 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 on these populations.

Economically disadvantaged people are at high risk for severe summer weather 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 2017-2021 American Community Survey for Broome County, there are 52,060 persons over the age of 65, 27,605 persons under the age of five, 26,990 non-English speakers, 29,008 persons with a disability, and 49,451 living in poverty. Figure 4.3.8-15 shows the FEMA National Risk Inventory's Social Vulnerability Index for the County of Broome, which is identified as "relatively high."

Figure 4.3.8-15. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA 2019

Impacts on General Building Stock

All buildings are exposed to severe storm hazards such as hailstorms and lightning strikes. An extreme hailstorm event can carry hail stones traveling at speeds greater than 100 miles per hour. This could cause structural damage to 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 United States between 2007 and 2011, which was valued at approximately $450 million of damage per year (NFPA 2013).

Potential building damage was evaluated by Hazus across the following damage categories: none, slight, moderate, extensive, and complete. Table 4.3.8-5 provides definitions of these categories of damage for a light wood-framed building. Definitions for other building types are included in the Hazus technical manual documentation.

Table 4.3.8-5. 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 cracks across shear wall panels or large cracks at plywood joints; lateral movement of floors and roof; toppling of 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	A 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; and large foundation cracks.

Source: FEMA 2022

The Hazus results of potential damage states for buildings in Broome County categorized by general occupancy classes (i.e., residential, commercial, industrial, etc.) are summarized in Table 4.3.8-6 for the 100-year MRP event. Hazus estimates that there will be $2,334,107 in damage to structures caused by the 100-year MRP event, with the estimated residential damage being the most expensive at $2,318,684, or 99.3 percent of the total damage. Table 4.3.8-7 summarizes the damage to structures for the 500 MRP event, which estimates that there will be $17,633,366 in damage to structures caused by the 500-year MRP event, with the estimated residential damage being the most expensive at $15,839,186, or 89.8 percent of the total damage.

Table 4.3.8-6. Estimated Building Losses Caused by the 100-Year Mean Return Period Hurricane by Occupancy

Jurisdiction	Estimated Building Losses Caused by the 100-Year Mean Return Period Hurricane	Estimated Building Losses Caused by the 100-Year Mean Return Period Hurricane for Residential Structures Only	Estimated Building Losses Caused by the 100-Year Mean Return Period Hurricane for Commercial Structures Only	Estimated Building Losses Caused by the 100-Year Mean Return Period Hurricane for All Other Occupancies Structures
Barker (T)	$87,324	$87,324	$0	$0
Binghamton (C)	$132,224	$132,224	$0	$0
Binghamton (T)	$135,054	$135,054	$0	$0
Chenango (T)	$252,858	$252,858	$0	$0
Colesville (T)	$355,093	$346,285	$3,969	$4,838
Conklin (T)	$80,926	$80,926	$0	$0
Deposit (V)	$102,531	$100,865	$989	$678
Dickinson (T)	$38,161	$38,161	$0	$0
Endicott (V)	$0	$0	$0	$0
Fenton (T)	$158,499	$158,499	$0	$0
Johnson City (V)	$60	$60	$0	$0
Kirkwood (T)	$124,852	$124,852	$0	$0
Lisle (T)	$31,822	$31,822	$0	$0
Lisle (V)	$3,865	$3,865	$0	$0
Maine (T)	$88,518	$88,518	$0	$0
Nanticoke (T)	$21,537	$21,537	$0	$0
Port Dickinson (V)	$22,495	$22,495	$0	$0
Sanford (T)	$305,292	$300,343	$2,936	$2,013
Triangle (T)	$71,940	$71,940	$0	$0
Union (T)	$18,549	$18,549	$0	$0
Vestal (T)	$880	$880	$0	$0
Whitney Point (V)	$34,544	$34,544	$0	$0
Windsor (T)	$229,663	$229,663	$0	$0
Windsor (V)	$37,419	$37,419	$0	$0
Broome County (Total)	**$2,334,107**	**$2,318,684**	**$7,894**	**$7,529**

Source: Hazus v6.0

Table 4.3.8-7. Estimated Building Losses Caused by the 500-Year Mean Return Period Hurricane by Occupancy

Jurisdiction	Estimated Building Losses Caused by the 500-Year Mean Return Period Hurricane	Estimated Building Losses Caused by the 500-Year Mean Return Period Hurricane for Residential Structures Only	Estimated Building Losses Caused by the 500-Year Mean Return Period Hurricane for Commercial Structures Only	Estimated Building Losses Caused by the 500-Year Mean Return Period Hurricane for All Other Occupancies Structures
Barker (T)	$271,123	$267,525	$1,736	$1,861
Binghamton (C)	$2,142,810	$1,802,749	$244,741	$95,320
Binghamton (T)	$643,201	$638,350	$2,517	$2,334
Chenango (T)	$1,238,145	$1,162,295	$66,497	$9,352
Colesville (T)	$404,386	$395,473	$4,030	$4,882
Conklin (T)	$596,722	$559,012	$23,848	$13,862
Deposit (V)	$60,481	$58,814	$989	$678
Dickinson (T)	$249,359	$229,795	$2,501	$17,063
Endicott (V)	$634,432	$570,463	$38,620	$25,350
Fenton (T)	$596,263	$577,496	$6,333	$12,434
Johnson City (V)	$1,048,032	$594,541	$424,383	$29,108
Kirkwood (T)	$563,480	$502,521	$36,808	$24,151
Lisle (T)	$278,984	$275,147	$1,120	$2,717
Lisle (V)	$33,998	$33,532	$136	$330
Maine (T)	$728,840	$698,684	$24,869	$5,288
Nanticoke (T)	$194,469	$191,957	$1,352	$1,160
Port Dickinson (V)	$146,143	$135,036	$1,344	$9,763
Sanford (T)	$181,204	$176,228	$2,944	$2,033
Triangle (T)	$207,777	$199,381	$2,946	$5,450
Union (T)	$3,625,136	$3,342,974	$83,462	$198,700
Vestal (T)	$3,086,188	$2,739,914	$258,790	$87,484
Whitney Point (V)	$99,682	$95,648	$1,415	$2,619
Windsor (T)	$511,953	$502,771	$2,625	$6,557
Windsor (V)	$90,559	$88,880	$487	$1,192
Broome County (Total)	**$17,633,366**	**$15,839,186**	**$1,234,493**	**$559,687**

Source: Hazus v6.0

Building damage as a result of the 100-year and 500-year MRP hurricanes was estimated for each municipality using Hazus. Table 4.3.8-8 summarizes estimated total building and content losses caused by the 100-year and 500-year MRP event by building occupancy class. For the 100-year MRP event, up to 12 buildings will have minor damage. The majority of the losses are estimated at the commercial occupancy class. For the 500-year MRP event, up to 98 buildings will have minor damage. The majority of the losses are estimated for the residential occupancy class.

Table 4.3.8-8. Estimated Damage (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 Mean Return Period Hurricane		500-Year Mean Return Period 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	88,869	100.0%	88,803	99.9%
		MINOR	2	<0.1%	68	0.1%
		MODERATE	0	0.0%	0	0.0%
		SEVERE	0	0.0%	0	0.0%
		DESTRUCTION	0	0.0%	0	0.0%
Commercial Buildings	4,971	NONE	4,424	99.8%	4,409	99.5%
		MINOR	7	0.2%	22	0.5%
		MODERATE	0	0.0%	0	0.0%
		SEVERE	0	0.0%	0	0.0%
		DESTRUCTION	0	0.0%	0	0.0%
Industrial Buildings	1,154	NONE	507	99.8%	505	99.5%
		MINOR	1	0.2%	3	0.5%
		MODERATE	0	0.0%	0	0.0%
		SEVERE	0	0.0%	0	0.0%
		DESTRUCTION	0	0.0%	0	0.0%
Government, Religion, Agricultural, and Education Buildings	2,131	NONE	1,319	99.9%	1,316	99.6%
		MINOR	2	0.1%	5	0.4%
		MODERATE	0	0.0%	0	0.0%
		SEVERE	0	0.0%	0	0.0%
		DESTRUCTION	0	0.0%	0	0.0%

Source: Hazus v6.0

Impacts 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 EMS will not be able to effectively respond in a power loss event to maintain the safety of residents 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 severe storm hazards, with risks similar to those discussed for the general building stock. Critical facilities must 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 Volume II.

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 Broome County for the 100-year and 500-year MRP events. For the 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, and fire stations will have the greatest chance of moderate damage. As a result of a 500-year MRP event, Hazus estimates that police stations have the greatest chance of sustaining minor damage, and fire stations will have the greatest chance of moderate damage. Table 4.3.8-9 and Table 4.3.8-10 summarize the damage state probabilities for critical facilities during the 100-year and 500-year MRP events, respectively.

Table 4.3.8-9. Estimated Critical Facilities Damage for the 100-Year MRP Hurricane Event

Facility Type	Loss of Days	Percent-Probability of Sustaining Damage			
		Minor	Moderate	Severe	Complete
Medical Facilities	0	0.0% - 0.1%	0.0%	0.0%	0.0%
Police Stations	0	0.0% - 0.3%	0.0%	0.0%	0.0%
Fire Stations	0	0.0% - 0.2%	0.0% - <0.1%	0.0%	0.0%
Schools	0	0.0% - 0.2%	0.0%	0.0%	0.0%
Emergency Operations Center	0	0.3%	0.0%	0.0%	0.0%

Source: Hazus v6.0

Table 4.3.8-10. Estimated Critical Facilities Damage for the 500-Year MRP Hurricane Event

Facility Type	Loss of Days	Percent-Probability of Sustaining Damage			
		Minor	Moderate	Severe	Complete
Medical Facilities	0	0.1% - 0.2%	0.0%	0.0%	0.0%
Police Stations	0	0.5% - 0.6%	0.0%	0.0%	0.0%
Fire Stations	0	0.2% - 0.3%	0.0% - <0.1%	0.0%	0.0%
Schools	0	0.2% - 0.4%	0.0%	0.0%	0.0%
Emergency Operations Center	0	0.5%	0.0%	0.0%	0.0%

Source: Hazus v6.0

Impacts on the Economy

Severe weather events can have short- and long-term 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 or replacement of buildings. Impacts on transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting and goods transport) transportation needs. 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 heating or cooling service 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 4.3.8-11. There are no predicted income, wage, or rental losses for the 100-year or 500-year MRP events. The building losses for the 100-year MRP event are $2,334,110, which is 13.2 percent of the 500-year MRP event's $17,633,370 in building losses.

Table 4.3.8-11. Total Business Interruption Loss (in Thousands of Dollars)

Mean Return Period (MRP)	Total Business Interruption Loss (in Thousands of Dollars)				
	Income Loss	Relocation Loss	Building Losses	Wages Losses	Rental Losses
100-Year	$0	$0	$2,334,110	$0	$0
500-Year	$0	$100	$17,633,370	$0	$0

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).

Hazus also estimates the volume of debris that may be generated because of a hurricane event. For the 100-year MRP event, Hazus estimates that over 31,000 tons of debris will be generated. For the 500-year MRP event, Hazus estimates that over 52,000 tons of debris will be generated countywide. Table 4.3.8-12 and Table 4.3.8-13 summarize the estimated debris generated because of these events by the municipality, respectively.

Table 4.3.8-12. Estimated Debris Created During the 100-Year MRP Hurricane Wind Event

Jurisdiction	Estimated Debris Created During the 100-Year Mean Return Period Hurricane Wind Event			
	Brick and Wood (tons)	Concrete and Steel (tons)	Tree (tons)	Eligible Tree Volume (cubic yards)
Barker (T)	0	0	1,335	1,202
Binghamton (C)	0	0	33	285
Binghamton (T)	0	0	801	961
Chenango (T)	0	0	1,101	2,370
Colesville (T)	6	0	2,535	2,283
Conklin (T)	0	0	799	1,277
Deposit (V)	2	0	3,663	2,564
Dickinson (T)	0	0	98	410
Endicott (V)	0	0	0	0
Fenton (T)	0	0	1,063	1,703
Johnson City (V)	0	0	0	1
Kirkwood (T)	0	0	992	1,488
Lisle (T)	0	0	1,339	1,205
Lisle (V)	0	0	163	147
Maine (T)	0	0	1,449	1,595
Nanticoke (T)	0	0	779	778
Port Dickinson (V)	0	0	58	244
Sanford (T)	6	0	10,892	7,626
Triangle (T)	0	0	859	773
Union (T)	0	0	5	6
Vestal (T)	0	0	5	6
Whitney Point (V)	0	0	412	371
Windsor (T)	0	0	2,680	2,270
Windsor (V)	0	0	282	268
Broome County (Total)	**14**	**0**	**31,344**	**29,832**

Source: Hazus v6.0
Note: These values are rounded to the nearest whole value.

Table 4.3.8-13. Estimated Debris Created During the 500-Year MRP Hurricane Wind Event

Jurisdiction	Estimated Debris Created During the 500-Year Mean Return Period Hurricane Wind Event			
	Brick and Wood (tons)	Concrete and Steel (tons)	Tree (tons)	Eligible Tree Volume (cubic yards)
Barker (T)	4	0	2,671	2,403
Binghamton (C)	365	0	583	5,108
Binghamton (T)	8	0	3,235	3,878
Chenango (T)	24	0	2,761	5,683
Colesville (T)	6	0	2,541	2,292
Conklin (T)	27	0	1,602	2,559
Deposit (V)	0	0	1,465	1,026
Dickinson (T)	11	0	305	1,247
Endicott (V)	87	0	145	895
Fenton (T)	6	0	2,128	3,405
Johnson City (V)	118	0	114	1,025
Kirkwood (T)	18	0	2,975	4,463
Lisle (T)	12	0	2,679	2,411
Lisle (V)	2	0	327	294
Maine (T)	8	0	4,349	4,784
Nanticoke (T)	9	0	2,335	2,335
Port Dickinson (V)	6	0	174	731
Sanford (T)	1	0	4,376	3,066
Triangle (T)	13	0	1,717	1,545
Union (T)	128	0	2,335	7,298
Vestal (T)	113	0	5,869	9,683
Whitney Point (V)	6	0	823	741
Windsor (T)	1	0	5,361	4,540
Windsor (V)	0	0	563	536
Broome County (Total)	**974**	**0**	**51,433**	**71,948**

Source: Hazus v6.0
Note: These values are rounded to the nearest whole value.

Impacts 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 they impact 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 the 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 Broome County. Refer to Section 4.3.2 (Disease Outbreak) for more information about these stressors.

Cascading Impacts on Other Hazards

Severe weather events and severe wind events can escalate flooding and utility failure impacts. Severe winds can be destructive to the functionality of utilities by breaching power lines and disconnecting the utility systems. Some severe storms may also negatively impact the structural integrity of dams and can lead to dam failures. Severe weather may carry extreme rainfall that could exacerbate flooding and contribute to erosion and landslides. Tropical storms and hurricanes can result in storm surge events that result in significant coastal flooding. More information about flooding can be found in Section 4.3.6 of this HMP.

Future Changes That May Impact Vulnerability

Understanding future changes that affect vulnerability can assist in planning for future development and ensure the establishment of appropriate mitigation, planning, and preparedness measures.

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 the Population

Broome County has experienced a slight decrease in its population since 2010. According to the U.S. Census Bureau, the County's population decreased by approximately 1 percent between 2010 and 2020 (U.S. Census 2023). Cornell University's Program on Applied Demographics projects Broome County will have a population of 186,950 by 2030 and 183,176 by 2040 (Cornell University 2018).

Changes in the density of the population can impact the number of persons exposed to severe storm events. Refer to Section 3 (County Profile), which includes a discussion on population trends for the County.

Climate Change

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 climate changes 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, transportation delays, accidents, and inconveniences.

Change of Vulnerability Since 2019 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, there can be increased risk from failed utility and transportation systems if they are not properly maintained and do not adapt to the changing environment. Since the 2019 HMP, an updated version of Hazus was released. This updated model includes longer historical wind events to pull from to generate probabilistic events.

SECTION 4. RISK ASSESSMENT

4.3 HAZARD PROFILES

4.3.9 Winter Storm

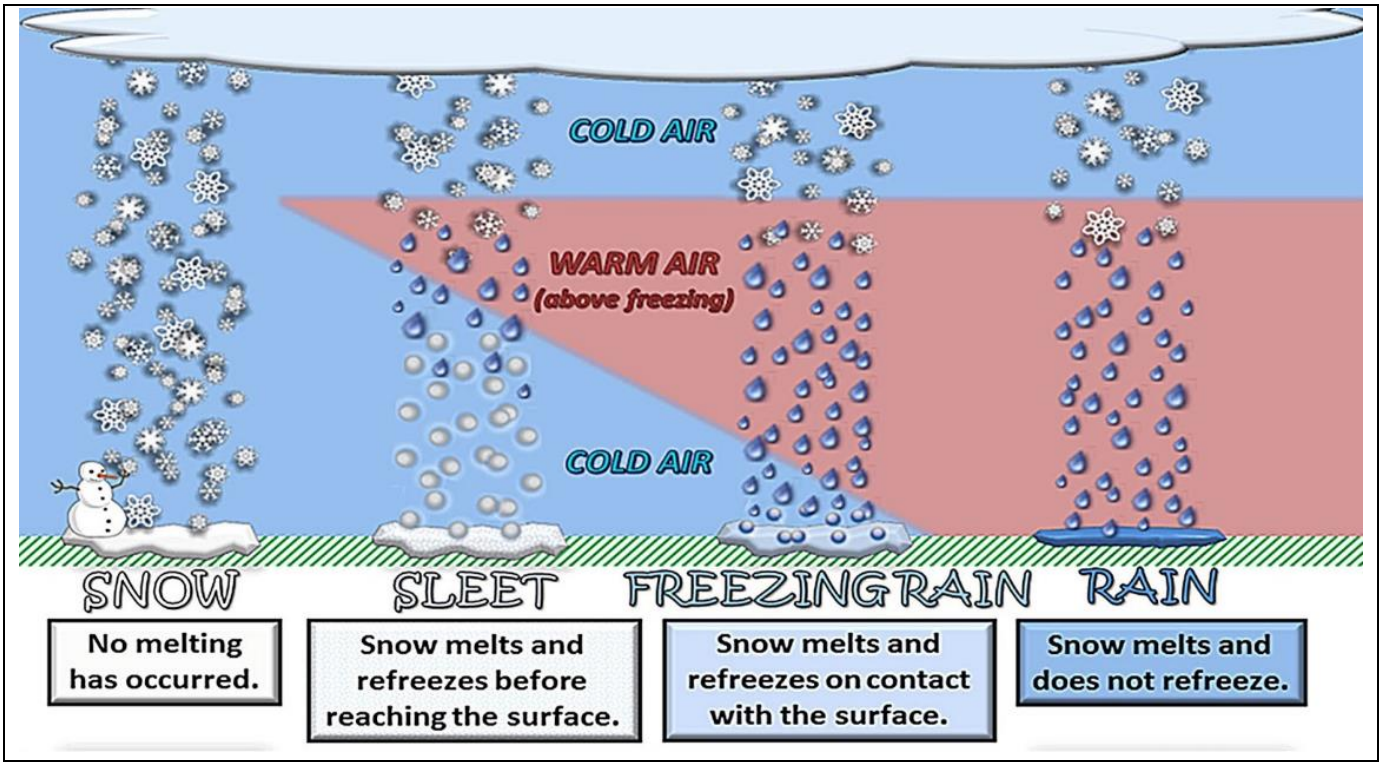
This section provides the hazard profile (hazard description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment for winter storms in Broome County.

Hazard Profile

Hazard Description

A winter storm is a weather event in which the main types of precipitation are snow, sleet, or freezing rain. It can include a combination of heavy snow, blowing snow, and dangerous wind chills. As shown in Figure 4-1, different air and surface temperatures produce conditions that are ideal for different types of precipitation associated with winter storms.

Figure 4-1. Winter Precipitation



Source: NOAA n.d

The following basic components are needed to make a winter storm (NOAA 2021):

- Moisture to form clouds and precipitation, such as may be attained by air blowing across a large lake or the ocean.
- Something to raise moist air to form clouds and cause precipitation, such as warm air colliding with cold air and being forced to rise over the cold dome or air flowing up a mountainside.
- Below-freezing temperatures in the clouds and near the ground to make snow and ice.

Broome County's winter storms include blizzards, snowstorms, and ice storms. These storms can immobilize an entire region or affect only a single community. The aftermath of a winter storm can affect a community or region for days, weeks, or even months. The impacts of such storms include cold temperatures, flooding, storm surges, closed and blocked roadways, downed utility lines, and power outages. For more information on extreme cold temperatures, refer to Section 4.3.5. (Extreme Temperature).

Heavy Snow

Snow is precipitation in the form of ice crystals. It originates in clouds when temperatures are below the freezing point (32 degrees Fahrenheit or °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.

Sleet

Sleet is rain that freezes into ice as droplets fall through colder air layers. The droplets are usually smaller than three-tenths of an inch in diameter (NSSL 2021).

Blizzard

A blizzard is a storm with sustained winds or frequent wind gusts of at least 35 miles per hour (mph) accompanied by falling or blowing snow that reduces visibility to a quarter mile or less, as the predominant conditions over a three-hour period. Extremely cold temperatures often are associated with blizzard conditions but are not a formal part of the definition. The hazards associated with the combination of snow, wind, and low visibility increase significantly when temperatures are below 20 °F. A severe blizzard is categorized as having temperatures near or below 10 °F, winds exceeding 45 mph, and visibility reduced by snow to near zero.

Storm systems powerful enough to cause blizzards usually form when the jet stream dips far to the south, allowing cold air from the north to encounter warm, moist air from the south. Blizzard conditions often develop on the northwest side of an intense storm system. The difference between the lower pressure in the storm and the higher pressure to the west creates a tight pressure gradient, resulting in strong winds and extreme conditions caused by the blowing snow (Lam 2019).

