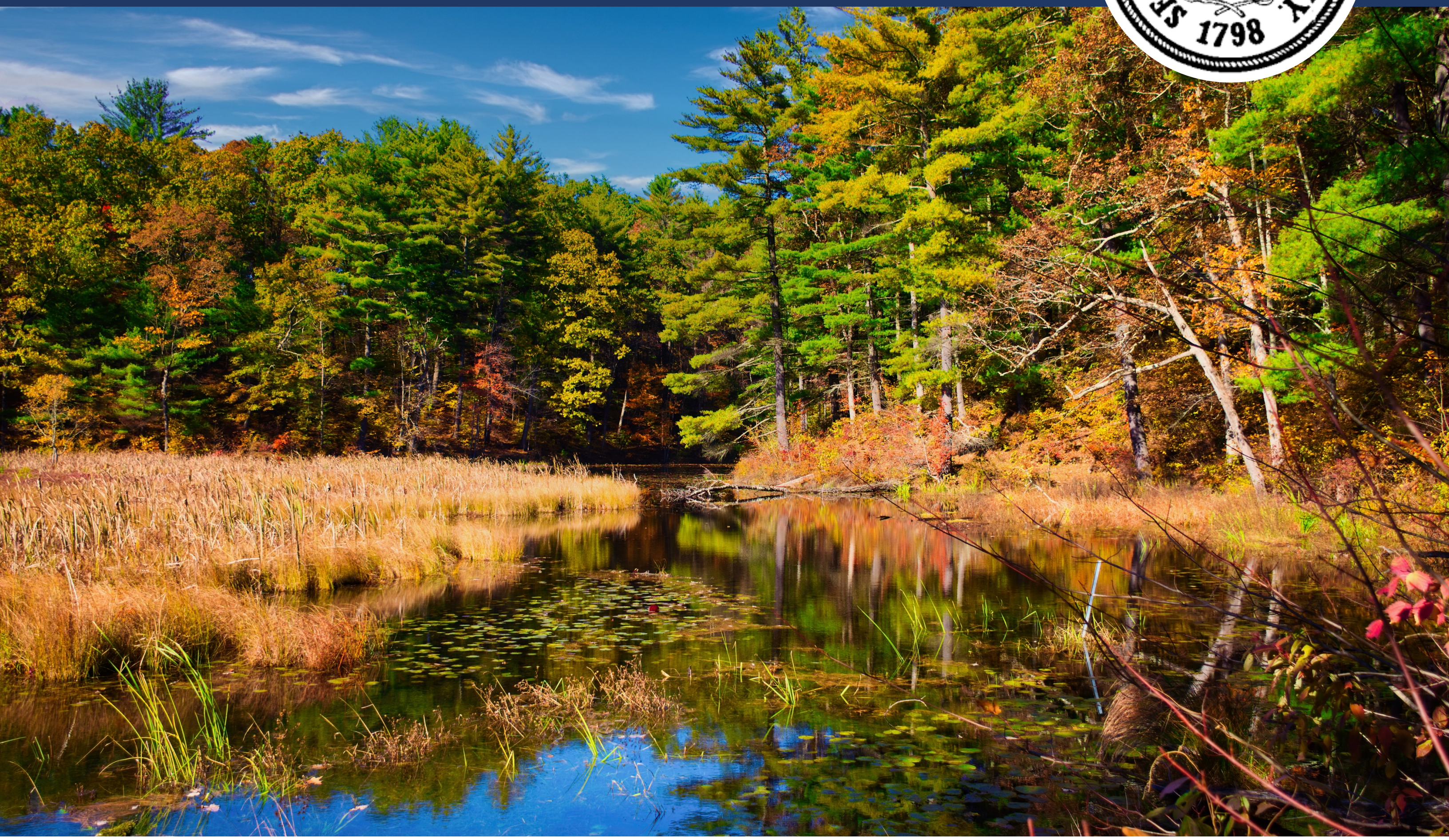
MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN UPDATE

Chenango County, New York

VOLUME I



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2021 Update

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SECTION 1. INTRODUCTION

1.1 BACKGROUND

A Hazard Mitigation Plan (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 damages to lives, property, and the economy from future disasters. Examples of mitigation projects include home acquisitions or elevations to remove structures from high risk areas, upgrades to critical public facilities, and infrastructure improvements. Ultimately, these actions reduce vulnerability, and communities are able to recover more quickly from disasters. Chenango County has demonstrated its commitment to reducing disaster losses by initially developing its multi-jurisdictional HMP in 2008 and again in 2015, updating information upon which to base a successful mitigation strategy to reduce the impacts of natural disasters and to increase the resiliency of its communities.