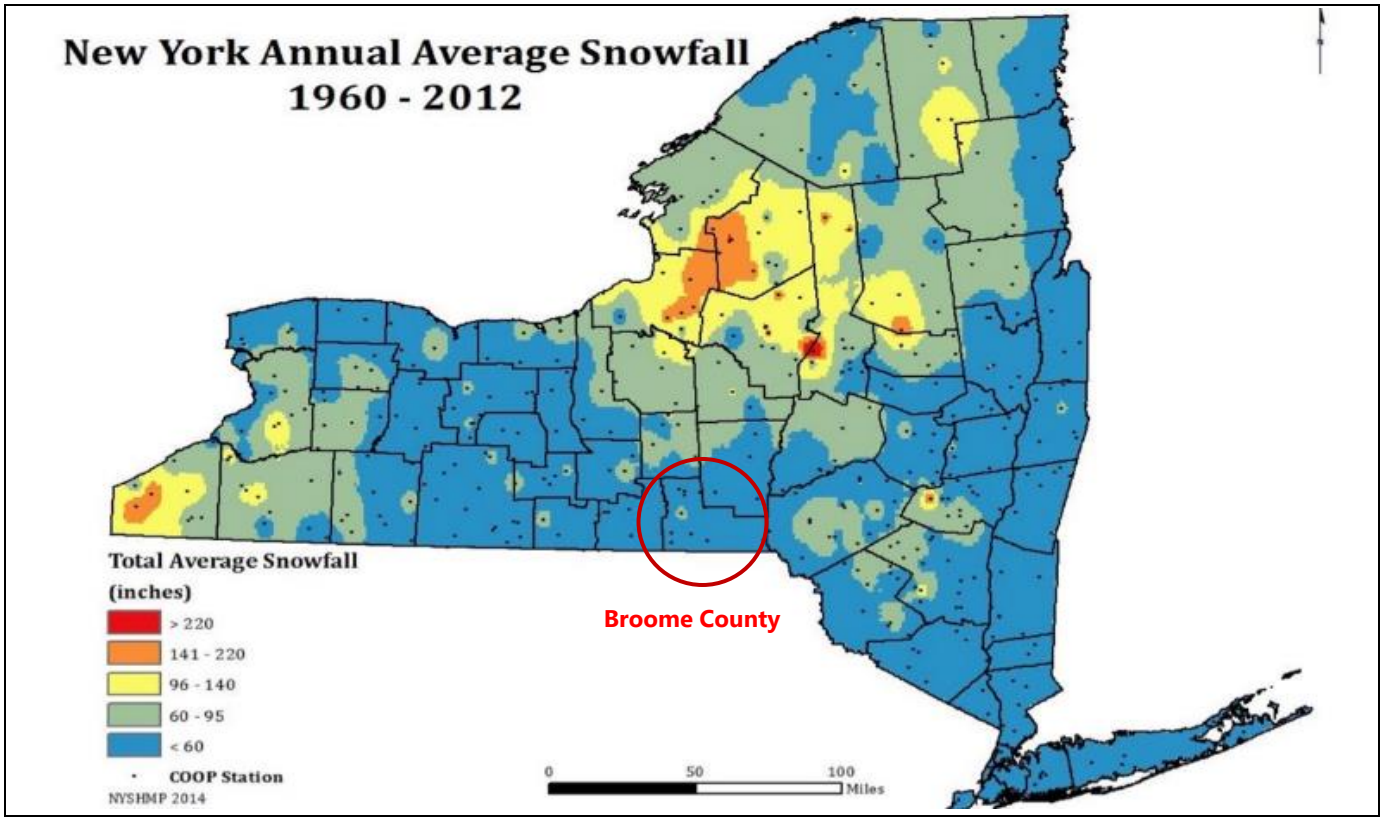
Ice Storm

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).

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 (NYS DHSES 2019). Figure 4-2 shows that Broome County receives, on average, less than 60 inches of snow per year.

Figure 4-2. New York Annual Average Snowfall, 1960-2012

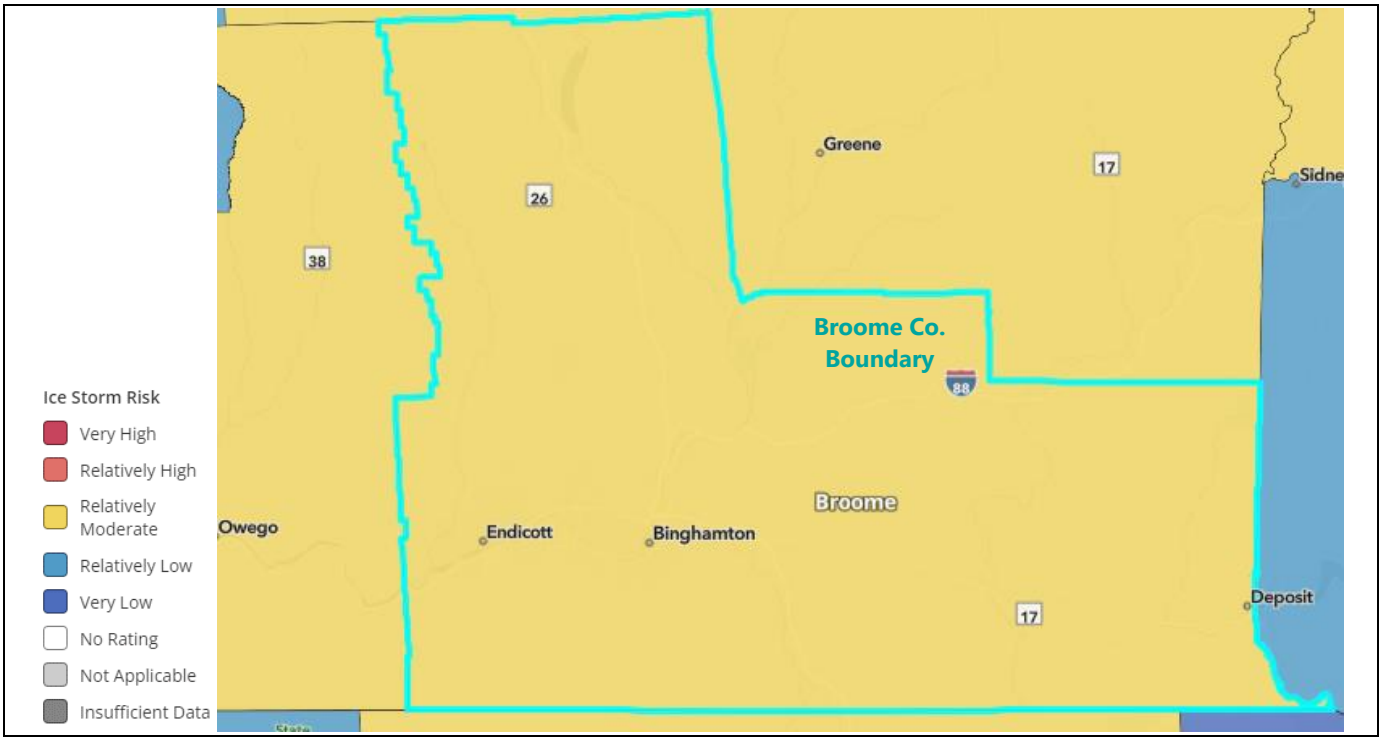


Source: NYS DHSES 2014

Figure 4-3 and Figure 4-4 show the Ice Storm Risk Index for Broome County at the county and census tract scales, respectively. According to this index, at the county scale, the County has a relatively moderate

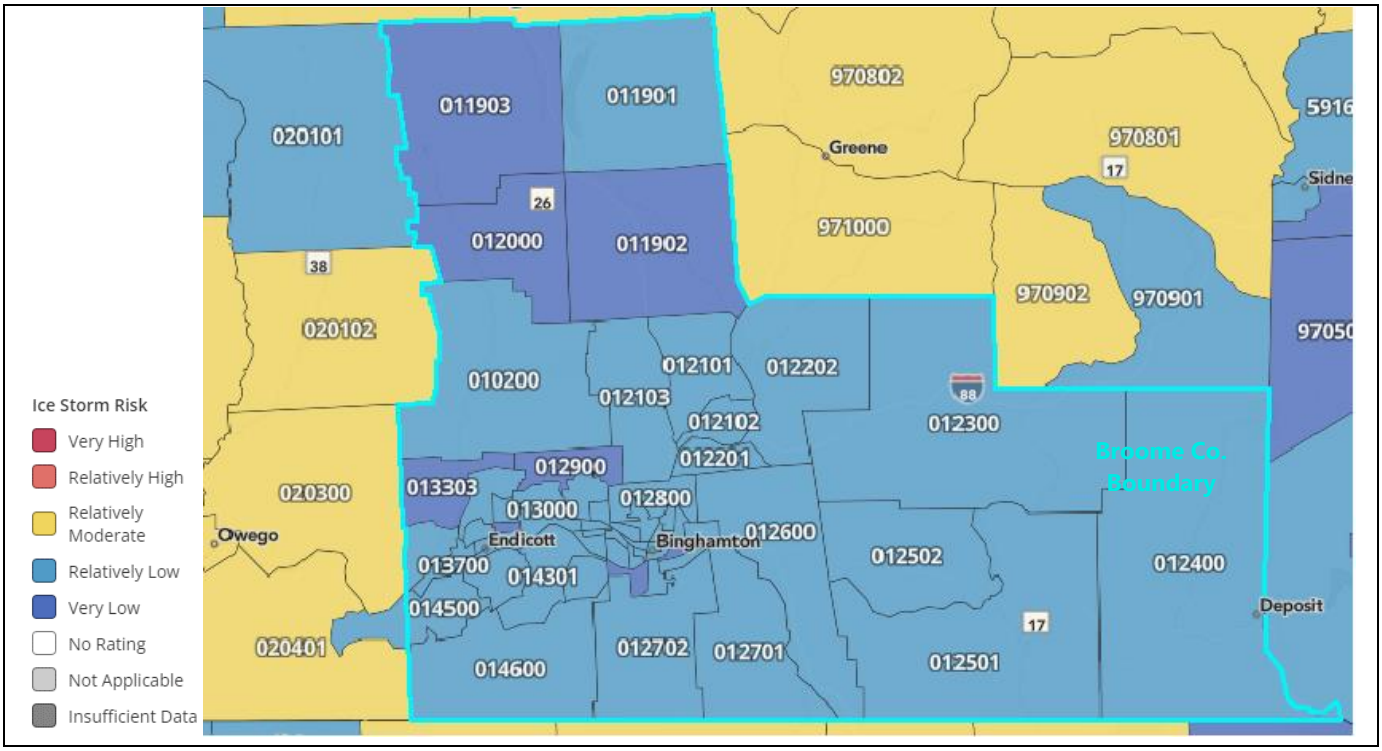
risk of ice storms; at the census tract scale, the County ranged from a very low risk to a relatively low risk (FEMA 2019).

Figure 4-3. National Risk Index Ice Storm Risk Index Score at the County Scale



Source: FEMA 2019

Figure 4-4. National Risk Index Ice Storm Index Score at the Census Tract Scale



Source: FEMA 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 the population. The NCDC has analyzed and assigned RSI values to over 500 storms since 1900 (NOAA n.d.). Table 4-1 presents the five RSI ranking categories.

Table 4-1. RSI Ranking Categories

Category	Description	RSI Value
1	Notable	1–3
2	Significant	3–6
3	Major	6–10
4	Crippling	10–18

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, as shown in Table 4-2.

Table 4-2. 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 12 hours.
Sleet Storm	Significant accumulations of solid pellets that form from the freezing of raindrops or partially melted snowflakes cause 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 the 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, and a high density of blowing snow with visibility frequently measured in feet prevailing over an extended period.

Source: NWS 2021

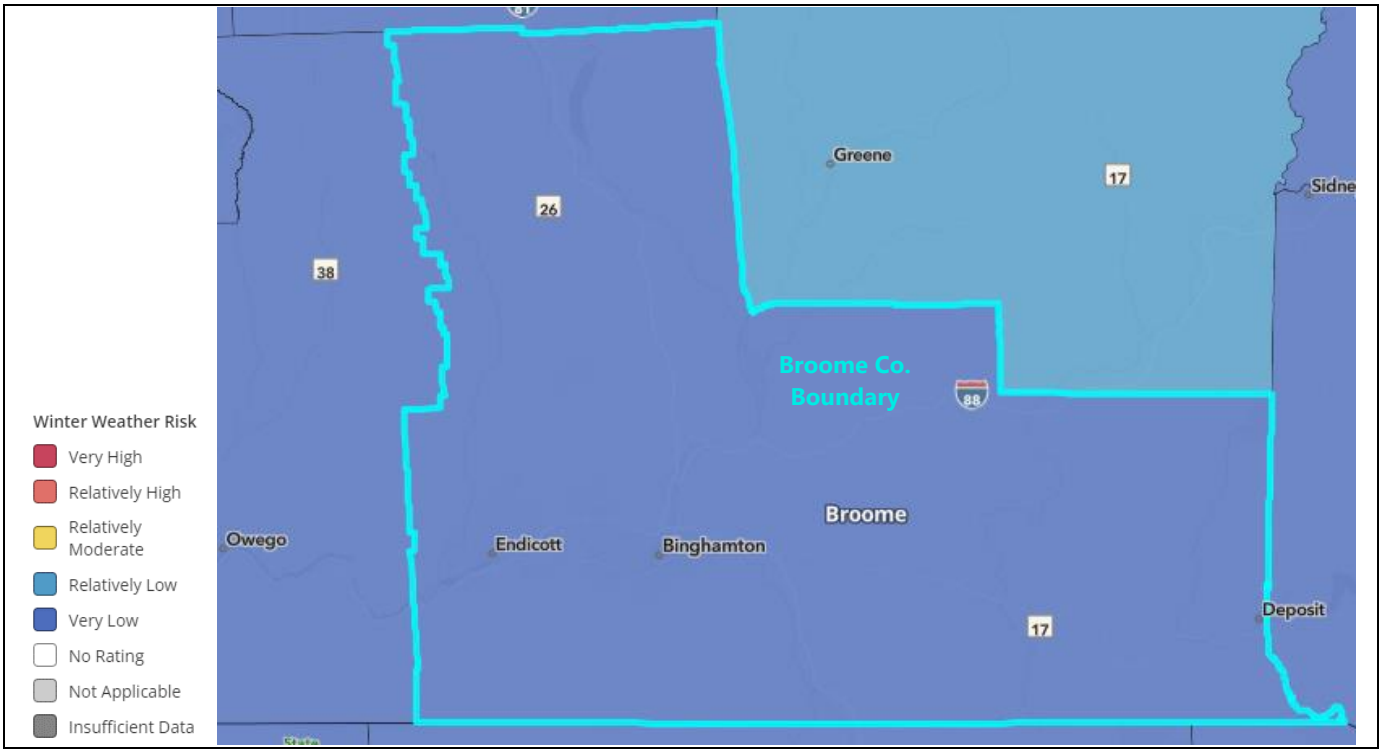
The NWS operates a network of observing systems—such as geostationary satellites, Doppler radars, and automated surface observing systems—that feed into state-of-the-art numerical computer models to project future conditions, ranging from hours to days. The model results are analyzed by NWS meteorologists who write and disseminate forecasts. The NWS uses winter weather watches, warnings, and advisories to help people anticipate what to expect in the days and hours before an approaching storm (NWS 2021). Refer to Figure 4-5 for the warning thresholds.

Figure 4-5. Winter Storm Warning Thresholds

Source: NWS 2021

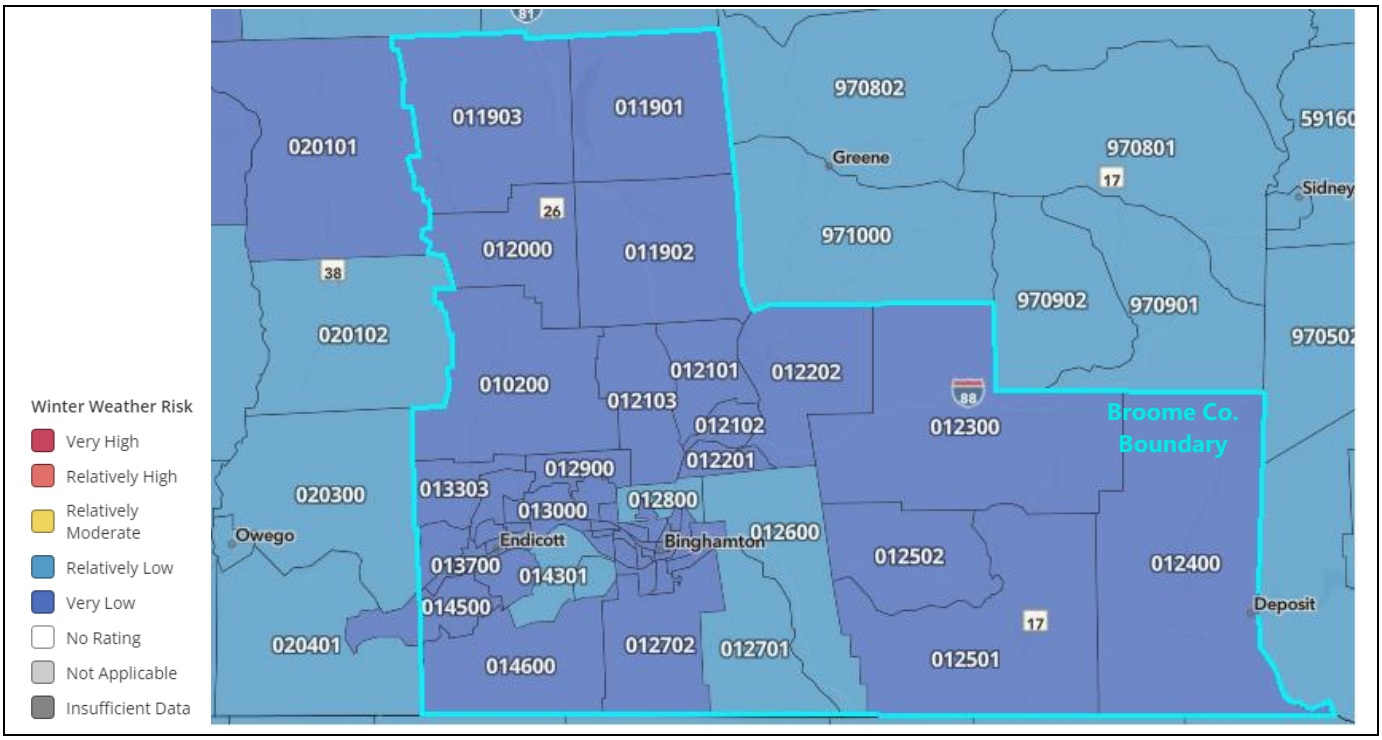
Figure 4-6 and Figure 4-7 show the Winter Weather Risk Index for Broome County at the county and census tract scales, respectively. According to this index, on the county scale, the County has a very low risk of winter weather; at the census tract scale, the County ranges from a very low risk to a relatively low risk (FEMA 2019).

Figure 4-6. National Risk Index Winter Weather Risk Index Score at the County Scale



Source: FEMA 2019

Figure 4-7. National Risk Index Winter Weather Index Score at the Census Tract Scale



Source: FEMA 2019

Previous Occurrences and Losses

This section presents the best available information on previous winter storm occurrences, impacts, and monetary losses in Broome County. Where multiple information sources were available, the results presented here were judged to be the most accurate and reliable. Citations are provided for each information source used.

FEMA Major Disasters and Emergency Declarations

Between 1953 and 2023, Broome County was included in four disaster (DR) or emergency (EM) declarations for winter storm-related events (see Table 4-3). Generally, these declarations cover a wide region of the state, including many counties at once (FEMA 2023). Detailed information about the declared disasters since 1954 is provided in Section 3 (County Profile).

Table 4-3. FEMA Winter Storm Disaster Declarations in Broome County (1953 to 2023)

Date of Event	Event Type	FEMA Declaration Number	Broome County Included in Declaration?	Description
March 13-17, 1993	Snowstorm	EM-3107-NY	Yes	Severe Blizzard
December 25, 2002 - January 4, 2003	Snowstorm	EM-3173-NY	Yes	Snowstorms
February 17-18, 2003	Snowstorm	EM-3184-NY	Yes	Snow
March 14-15, 2017	Snowstorm	DR-4322-NY	Yes	Severe Winter Storms and Snowstorms

U.S. Department of Agriculture Disaster Declarations

The Secretary of 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 contiguous counties. Between 2019 and 2023, Broome County was not included in any winter storm-related agricultural disaster declarations.

Previous Events

Many sources provide information regarding previous occurrences and losses associated with winter storm events in Broome County. The 2019 HMP discussed specific winter storm events that occurred in the County through 2019. For this 2024 HMP update, winter storm events were summarized between January 1, 2019, and December 31, 2023, as listed in Table 4-4. Significant events include those that resulted in losses greater than $5,000 in property or crop damages or fatalities as reported by the NCEI, events that led to a FEMA disaster declaration, and events that led to a USDA declaration.

Table 4-4. Winter Storm Events in Broome County (2019 to 2023)

Date of Event	Event Type	FEMA or USDA Declaration Number	Broome County Included in Declaration?	Location Impacted	Description
January 19 – 20, 2019	Heavy Snow	N/A	N/A	Broome County	A large winter storm deposited between 8 to 15 inches of snow throughout central New York. Many areas of central New York also experienced freezing rain and ice accumulations. No damages were documented.
December 1 – 2, 2019	Heavy Snow	N/A	N/A	Broome County	A two-part storm moved through the County, starting with sleet, freezing rain, and some snow. The second half of the storm brought moderate to heavy snow throughout the region depositing a total of 7 to 13 inches throughout the County. No damages were documented.
February 7, 2020	Heavy Snow	N/A	N/A	Broome County	A quick period of heavy snowfall deposited 4 to 9 inches across the region. No damages were documented.
December 16 – 17, 2020	Heavy Snow	N/A	N/A	Broome County	A Nor'easter developed and deposited snow at a rate of 5 to 6 inches per hour and snowfall totals were between 30 to 40 inches in most areas. There were $100,000 in property damages documented.
January 31 – February 3, 2021	Winter Weather/ Winter Storm	N/A	N/A	Broome County	A long-duration storm brought moderate to heavy snowfall to central New York. Snowfall totals were between 9 to 14 inches and no damages were documented.
January 16 – 17, 2022	Heavy Snow	N/A	N/A	Broome County	Bands of heavy snowfall affected the County, depositing snowfall totals between 6 and 14 inches. Gusty winds resulted in snow drifts. No damages were documented.
February 3 – 4, 2022	Winter Weather	N/A	N/A	Broome County	Snowfall rates surpassed an inch an hour and accumulations were 1 to 4 inches. Ice also accumulated to nearly half an inch. No damages were documented.
March 9, 2022	Heavy Snow	N/A	N/A	Broome County	Snowfall accumulations totaled from 4 to 8 inches. No damages were documented.
March 12, 2022	Heavy Snow	N/A	N/A	Broome County	Heavy bands of snow produced snow rates of 1 to 2 inches per hour and resulted in accumulations from 6 to 11 inches throughout the area. No damages were documented.
April 18 – 19, 2022	Heavy Snow	N/A	N/A	Broome County	Heavy snowfall brought down trees and powerlines resulting in widespread power outages with nearly 100,000 people in New York without power. Snow accumulations were documented between 6 to 15 inches. About $274,650 in property damages were documented.

Date of Event	Event Type	FEMA or USDA Declaration Number	Broome County Included in Declaration?	Location Impacted	Description
December 15 – 16, 2022	Winter Storm	N/A	N/A	Broome County	Precipitation started as a freezing rain mix and became mostly snow as the day progressed. Travel conditions became hazardous as snowfall picked up and deposited between 4 and 10 inches. No damages were documented.

Sources: NCEI 2023

Probability of Future Occurrence

For the 2024 HMP update, the most up-to-date data was collected to calculate the probability of future occurrence of winter storm events for the County as shown in Table 4-5. Information from FEMA, NOAA-NCEI storm events database, the 2019 New York State HMP, and the 2019 Broome County HMP were used to identify the number of severe winter weather events that occurred between 1954 and 2023.

Table 4-5. Probability of Future Winter Storm Events in Broome County

Hazard Type	Number of Occurrences Between 1954 and 2023	% Chance of Occurring in Any Given Year
Blizzard	0	0%
Heavy Snow	60	82.19%
Ice Storm	5	6.85%
Sleet	0	0%
Winter Storm	20	27.40%
Winter Weather	7	9.59%
TOTAL	**92**	**100%**

Sources: FEMA 2023; USDA 2023; NOAA 2023

Note: Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act and selected events since 1968. Due to limitations in data, not all winter storm events occurring between 1954 and 1923 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

Based on the County's history of winter storm events, Broome County could experience at least one winter storm event (of any type) in a given year. Based on these records and input from the Planning Partnership, the probability of occurrence of winter storms in the County is considered "frequent."

Climate Change Impacts

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 Southern Tier, which encompasses Broome County, is expected to experience temperature increases of 4.4 to 6.3 ºF by the 2050s and 5.7 to 9.9 ºF by the 2080s (baseline of 47.5 ºF, middle range projection). Precipitation totals are estimated to increase by 4 to 10 percent by the 2050s and 6 to 14 percent by the 2080s (baseline of 35 inches, middle range projection) (NYSERDA 2011/2014).

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 the 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

For the severe winter storm hazard, all assets in the County (population, structures, critical facilities, and lifelines) are considered exposed and vulnerable to a winter storm event.

Impacts on Life, Health, and Safety

Overall Population

The entire population of Broome County (198,683) is exposed to severe winter storm events (U.S. 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 Populations

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 of 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 of hypothermia due to the lack of a warming shelter from the cold temperatures

that are associated with winter weather. Those who are at or around the poverty level in the County are dependent on their limited income and may not be able to afford to stay 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 2017-2021 American Community Survey, there are 37,752 persons over the age of 65 years, 10,142 persons under the age of 5 years, 3,165 non-English speakers, 30,857 persons with a disability, and 35,372 living in poverty (refer to Table 4-6). Severe winter storm events can reduce the ability of these populations to access emergency services. Figure 4-8 displays the FEMA National Risk Inventory's Social Vulnerability Index for the County of Broome, which is identified as "relatively high."

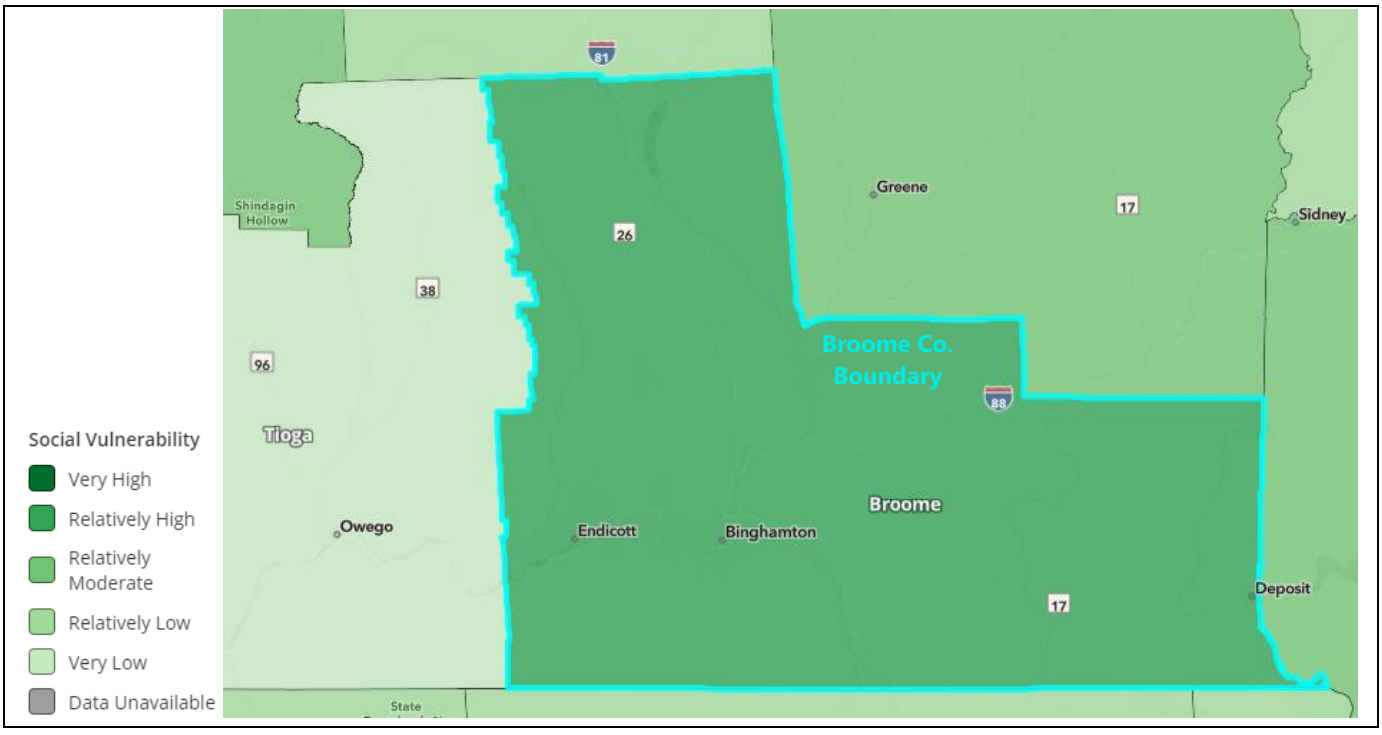
Table 4-6. Vulnerable Populations in Broome County by Jurisdiction

Jurisdiction	Vulnerable Population				
	Over 65	Under 5	Non-English Speaking	Disability	Poverty Level
Barker (T)	465	142	49	342	537
Binghamton (C)	7,642	2,588	1,051	9,632	14,894
Binghamton (T)	822	206	5	710	454
Chenango (T)	2,236	861	37	1,359	1,292
Colesville (T)	1,299	161	0	812	345
Conklin (T)	1,116	227	182	637	584
Deposit (V)*	110	49	0	123	153
Dickinson (T)	829	32	63	611	345
Endicott (V)*	2,337	664	107	2,544	3,535
Fenton (T)	1,223	518	49	828	962
Johnson City (V)*	2,864	821	356	2,718	2,938
Kirkwood (T)	1,045	116	61	736	768
Lisle (T)	373	157	0	405	207
Lisle (V)*	48	4	0	45	23
Maine (T)	1,141	311	0	927	873
Nanticoke (T)	384	68	0	265	123
Port Dickinson (V)*	235	77	26	208	223
Sanford (T)	469	27	0	243	91
Triangle (T)	300	40	0	298	251
Union (T)	6,306	1,300	301	3,358	2,549
Vestal (T)	5,068	1,261	876	3,025	3,318
Whitney Point (V)*	221	32	0	168	340
Windsor (T)	1,002	452	0	713	458
Windsor (V)*	217	28	2	150	109

Jurisdiction	Vulnerable Population				
	Over 65	Under 5	Non-English Speaking	Disability	Poverty Level
Broome County (Total)	37,752	10,142	3,165	30,857	35,372

Source: U.S. Census, American Community Survey 5-Year Estimates 2017-2021
Note: Persons per household = 2.33; Number used to calculate Non-English speaking population.
** The following Villages are contained with Towns; the Population totals were adjusted based on the average population based on the count of Residential structures from the General Building Stock data. Deposit (V) is 52% within Sanford (T); Endicott (V) & Johnson City (V) are 100% within Union (T); Lisle (V) is 100% within Lisle (T); Port Dickinson (V) is 100% within Dickinson (T); Whitney Point (V) is 100% within Triangle (T); Windsor (V) is 100% within Windsor (T).*

Figure 4-8. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA 2019

Impacts 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 severe winter storm hazards 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.

Impacts 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 citizens to dangerous conditions; following the winter season, resources for road maintenance and repair are required.

Impacts 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.

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 people to commute into and out of the area for work or school. The loss of power and closure of roads prevent the commuter population from traveling to work within and outside of the County and may cause a loss in economic productivity.

Impacts on the Environment

Severe winter weather can have a major impact on the environment. Winter weather creates changes in natural processes. For example, an excess amount of snowfall and earlier warming periods may affect processes such as flow within water resources (USGS 2020). Rain-on-snow events can also exacerbate runoff rates with warming winter weather. Increased flow rates and excess volumes of water can erode banks, tear apart habitats along stream banks, and disrupt terrestrial plants and animals. A community's methods to maintain its infrastructure through winter weather may also have an impact on the environment.

Cascading Impacts on Other Hazards

Severe winter weather events may exacerbate flooding. The thawing of snow and ice associated with winter weather events can create major flooding issues in the County. Mitigating winter weather hazards through snow and ice removal could minimize the potential risk of flooding during a warming period. Refer to 4.3.6 (Flood) for more information about the flood hazard of concern.

Future Changes That May Impact Vulnerability

Understanding future changes that affect vulnerability can assist in planning for future development and ensure the establishment of appropriate mitigation, planning, and preparedness measures.

Projected Development

As discussed in Section 3, areas targeted for future growth and development have been identified across the County. Any new development could be impacted by severe winter storm events. Current state land use and building codes incorporate standards that address and mitigate snow accumulation. Some local municipalities have implemented the following activities to eliminate loss of life and property and infrastructure damages during winter storm events (NYS DHSES 2019):

- 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.

Projected Changes in the Population

Broome County has experienced a decrease in its population since 2010. According to the U.S. Census Bureau, the County's population increased by 1 percent between 2010 and 2020 (US Census 2023). Cornell University's Program on Applied Demographics projects Broome County will have a population of 186,950 by 2030 and 183,176 by 2040 (Cornell University 2018).

A reduction in population means that not as many people will be impacted by winter storm events that may occur in the County. The decreasing population may also lead to a reduction in individuals who are trained to provide emergency management and support to the County population. Section 3 (County Profile) includes a more thorough discussion of population trends for the County.

Climate Change

The State of New York will see an increase in average annual temperatures and precipitation. Climate change can 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 2019 HMP

Broome County remains vulnerable to severe winter storm events. Since the 2019 analysis, population statistics have been updated using the 2020 U.S. Census. Overall, this vulnerability assessment uses more accurate and updated data and information, which provides more accurate estimated exposure and potential losses for Broome County.

SECTION 4. RISK ASSESSMENT

4.3 HAZARD PROFILE

4.3.1 Wildfire

This 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 wildfire in Broome County.

Hazard Profile

Hazard Description

Wildfires are uncontrolled fires that spread through vegetation and can threaten lives and properties if not properly contained. Wildfires do not include fires that are purposefully ignited for ecosystem restoration purposes or naturally ignited and left to burn to achieve such purposes. Wildfires can ignite by natural causes such as lightning strikes or human causes such as uncontrolled burning of debris or bonfires. There are different terms for wildfire types based on the burn characteristics and materials consumed:

- **Forest Fire**—Uncontrolled fire on lands covered wholly or in part by timber, brush, grass, grain, or other flammable vegetation (NWCG 2012).
- **Brush Fire**—A fire burning in vegetation that is predominantly shrubs, brush, and scrub growth (NWCG 2012).
- **Grass Fire**—Uncontrolled wildfire where most of the burned area is grasslands. Grass fires generally travel and spread quickly and can move up to 15 miles an hour (ESA n.d.) (NWCG 2012).
- **Range Fire**—Fire that occurs on rangeland (NWCG 2012).
- **Ground Fire**—A fire that consumes the organic material beneath the ground surface litter (e.g. peat fire) (NWCG 2012).

Wildfires can also be characterized as surface or crown fires. Surface wildfires generally take place above ground, burning organic materials along the forest floor. Crown fires take place above ground, burning tops of trees and canopy covers high above the forest floor.

Wildland-urban interface (WUI) fires are fires that occur in transition zones between unoccupied lands and human development. The WUI, which is highly susceptible to human-caused ignitions, is where structures or other human development meet with undeveloped wildlands, forests, and vegetative fuels (USFA n.d.). More than 60 thousand communities in the United States are at risk for WUI fires (USFA n.d.). The WUI is projected to grow by 2 million acres per year in the U.S. (DHS 2019). In the State of New York, 15.1 to 30 percent of houses are in the WUI.

Wildfire season in Broome County is generally during late summer and early fall. Dry, hot conditions are ideal for wildfire events, as trees and shrubs become suitable fuels. Increased wind activity in the county also increases the chance of wildfires. Winds can cause rapid spread of fires and severe destruction to communities in Broome County, especially those in WUI areas (BCNY 2023).

Location

Figure 4-1 and Figure 4-2 show the Wildfire Risk Index for Broome County at the county and census tract scales, respectively. According to the National Risk Index, at the county scale, the County has a very low risk of wildfire; at the census tract scale, portions of the County have no rating, but other census tracts range from a very low risk to a relatively low risk (FEMA 2019).

Extent

Wildfire behavior is how fuels ignite and flames develop or spread. The behavior of wildfires depends on the fuels present, the weather conditions, and the topography of the affected area. Behavior is critical information that determines the appropriate response activities. Wildfire management and projection rely heavily on the success of pre-suppression planning efforts and actual suppression actions that are based on wildfire behavior. Wildfire behavior is a function of three elements—fuel, weather, and topography—as described in the following sections.

Fuel

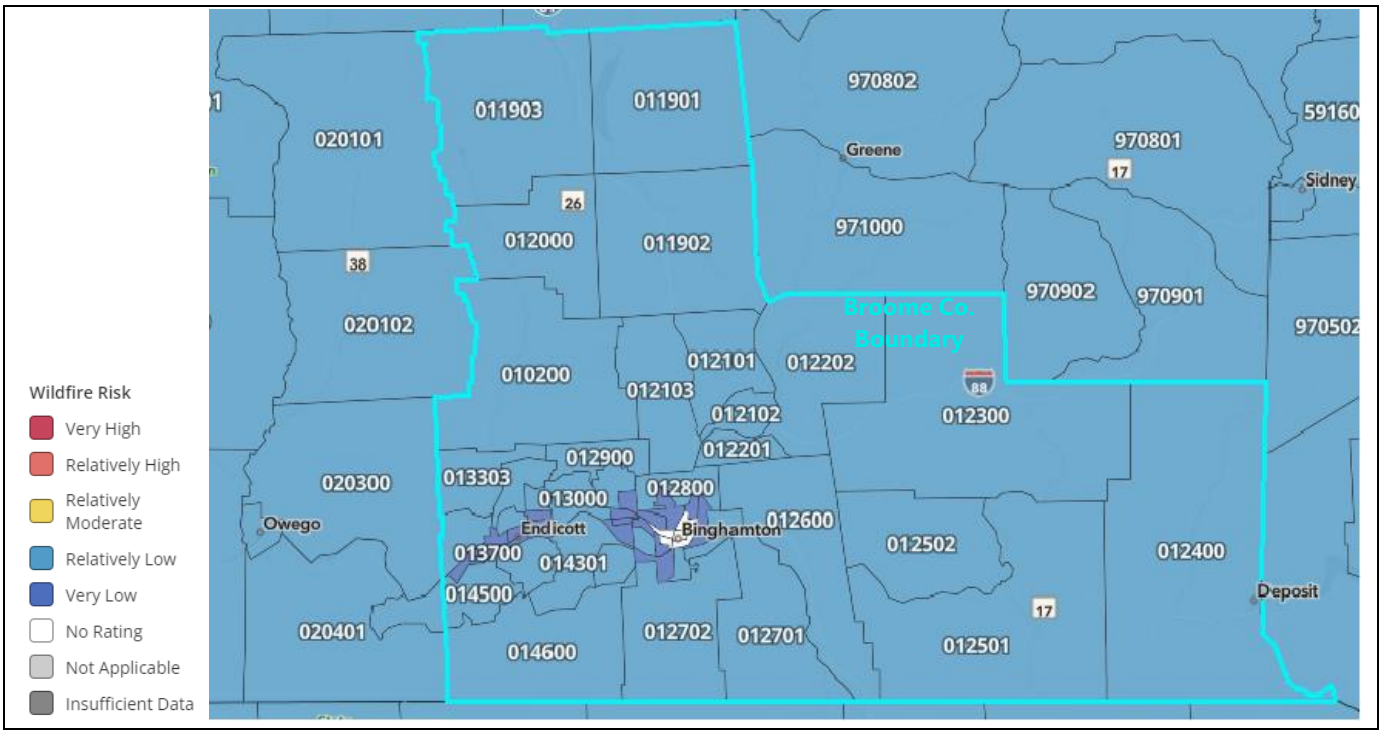
Wildfire fuels are distinguished by type of material and weight or volume, also known as fuel loading. Fuel loading is the amount of vegetation material that is available in the area. If the fuel loading doubles, the energy released from the flame also doubles. For a given fuel type, the burn index indicates the estimated amount of potential energy that can be released, the required effort to ignite a flame in the fuel, and the expected flame length. For example, grass fires tend to have less energy relative to other fuels yet can spread at a rapid pace (FEMA 1997). The U.S. Forest Service (USFS) classifies fuels as follows (USFS 2003):

- **Surface fuels (Understory)**—Typically grasses, shrubs, litter, and woody materials that are on the ground. Understory wildfires burn low vegetation and woody debris. Under ideal conditions, they can reduce the likelihood of future uncontrolled wildfires by limiting the amount of ground fuels available.
- **Ladder fuels (Midstory)**—Typically small trees or shrubs (alive or dead), lower branches from larger trees, needles, vines, lichen, and mosses. Ladder fuels also include any other combustible organic matter that is located between the top of surface fuels and the bottom of the tree overstory.
- **Crown fuels (Overstory)**—Typically live or dead fine materials suspended above the ground in treetops. The tree canopies are the primary fuel layer in a forest crown wildfire.

Figure 4-1. National Risk Index Wildfire Risk Index Score at the County Scale

Source: FEMA 2019

Figure 4-2. National Risk Index Wildfire Index Score at the Census Tract Scale



Source: FEMA 2019

Weather

Weather influences wildfire behavior, and its continuously changing nature means that the likelihood of wildfires can change frequently. High temperatures and low humidity can result in heightened wildfire activity. Thunderstorms and strong fronts that produce drastic winds cause shifts in wildfire intensity and frequency. Winds play a large role in the direction of wildfires, and many of the most destructive wildfire hazard events have been marked by high winds in the vicinity of the fire (FEMA 1997).

An air mass is a body of air that covers a wide area and shows uniform properties horizontally. It can affect wildfire behavior through factors such as temperature and relative humidity, local wind speeds, cloud cover, precipitation intensity and frequency, and more (NWS 2009).

The National Fire Danger Rating System is used to rate wildfire danger in the State of New York. The system considers current and antecedent weather patterns, fuels present, and fuel moisture. Table 4.3.1-1 shows the fire danger classes with associated color codes and descriptions of wildfire characteristics and impacts on the affected area.

Table 4.3.1-1. Fire Danger Rating System in the State of New York State

Fire Danger Class	Color Code	Description
Red Flag	—	Short-term, temporary warning that indicates the presence of dangerous conditions (temperature, wind, relative humidity, fuel, drought, etc.) that can contribute to a new wildfire or rapid spread. This warning can be issued at any Fire Danger Class.
Extreme	Red	Wildfires can start quickly and spread rapidly. Characterized by high-intensity burns creating potentially serious conditions. Development is typically from smaller fires than the very high Fire Danger Class. Some wildfires that develop in heavy slash or conifer may be unmanageable. The only safe action is on the flanks during these conditions, until the weather changes or the fuel supply diminishes.
Very High	Orange	Wildfires can start easily from any cause and spread rapidly immediately after ignition. Wildfires in this class will increase in intensity and are a constant danger. Wildfires that burn light fuels have the potential to develop into high-intensity wildfires, with long-distance spotting or fire whirlwinds, as they approach heavier fuels.
High	Yellow	Fine dead fuels will ignite quickly, allowing a wildfire to start easily from many causes. Unattended brush campfires are likely to cause fires in this Fire Danger Class. Wildfires spread quickly, and short-distance spotting is common. High-density burning can occur on slopes or in areas with fine fuels. Unless action is taken, smaller wildfires can become serious and uncontrolled.
Moderate	Blue	Wildfires can start from accidental causes. Lightning wildfires are common in this Fire Disaster Class. Often, the wildfires will burn briskly through open, cured (having dead material) grasslands and spread quickly if wind conditions are optimal. Timber wildfires in this class spread slower than grass fires. The average intensity for these wildfires is moderate due to the heavy concentration of dried fuel. These wildfires are not likely to become serious and can generally be managed.
Low	Green	Fuels do not ignite easily but do give off high-intensity burns. Lightning fires are included in this Fire Danger Class. Some wildfires that occur in cured (having dead material) grasslands may burn for a few hours after rain, as wood wildfires spread slowly by smoldering in irregular fingers. This Fire Disaster Class presents little danger.

Source: NYS DHSES 2022

Topography

The topography of an area has a large impact on wildfire behavior, and the slope is a major factor. When the uphill slope doubles, so does the rate at which the wildfire spreads. The movement of air over a specific terrain can direct a wildfire course as well. For example, a gulch, which is the steep side of a river ravine, can funnel air and act as a chimney that intensifies wildfire behavior becoming ideal for rapid spread. Saddles on ridgetops, which are the lowest areas between two highlands or peaks, offer lower resistance to airflow and tend to draw wildfires. The heating of dry, south-facing slopes due to the sun creates upslope thermal winds that can produce unpredictable wildfire behavior. Topography also can aid with inhibiting wildfire spread, as fires move more slowly downslope (FEMA n.d.).

Previous Occurrences and Losses

This section presents the best available information on previous wildfire occurrences, impacts, and monetary losses in Broome County. Where multiple information sources were available, the results presented here were judged to be the most accurate and reliable. Citations are provided for each information source used.

FEMA Major Disaster and Emergency Declarations

Broome County has not been included in any FEMA Major Disaster (DR) or Emergency (EM) declaration for fire hazard events since the previous plan (2019).

U.S. Department of Agriculture Disaster Declarations

Broome County has not been included in any U.S. Department of Agriculture Disaster (USDA) declarations for wildfire events since the previous plan (2019).

Previous Events

Table 4.3.1-2 identifies the known wildfire events that impacted Broome County since the last plan update (2019).

Table 4.3.1-2. Wildfire Events in Broome County, 2018-2024

Date of Event	Event Type	FEMA Declaration	Impact Description
05/24/2022	Wildfire	--	Wildfire was recorded by the National Interagency Fire Center. This wildfire occurred in the Broome County area and ranged a quarter mile in length.

Source: NIFC, 2023

Probability of Future Hazard Events

Dangerous wildfires do not occur every year in the eastern region of the United States, but the State of New York's fire history shows a pattern of events that have caused human death, loss of property, forest destruction, and air pollution in the past (DHSES 2019). Based on historical events, it is unlikely that wildfire events will occur frequently in Broome County in the future. However, as temperatures increase and precipitation rates vary, the probability of future wildfire events will likely increase across the state

(see the following section on Climate Change Impacts). Therefore, it is likely that wildfires of varied severity will occur in the state in the future. It is estimated that Broome County will continue to experience direct and indirect impacts of wildfire and its impacts on occasion, with the secondary effects causing potential disruption or damage to agricultural activities and tourism. Table 4.3.1-3 shows the future occurrence of wildfire events in Broome County. Broome County has a 7.1 percent probability of wildfire events in any given year.

Table 4.3.1-3. Future Occurrence of Wildfire Events in Broome County

Hazard Type	Number of Occurrences Between 1954 and 2024	% Chance of Occurrence in Any Given Year
Wildfire	5	7.1%

Source: NOAA-NCEI, 2023

Climate Change Impacts

Climate change makes forests more susceptible to severe fires due to changing precipitation patterns. However, not every area will be affected in the same way. For example, forests of the Midwest and Northeast face an uncertain future as the climate continues to change. Forests vary widely across the region, and vulnerabilities are strongly influenced by regional differences in climate impacts and adaptive capacity (MitigateNY 2018).

Wildfire likelihood and extent are determined by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain and thus are more likely to expand into residential neighborhoods.

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). Summer droughts are also projected to increase, affecting water supply, agriculture, ecosystems, and energy projects (NYSERDA 2014). Hot dry spells create the highest fire risk. With the increase in temperatures, heat waves will become more frequent and intense, posing new challenges to the energy system, air quality, and agriculture, and potentially increasing the risk of wildfire.

One of the most serious climate change concerns around wildfires is that climate change could lead to an increase in the conditions that lead to larger wildfires. This is especially important to the State because a majority of the area burned in the Eastern US results from a limited number of exceptionally large wildfires. Very large fires (VLFs) are wildfire events associated with significant economic, human health, and environmental risk unique from other conventional wildfires (Podschwit, et al. 2018). Recent studies have found that the factors and conditions associated with VLFs are closely related to factors that drive

climate change. This research also showed that the probability of VLF conditioned by fire occurrence increases when long-term drought, depleted fuel moisture, and elevated fire weather align (MitigateNY 2018).

In the Southern Tier Region, where Broome County is located, it is estimated that temperatures will increase by 3.5 ºF to 5.5 ºF by the 2050s and 4.5 ºF to 8.5 ºF by the 2080s (baseline of 46 ºF). Precipitation totals will increase by 0 percent to 10 percent by the 2050s and 5 percent to 10 percent by the 2080s (baseline of 38 inches) (NYSERDA 2014). Figure 4-3 illustrates the different climate regions throughout New York State.

Figure 4-3. Climate Regions of New York State

Source: NYSERDA 2014

Vulnerability Assessment

Wildfire hazard areas were delineated using the WUI, which is based on the 2021 Census and 2012 National Land Cover Dataset and the Protected Areas Database. The WUI area is divided into two categories: intermix and interface. **Error! Reference source not found.** shows these WUI areas in Broome County. Intermix refers to the blending of lower-density housing with natural wildland vegetation, whereas interface denotes high-density development situated alongside undeveloped wildland vegetation (NIST 2023). Burning embers, also called firebrands, can carry fire ahead of the flame front, igniting buildings located up to a mile away from the main fire (CalFire-OSFM 2024). Therefore, even structures not within the forest are at risk from wildfire. This buffer distance, along with housing density and vegetation type, were used to define the WUI.

Asset data (population, building stock, critical facilities, historic assets, and new development) was used to support an evaluation of assets exposed and potential impacts and losses associated with the wildfire hazard. To determine what assets are exposed to wildfire, available GIS data were overlaid with the WUI hazard area. Assets with their centroid located in the hazard area were totaled to estimate the number of assets exposed to a wildfire event and their replacement cost value.

Impacts on Life, Health, and Safety

Wildfires have the potential to impact the health and lives of residents and responders, structures, infrastructure, and natural resources. The most vulnerable populations are emergency responders and those within a short distance of the interface between the built environment and the wildland environment. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxins (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility.

Overall Population

Table 4.3.1-4 summarizes the estimated population exposed to the wildfire hazard by a municipality. Based on the analysis, an estimated 117,554 residents, or 59.2 percent of the County's population, are located in the intermix hazard area. Overall, the City of Binghamton has the greatest number of individuals located in the wildfire intermix area (42,796 persons). An estimated 53,874 residents, or 27.1 percent of the County's population, are located in the interface hazard area. Overall, the Town of Vestal has the greatest number of individuals located in the interface hazard area (11,878 persons).

Table 4.3.1-4. Estimated Population Located Within the WUI

Jurisdiction	Total Population	Estimated Population in the WUI			
		Number of People in the Wildfire Intermix Hazard Area	Percent of Total	Number of People in the Wildfire Interface Hazard Area	Percent of Total
Barker (T)	2,509	649	25.9%	1,358	54.1%
Binghamton (C)	47,969	42,796	89.2%	2,684	5.6%
Binghamton (T)	4,617	1,605	34.8%	2,984	64.6%
Chenango (T)	10,959	5,183	47.3%	5,658	51.6%
Colesville (T)	4,868	1,368	28.1%	2,462	50.6%
Conklin (T)	5,008	2,412	48.2%	2,435	48.6%
Deposit (V)	721	547	75.9%	173	24.0%
Dickinson (T)	3,401	2,494	73.3%	895	26.3%
Endicott (V)	13,667	9,547	69.9%	104	0.8%
Fenton (T)	6,429	2,951	45.9%	3,355	52.2%

Jurisdiction	Total Population	Estimated Population in the WUI			
		Number of People in the Wildfire Intermix Hazard Area	Percent of Total	Number of People in the Wildfire Interface Hazard Area	Percent of Total
Johnson City (V)	15,343	12,866	83.9%	1,595	10.4%
Kirkwood (T)	5,481	2,446	44.6%	2,884	52.6%
Lisle (T)	2,343	983	42.0%	480	20.5%
Lisle (V)	348	295	84.8%	52	14.9%
Maine (T)	5,168	1,358	26.3%	3,438	66.5%
Nanticoke (T)	1,581	448	28.3%	803	50.8%
Port Dickinson (V)	1,699	1,345	79.2%	353	20.8%
Sanford (T)	1,518	192	12.6%	743	48.9%
Triangle (T)	1,849	705	38.1%	661	35.7%
Union (T)	27,128	7,601	28.0%	5,540	20.4%
Vestal (T)	29,313	17,298	59.0%	11,878	40.5%
Whitney Point (V)	960	709	73.9%	242	25.2%
Windsor (T)	4,897	981	20.0%	2,968	60.6%
Windsor (V)	907	775	85.4%	129	14.2%
Broome County (Total)	**198,683**	**117,554**	**59.2%**	**53,874**	**27.1%**

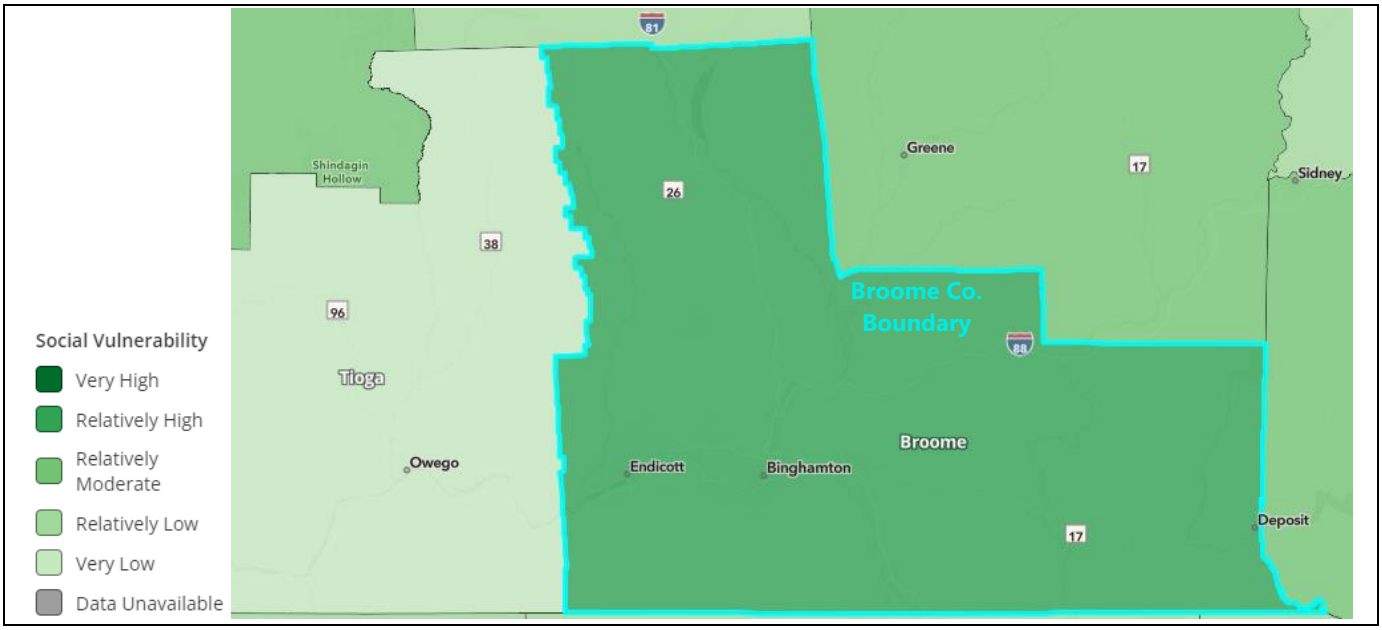
Sources: U.S. Census, American Community Survey 5-Year Estimates 2017-2021; Radeloff et al. 2012
Note: Values are rounded down.

Socially Vulnerable Populations

According to Census data, there are 37,752 persons over the age of 65 years, 10,142 persons under the age of five years, 3,165 non-English speakers, 30,857 persons with a disability, and 35,372 individuals living in poverty in Broome County. Economically disadvantaged populations are more vulnerable to wildfires because they are more likely to make decisions to evacuate based on net economic impacts on their families. The population over age 65 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 wildfire event, and they may have more difficulty evacuating. Figure 4-4 shows the FEMA National Risk Inventory's Social Vulnerability Index for the County of Broome, which is identified as "relatively high."

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly, and those with respiratory and cardiovascular diseases.

Figure 4-4. FEMA Social Vulnerability Index for Natural Hazards



Source: FEMA 2019

Table 4.3.1-5 presents the estimated socially vulnerable populations located in the wildfire intermix hazard area. Of the 117,554 persons in the wildfire intermix hazard area, there are 10,760 persons over the age of 65 years, 2,802 persons under the age of five years, 724 non-English speakers, 7,421 persons with a disability, and 7,012 individuals living in poverty.

Table 4.3.1-6 presents the estimated socially vulnerable populations located in the wildfire interface hazard area. Of the 53,874 persons in the wildfire interface hazard area, there are 21,200 persons over the age of 65 years, 5,965 persons under the age of five years, 2,142 non-English speakers, 19,359 persons with a disability, and 24,411 living in poverty.

Impacts on General Building Stock

Buildings in the wildfire intermix and interface hazard areas are vulnerable to wildfires. Buildings constructed of wood or vinyl siding are generally more likely to be impacted than buildings constructed of brick or concrete. Table 4.3.1-7 shows the estimated exposure of the wildfire hazard areas by jurisdiction. There are an estimated 56,221 buildings in the wildfire intermix hazard area, representing 52.6 percent of the County's total general building stock inventory replacement cost value. The City of Binghamton has the greatest number of buildings in the wildfire intermix hazard area (22,280 buildings or 88.3 percent of its total building stock). There are an estimated 24,149 buildings in the wildfire interface hazard area, representing 16.3 percent of the County's total general building stock inventory replacement cost value. The Town of Vestal has the greatest number of its buildings in the wildfire interface hazard area (3,695 buildings or 38.8 percent of its total building stock).

Table 4.3.1-5. Estimated Vulnerable Persons Located Within the Wildfire Intermix Hazard Area

Jurisdiction	Vulnerable Population					Estimated Vulnerable Persons Located Within the Wildfire Intermix Hazard Area									
	Over 65	Under 5	Non-English Speaking	Disability	Poverty Level	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
Barker (T)	465	142	49	342	537	251	54.0%	76	53.5%	26	53.1%	185	54.1%	290	54.0%
Binghamton (C)	7,642	2,588	1,051	9,632	14,894	427	5.6%	144	5.6%	58	5.5%	539	5.6%	833	5.6%
Binghamton (T)	822	206	5	710	454	531	64.6%	133	64.6%	3	60.0%	458	64.5%	293	64.5%
Chenango (T)	2,236	861	37	1,359	1,292	1,154	51.6%	444	51.6%	19	51.4%	701	51.6%	667	51.6%
Colesville (T)	1,299	161	0	812	345	657	50.6%	81	50.3%	0	0.0%	410	50.5%	174	50.4%
Conklin (T)	1,116	227	182	637	584	542	48.6%	110	48.5%	88	48.4%	309	48.5%	284	48.6%
Deposit (V)	110	49	0	123	153	26	23.6%	11	22.4%	0	0.0%	29	23.6%	36	23.5%
Dickinson (T)	829	32	63	611	345	218	26.3%	8	25.0%	16	25.4%	160	26.2%	90	26.1%
Endicott (V)	2,337	664	107	2,544	3,535	17	0.7%	5	0.8%	0	0.0%	19	0.7%	27	0.8%
Fenton (T)	1,223	518	49	828	962	638	52.2%	270	52.1%	25	51.0%	432	52.2%	502	52.2%
Johnson City (V)	2,864	821	356	2,718	2,938	297	10.4%	85	10.4%	37	10.4%	282	10.4%	305	10.4%
Kirkwood (T)	1,045	116	61	736	768	549	52.5%	61	52.6%	32	52.5%	387	52.6%	404	52.6%
Lisle (T)	373	157	0	405	207	76	20.4%	32	20.4%	0	0.0%	82	20.2%	42	20.3%
Lisle (V)	48	4	0	45	23	7	14.6%	0	0.0%	0	0.0%	6	13.3%	3	13.0%
Maine (T)	1,141	311	0	927	873	759	66.5%	206	66.2%	0	0.0%	616	66.5%	580	66.4%
Nanticoke (T)	384	68	0	265	123	195	50.8%	34	50.0%	0	0.0%	134	50.6%	62	50.4%
Port Dickinson (V)	235	77	26	208	223	48	20.4%	16	20.8%	5	19.2%	43	20.7%	46	20.6%
Sanford (T)	469	27	0	243	91	229	48.8%	13	48.1%	0	0.0%	118	48.6%	44	48.4%
Triangle (T)	300	40	0	298	251	107	35.7%	14	35.0%	0	0.0%	106	35.6%	89	35.5%
Union (T)	6,306	1,300	301	3,358	2,549	1,287	20.4%	265	20.4%	61	20.3%	685	20.4%	520	20.4%
Vestal (T)	5,068	1,261	876	3,025	3,318	2,053	40.5%	510	40.4%	354	40.4%	1,225	40.5%	1,344	40.5%
Whitney Point (V)	221	32	0	168	340	55	24.9%	8	25.0%	0	0.0%	42	25.0%	85	25.0%
Windsor (T)	1,002	452	0	713	458	607	60.6%	273	60.4%	0	0.0%	432	60.6%	277	60.5%
Windsor (V)	217	28	2	150	109	30	13.8%	3	10.7%	0	0.0%	21	14.0%	15	13.8%
Broome County (Total)	**37,752**	**10,142**	**3,165**	**30,857**	**35,372**	**10,760**	**28.5%**	**2,802**	**27.6%**	**724**	**22.9%**	**7,421**	**24.0%**	**7,012**	**19.8%**

Source: U.S. Census, American Community Survey 5-Year Estimates 2017-2021; Radeloff et al. 2012

Note: Persons per household = 2.33. The number used to calculate the non-English-speaking population. Values are rounded down.

Table 4.3.1-6. Estimated Vulnerable Persons Located Within the Wildfire Interface Hazard Area

Jurisdiction	Vulnerable Population					Estimated Vulnerable Persons Located Within the Wildfire Interface Hazard Area									
	Over 65	Under 5	Non-English Speaking	Disability	Poverty Level	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
Barker (T)	465	142	49	342	537	120	25.8%	36	25.4%	12	24.5%	88	25.7%	138	25.7%
Binghamton (C)	7,642	2,588	1,051	9,632	14,894	6,817	89.2%	2,308	89.2%	937	89.2%	8,593	89.2%	13,287	89.2%
Binghamton (T)	822	206	5	710	454	285	34.7%	71	34.5%	1	20.0%	246	34.6%	157	34.6%
Chenango (T)	2,236	861	37	1,359	1,292	1,057	47.3%	407	47.3%	17	45.9%	642	47.2%	611	47.3%
Colesville (T)	1,299	161	0	812	345	365	28.1%	45	28.0%	0	0.0%	228	28.1%	96	27.8%
Conklin (T)	1,116	227	182	637	584	537	48.1%	109	48.0%	87	47.8%	306	48.0%	281	48.1%
Deposit (V)	110	49	0	123	153	83	75.5%	37	75.5%	0	0.0%	93	75.6%	116	75.8%
Dickinson (T)	829	32	63	611	345	608	73.3%	23	71.9%	46	73.0%	448	73.3%	253	73.3%
Endicott (V)	2,337	664	107	2,544	3,535	1,632	69.8%	463	69.7%	74	69.2%	1,777	69.9%	2,469	69.8%
Fenton (T)	1,223	518	49	828	962	561	45.9%	237	45.8%	22	44.9%	380	45.9%	441	45.8%
Johnson City (V)	2,864	821	356	2,718	2,938	2,401	83.8%	688	83.8%	298	83.7%	2,279	83.8%	2,463	83.8%
Kirkwood (T)	1,045	116	61	736	768	466	44.6%	51	44.0%	27	44.3%	328	44.6%	342	44.5%
Lisle (T)	373	157	0	405	207	156	41.8%	65	41.4%	0	0.0%	169	41.7%	86	41.5%
Lisle (V)	48	4	0	45	23	40	83.3%	3	75.0%	0	0.0%	38	84.4%	19	82.6%
Maine (T)	1,141	311	0	927	873	299	26.2%	81	26.0%	0	0.0%	243	26.2%	229	26.2%
Nanticoke (T)	384	68	0	265	123	109	28.4%	19	27.9%	0	0.0%	75	28.3%	34	27.6%
Port Dickinson (V)	235	77	26	208	223	186	79.1%	60	77.9%	20	76.9%	164	78.8%	176	78.9%
Sanford (T)	469	27	0	243	91	59	12.6%	3	11.1%	0	0.0%	30	12.3%	11	12.1%
Triangle (T)	300	40	0	298	251	114	38.0%	15	37.5%	0	0.0%	113	37.9%	95	37.8%
Union (T)	6,306	1,300	301	3,358	2,549	1,767	28.0%	364	28.0%	84	27.9%	940	28.0%	714	28.0%
Vestal (T)	5,068	1,261	876	3,025	3,318	2,990	59.0%	744	59.0%	516	58.9%	1,785	59.0%	1,958	59.0%
Whitney Point (V)	221	32	0	168	340	163	73.8%	23	71.9%	0	0.0%	124	73.8%	251	73.8%
Windsor (T)	1,002	452	0	713	458	200	20.0%	90	19.9%	0	0.0%	142	19.9%	91	19.9%
Windsor (V)	217	28	2	150	109	185	85.3%	23	82.1%	1	50.0%	128	85.3%	93	85.3%
Broome County (Total)	**37,752**	**10,142**	**3,165**	**30,857**	**35,372**	**21,200**	**56.2%**	**5,965**	**58.8%**	**2,142**	**67.7%**	**19,359**	**62.7%**	**24,411**	**69.0%**

Source: U.S. Census, American Community Survey 5-Year Estimates 2017-2021; Radeloff et al. 2012

Note: Persons per household = 2.33. The number used to calculate the non-English-speaking population. Values are Rounded Down

Table 4.3.1-7. Estimated Number and Total Replacement Cost Value of Structures Located in the WUI

Jurisdiction	Jurisdiction Total		Intermix WUI				Interface WUI			
	Number of Buildings	Replacement Cost Value	Number of Buildings	Percent of Total	Replacement Cost Value of Buildings	Percent of Total	Number of Buildings	Percent of Total	Replacement Cost Value of Buildings	Percent of Total
Barker (T)	1,265	$458,008,966	331	26.2%	$128,756,996	28.1%	669	52.9%	$219,845,171	48.0%
Binghamton (C)	25,243	$25,457,379,910	22,280	88.3%	$18,991,656,855	74.6%	1,331	5.3%	$937,485,409	3.7%
Binghamton (T)	2,121	$819,770,287	728	34.3%	$249,593,763	30.4%	1,377	64.9%	$563,776,242	68.8%
Chenango (T)	5,183	$3,461,760,757	2,475	47.8%	$1,279,106,244	36.9%	2,585	49.9%	$1,229,580,628	35.5%
Colesville (T)	2,476	$1,191,537,444	698	28.2%	$229,723,809	19.3%	1,225	49.5%	$419,761,900	35.2%
Conklin (T)	2,520	$1,512,740,573	1,242	49.3%	$668,252,478	44.2%	1,187	47.1%	$636,665,335	42.1%
Deposit (V)	468	$264,974,793	364	77.8%	$207,171,518	78.2%	101	21.6%	$31,628,670	11.9%
Dickinson (T)	1,447	$1,107,438,719	1,009	69.7%	$392,275,646	35.4%	397	27.4%	$359,466,038	32.5%
Endicott (V)	7,011	$5,891,635,188	4,841	69.0%	$4,095,414,307	69.5%	50	0.7%	$17,424,516	0.3%
Fenton (T)	3,166	$1,276,510,649	1,477	46.7%	$742,745,592	58.2%	1,626	51.4%	$501,756,772	39.3%
Johnson City (V)	7,904	$17,304,375,644	6,564	83.0%	$8,018,315,296	46.3%	785	9.9%	$2,071,698,517	12.0%
Kirkwood (T)	2,628	$2,560,128,948	1,184	45.1%	$1,279,384,656	50.0%	1,324	50.4%	$711,254,227	27.8%
Lisle (T)	1,108	$396,905,321	457	41.2%	$171,745,087	43.3%	229	20.7%	$82,988,311	20.9%
Lisle (V)	135	$62,277,436	117	86.7%	$57,439,371	92.2%	18	13.3%	$4,838,065	7.8%
Maine (T)	2,431	$1,346,741,610	652	26.8%	$276,160,564	20.5%	1,602	65.9%	$993,356,634	73.8%
Nanticoke (T)	762	$278,505,563	217	28.5%	$61,558,377	22.1%	377	49.5%	$145,466,362	52.2%
Port Dickinson (V)	845	$315,481,120	660	78.1%	$234,365,225	74.3%	182	21.5%	$70,695,742	22.4%
Sanford (T)	1,399	$483,498,227	175	12.5%	$55,009,170	11.4%	673	48.1%	$225,830,984	46.7%
Triangle (T)	915	$437,291,241	348	38.0%	$221,767,481	50.7%	326	35.6%	$116,380,522	26.6%
Union (T)	13,013	$15,447,295,551	3,727	28.6%	$3,577,699,654	23.2%	2,616	20.1%	$3,018,963,474	19.5%
Vestal (T)	9,532	$13,318,921,679	5,436	57.0%	$8,223,177,008	61.7%	3,695	38.8%	$2,537,587,797	19.1%
Whitney Point (V)	439	$397,093,693	322	73.3%	$323,987,325	81.6%	109	24.8%	$65,467,737	16.5%
Windsor (T)	2,685	$956,635,388	551	20.5%	$213,162,402	22.3%	1,604	59.7%	$517,800,547	54.1%
Windsor (V)	435	$420,256,617	366	84.1%	$360,750,159	85.8%	61	14.0%	$45,648,920	10.9%
Broome County (Total)	**95,131**	**$95,167,165,323**	**56,221**	**59.1%**	**$50,059,218,981**	**52.6%**	**24,149**	**25.4%**	**$15,525,368,521**	**16.3%**

Source: Broome County GIS & Mapping Services; RS Means 2022; Radeloff et al. 2012

Impacts on Critical Facilities and Community Lifelines

Table 4.3.1-8 summarizes the number of community lifelines exposed to the wildfire hazard. Of 543 community lifelines in the wildfire intermix hazard area, the greatest numbers are in the Safety and Security or Transportation category (119 each). Of the 340 community lifelines in the wildfire interface hazard area, the greatest number are in the Safety and Security category (97).

Table 4.3.1-8. Number of Lifelines Located in the WUI

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines in the Wildfire Intermix Hazard Area	Number of Lifelines in the Wildfire Interface Threat Area
Communications	60	7	33
Energy	0	0	0
Food, Water, Shelter	161	91	38
Hazardous Material	210	107	22
Health and Medical	41	24	6
Safety and Security	243	119	54
Transportation	516	119	97
Water Systems	197	76	90
Broome County (Total)	**1,428**	**543**	**340**

Source: Broome County 2023; Radeloff et al. 2012

Wildfires affect the County's water supplies because of residual pollutants like char or debris clogging wastewater pipes, culverts, and other water infrastructure. Wildfires may also impact transportation by blocking or preventing access and isolating residents and emergency service providers. Char and debris polluting the air can make it difficult to drive, and flames close to roadways can make travel unsafe.

Impacts on the Economy

Wildfires can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed businesses. Fire suppression and control can cost thousands of dollars in public funding, requiring hundreds of operating hours for fire apparatus and thousands of labor hours from firefighters. There are also costs to local businesses that excuse volunteer firefighters from working to fight the fires. Closure of major roadways and cancellation of outdoor events due to nearby fire and smoke can also result in economic impacts.

Table 4.3.1-7 lists replacement cost values of buildings in wildfire hazard areas. Approximately $50 billion of the County's replacement cost value (52.6 percent) is located in the wildfire intermix hazard area. The City of Binghamton has the highest replacement cost value exposed ($18.9 billion). The Village of Lisle has the highest percentage of replacement cost value exposed (92.2 percent). Approximately $15.5 billion of the County's replacement cost value (16.3 percent) is located in the wildfire interface hazard area. The Town of Union has the highest replacement cost value exposed ($3 billion). The Town of Maine has the highest percentage of replacement cost value exposed (73.8 percent).

Impacts on the Environment

Wildfires are a necessary part of ecosystem health because they can lessen the accumulation of flammable dead organic matter reducing the risk of uncontrolled fires. However, intense or uncontrolled fires cause severe damage to the environment, including burning and killing of plant and animal life. Intense fires can also heat narrow and shallow waterways, damaging aquatic systems.

Post-fire runoff polluted with debris and contaminants can be extremely harmful to terrestrial ecosystems and aquatic life (USGS 2023), although studies show that forest fires are less harmful to the environment than urban fires (Harvard University 2022). The age and density of infrastructure in Broome County can exacerbate the consequences of fires on the environment because of the increased number of contaminants released from aged burning infrastructure. Chemicals such as iron lead, zinc, and other materials are now known to be dangerous for exposure. However, older infrastructure may still contain many of these chemicals and materials which are now controlled for new development standards. When an old structure burns, these dangerous chemicals may leach into stormwater, contaminate nearby streams, and impair aquatic life.

Intense wildfire events that destroy existing ecosystems can increase invasive species that may be able to move into an area with a lack of natural competitors (U.S. Department of the Interior 2012).

Cascading Impacts on Other Hazards

Following wildfires, cascading hazards such as debris flow, landslides, and flooding may occur due to the loss of stabilizing vegetation, resulting in potentially catastrophic sequences. When wildfire hits drought-stricken areas, watersheds and reservoirs can be further impacted by ash and debris flows, water treatment facilities may shut down with damage or loss of power, crops can be destroyed, and smoke can affect animal and human health (NIDIS 2023).

Flooding after a wildfire is often more severe, as debris and ash left from the fire can form mudflows. During and after a rain event, as water moves across charred and denuded ground, it can pick up soil and sediment and carry it in a stream of floodwaters. These mudflows have the potential to cause significant damage to impacted areas. Areas directly affected by fires and those located below or downstream of burn areas are most at risk for flooding (FEMA 2020). For detailed information regarding flooding, see Section 4.3.6 (Flood).

Intense wildfire events that destroy existing ecosystems can increase invasive species that may be able to move into an area with a lack of natural competitors (U.S. Department of the Interior 2012).

Future Changes That May Impact Vulnerability

Understanding future changes that affect vulnerability can assist in planning for future development and ensure the establishment of appropriate mitigation, planning, and preparedness measures.

Projected Development

As discussed in Section 3 (County Profile), areas targeted for future growth and development have been identified across the County. Any changes in development can impact the County's risk to the wildfire hazard. Additional future development within the County will ultimately increase the risk of wildfire, especially if the development is located near WUI. New development with a mix of ornamental vegetation, and wildland fuels will require continued assessment of the hazard to determine mitigation risk. Therefore, the County plans to implement wildfire management strategies in existing building codes to protect structures against the residual impacts from wildfires such as heat, debris, and char. Furthermore, new development within the County is generally built with access to transit routes that will enable easier evacuation during a wildfire event. These mitigation strategies aid in lessening the risk of wildfire events, to work to offset the increase from new additional development and build-out.

Projected Changes in the Population

Broome County has experienced a decrease in its population from 2010 to 2022. According to the U.S. Census Bureau, the County's population increased by approximately 0.95 percent between 2010 and 2020 (U.S. Census 2023). Cornell University's Program on Applied Demographics projects that Broome County will have a population of 186,950 by 2030 and 183,176 by 2040 (Cornell University 2018).

Any changes in the density of the population can impact the number of persons exposed to the wildfire hazard. As Broome County's population continues to decline at a small rate, wildfire risk will also decline. Additionally, fire suppression capabilities are high at the state and local levels, which contributes to a lower wildfire risk for the County.

Climate Change

Climate change associated with warmer temperatures, changes in rainfall, and increased periods of drought may create an atmospheric and fuel environment that is more conducive to large, severe fires (United Nations 2021). Changes in climate patterns may impact the distribution and perseverance of insect outbreaks that create dead trees (increase fuel). When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain and are more likely to expand into residential neighborhoods.

Average temperatures are anticipated to increase in New York, potentially changing the suitability of habitats for specific types of trees, altering the fire regime, and influencing the frequency and intensity of fire events. Prolonged and more frequent heat waves and droughts have the potential to increase the likelihood of a wildfire. Stronger winds may make it harder to contain fires, increasing the County's vulnerability to this hazard.

Change of Vulnerability Since 2019 HMP

The 2024 HMP has been updated to reflect the 2020 Decennial Census and the 2021 ACS 5-year estimates for population changes. The building stock inventory was updated using data from Broome County.

Further, the building stock inventory replacement cost values were updated using RS Means 2022 values, providing an overall update to the assets assessed in this risk assessment.

SECTION 4. RISK ASSESSMENT

4.4 HAZARD RANKING

This plan assessed a comprehensive range of natural hazards that pose a significant risk to Broome County. The risk assessment shows that each jurisdiction participating in this HMP has different levels of vulnerability to and potential impacts from each of the hazards. Each jurisdiction needs to recognize the hazards that pose the greatest risk to its community and direct its attention and resources accordingly to manage risk and reduce losses. To achieve this, the hazards of concern were ranked using methodologies promoted by FEMA's hazard mitigation planning guidance and input from all participating jurisdictions. These rankings vary among the jurisdictions—a hazard may be ranked low for one municipality but high for the County or another municipality due to differences in vulnerability and impact. Jurisdictional ranking results are presented in each jurisdictional annex in Volume II.

4.4.1 Categories Used in Ranking

The ranking methodology is based on four risk assessment categories, with the following scoring parameters defined for each category:

- *Level* is a qualitative description of how each hazard rates in each category (such as low to high, or unlikely to frequent).
- *Benchmark values* are determinable quantities or descriptions that define which level should apply to each hazard.
- *Numeric value* is the hazard's score in each category, based on the assigned level.
- *Weighting* is a multiplier applied to each hazard's numeric value in each category, to represent the relative importance of the category (the higher the weighting, the more important the category).

The following sections describe the categories and their associated scoring parameters.

Probability of Occurrence

The probability of occurrence of the hazard scenario evaluated was estimated by examining the historical record or calculating the likelihood of annual occurrence. When no scenario was assessed, an examination of the historical record and

The hazard ranking methodology for some hazards of concern is based on a scenario event that only impacts specific areas (such as a floodplain), while others are based on their potential risk to the County as a whole. In order to account for these differences, the quantitative hazard ranking methodology was adjusted using professional judgement and subject-matter input. The limitations of this analysis are recognized, given that 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.

judgment were used to estimate the probability of the occurrence of an event in the local planning area. Table 4.4-1 summarizes the scoring parameters for probability of occurrence.

Table 4.4-1. Values and Weights for Probability of Occurrence

Level	Benchmark Value	Numeric Value	Weighting
Unlikely	A hazard event is not likely to occur or has less than a 1 percent annual probability of occurring.	0	30%
Rare	Between 1 and 10 percent annual probability of a hazard event occurring.	1	
Occasional	Between 10 and 100 percent annual probability of a hazard event occurring.	2	
Frequent	100 percent annual probability; a hazard event may occur at least once a year.	3	

Consequence

Consequence represents the expected vulnerability or impact associated with the hazard. This is rated for three subcategories: vulnerability of people; vulnerability of property; and economic impacts on the community. A numeric value based on defined benchmarks is assigned for each subcategory, and a factor is applied to those values representing the relative importance of each subcategory. The total numeric value for consequence is the sum of the factored numeric values for each subcategory. Table 4.4-2 summarizes the scoring parameters for consequence.

Table 4.4-2. Values and Weights for Consequence

Level	Benchmark Value	Numeric Value	Factor	Weighting
Population Vulnerability (Numeric Value x 3)				30%
None	No population vulnerable to the hazard	0	3	
Low	14 percent or less of the population is exposed to a hazard with the potential for measurable life-safety impact due to its extent and location.	1		
Medium	15 to 29 percent of the population is exposed to a hazard with the potential for measurable life-safety impact due to its extent and location.	2		
High	30 percent or more of the population is exposed to a hazard with potential for measurable life-safety impact, due to its extent and location.	3		
Property Vulnerability (Numeric Value x 2)				
None	No property vulnerable to the hazard	0	2	
Low	Property vulnerability is 14 percent or less of the total number of structures.	1		
Medium	Property vulnerability is 15 to 29 percent of the total number of structures.	2		
High	Property vulnerability is 30 percent or more of the total number of structures.	3		
Economic Impact (Numeric Value x 1)				
None	No estimated loss due to the hazard	0	1	
Low	The loss estimate is 9 percent or less of the total replacement cost for the community.	1		
Medium	The loss estimate is 10 to 19 percent of the total replacement cost for the community.	2		
High	The loss estimate is 20 percent or more of the total replacement cost for the community.	3		

Adaptive Capacity

Adaptive capacity describes a jurisdiction's administrative, technical, planning/regulatory, and financial ability to protect itself from or withstand a hazard event. Mitigation measures that can increase a jurisdiction's capacity to withstand and rebound from events include codes or ordinances with higher standards or guidelines for design or siting; deployable resources; and plans or procedures for responding to an event.

A rating of "weak" for adaptive capacity means a jurisdiction does not have the capability to effectively respond, which increases vulnerability. A "strong" adaptive capacity means the jurisdiction does have the capability to effectively respond, which decreases vulnerability. These ratings were assigned using the results of the capability assessment (Section 5) with input from each jurisdiction. Table 4.4-3 summarizes the scoring parameters for adaptive capacity.

Table 4.4-3. Values and Weights for Adaptive Capacity

Level	Benchmark Value	Numeric Value	Weighting
Weak	Weak, outdated, or inconsistent plans, policies, codes, or ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	1	30%
Moderate	Plans, policies, codes/ordinances in place and meet minimum requirements; mitigation strategies identified but not implemented on a widespread scale; jurisdiction can recover but needs outside resources.	0	
Strong	Plans, policies, codes/ordinances in place and exceed minimum requirements; mitigation/protective measures in place; jurisdiction has the ability to recover quickly because resources are readily available.	-1	

Climate Change

Current climate change projections were evaluated as part of the hazard ranking to account for potential increases in the severity or frequency of the hazard. This category is important because the hazard ranking helps guide and prioritize the mitigation strategy as a long-term future vision for mitigating the hazards of concern. The potential impacts that climate change may have on each hazard of concern are discussed in the risk assessment chapters for each hazard. Table 4.4-4 summarizes the scoring parameters for climate change. The benchmark values are similar to the confidence levels outlined in the National Climate Assessment 2023. The benchmark values are similar to the confidence levels outlined in the National Climate Assessment 2023.

Table 4.4-4. Values and Weights for Climate Change

Level	Benchmark Value	Numeric Value	Weighting
Low	No local data are available; modeling projects are uncertain on whether there is increased future risk; confidence level is low (inconclusive evidence).	1	10%
Medium	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change; the confidence level is medium to high (moderate evidence).	2	
High	Studies and modeling projections indicate exacerbated conditions and increased future risk due to climate change; very high confidence level (strong evidence, well documented, and acceptable methods).	3	

4.4.2 Total Ranking Score

The total ranking score based on the categories described above is calculated using the following equation:

Risk Ranking Score Equation

Ranking Score= [(Consequence on Population x 3) + (Consequence on Property x 2) + (Consequence on Economy x 1)] x 0.3 + Adaptive Capacity x 0.3 + Climate Change x 0.1 + Probability of Occurrence x 0.3

Using this equation, the highest possible ranking score is 7.5. The higher the number, the greater the relative risk. Based on the score for each hazard, a hazard ranking is assigned to each hazard of concern as follows:

- Low = Values less than 3.9
- Medium = Values between 3.9 and 4.9
- High = Values greater than 4.9

All planning partners applied the same methodology to develop the hazard rankings to ensure consistency in the overall ranking of risk. However, each jurisdiction had the ability to alter rankings based on local knowledge and experience in handling each hazard.

4.4.3 Hazard Ranking Results

Using the methodology described in this section, the hazard ranking for the identified hazards of concern was determined for each partner. The hazard ranking for Broome County is detailed in the following tables:

- Table 4.4-5 shows the unweighted numeric values assigned for the probability of occurrence for each hazard.
- Table 4.4-6 shows the numeric values assigned for each subcategory of consequence for each hazard. Results are shown after applying the subcategory factors, but not the category-wide weighting.

- Table 4.4-7 shows the unweighted numeric values assigned for adaptive capacity and climate change for each hazard.
- Table 4.4-8 shows the total weighted hazard ranking scores for each hazard of concern. This countywide hazard score includes the entire planning area and may not reflect the highest risk for all planning partners.

The overall ranking for each jurisdiction is included in Table 4.4-9 and in the annexes in Volume II.

Table 4.4-5. Probability of Occurrence for Hazards of Concern for Broome County

Hazard of Concern	Probability	Numeric Value
Dam and Levee Failure	Occasional	2
Disease Outbreak	Occasional	2
Drought	Frequent	3
Earthquake	Rare	1
Extreme Temperature	Frequent	3
Flood	Frequent	3
Invasive Species	Occasional	2
Severe Storm	Frequent	3
Severe Winter Storm	Frequent	3
Wildfire	Occasional	2

Table 4.4-6. Consequence Rating for Hazards of Concern for Broome County

Hazard of Concern	Population			Property			Economy			Total Impact Rating (Population + Property + Economy)
	Consequence	Numeric Value	Multiplied by Factor (3)	Consequence	Numeric Value	Multiplied by Factor (2)	Consequence	Numeric Value	Multiplied by Factor (1)	
Dam and Levee Failure	High	3	9	High	3	6	Medium	2	2	17
Disease Outbreak	Medium	2	6	Medium	2	4	Medium	2	2	12
Drought	Medium	2	6	Low	1	2	Medium	2	2	10
Earthquake	Low	1	3	Low	1	2	Low	1	1	6
Extreme Temperature	High	3	9	Low	1	2	Medium	2	2	13
Flood	High	3	9	High	3	6	Medium	2	2	17
Invasive Species	Low	1	3	Medium	2	4	Medium	2	2	9
Severe Storm	High	3	9	Medium	2	4	Medium	2	2	15
Severe Winter Storm	High	3	9	High	3	6	Low	1	1	16
Wildfire	Medium	2	6	Medium	2	4	Medium	2	2	12

Table 4.4-7. Adaptive Capacity and Climate Change Ratings for Hazards of Concern Broome County

Hazard of Concern	Adaptive Capacity		Climate Change	
	Level	Numeric Value	Level	Numeric Value
Dam and Levee Failure	Medium	0	Medium	2
Disease Outbreak	Medium	0	Medium	2
Drought	Medium	0	High	3
Earthquake	Low	1	Medium	2
Extreme Temperature	Medium	0	High	3
Flood	Medium	0	High	3
Invasive Species	Medium	0	Medium	2
Severe Storm	High	-1	High	3
Severe Winter Storm	High	-1	High	3
Wildfire	Medium	0	High	3

Table 4.4-8. Total Hazard Ranking Scores for the Hazards of Concern for Broome County

Hazard of Concern	Probability x 30%	Total Consequence x 30%	Adaptive Capacity x 30%	Changing Future Conditions x 10%	Total Hazard Ranking Score
Dam and Levee Failure	0.6	5.1	0	0.2	5.9
Disease Outbreak	0.6	3.6	0	0.2	4.4
Drought	0.9	3.0	0	0.3	4.2
Earthquake	0.3	1.8	0.3	0.2	2.6
Extreme Temperature	0.9	3.9	0	0.3	5.1
Flood	0.9	5.1	0	0.3	6.3
Invasive Species	0.6	2.7	0	0.2	3.5
Severe Storm	0.9	4.5	-0.3	0.3	5.4
Severe Winter Storm	0.9	4.8	-0.3	0.3	5.7
Wildfire	0.6	3.6	0	0.3	4.5

Table 4.4-9. Overall Ranking of Hazards by Jurisdiction

Jurisdiction	Dam and Levee Failure	Disease Outbreak	Drought	Earthquake	Extreme Temperature	Flood	Invasive Species	Severe Storm	Severe Winter Storm	Wildfire
Town of Barker	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
City of Binghamton	Medium	Medium	Medium	Low	High	Medium	Medium	High	High	Medium
Town of Binghamton	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Town of Chenango	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Town of Colesville	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Town of Conklin	Medium	Medium	Medium	Low	High	High	Medium	High	High	Medium
Village of Deposit	Medium	Medium	Medium	Low	High	Medium	Medium	High	High	Medium
Town of Dickinson	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Village of Endicott	Medium	Medium	Medium	Low	High	High	Medium	High	High	Medium
Town of Fenton	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Village of Johnson City	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Town of Kirkwood	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Village of Lisle	Medium	Medium	Medium	Low	High	High	Medium	High	High	Medium
Town of Maine	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Town of Nanticoke	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Village of Port Dickinson	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Town of Sanford	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Town of Triangle	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Town of Union	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Town of Vestal	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Village of Whitney Point	Medium	Medium	Medium	Low	High	High	Medium	High	High	Medium
Town of Windsor	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
Village of Windsor	Medium	Medium	Medium	Low	High	Low	Medium	High	High	Medium
County of Broome	**High**	**Medium**	**Medium**	**Low**	**High**	**High**	**Medium**	**High**	**High**	**Medium**

SECTION 5. CAPABILITY ASSESSMENT

According to the Federal Emergency Management Agency's (FEMA) Mitigation Planning How-To Guide #3, a capability assessment is an inventory of a community's missions, programs, and policies and an analysis of its capacity to carry them out. This assessment is an integral part of the planning process. The assessment process enables the identification, review, and analysis of current local and state programs, policies, regulations, funding, and practices that could either facilitate or hinder mitigation (FEMA 2013).

During the original planning process, the County and participating municipalities identified and assessed their capabilities in the areas of existing programs, policies, and technical documents. By completing this assessment, each jurisdiction learned how or whether they would be able to implement certain mitigation actions by determining the following:

- Limitations that could exist in undertaking actions.
- The range of local and state administrative, programmatic, regulatory, financial, and technical resources available to assist in implementing mitigation actions.
- Mitigation actions that could be technically, legally (regulatory), administratively, politically, or fiscally challenging or infeasible because they are outside the scope of current capabilities.
- Opportunities to enhance local capabilities to support long-term mitigation and risk reduction.

During the plan update process, all participating jurisdictions were tasked with assessing their capabilities, evaluating the effectiveness of those capabilities in supporting hazard mitigation, and identifying opportunities to enhance the capabilities.

County and municipal capabilities in the planning and regulatory, administrative and technical, and fiscal arenas can be found in the capability assessment section of each jurisdictional annex in Volume II. Each annex also describes the jurisdiction's current integration of hazard mitigation into existing planning, regulatory, and operational/administrative framework (integration capabilities) and plans for further integration (integration actions). A summary of continued efforts to develop and promote a comprehensive and holistic approach to hazard mitigation countywide is presented in Section 7.

The following sections summarize the federal, state, county, and local planning, regulatory, administrative, technical, and fiscal programs available to promote and support mitigation and risk reduction in Broome County.

5.1 PLANNING AND REGULATORY CAPABILITIES

5.1.1 County and Local

Municipal Land Use Planning and Regulatory Authority

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.

Section 239 of the New York State General Municipal Law requires the referral of certain local planning actions to the County Planning Department for the examination of possible inter-municipal impacts. The department conducts reviews and renders advisory opinions on land use proposals in the county. The senior planner from the department serves as hazard mitigation coordinator, provides continuous support for the implementation of mitigation projects and educational outreach, and serves as a resource to the County and municipalities.

Broome County Comprehensive Emergency Management Plan

The Broome County Department of Emergency Services maintains the Broome County Comprehensive Emergency Management Plan (CEMP), an all-hazard plan that describes how the County will organize and respond to emergencies and disasters. It is based on and consistent with federal, state, and county laws, as well as all other applicable plans and policies, including the National Response Framework and the New York State CEMP. The department also provides planning, training, resources, responses, warning, coordination, and information to the public, elected officials, and public safety agencies, to assist them in preparing for, responding to, and mitigating emergencies and disasters that affect the residents of Broome County.

Broome County Debris Management Plan

Broome County developed a debris management plan that provides municipalities with an organizational structure, guidance, and standardized procedures for the removal and disposal of flood debris. This plan details the roles and responsibilities of offices and personnel involved with debris management; health and safety procedures to be followed; environmental regulations and permits to obtain for debris management; the County's approach for using reduction, reuse, and reclamation; and the protocol and prioritization of areas for debris removal.

Broome County Watershed Flood Hazard Mitigation Plan

In 2016, the Broome County Planning Department released the Broome County Watershed Flood Hazard Mitigation Plan. This plan provides an overview of the flood hazard risks throughout the County and acts as a tool for local municipal officials to make informed decisions on where to locate flood mitigation

activities to achieve the maximum benefit of their flood mitigation funds. This report established a database of flood hazards throughout the County with a systematic method to evaluate and rank flood risks. In addition, the report included conceptual designs and a cost-benefit analysis for three high-risk mitigation projects. The plan can be found online at the following link: http://www.gobroomecounty.com/files/planning/_pdf/BCWFHMA%20-%20Report%20for%20Web.pdf.

Local Waterfront Revitalization Program

A Local Waterfront Revitalization Program (LWRP) consists of a planning document prepared by a community and the program established to implement the plan. An LWRP can be comprehensive and address all issues that affect a community's entire waterfront, or it can address only the most critical issues facing a significant portion of its waterfront. An approved LWRP reflects community consensus and provides a clear direction for appropriate future development. It establishes a long-term partnership among local government, community-based organizations, and the state. Funding to advance the preparation, refinement, or implementation of an LWRP is available from the New York State Environmental Protection Fund and other sources (New York State Division of Planning 2018).

Any village, town, or city located along the state's coast or designated inland waterway can prepare an LWRP. Municipalities are encouraged to address local revitalization in a broad context aligned with regional economic development strategies and regional resource protection and management programs (New York State Division of Planning 2018).

The Waterfront Revitalization of Coastal Areas and Inland Waterways Act offers local governments the opportunity to participate in the state's Coastal Management Program (CMP) on a voluntary basis. To participate, local governments prepare and adopt an LWRP. During this process, local governments implement the CMP through the use of powers such as zoning and site plan review (New York State Division of Planning 2018).

When an LWRP is approved by the New York State Secretary of State, the state ensures the actions in the LWRP are consistent with the state's CMP goals and actions. Title 19 of New York Codes, Rules, and Regulations (NYCRR) Parts 600, 601, 602, and 603 provide the rules and regulations that implement the provisions of the Waterfront Revitalization of Coastal Areas and Inland Waterways Act (New York State Division of Planning 2018).

The New York Department of State website (https://dos.ny.gov/local-waterfront-revitalization-program) provides a list of all approved LWRPs. As of the date of this plan update, the City of Binghamton has the only approved LWRP plan in Broome County and this plan is currently under update.

Broome County has a county-wide Intermunicipal Waterfront Access Plan. While this is not a full LWRP, it does integrate many of the components on a Countywide scale and can serve as a framework for communities in developing a local LWRP or in other waterfront planning. Broome County has been awarded a grant to update the plan.

5.1.2 State and Federal

National Flood Insurance Program

The National Flood Insurance Program (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. There are three components to the NFIP: flood insurance, floodplain management, and flood hazard mapping.

Communities participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally-backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary. Flood damage in the United States is reduced by nearly $1 billion each year through communities implementing sound floodplain management requirements and property owners purchasing flood insurance. Buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance (FEMA 2008).

All municipalities in Broome County actively participate in the NFIP. As of November 30, 2023, there were 1,611 NFIP policies in Broome County. There have been 2,948 claims made, totaling over $119 million for damage to structures and contents. There are 485 NFIP repetitive loss properties and 75 severe repetitive loss properties in the county.

Municipal participation in and compliance with the NFIP is supported at the federal level by FEMA and the Insurance Services Organization and at the state level by the New York State Department of Environmental Conservation (NYSDEC) and New York State Office of Emergency Management (a division of NYS DHSES). Additional information on the NFIP program and its implementation throughout the county can be found in the flood hazard profile (Section 4.3.6).

Municipalities that participate in the NFIP can adopt higher regulatory standards when implementing the provisions of the NFIP. Specifically identified are the following:

- **Base Flood Elevation (BFE):** The elevation of surface water due to flooding that has a 1 percent chance of being equaled or exceeded in any given year.
- **Freeboard**: New York State requires the lowest floor of a building, including any basement, to be at or above the BFE plus 2 feet; the additional 2 feet is referred to as freeboard. The elevation requirement can be achieved by means of properly compacted fill, a solid slab foundation, or a crawl space foundation, which contains permanent openings to let flood waters in and out. Non-residential structures might be flood-proofed instead of elevated. Where a local floodplain administrator has information to estimate a BFE, such as historic flood records or a hydraulic study, that elevation must be used. If the development consists of more than 5 acres or more than 50 lots,

the permit applicant must determine the BFE and build accordingly (NYSDEC 2018). Communities can go beyond this requirement, providing additional freeboard.

- **Cumulative Substantial Improvements/Damages**: The NFIP allows improvements valued at up to 50 percent of the building's pre-improvement value to be permitted without meeting the flood protection requirements. Over the years, a community can issue a succession of permits for repairs or improvements to the same structure, each at less than 50 percent of the building value but cumulatively exceeding 50 percent above the initial value. This can greatly increase the overall flood damage potential for structures within a community. The community can choose to account for substantial improvement cumulatively so that once a threshold of improvement within a certain length of time is reached, the structure is considered to be substantially improved and be required to meet flood protection requirements.

Community Rating System

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 for participating communities to reflect the reduced flood risk resulting from community actions meeting the three goals of the CRS:

- Reduce flood losses
- Facilitate accurate insurance rating
- Promote the awareness of flood insurance (FEMA 2012).

The amount of premium discount depends on the credits the community earns for its floodplain management activities. A community receives a CRS classification based on its total credit score. There are 10 CRS classes. Class 1 requires the most credit points and gives the greatest premium reduction or discount. A community that does not apply for the CRS, or does not obtain the minimum number of credit points, is a Class 10 community and receives no discount on premiums.

As of October 2023, three communities in Broome County are actively participating in the CRS program: The Town of Union (Class 8), the Town of Chenango (Class 9), and the Village of Johnson City (Class 9).

Other communities in Broome County have explored the possibility of participating but concluded that the program savings would not be cost-beneficial in the long run.

New York State Floodplain Management

NYSDEC programs that have a bearing on floodplain management are managed by the 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 using both structural and nonstructural means.

The Dam Safety Section is responsible for "reviewing repairs and modifications to dams and assuring 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 the construction, operation, and maintenance of flood control facilities.

The Floodplain Management Section is responsible for reducing flood risk to life and property through the 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.

Climate Leadership and Community Protection Act

New York State's Climate Leadership and Community Protection (the Climate Act), (bill S6599) was signed into law in 2019. This Act requires New York to reduce economy-wide greenhouse gas emissions by 40 percent by 2030, and no less than 85 percent by 2050 from 1990 levels. In addition, the Climate Act includes requirements for renewable energy generation and end-use energy savings and calls for 100 percent zero-emission electricity by 2040 for New York State, with 70 percent renewable energy by 2030. The statute creates a Climate Action Council charged with developing a scoping plan of recommendations to meet these directives and place New York on a path toward carbon neutrality. The Climate Act includes improving community adaptation and resilience to climate change by having a strong focus on a just transition to a low-carbon economy for disadvantaged communities. The Climate Act has created:

- New York's Scoping Plan - The Climate Act formed a Climate Action Council (Council) tasked with developing a framework for how the State will achieve the objectives of the Climate Act. The Council released a draft scoping plan in December 2021 with a public comment period that included 11 public hearings held throughout the state. On December 19, 2022, the Council released a final Scoping Plan which outlines recommended policies and actions to help New York meet the directives of the Climate Act. As required under the Climate Act, the Council will update the Scoping Plan every five years to ensure the plan continues to meet the State's climate directives.
- Disadvantaged Communities Barriers and Opportunities Report and Disadvantaged Communities Criteria - The Disadvantaged Communities Barriers and Opportunities Report (PDF), required by the Climate Act, analyzes why some communities are disproportionately impacted by climate change and air pollution and have unequal access to clean energy. The report recommends actions for New York State agencies to design climate protection and clean energy programs through a lens of justice. The recommendations are incorporated into New York's Scoping Plan. The Climate Act charged the Climate Justice Working Group (CJWG) with the development of criteria (leaves DEC website) to identify disadvantaged communities to ensure that frontline and otherwise underserved

communities benefit from the state's historic transition to cleaner, greener sources of energy, reduced pollution, and cleaner air, and economic opportunities.

Additional details on the CRRA are provided on the website: https://www.nyserda.ny.gov/All-Programs/CLCPA.

Northeast Regional Climate Center

Climate change is increasing the frequency of heavy rainfall events, and the Northeast Regional Climate Center (NRCC) partnered with the New York State Energy Research and Development Authority to compare methods of downscaling global climate model output and create extreme precipitation projections for New York State. These products are designed for use by municipal officials, researchers, planners, highway departments, and other decision-makers who need to take storm events into account.

For example, the NRCC provides intensity-duration-frequency curves that show the probability of heavy rainfall events and incorporate climate projections for officials to plan for future conditions. These curves display how precipitation events are being affected by New York State's rapidly changing climate (NRCC 2015). NRCC also maintains the "Extreme Precipitation in New York & New England" website, an interactive tool for extreme precipitation analysis (NRCC 2018). This tool can be used by municipalities to assist them in the design and feasibility assessment of future projects and allow them to see the future intensity and frequency of rain events.

5.2 ADMINISTRATIVE AND TECHNICAL CAPABILITIES

5.2.1 County and Local

Broome County Department of Planning and Economic Development

The Broome County Department of Planning and Economic Development implements projects and programs to improve the economy, environment, and physical infrastructure of the county. The department provides technical planning guidance and assistance to the County Executive and County Legislature and extends professional services to local municipalities and other public and private entities. Its assistance covers the areas of land use planning and zoning, grants, economic development, cartography, community assistance, research, and infrastructure development. The Department of Planning and Economic Development consists of the following divisions:

- Planning and Economic Development
- Geographic Information System/Mapping
- Environmental Management Council
- Binghamton Metropolitan Transportation Study

The following are examples of planning services provided by the department:

- Provide ongoing community technical assistance, including the provision of assistance to municipalities on drafting or updating their comprehensive plans. Assistance ranges from the full spectrum of planning services to minor assistance such as mapping and community surveys.
- Oversee and administer the development of regional planning efforts, including partnering with other municipalities for a government funding request and subsequent administering and coordination of projects.
- Conduct reviews and render advisory opinions on land use proposals covered under the law, as mandated under New York State General Municipal Law 239.
- Host training in land use and zoning issues for local appointed and elected officials.
- Assist regarding the State Environmental Quality Review to other departments in the county in conjunction with the Environmental Management Council and conduct federal environmental reviews linked to specific projects or grants.
- Review, evaluate, and rate county departmental requests for projects to be included in the CIP to be given to the Budget and Research Department for inclusion in the CIP.
- Provide demographic data products and other data, including business and construction figures, to the county Industrial Development Agency, the public, and the private sector.
- Conduct reviews of the three agricultural districts in the county to measure the effectiveness of the district with respect to compliance with the intent of the law and to modify its boundaries, if necessary.

Broome County Emergency Services Department

The Emergency Services Department provides planning, training, resources, response, warning, coordination, and information to the public, elected officials, and public safety agencies to assist them in preparing for, responding to, and mitigating emergencies and disasters. The Department is comprised of the following divisions:

- The **Communications** division administers the Broome County Emergency Dispatch/911 Center, taking nearly 500,000 calls per year and dispatching approximately 200,000 of them.
- The **Public Safety Systems Division** administers the Broome County emergency communications systems and infrastructure.
- The **Emergency Management Division** conducts hazard vulnerability studies, provides disaster planning and preparedness for response and recovery, and administers the County's NY-Alert emergency public notification system.
- The **Emergency Medical Services Division** administers NYS-certified emergency medical training programs, plans for adequate delivery of emergency medical services, and coordinates mutual aid among EMS providers.

- The **Fire Prevention and Control Division** administers the New York State Outreach Fire Training program, Broome County Fire Mutual Aid Plan, Hazardous Materials Response Team, Wildland Search & Rescue Team, Water Rescue and Dive Team, Firefighter Assist and Search Teams, and Fire Investigation Team.
- The **Public Safety Programs Division** consists of several initiatives to enhance public safety, including the School Safety Program, Stop Driving While Intoxicated, and the School Bus Stop-Arm Program.

Broome County Department of Emergency Services encourages residents to subscribe to NY-Alert, New York State's Mass Notification System, to receive critical information and emergency alerts on what is happening in Broome County. This system contains critical, emergency-related information including instructions and recommendations in real-time by emergency personnel. Information can include severe weather warnings, significant highway closures, hazardous material spills, and other emergency conditions.

Broome County Soil and Water Conservation District

The Broome County Soil and Water Conservation District is the lead agency for nonpoint source pollution abatement, municipal stormwater assistance, technical planning and grant writing for natural resource issues, and the design and implementation of agricultural best management practices in the County. Property owners can receive technical information as it pertains to soil, water, and other natural resource issues on their property.

Using a state stream recovery grant, the Soil and Water Conservation District stabilized over 2,500 feet of stream banks to prevent future flooding damage in Binghamton, Windsor, Vestal, Sanford, Fenton, Kirkwood, and the Town of Binghamton. It also removed excess stream debris over 4,500 feet of streams in Windsor, Fenton, Vestal, Sanford, Maine, and Chenango to help slow downstream flows and reduce erosion. Currently, the district is working with the New York State Governor's Office of Storm Recovery to administer a $3 million New York Communities Rising Regional River Initiative, which will go toward flood mitigation projects throughout the county.

Broome County Department of Public Works

The Department of Public Works consists of the following divisions that provide services to enhance the community:

- The **Administration Division** provides clerical, accounting, contract administration, and other related services to all divisions of the Department of Public Works.
- The **Engineering Division** provides engineering design and project management services to maintain County infrastructure, including bridges, culverts, facilities, and roadways, and to deliver

technical support to other Public Works divisions, County departments, and residents of Broome County.

- The **Buildings and Grounds Division** provides services to ensure uninterrupted facility utilization.
- The **Broome County Government Security Division** provides services to ensure the safety and security of the County employees and members of the public who enter County facilities and attend County-sponsored events.
- The **Solid Waste Management Division** provides residents and businesses with a comprehensive program for managing solid waste.
- The **Highway Division** provides a highway road system to move people and goods throughout the county to enhance community growth, economic well-being, and quality of life.

Broome County Community Organizations Active in Disaster

Broome County Community Organizations Active in Disaster (BCCOAD) provides a collaborative structure to coordinate the work of community organizations and resources for disaster mitigation, preparation, response, and recovery in Broome County. Created in 2009, BCCOAD is a membership program for independent organizations active in any phase of disaster in Broome County.

BCCOAD uses community disaster education, hazard analysis, training exercises, classes for community leadership, local emergency management plans, and the expertise of its members to bring holistic disaster awareness to the community.

BCCOAD has recruited over 1,000 volunteers working over 50,000 hours to help local communities recover from disasters, including the 2011 flood recovery process. The volunteers have assisted individuals with FEMA registration and with repairing or rebuilding over 100 homes. In 2015, BCCOAD hosted a FEMA Local Volunteer and Donations Management training to strengthen the capacity of local organizations to handle volunteers and donations during a disaster. BCCOAD publishes a monthly newsletter that provides readers with safety and preparedness information.

Broome County Department of Social Services

The Broome County Department of Social Services provides publicly funded social services and cash assistance programs. The department works directly with the American Red Cross, schools, and local jurisdictions to establish and maintain an inventory of suitable shelter locations. It can assist with the coordination and communication of shelter availability by the execution of the Broome County CEMP, which documents Countywide sheltering policies and procedures.

The "Mass Care, Emergency Assistance, Housing, and Human Services" Emergency Support Function of the CEMP (ESF #6) supports county, local, and non-governmental organization efforts to address the needs of individuals and families impacted by an emergency or disaster. As the primary County agency for ESF #6, the Department of Social Services is responsible for supporting mass care activities of the county government for large-scale incident management. This includes sheltering, feeding operations,

emergency first aid, bulk distribution of emergency items, and collecting and providing information on victims to family members. Local organizations supporting sheltering during an emergency include Broome County Health Department, Broome County Government Security Division, American Red Cross, UHS, Inc., Our Lady of Lourdes Hospital, Broome-Tioga Board of Cooperative Educational Services, pharmacies, medical suppliers, and animal shelters.

5.2.2 State and Federal

New York State Division of Homeland Security and Emergency Services

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. NYS DHSES administers the FEMA mitigation grant programs in the state and supports local mitigation planning in addition to developing and routinely updating the State Hazard Mitigation Plan.

NYS DHSES prepared the current State Hazard Mitigation Plan, working with input from other state agencies, authorities, and organizations. The plan was approved by FEMA in 2023 and enables New York to remain 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 2023 New York State HMP was used as guidance in completing the Broome County HMP Update. The state HMP can be found here: https://mitigateny.org/.

New York State Department of State's Division of Building Standards and Codes

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 (Uniform Code) and Energy Conservation Construction Code (Energy Code). These codes provide for the construction of safe, resilient, and energy-efficient buildings throughout New York State.

The statutory responsibility for developing and maintaining the Uniform Code and the 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.

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 to approve these more restrictive standards and codes when they comply with 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.

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.

New York State Department of Transportation

It is the mission of the New York State Department of Transportation (NYSDOT) to provide a safe, reliable, equitable, and resilient transportation system that connects communities, enhances quality of life, and supports the economic well-being of New York State. Broome County is served by the Southern Tier, Region 9 NYSDOT office, which is based out of the City of Binghamton.

NYSDOT offers a variety of grant, education, and training opportunities; has several environmental initiatives and programs; issues permits for traffic signals, driveways, advertisements, and other permitting needs; provides statistical roadway information; and provides information on community resources, such as scenic highways and fishing access sites.

5.3 FISCAL CAPABILITIES

5.3.1 County and Local

Hotel Motel (Occupancy Tax) Fund Grants

Broome County collects funds through an occupancy tax on stays at the County's hotels and motels. Municipalities and not-for-profit organizations may apply for these funds under two categories. The purpose of this fund is to support events, projects, and programs that support the economic development, tourism, and community improvement goals of the County and local communities.

Small Community Fund Grants

This fund supports small projects to enhance community character or smaller contributions that leverage other funds for larger projects. The intent of this program is to highlight the importance of diverse

communities. Grants are available to municipalities and non-profit organizations. Non-profits must be registered as such with the U.S. Internal Revenue Service and New York State Charities Bureau at the time of application. Private entities may not apply.

Economic Development and Marketing Grants

This fund supports projects anywhere in Broome County that can demonstrate a positive impact on the local economy and tourism. These may be projects that bring in visitors from other areas, improve community character, or support efforts to leverage private investment, among others. These are accepted on a rolling basis but will be awarded twice annually.

Community Beautification and Environmental Stewardship

The Community Beautification & Environmental Stewardship Grant Program offers a range of grants based on project scope and funding availability. These are mini-grants of up to $2,500 open to communities, non-profits, and schools to encourage community beautification and environmental stewardship. Eligible project opportunities must focus on one of the following: litter prevention, waste reduction, recycling, beautification, community greening- street plantings, composting, and community gardens.

Local Fiscal Capabilities

Broome County municipalities fund mitigation projects through local budgets and local appropriations (including referendums and bonding). Many municipalities noted during the planning process that they are faced with decreasing revenues, budget constraints, and tax caps. To overcome these fiscal challenges, municipalities continue to leverage the sharing of resources and combine available funding with grants and other sources. Plans and inter-municipal cooperation are beneficial in obtaining grants.

5.3.2 State and Federal

FEMA

Hazard Mitigation Assistance

FEMA Hazard Mitigation Assistance (HMA) programs provide funding for eligible activities that reduce or eliminate long-term risk to people and property from future disasters. These activities are referred to as hazard mitigation. States, local, tribal, and territorial governments may apply for this funding to support them in building climate resilience Table 5-1 provides an overview of cost share requirements for these grants. Details about grant programs and further descriptions of these opportunities can be found at: https://www.fema.gov/hazard-mitigation-assistance.

Table 5-1. FEMA HMA Grant Cost Share Requirements

Program	Mitigation Award Activity (percent of federal/non-federal cost share)
Hazard Mitigation Grant Program	75/25
Hazard Mitigation Grant Program—Post-Fire	75/25
Building Resilient Infrastructure and Communities	75/25
Building Resilient Infrastructure and Communities—Economically Disadvantaged Rural Communities	up to 90/10
Flood Mitigation Assistance—Localized Flood Risk Reduction, Project Scoping, individual mitigation of insured properties, and planning grants	75/25
Flood Mitigation Assistance—Socially Vulnerable Communities with a Centers for Disease Control and Prevention (CDC) Social Vulnerability Index (SVI) of 0.5 or greater.	up to 90/10
Flood Mitigation Assistance – Repetitive Loss (RL) Property	90/10
Flood Mitigation Assistance – Severe Repetitive Loss (SRL) Property	100/0

Source: FEMA 2023

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) is a post-disaster mitigation program. FEMA makes these grants available to states after each federal disaster declaration. The HMGP can provide up to 75 percent funding for cost-effective projects in an area covered by a federal disaster declaration that will protect public or private property or that will reduce likely damage from future disasters. Examples of projects include the 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. Applicants must have a FEMA-approved HMP (this plan).

Eligible applicants 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 could be considered as additional HMGP funding becomes available. Additional information regarding the HMGP is available on the FEMA website: https://www.fema.gov/hazard-mitigation-grant-program.

Flood Mitigation Assistance

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. 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. Of the remaining 25 percent, no more than half can be provided as in-kind contributions from third parties.

At a 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. The NYS DHSES serves as the grantee and program administrator for the FMA program. The FMA program is detailed on the FEMA website: https://www.fema.gov/flood-mitigation-assistance-grant-program.

Building Resilient Infrastructure and Communities Program

Building Resilient Infrastructure and Communities (BRIC) is a funding program to support states, local communities, tribes, and territories with hazard mitigation projects that will reduce the risks they face from disasters and natural hazards. The program's guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency.

Cost share is required for all sub-applications funded under this program. Generally, the cost share is 75 percent federal and 25 percent non-federal. However, economically disadvantaged rural communities are eligible for an increase in cost share of up to 90 percent of federal funding. For additional information regarding the BRIC program, refer to: https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities.

Extraordinary Circumstances

FEMA may grant exemptions to the hazard mitigation planning requirement for HMA funds in cases of extraordinary circumstances. Extraordinary circumstances exist when a determination is made by the applicant and FEMA that the proposed project is consistent with the priorities and strategies identified in the state hazard mitigation plan and that the jurisdiction meets at least one of the following criteria:

- The jurisdiction meets the small, impoverished community criteria (see Part VIII, B.2 of HMA Unified Guidance).
- The jurisdiction has been determined to have had insufficient capacity due to a lack of available funding, staffing, or other necessary expertise to satisfy the mitigation planning requirement before the current disaster or application deadline.
- The jurisdiction has been determined to have been at low risk from hazards because of low frequency of occurrence or minimal damage from previous occurrences as a result of sparse development.
- The jurisdiction experienced significant disruption from a declared disaster or another event that impacts its ability to complete the mitigation planning process before award or final approval of a project award.
- The jurisdiction does not have a mitigation plan for reasons beyond the control of the state, federally recognized tribe, or local community, such as Disaster Relief Fund restrictions that delay FEMA from granting a sub-award before the expiration of the local or tribal mitigation plan.

The applicant must provide written justification that identifies the specific criteria or circumstance listed above, explains why there is no longer an impediment to satisfying the mitigation planning requirement, and identifies the specific actions or circumstances that eliminated the deficiency.

If the jurisdiction does not meet at least one of these criteria, the region must coordinate with FEMA's Risk Reduction and Risk Analysis Divisions for HMGP. For BRIC and FMA, the region must coordinate and seek concurrence before granting an exception. For FMA project sub-awards, the local FEMA region might apply extraordinary circumstances when justification is provided and with concurrence from FEMA's Risk Reduction and Risk Analysis Divisions. If an exception is granted, a local mitigation plan must be approved by FEMA within 12 months of the award of the project sub-award to that community.

When HMGP project funding is awarded under extraordinary circumstances, the recipient shall acknowledge in writing to the Regional Administrator that a plan will be completed within 12 months of the sub-award. The recipient must provide a work plan for completing the local or tribal mitigation plan, including milestones and a timetable, to ensure that the jurisdiction will complete the plan in the required time. This requirement shall be incorporated into the award (both the planning and project sub-award agreements if a planning sub-award is also awarded).

Post-Disaster Assistance

Individual Assistance

Individual Assistance (IA) provides help for homeowners, renters, businesses, and some non-profit entities after disasters occur. For homeowners and renters, those who suffered uninsured or underinsured losses could be eligible for a Home Disaster Loan to repair or replace damaged real estate or personal property. Renters are eligible for loans to cover personal property losses. Individuals are allowed to borrow up to $200,000 to repair or replace real estate, $40,000 to cover losses to personal property, and an additional 20 percent for mitigation. For businesses, loans could be made to repair or replace disaster damages to property owned by the business, including real estate, machinery and equipment, inventory, and supplies. Businesses of any size are eligible. Non-profit organizations, such as charities, churches, and private universities are eligible. An Economic Injury Disaster Loan provides necessary working capital until normal operations resume after a physical disaster but is restricted to small businesses only. IA is detailed on the FEMA website: https://www.fema.gov/individual-disaster-assistance.

Public Assistance

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. PA is detailed on the FEMA website: https://www.fema.gov/public-assistance-local-state-tribal-and-non-profit.

Assistance to Firefighters Grant Program

The 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.

Emergency Management Performance Grants Program

The Emergency Management Performance Grant (EMPG) provides state, local, tribal, and territorial emergency management agencies with the resources required for implementation of the National Preparedness System and works toward the national preparedness goal of a secure and resilient nation. The EMPG's allowable costs support efforts to build and sustain core capabilities across the prevention, protection, mitigation, response, and recovery mission areas.

Homeland Security Grant Program

The Homeland Security Grant Program (HSGP) plays an important role in the implementation of the National Preparedness System by supporting the building, sustainment, and delivery of core capabilities essential to achieving the national preparedness goal of a secure and resilient nation. It supports efforts to build and sustain core capabilities across the prevention, protection, mitigation, response, and recovery mission areas. This includes two priorities: building and sustaining law enforcement terrorism prevention capabilities and maturation; and enhancement of state and major urban area fusion centers (HSGP 2020). HSGP is comprised of three interconnected grant programs: the State Homeland Security Program, the Urban Areas Security Initiative, and Operation Stonegarden. Together, these grant programs fund a range of preparedness activities including planning, organization, equipment purchase, training, exercises, and management and administration. Additional information regarding HSGP is available on the website: https://www.fema.gov/homeland-security-grant-program.

Rehabilitation of High Hazard Potential Dam Program

The Rehabilitation of High Hazard Potential Dams (HHPD) grant provides technical, planning, design, and construction assistance in the form of grants for the rehabilitation of eligible high-hazard potential dams. In a state or territory with an approved dam safety program, the State Administrative Agency or an equivalent state agency is eligible to apply for the HHPD grant. Each eligible state may submit only one HHPD grant application. Eligible high-hazard potential dams are defined as non-federal dams:

- Located in a state or territory with a dam safety program
- Classified as high hazard potential by the dam safety agency in the state or territory where the dam is located
- With a current, approved emergency action plan by the state or territorial dam safety agency

- Failing to meet minimum dam safety standards of the state or territory and posing an unacceptable risk to the public

For additional information regarding the HHPD program, refer to the following link: https://www.fema.gov/emergency-managers/risk-management/dam-safety/grants/resources.

In New York State, the NYSDEC applies for HHPD funding on behalf of the State. New York State has not been awarded any HHPD funds since 2020 to support eligible dam repairs. Funding is available to local government and non-profit owners of high-hazard dams.

Small-Business Administration

Small-Business Administration Loans

The Small Business Administration (SBA) provides low-interest disaster loans to homeowners, renters, businesses 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 can apply for up to $200,000 to replace or repair their primary residence. Renters and homeowners can 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. Additional information regarding SBA loans is available on the SBA website: https://www.sba.gov/managing-business/running-business/emergency-preparedness/disaster-assistance.

U.S. Department of Health and Human Services

Social Services Block Grant Program

The Social Services Block Grant (SSBG) is a flexible funding source that allows states and territories to tailor social service programming to their population's needs. Through the SSBG, states provide essential social services that help achieve a myriad of goals to reduce dependency and promote self-sufficiency; protect children and adults from neglect, abuse, and exploitation; and help individuals who are unable to take care of themselves to stay in their homes or to find the best institutional arrangements.

U.S. Department of Housing and Urban Development

Community Development Block Grants

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 limited instances and during times of urgent need (e.g., post-disaster) as defined by the CDBG National Objectives, CDBG funding can 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. Additional information regarding CDBG is available on the website: https://www.hudexchange.info/programs/cdbg-entitlement/.

Community Development Block Grant Disaster Recovery (CDBG-DR) grant funds are appropriated by Congress and allocated by HUD to rebuild disaster-impacted areas and provide crucial seed money to start the long-term recovery process. These flexible grants help cities, counties, Indian tribes, and States recover from presidentially declared disasters, especially in low-income areas, subject to the availability of supplemental appropriations. Since CDBG-DR assistance may fund a broad range of recovery activities, HUD can help communities and neighborhoods that otherwise might not recover due to limited resources.

Disaster Housing Assistance Program

The Disaster Housing Assistance Program provides emergency assistance for housing, including minor repairs of the home to establish livable conditions, mortgage, and rental assistance.

HOME Investment Partnerships Program

The HOME Investment Partnerships Program (HOME) provides grants to states and localities that communities use—often in partnership with local nonprofit groups—to fund a wide range of activities, including building, buying, and/or rehabilitating affordable housing for rent or homeownership or providing direct rental assistance to low-income people. HOME is the largest federal block grant to state and local governments designed exclusively to create affordable housing for low-income households. HOME funds are awarded annually as grants to participating jurisdictions. The program's flexibility allows states and local governments to use HOME funds for grants, direct loans, loan guarantees or other forms of credit enhancements, or rental assistance or security deposits.

The program's requirement that participating jurisdictions match 25 cents of every dollar in program funds mobilizes community resources in support of affordable housing.

Section 108 Loan Guarantee Program

The Section 108 Loan Guarantee Program (Section 108) provides communities with a source of low-cost, long-term financing for economic and community development projects. Section 108 financing provides an avenue for communities to undertake larger, more costly projects, where they may have limited resources to invest upfront.

Section 108 can fund economic development, housing, public facilities, infrastructure, and other physical development projects, including improvements to increase resilience against natural disasters. This

flexibility of use makes it one of the most potent and important public investment tools that HUD offers to states and local governments.

Section 108 assistance can be deployed in two ways:

- Directly by the community or its governmental or non-profit partner to carry out an eligible project
- Indirectly with a community or its partner re-lending (or, in limited circumstances, granting) the funds to a developer or business to undertake an eligible project

U.S. Department of Transportation

Federal Highway Administration—Emergency Relief

Federal Highway Administration (FHWA) Emergency Relief is a grant program that can be used for the repair or reconstruction of federal-aid highways and roads on federal lands that have suffered serious damage as a result of a disaster. New York State serves as the liaison between local municipalities and FHWA, making the municipalities sub-applicants of New York State. The program is appropriated $100 million annually. For information regarding the FHWA Emergency Relief Program, refer to: https://www.fhwa.dot.gov/programadmin/erelief.cfm

Federal Transit Administration—Emergency Relief

Federal Transit Authority (FTA) Emergency Relief is a grant program that funds capital projects to protect, repair, reconstruct, or replace equipment and facilities of public transportation systems. Administered by the FTA and directly allocated to mass transit and port authorities, this transportation-specific fund was created as an alternative to FEMA's PA. Additional information regarding the FTA Emergency Relief Program is available on the website: https://www.transit.dot.gov/funding/grant-programs/emergency-relief-program/emergency-relief-program.

Federal Highway Administration—Recreational Trails

The Recreational Trails Program is an assistance program of the FHWA that provides funds to states to develop and maintain recreational trails and trail-related facilities for both nonmotorized and motorized recreational trail uses. The program requires that states use 30 percent of funds for non-motorized recreation, 30 percent for motorized recreation, and 40 percent for diverse recreational trail use.

In New York State, the Recreational Trails Program is administered by the Office of Parks, Recreation, and Historic Preservation.

Rebuilding American Infrastructure with Sustainability and Equity Grant Program

The Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant program provides an opportunity for the U.S. Department of Transportation (USDOT) to invest in road, rail, transit, and port projects that promise to achieve national objectives. The RAISE program enables USDOT to examine these

projects on their merits to help ensure that taxpayers are getting the highest value for every dollar invested.

The eligibility requirements of RAISE allow project sponsors at the state and local levels to obtain funding for multi-modal, multi-jurisdictional projects that are more difficult to support through traditional USDOT programs. RAISE can provide funding directly to any public entity, including municipalities, counties, port authorities, tribal governments, or others, in contrast to traditional federal programs that provide funding to very specific groups of applicants (mostly state departments of transportation and transit agencies). This flexibility allows RAISE and USDOT partners at the state and local levels to work directly with a host of entities that own, operate, and maintain much of that nation's transportation infrastructure but otherwise cannot turn to the federal government for support.

U.S. Department of Agriculture

Community Facilities Direct Loan and Grant Program

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 to the local community for the orderly development of the community in a primarily rural area and does not include private, commercial, or business undertakings. Funds can be used to purchase, construct, and/or improve essential community facilities, purchase equipment, and pay related project expenses. Rural areas including cities, villages, townships, towns, and federally recognized tribal lands, with no more than 20,000 residents according to the latest U.S. Census, are eligible for this program.

Emergency Loan Program

The Emergency loan program is triggered when a natural disaster is designated by the Secretary of Agriculture, or a natural disaster or emergency is declared by the President under the Stafford Act. These loans help producers who suffer qualifying farm-related losses directly caused by the disaster in a county declared or designated as a primary disaster or quarantine area. Also, farmers located in counties that are contiguous to the declared, designated, or quarantined area may qualify for emergency loans.

For production losses, a 30 percent reduction in a primary crop in a designated or contiguous county is required. Losses to quality, such as receiving a 30 percent reduced price for flood-damaged crops, may be eligible for assistance, too.

Emergency Watershed Protection Program

The Emergency Watershed Protection (EWP) Program, a federal emergency recovery program, helps local communities recover after a natural disaster. The EWP program offers technical and financial assistance to help local communities relieve imminent threats to life and property caused by floods, fires, windstorms, and other natural disasters that impair a watershed. EWP does not require a disaster declaration by federal or state government officials for program assistance to begin. The Natural

Resources Conservation Service (NRCS) state conservationist can declare a local watershed emergency and initiate EWP program assistance in cooperation with an eligible sponsor. The sponsor must sign a cooperative agreement with NRCS. The EWP program offers financial and technical assistance for various activities, including the following:

- Remove debris from stream channels, road culverts, and bridges
- Reshape and protect eroded streambanks
- Correct damaged or destroyed drainage facilities
- Establish vegetative cover on critically eroding lands
- Repair levees and structures
- Repair certain conservation practices
- Buyouts

Additional information regarding the EWP is detailed below and available on the website: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/.

EWP – Recovery

The EWP – Recovery program is aimed at relieving imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences. Public and private landowners are eligible for assistance but must be represented by a project sponsor that must be a legal subdivision of the state, such as a city, county, township, or conservation district, and Native American Tribes or Tribal governments. NRCS will pay up to 75 percent of the construction cost of emergency measures. The remaining 25 percent must come from local sources and can be in the form of cash or in-kind services.

EWP – Recovery work is not limited to any one set of measures. The program is designed for the installation of recovery measures to safeguard lives and property as a result of a natural disaster. NRCS completes a Damage Survey Report, which provides a case-by-case investigation of the work necessary to repair or protect a site. Watershed impairments that the EWP Program addresses are debris-clogged stream channels, undermined and unstable streambanks, jeopardized water control structures and public infrastructures, wind-borne debris removal, and damaged upland sites stripped of protective vegetation by fire or drought.

EWP – Floodplain Easement

Privately owned lands or lands owned by local and state governments might be eligible for participation in the EWP – Floodplain Easement program. To be eligible, lands must meet one of the following criteria:

- Lands that have been damaged by flooding at least once within the previous calendar year or have been subject to flood damage at least twice within the previous 10 years
- Other lands within the floodplain that would contribute to the restoration of flood storage and flow, provide for control of erosion or improve the practical management of the floodplain easement
- Lands that would be inundated or adversely impacted as a result of a dam breach

Through this program, easements are restored to the natural environment to the extent practicable. Work can include both structural and nonstructural practices to restore flood storage and flow, control erosion, and improve the practical management of the easement.

Structures, including buildings, within the floodplain easement must be demolished and removed or relocated outside the 100-year floodplain or dam breach inundation area.

U.S. Fish and Wildlife Service

Partners for Fish and Wildlife

The Partners for Fish and Wildlife Program provides free technical and financial assistance to landowners, managers, tribes, corporations, schools, and nonprofits interested in improving wildlife habitat on their land. These projects range in size from a wetland of a few acres to a grassland restoration covering several hundred thousand acres.

Many Partners for Fish and Wildlife projects take place on working landscapes such as forests, farms, and ranches. Efforts are focused on areas of conservation concern, such as upland forests, wetlands, native prairies, marshes, rivers, and streams. Projects are designed to benefit federal trust species including migratory birds and endangered, threatened, or at-risk species.

U.S. Environmental Protection Agency

Smart Growth Implementation Assistance Program

The Smart Growth Implementation Assistance program focuses on complex 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.

Clean Water Act Section 604(b) Water Quality Planning Grants

Water Quality Planning Grants provide funding to implement regional comprehensive water quality management planning activities as described in Section 604(b) of the federal Clean Water Act. Funds are to be used for water quality management planning activities, including tasks to determine the nature, extent, and causes of point and nonpoint source water pollution problems, and to develop plans to resolve these problems.

U.S. Economic Development Administration

The U.S. Economic Development Administration (USEDA) is an agency of the U.S. Department of Commerce that supports regional economic development in communities around the country. It provides funding to support comprehensive planning and makes strategic investments that foster employment

creation and attract private investment in economically distressed areas of the United States. Additional information is available on the USEDA website: https://www.eda.gov/.

Public Works Program

Through its Public Works Program, USEDA invests in key public infrastructure, such as traditional public works projects, including water and sewer system improvements, expansion of port and harbor facilities, brownfields, multitenant manufacturing and other facilities, business and industrial parks, business incubator facilities, redevelopment technology-based facilities, telecommunications facilities, and development facilities.

Economic Adjustment Program

Through its Economic Adjustment Program, USEDA administers its Revolving Loan Fund Program, which supplies small businesses and entrepreneurs with the gap financing needed to start or expand their business in areas that have experienced or are under threat of serious structural damage to the underlying economic base.

National Park Service

Land and Water Conservation Fund

The Land and Water Conservation Fund (LWCF) was established by Congress in 1964 to fulfill a bipartisan commitment to safeguard natural areas, water resources, and cultural heritage, and to provide recreation opportunities. Using no taxpayer dollars, the LWCF invests earnings from offshore oil and gas leasing to help strengthen communities, preserve history, and protect the national endowment of lands and waters. The LWCF program is divided into the "State Side," which provides grants to State and local governments, and the "Federal Side," which is used to acquire lands, waters, and interests therein necessary to achieve the natural, cultural, wildlife, and recreation management objectives of federal land management agencies. The LWCF was permanently reauthorized in 2019 and permanently funded in August 2020.

New York State Department of Transportation

BRIDGE NY

The BRIDGE NY program, administered by the NYSDOT, is open to all municipal owners of bridges and culverts. Projects are awarded through a competitive process and support all phases of project development. Projects selected for funding under the BRIDGE NY Initiative are evaluated based on the resiliency of the structure, including such factors as hydraulic vulnerability and structural resiliency; the significance and importance of the bridge, including traffic volumes, detour considerations, number and types of businesses served, and impacts on commerce; and the current bridge and culvert structural conditions. Information regarding the program can be found on the following website: https://www.dot.ny.gov/BRIDGENY.

New York State Department of Environmental Conservation

Climate Smart Communities Grant Program

Climate Smart Community (CSC) grants support mitigation and adaptation projects to reduce greenhouse gas emissions and prepare for the effects of climate change. The CSC program enables high-performing registered communities to achieve recognition for their leadership. Designed around 10 pledge elements, the certification program recognizes communities achieving any of over 130 total possible actions through a rating system leading to four levels of award: Certified, Bronze, Silver, and Gold. Recertification of completed actions is required every five years. Details of the program and the specific documentation required for each action are described in the CSC Certification Manual at http://www.dec.ny.gov/docs/administration_pdf/certman.pdf.

Competitive grants ranging from $25,000 to $100,000 provide support for local governments to become certified CSCs. All counties, cities, towns, and villages of New York State are eligible to receive funding. The CSC grant program will provide 50/50 matching grants for eligible projects. It offers free technical support on energy and climate and guidance tailored to New York State communities. Funding is available for the following:

- Implementation projects that advance climate adaptation and mitigation actions, including the following:
  - Construction of natural resiliency measures
  - Relocation or retrofit of climate-vulnerable facilities
  - Conservation or restoration of riparian areas and tidal marsh migration areas
  - Reduction of flood risk
  - Clean transportation
  - Reduction or recycling of food waste
- Certification projects that advance actions aligned with CSC certification requirements, including the following:
  - Right-sizing government fleets
  - Developing natural resource inventories
  - Conducting vulnerability assessments
  - Developing climate adaptation strategies
  - Updating hazard mitigation plans to address changing conditions and reduce climate vulnerability

As of April 2024, 408 communities have committed to acting on climate through the CSC program. In Broome County, four communities participate in the program:

- Village of Whitney Point – No current rating
- Village of Johnson City – No current rating

- City of Binghamton – Bronze
- County of Broome – Bronze

Additional information regarding the CSC program is available on the website: http://www.dec.ny.gov/energy/50845.html.

Volunteer Fire Assistance Grants

This 50/50 matching funds program makes funds available to rural fire companies for the purchase of wildland firefighting equipment such as portable backpack pumps, Nomex protective clothing, hand tools, hard hats, hoses, portable radios, and dry hydrants.

Environmental Protection Fund

New York State's Environmental Protection Fund (EPF) is a source of funding for capital projects that protect the environment and enhance communities. Capital projects are usually large projects that purchase land or construct facilities. Most projects that receive grants of EPF money combine it with other funding sources that require matching funds.

The EPF also supports the stewardship of public lands, including state parks and millions of acres of public lands throughout the state. Through partnerships with volunteer organizations, state agencies use stewardship funding to manage trails and lands, protect natural resources, preserve wildlife habitats, make critical capital improvements at parks and campgrounds, educate students about conservation, and provide access to persons with disabilities.

New York State Environmental Facilities Corporation

https://www.dec.ny.gov/pubs/4774.html.

Clean Water State Revolving Fund

The Clean Water State Revolving Fund (CWSRF) provides interest-free or low-interest rate financing for wastewater and sewer infrastructure projects to municipalities throughout New York State. Projects eligible for financing include construction or restoration of sewers and wastewater treatment facilities, stormwater management, landfill closures, and habitat restoration and protection projects.

The New York State Environmental Facilities Corporation (EFC) provides both short- and long-term financing—interest-free or low-interest—to accommodate municipalities of all population sizes with varying financial needs. When communities repay their financings, it allows EFC to finance new projects, and the funds "revolve" over time.

Water Quality Improvement Project Program

The Water Quality Improvement Project program is a competitive reimbursement grant program that funds projects that directly address documented water quality impairments. The program is open to local governments and not-for-profit corporations. Grant recipients can receive:

- Up to 75 percent of the project costs for high-priority wastewater treatment improvement, non-agricultural nonpoint source abatement and control, land acquisition for source water protection, aquatic habitat restoration, and municipal separate storm sewer system projects
- Up to 50 percent for salt storage projects
- Up to 40 percent for general wastewater infrastructure improvement projects

Additional information regarding this program is available on the following website:

Wastewater Infrastructure Engineering Planning Grant

The Wastewater Infrastructure Engineering Planning Grant assists municipalities with the engineering and planning costs of CWSRF-eligible water quality projects. Eligibility for municipalities is based on median household income as follows:

- Median household income of $65,000 or less in the Regional Economic Development Council (REDC) regions of Capital District, Southern Tier, North Country, Mohawk Valley, Central New York, Finger Lakes, or Western New York (Broome County is located in the Southern Tier region)
- Median household income of $85,000 or less in REDC regions of Long Island, New York City, or Mid-Hudson;

Grants with a 20 percent required local match could finance activities, including engineering and consultant fees for engineering and planning services to produce an engineering report. Funding priorities go to projects that have one of the following qualities:

- Required by an executed order on consent
- Required by a draft or final State Pollutant Discharge Elimination System permit
- Upgrading or replacing an existing wastewater system
- Constructing a wastewater treatment and/or collection system for an area with failing onsite septic systems
- Identified in a total maximum daily load implementation plan

The goal of the Engineering Planning Grant program is to advance water quality projects to construction, so successful applicants can use the engineering report funded by the grant to seek financing through the CWSRF program, Water Quality Improvement Project program, or other funding entities to further pursue the identified solution. Details regarding this program can be found on the website: https://www.dec.ny.gov/pubs/81196.html.

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Empire State Development

Empire State Development offers a wide range of financing, grants, and incentives to promote business and employment growth and real estate development throughout the state. Several programs address infrastructure construction associated with project development, acquisition, and demolition associated with project development and brownfield remediation and redevelopment. Additional information regarding Empire State Development is available on the website: https://esd.ny.gov/.

SECTION 6. MITIGATION STRATEGY

6.1 OVERVIEW

This section presents mitigation strategies for Broome County to reduce potential exposure and losses identified as concerns in the Risk Assessment portion of this plan. The Steering Committee reviewed the Risk Assessment to identify and develop these mitigation actions.

This section includes the following elements:

- Background and Past Mitigation Accomplishments
- General Mitigation Planning Approach
- Review and Update 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.

Mitigation actions can include activities such as revisions to land-use planning, training and education, and structural and nonstructural safety measures.

6.2 BACKGROUND AND PAST MITIGATION ACCOMPLISHMENTS

In accordance with the requirements of the Disaster Mitigation Act of 2000, detailed on pages 1-2 in Section 1 (Introduction), a discussion regarding past mitigation activities and an overview of past efforts is provided as a foundation for understanding the mitigation goals, objectives, and activities outlined in this plan update. Broome County, through previous and ongoing hazard mitigation activities, has demonstrated that it is proactive in protecting its physical assets and citizens against losses from natural hazards. Examples of previous and ongoing actions and projects include the following:

- Culvert upgrades and replacement.
- Repetitive Loss Property and Severe Repetitive Loss Property outreach and buyout.
- Countywide CRS assistance to communities.
- Flood hazard mitigation alternatives.

6.3 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, including the following:

- DMA 2000 regulations, specifically 44 CFR 201.6 (local mitigation planning).
- FEMA *Local Mitigation Planning Handbook*, March 2013.
- FEMA *Local Mitigation Plan Review Guide*, October 1, 2011.

- 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*, 2022.

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 mitigation goals have been developed based on the risk assessment results, discussions, research, and input from the 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, which when combined form a strategy or course of action to meet a goal. Unlike goals, objectives are a stand-alone measurement of the effectiveness of a mitigation action, rather than a subset of a goal. The objectives also are used to help establish priorities.

The goals and associated objectives for Broome County and municipalities included in the plan were developed based in part on a review of the hazard mitigation goals and objectives established in the 2019 NYS HMP, the 2019 Broome County HMP, as well as the current or expired municipal hazard mitigation plans within the county. Further, these goals were selected to be compatible with the needs and goals expressed in other available County and local community planning documents. Achievement of these goals helps to define the effectiveness of a mitigation strategy.

Table 6-1 presents the updated hazard mitigation planning goals and objectives established for this plan update.

Table 6-1. Broome County Hazard Mitigation Plan Goals and Objectives

Goal	Objective
Goal 1: Protect life, property, and the economy from natural hazards through	Objective 1-1: Work with all levels of leadership to implement and build capacity to pursue feasible, cost-effective, sustainable, and publicly led mitigation projects to protect lives and property by making homes, businesses, infrastructure, and critical facilities resistant to hazards.

Goal	Objective
planning, preparing, and mitigating.	Objective 1-2: Educate and encourage private property owners to take preventive mitigation actions in areas that are especially vulnerable to hazards, such as through the Community Rating System program.
	Objective 1-3: Better characterize flood hazard events by conducting additional hazard studies, improving flood hazard mapping, and creating flood and dam inundation models incorporating High Hazard Potential Dams program requirements.
	Objective 1-4: Encourage homeowners, renters, and businesses to purchase insurance coverage for damages caused by hazards.
	Objective 1-5: Implement mitigation activities that encourage environmental stewardship and protection of the environment.
	Objective 1-6: Incorporate hazard mitigation planning into post-disaster recovery projects and operations by recording lessons learned from previous hazard events to improve future response and mitigation strategies.
	Objective 1-7: Mitigate impacts of natural hazards on businesses, communities, and local economies.
Goal 2: Increase public awareness and enhance current outreach programs to provide resources to stakeholders, local government officials, businesses, and the general public on the different risks, resilience strategies, and safety measures associated with natural hazards.	Objective 2-1: Develop and implement additional education and outreach programs to increase public awareness of the hazard risks and educate the public on specific, individual preparedness activities. Specifically target residents, businesses, realtors, insurance agents, and mortgage lenders.
	Objective 2-2: Inform government officials, school districts, and non-profits about tools, partnership opportunities, funding resources, and government initiatives to assist in implementing mitigation activities and increase knowledge and understanding of risks and defective mitigation strategies
	Objective 2-3: Enhance the technological capabilities of the jurisdictions and agencies in the county to better profile and assess exposure to hazards.
	Objective 2-4: Provide comprehensive information online for local emergency service providers, municipalities, the media, and the public during and immediately following disaster and hazard events including emergency traffic routes, restrictions and road closures, evacuations, shelter locations, and others
	Objective 2-5: Increase public awareness of existing warning systems
	Objective 2-6: Establish a consistent message for "State of Emergency" declarations and educate the public on the meaning of those declarations.
Goal 3: Encourage, expand, and strengthen partnerships between government agencies, private sector businesses, and non-profit organizations to develop public outreach strategies and provide resources and involvement before, during, and after disasters, and to create a more resilient Broome County.	Objective 3-1: Strengthen inter-jurisdiction and inter-agency communication, coordination, and partnerships to inform agencies of local project priorities and to foster hazard mitigation strategies and/or projects designed to benefit multiple jurisdictions.
	Objective 3-2: Identify and implement ways to engage public agencies with individual citizens, non-profit organizations, businesses, and industries to implement mitigation activities more effectively.
	Objective 3-3: Encourage shared services in acquiring, maintaining, and providing emergency services and equipment, and planning and executing mitigation projects.
	Objective 3-4: Implement tools to enhance the capability to collect, analyze, and share data amongst partners.
Goal 4: Enhance emergency services planning to include natural hazard event planning impacts on populations and property.	Objective 4-1: Where appropriate, coordinate and integrate hazard mitigation activities with existing local emergency operations plans.
	Objective 4-2: Identify the need for, and acquire, any special emergency services, training, and equipment to enhance response capabilities for specific hazards.
	Objective 4-4: Ensure continuity of governmental operations, emergency services, and community lifelines at the county and local level during and immediately after disaster and hazard events.
	Objective 4-5: Improve communications to residents and businesses before, during, and after all hazards.
	Objective 4-6: Promote the use of emergency systems and weather alert systems for all hazards.
	Objective 4-7: Encourage NIMS training for all appropriate personnel including elected officials.
Goal 5: Improve the resilience of critical facilities,	Objective 5-1: Improve or protect vital infrastructure and critical facilities to reduce the disruption of activities after a natural hazard event.

Goal	Objective
community lifelines, and other buildings located within hazard-vulnerable areas to reduce impacts of natural hazard events and climate change-influenced hazards in Broome County.	Objective 5-2: Review, evaluate, and improve existing local laws and ordinances, building codes, safety inspection procedures, and applicable rules to ensure that they employ best practices for the protection of buildings and environmental resources.
	Objective 5-3: Prioritize and promote sustainable communities, green infrastructure, and hazard resilient development.
	Objective 5-4: Decrease the potential local economic loss and maintain local and government business continuity after a natural hazard event.
	Objective 5-5: Encourage the establishment of policies at the local level that address relevant data needs, allow jurisdictions to pursue funding, build funding into existing planning programs, and budget to ensure the prioritization and implementation of mitigation projects that benefit community lifelines, critical facilities, services, and infrastructure.
	Objective 5-6: Encourage the establishment of policies that reflect the best available information regarding current and future hazard risk.
	Objective 5-7: Identify technological solutions that may help to improve the resiliency and redundancy of our infrastructure and enhance our ability to inform the public during a disaster.
	Objective 5-8: Identify and protect socially vulnerable populations and underserved communities and provide them with assistance in recovering from hazard impacts.
Goal 6: Ensure consistency between goals, objectives, and mitigation strategies from the Broome County Hazard Mitigation Plan with existing and future land-use planning documents, existing regulatory programs, zoning code updates, and flood damage prevention ordinances, as well as State and Federal hazard mitigation strategies.	Objective 6-1: Fully integrate the recommendations of this plan into existing local and county laws, plans, ordinances, natural resource management activities, and programs to encourage resilient and sustainable efforts throughout the county.
	Objective 6-2: Minimize new development within hazard-prone areas.
	Objective 6-3: Ensure that public and private facilities and infrastructure meet established building codes and rigorously enforce the codes to address any identified deficiencies.

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 2019 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 Mitigation Strategies

For each mitigation action identified in the 2019 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 the 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 a review of county and local plans and reports.

In February 2024, 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 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 floods, severe summer weather, severe winter weather, and tornados. 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.

To assist with the development of mitigation actions, municipalities were provided with the following:

- 2024 HMP goals and objectives
- 2019 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)

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

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 Broome 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 whom 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 in 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 a 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 in 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 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 6-2. 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 6-2 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

7.1 OVERVIEW

This section details the formal process that will ensure that the Hazard Mitigation Plan (HMP) remains an active and relevant document and that the Planning Partnership maintains its eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. In addition, this section describes how public participation will be integrated throughout the plan maintenance and implementation process. It explains how the mitigation strategies outlined in this plan update will be incorporated into existing planning mechanisms and programs, such as comprehensive land use planning processes, capital improvement planning, and building code enforcement and implementation. The plan's format allows sections to be reviewed and updated when new data becomes available, resulting in a plan that will remain current and relevant.

The plan maintenance matrix is shown in **Error! Reference source not found.** and provides a synopsis of responsibilities for plan monitoring, evaluation, and update, which are discussed in further detail in the following sections.

The overarching goal of the plan maintenance procedure is to ensure that all participating jurisdictions remain engaged in not only implementing the plan but in its continuous review and update, to ensure it is a relevant and living document. The County is committed to supporting municipalities in frequent communications regarding the status of mitigation projects and to communicating the mitigation successes amongst the County agencies and municipalities. This maintenance procedure is a springboard for each community to routinely use the plan as a resource and roadmap to fund and implement projects to increase the resiliency of their communities.

Table 7-1. Plan Maintenance Matrix

Task	Approach	Timeline	Lead Responsibility	Support Responsibility
Monitoring	Preparation of status updates and action implementation tracking as part of submission for the Annual Progress Report	October or upon a major update to the Master Plan or major disaster	Jurisdictional points of contact are identified in Section 8 (Planning Partnership) and Section 9 (Jurisdictional Annexes)	Jurisdictional implementation lead identified in Section 8 (Planning Partnership) and Section 9 (Jurisdictional Annexes)
Integration	For the integration of mitigation action principles to become an organic part of the ongoing county and municipal activities, the County will incorporate the distribution of	October each year with interim email reminders to address integration in county and municipal activities	HMP Coordinator and jurisdictional points of contact identified in Section 8 (Planning Partnership) and Section 9 (Jurisdictional Annexes)	HMP Coordinator

Task	Approach	Timeline	Lead Responsibility	Support Responsibility
	the safe growth worksheet for annual review and update by all participating jurisdictions.			
Evaluation	Review the status of previous actions as submitted by the monitoring task lead and support to assess the effectiveness of the plan; compile and finalize the Annual Progress Report	Finalized progress report completed by January 31st of each year	Steering Committee; Plan Maintenance element	Jurisdictional points of contact identified in Section 9 (Jurisdictional Annexes)
Update	Reconvene the planning partners, at a minimum, every five years to guide a comprehensive update to review and revise the plan.	Every five years or upon major update to the Master Plan or major disaster	HMP Coordinator	Jurisdictional points of contact identified in Section 9 (Jurisdictional Annexes)

7.2 MONITORING, EVALUATING AND UPDATING THE PLAN

The HMP Coordinator is assigned to manage the maintenance and update of the plan during its performance period. The HMP Coordinator will chair the Planning Partnership and be the point of contact for questions regarding the plan and its implementation as well as to coordinate incorporation of additional information into the plan.

The Planning Partnership shall fulfill the monitoring, evaluation, and updating responsibilities identified in this section which is comprised of a representative from each participating jurisdiction. Each jurisdiction is expected to maintain a representative on the Planning Partnership throughout the plan performance period (five years from the date of plan adoption). As of the date of this plan, primary and secondary mitigation planning representatives (points of contact) are identified in each jurisdictional annex in Section 9 (Jurisdictional Annexes).

Regarding the composition of the committee, it is recognized that individual commitments change over time, and it shall be the responsibility of each jurisdiction and its representatives to inform the HMP Coordinator of any changes in representation. The HMP Coordinator will strive to keep the committee makeup as a uniform representation of planning partners and stakeholders within the planning area.

Currently, the Broome County HMP Coordinator is designated as Stephanie Brewer, Senior Planner, Broome County Planning and Economic Development Department

7.2.1 Monitoring

The Planning Partnership shall be responsible for monitoring progress on and evaluating the effectiveness of, the plan, and documenting annual progress. Each year, beginning one year after plan development, Broome County and local Planning Partnership representatives will collect and process information from

the departments, agencies, and organizations involved in implementing mitigation projects or activities identified in their jurisdictional annexes (Section 9) of this plan, by contacting persons responsible for initiating and/or overseeing the mitigation projects.

In the first year of the performance period, this will be accomplished by utilizing an online performance progress reporting system, the BATool[SM] which will enable municipal and county representatives of directly access mitigation initiatives to easily update the status of each project, document successes or obstacles to implementation, add or delete projects to maintain mitigation project implementation. It is anticipated that all participating partners will be prompted by the tool to update progress on a quarterly basis, providing an incentive for participants to refresh their mitigation strategies and to continue the implementation of projects. It is expected that this reporting system will support the submittal of an increased number of project grant fund applications due to the functionality of the system which facilitates the sorting and prioritization of projects.

In addition to progress on the implementation of mitigation actions, including efforts to obtain outside funding; and obstacles or impediments to the implementation of actions, the information that Planning Partnership representatives shall be expected to document, as needed and appropriate include any grant applications filed on behalf of any of the participating jurisdictions, hazard events and losses occurring in their jurisdiction, additional mitigation actions believed to be appropriate and feasible, and public and stakeholder input.

Plan monitoring for years two through four of the plan performance periods will be similarly addressed via the BATool[SM] or manually.

7.2.2 Integration Process of the HMP into Municipal Planning Mechanisms

The Broome County Planning Partnership was tasked with identifying how hazard mitigation is integrated into existing planning mechanisms. Refer to Section 9 (Jurisdictional Annexes) for how this is done for each participating municipality. During this process, many municipalities recognized the importance and benefits of incorporating hazard mitigation into future municipal planning and regulatory processes.

The Planning Partnership representatives will incorporate mitigation planning as an integral component of daily government operations. Planning Partnership representatives will work with local government officials to integrate the newly adopted hazard mitigation goals and actions into the general operations of government and partner organizations. Further, the sample adoption resolution (Appendix A – Plan Adoption) includes a resolution item stating the intent of the local governing body to incorporate mitigation planning as an integral component of government and partner operations. By doing so, the Planning Partnership anticipates that the following will be achieved:

1. Hazard mitigation planning will be formally recognized as an integral part of overall planning and emergency management efforts;

2. The Hazard Mitigation Plan, Comprehensive Plans, Emergency Management Plans, and other relevant planning mechanisms will become mutually supportive documents that work in concert to meet the goals and needs of County residents.

During the HMP annual review process, each participating municipality will be asked to document how they are utilizing and incorporating the Broome County HMP into their day-to-day operations and planning and regulatory processes. Additionally, each municipality will identify additional policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions and include these findings and recommendations in the Annual HMP Progress Report. The following checklist was adapted from FEMA's Local Mitigation Handbook (2023, Appendix A, Worksheet 4.2. This checklist will help a community analyze how hazard mitigation is integrated into local plans, ordinances, regulations, ordinances, and policies. Completing the checklist will help municipalities identify areas that integrate hazard mitigation currently and where to make improvements and reduce vulnerability to future development. In this manner, the integration of mitigation into municipal activities will evolve into an ongoing culture within the county and its municipalities.

Table 7-2. Safe Growth Checklist

Planning Mechanisms	Do You Do This?		Notes: How is it being done or how will this be utilized in the future?
	Yes	No	
Operating, Municipal, and Capital Improvement Program Budgets			
When constructing upcoming budgets, hazard mitigation actions will be funded as the budget allows. Construction projects will be evaluated to see if they meet the hazard mitigation goals.			
Annually, during the adoption process, the municipality will review mitigation actions when allocating funding.			
Do budgets limit expenditures on projects that would encourage 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?			
Do budgets provide funding for hazard mitigation projects identified in the County HMP?			
Human Resource Manual			
Do any job descriptions specifically include identifying and/or implementing mitigation projects/actions or other efforts to reduce natural hazard risk?			
Building and Zoning Ordinances			
Prior to, zoning changes, or development permitting, the municipality will review the			

hazard mitigation plan and other hazard analyses to ensure consistent and compatible land use.			
Does the zoning ordinance discourage development or redevelopment within natural areas including wetlands, floodways, and floodplains?			
Does it contain natural overlay zones that set conditions?			
Does the ordinance require developers to take additional actions to mitigate natural hazard risk?			
Do rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use?			
Do the ordinances prohibit development within, or filling of, wetlands, floodways, and floodplains?			
Subdivision Regulations			
Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas?			
Do the subdivision regulations restrict the subdivision of land within or adjacent 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?			
Master Plan			
Are the goals and policies of the plan related to those of the County HMP?			
Does the future land use map clearly identify natural hazard areas?			
Do the land use policies discourage the development or redevelopment of natural hazard areas?			
Does the plan provide adequate space for expected future growth in areas located outside natural hazard areas?			
Land Use			
Does the future land use map clearly identify natural hazard areas?			
Do the land use policies discourage the development or redevelopment of natural hazard areas?			
Does the plan provide adequate space for expected future growth in areas located outside natural hazard areas?			
Transportation Plan			

Does the transportation plan limit access to hazard areas?			
Is transportation policy used to guide growth to safe locations?			
Environmental Management			
Are environmental systems that protect development from hazards identified and mapped?			
Do environmental policies maintain and restore protective ecosystems?			
Do environmental policies provide incentives to development that are located outside protective ecosystems?			
Grant Applications			
Data and maps will be used as supporting documentation in grant applications.			
Municipal Ordinances			
When updating municipal ordinances, hazard mitigation will be a priority.			
Economic Development			
Local economic development groups will consider information regarding identified hazard areas when assisting new businesses in finding a location.			
Public Education and Outreach			
Does the municipality have any public outreach mechanisms/programs in place to inform citizens about natural hazards, risks, and ways to protect themselves during such events?			

7.2.3 Evaluating

The evaluation of the plan is an assessment of whether the planning process and actions have been effective, if the 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 plan review meeting of the Planning Partnership, to be held either in person or via teleconference approximately one year from the date of local adoption of this update, and successively thereafter. At least two weeks before the annual plan review meeting, the Broome County HMP Coordinator will advise Planning Partnership members of the meeting date, agenda, and expectations of the members.

The Broome County HMP Coordinator will be responsible for calling and coordinating the annual plan review meeting and soliciting input regarding progress toward meeting plan goals and objectives. These evaluations will assess whether the following items have occurred:

- Goals and objectives address current and expected conditions.

- The nature or magnitude of the risks has changed.
- Current resources are appropriate for implementing the HMP and if different or additional resources are now available.
- Actions were cost-effective.
- Schedules and budgets are feasible.
- Implementation problems, such as technical, political, legal, or coordination issues with other agencies are present.
- Outcomes have occurred as expected.
- Changes in county, city, town, or village resources impacted plan implementation (e.g., funding, personnel, and equipment)
- New agencies/departments/staff should be included, including other local governments as defined under 44 CFR 201.6.

Specifically, the Planning Partnership will review the mitigation goals, objectives, and activities using performance-based indicators, including new agencies/departments, project completion, achievement of the goals and objectives, resource allocation, timeframes, budgets, lead/support agency commitment, and feasibility.

Finally, the Planning Partnership will evaluate how other programs and policies have conflicted with or augmented planned or implemented measures and shall identify policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions ("Implementation of Mitigation Plan through Existing Programs" subsection later in this section discusses this process). Other programs and policies can include those that address economic development, environmental preservation, historic preservation, redevelopment, health and/or safety, recreation, land use/zoning, public education and outreach, and transportation.

The Planning Partnership should refer to the evaluation forms, Worksheets #2 and #4 in the FEMA 386-4 guidance document, to assist in the evaluation process (see Appendix G – Plan Review 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 County HMPs.

The Broome County HMP Coordinator shall be responsible for preparing an Annual HMP Progress Report for each year of the performance period, based on the information provided by the local Planning Partnership members, the information presented at the annual Planning Partnership meeting, 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 on an annual basis, the Planning Partnership will be able to assess which projects are completed, which are no longer feasible, and which projects should require additional funding.

The Annual HMP Progress Report shall be posted on the Broome County Planning and Economic Development Department website to keep the public apprised of the plan's implementation. Additionally, the website provides a general overview of the plan and its purpose and use in the community. For communities who might choose to join the NFIP CRS program, this report will also be provided to each CRS participating community in order to meet annual CRS recertification requirements. To meet this recertification timeline, the Planning Partnership will strive to complete the review process and prepare an Annual HMP Progress Report by October 15th of each year.

The HMP will also be evaluated and revised following any major disasters, 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 damages 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.

7.2.4 Updating

44 CFR 201.6.d.3 requires that local hazard mitigation plans be reviewed, revised as appropriate, and resubmitted for approval in order to remain eligible for benefits awarded under DMA 2000. It is the intent of the Broome County HMP Planning Partnership to update this plan on a five-year cycle from the date of initial plan adoption.

To facilitate the update process, the Broome County HMP Coordinator, with the support of the Planning Partnership, shall use the second annual Planning Partnership meeting to develop and commence the implementation of a detailed plan update program. The Broome County HMP Coordinator shall invite representatives from NYS DHSES to this meeting to provide guidance on plan update procedures. This program shall, at a minimum, establish who shall be responsible for managing and completing the plan update effort, what needs 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 Planning Partnership shall determine what resources will be needed to complete the update. The Broome County HMP Coordinator shall be responsible for assuring that needed resources are secured.

Following each five-year update of the mitigation plan, the updated plan will be distributed for public comment. After all comments are addressed, the HMP will be revised and distributed to all planning group members and the New York State Hazard Mitigation Officer.

7.2.5 Grant Monitoring and Coordination

Broome County recognizes the importance of having an annual coordination period that helps each planning partner become aware of upcoming mitigation grant opportunities and identifies multi-

jurisdiction projects to pursue. Grant monitoring will be the responsibility of each municipal partner as part of their annual progress reporting. The Broome County HMP Coordinator will keep the planning partners apprised of Hazard Mitigation Assistance (HMA) grant openings and assist in developing letters of intent for grant opportunities when practicable.

Broome County intends to be a resource to the planning partnership in the support of project grant writing and development. The degree of this support will depend on the level of assistance requested by the partnership during open windows for grant applications. As part of grant monitoring and coordination, Broome County intends to provide the following support:

- Notification to planning partners about impending grant opportunities.
- A current list of eligible, jurisdiction-specific projects for funding pursuit consideration.
- Notification about mitigation priorities for the fiscal year to assist the planning partners in the selection of appropriate projects.

Grant monitoring and coordination will be integrated into the annual progress report or as needed based on the availability of non-HMA or post-disaster funding opportunities.

7.3 IMPLEMENTATION OF MITIGATION PLAN THROUGH 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. Within the County, there are many existing plans and programs that support hazard risk management, and thus it is critical that this hazard mitigation plan integrate and coordinate with, and complement, those existing plans, and programs.

Section 5 Capability Assessment provides a summary and description of the existing plans, programs, and regulatory mechanisms at all levels of government (federal, state, county, and local) that support hazard mitigation within the County. Within each jurisdictional annex in Section 9 (Jurisdictional Annexes), 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").

Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan 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/education plans

Some action items do not need to be implemented through regulation. Instead, these items 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.

7.4 CONTINUED PUBLIC INVOLVEMENT

Broome 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 (https://broomecountyny.gov/planning/hazardmitigation). In addition, public outreach, and dissemination of the HMP will include the following elements:

- Links to the plan on municipal websites of each jurisdiction with capability.
- Continued utilization of existing social media outlets (i.e., Facebook, X) to inform the public of natural hazard events, such as floods and severe storms.
- Educate the public via the jurisdictional websites on how these applications can be used in an emergency situation.

Planning Partnership representatives and the Broome County 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 the 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 Broome County 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 also be held as

deemed necessary by the planning group. The purpose of these meetings would be to provide the public with an opportunity to express concerns, opinions, and ideas about the mitigation plan.

The Planning Partnership representatives shall be responsible for ensuring that the following objectives are achieved:

- Public comment and input on the plan, and hazard mitigation in general, are recorded and addressed, as appropriate.
- Copies of the latest approved plan (or draft in the case that the five-year update effort is underway) are available for review, along with instructions to facilitate public input and comment on the Plan.
- Appropriate links to the Broome County Hazard Mitigation Plan website are included on municipal websites.
- Public notices are made as appropriate to inform the public of the availability of the plan, particularly during Plan update cycles.

The Broome County HMP Coordinator shall be responsible for ensuring that:

- Public and stakeholder comments and input on the plan, and hazard mitigation in general, are recorded and addressed, as appropriate.
- The Broome 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.