In response to the requirements of the Disaster Mitigation Act of 2000 (DMA 2000), Chenango County and the municipalities located therein have developed this Hazard Mitigation Plan (HMP), which represents a regulatory update to the December 2015 "Chenango County Multi-Jurisdictional Hazard Mitigation Plan Update". The DMA 2000 amends the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) and is designed to improve planning for, response to, and recovery from disasters by requiring state and local entities to implement pre-disaster mitigation planning and develop HMPs. The Federal Emergency Management Agency (FEMA) has issued guidelines for HMPs. The New York State Division of Homeland Security and Emergency Services (NYS DHSES), formerly the NYS Office of Emergency Management (NYSOEM), also supports plan development for jurisdictions in New York State and issued the NYS DHSES Hazard Mitigation Planning Standards for HMPs developed with NYS DHSES-administered funds.

> ***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.

Specifically, the DMA 2000 requires that states, with support from local governmental agencies, develop and update HMPs on a five-year basis to prepare for and reduce the potential impacts of natural hazards. The DMA 2000 is intended to facilitate cooperation between state and local authorities, prompting them to work together. This enhanced planning better enables local and State governments to articulate accurate needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects.

> Chenango County has been included in 29 FEMA (major and emergency) declarations.

1.1.1 DMA 2000 Origins -The Stafford Act

In the early 1990s, a new federal policy regarding disasters began to evolve. Rather than reacting whenever disasters strike communities, the federal government began encouraging communities to first assess their vulnerability to various disasters and proceed to take actions to reduce or eliminate potential risks. The logic is that a disaster-resistant community can rebound from a natural disaster with less loss of property or human injury, at much lower cost, and, consequently, more quickly. Moreover, these communities minimize other costs associated with disasters, such as the time lost from productive activity by business and industries.

The DMA 2000 provides an opportunity for states, tribes, and local governments to take a new and revitalized approach to mitigation planning. The DMA 2000 amended the Stafford Act by repealing the previous mitigation planning provisions (Section 409) and replacing them with a new set of requirements (Section 322). Section 322 sets forth the requirements that communities evaluate natural hazards within their respective jurisdictions and develop an appropriate plan of action to mitigate those hazards, while emphasizing the need for State, tribal and local governments to closely coordinate mitigation planning and implementation efforts.

The amended Stafford Act requires that each local jurisdiction identify potential natural hazards to the health, safety, and well-being of its residents and identify and prioritize actions that the community can take to mitigate those hazards—before disaster strikes. To remain eligible for hazard mitigation assistance from the federal government, communities must first prepare and then maintain and update an HMP (this plan).

Responsibility for fulfilling the requirements of Section 322 of the Stafford Act and administering the FEMA Hazard Mitigation Program has been delegated to the State of New York, specifically to NYS DHSES. FEMA also provides support through guidance, resources, and plan reviews.

1.1.2 Benefits of Mitigation Planning

The planning process helps prepare citizens and government agencies to better respond when disasters occur. Also, mitigation planning allows Chenango County as a whole, and participating municipalities, to remain eligible for mitigation grant funding for mitigation projects that will reduce the impact of future disaster events. Eligible projects include property acquisition and structure demolition, structure elevation, localized flood risk reduction projects, infrastructure retrofit, soil stabilization, wildfire mitigation, post-disaster code enforcement, wind retrofit for one- and two-family residences, and planning related activities. The long-term benefits of mitigation planning include the following:

National Benefit-Cost Ratio (BCR) Per Peril *BCR numbers in this study have been rounded	Beyond Code Requirements	Federally Funded
Overall Hazard Benefit-Cost Ratio	$4:1	$6:1
Riverine Flood	$5:1	$7:1
Hurricane Surge	$7:1	Too few grants
Wind	$5:1	$5:1
Earthquake	$4:1	$3:1
Wildland-Urban Interface Fire	$4:1	$3:1

Source: FEMA 2018; Federal Insurance Mitigation Administration 2018
Note: Natural hazard mitigation saves $6 on average for every $1 spent on federal mitigation grants.

- An increased understanding of hazards faced by Chenango County and their inclusive municipalities.
- Building more sustainable and disaster-resistant communities.
- Increasing education and awareness of hazards and their threats, as well as their risks.
- Developing implementable and achievable actions for risk reduction in the and its jurisdictions.
- Financial savings through partnerships that support planning and mitigation efforts.
- Focused use of limited resources on hazards that have the biggest impact on the community.
- Reduced long-term impacts and damages to human health and structures.
- Reduced repair costs.

1.1.3 Organizations Involved in the Mitigation Planning Effort

Chenango County and the participating jurisdictions intend to implement this HMP with full coordination and participation of county and local departments, organizations and groups, and relevant state and federal entities. Coordination helps to ensure that stakeholders have established communication channels and relationships necessary to support mitigation planning and mitigation actions included in Section 6 (Mitigation Strategy) and in the jurisdictional annexes in Section 9 (Jurisdictional Annexes).

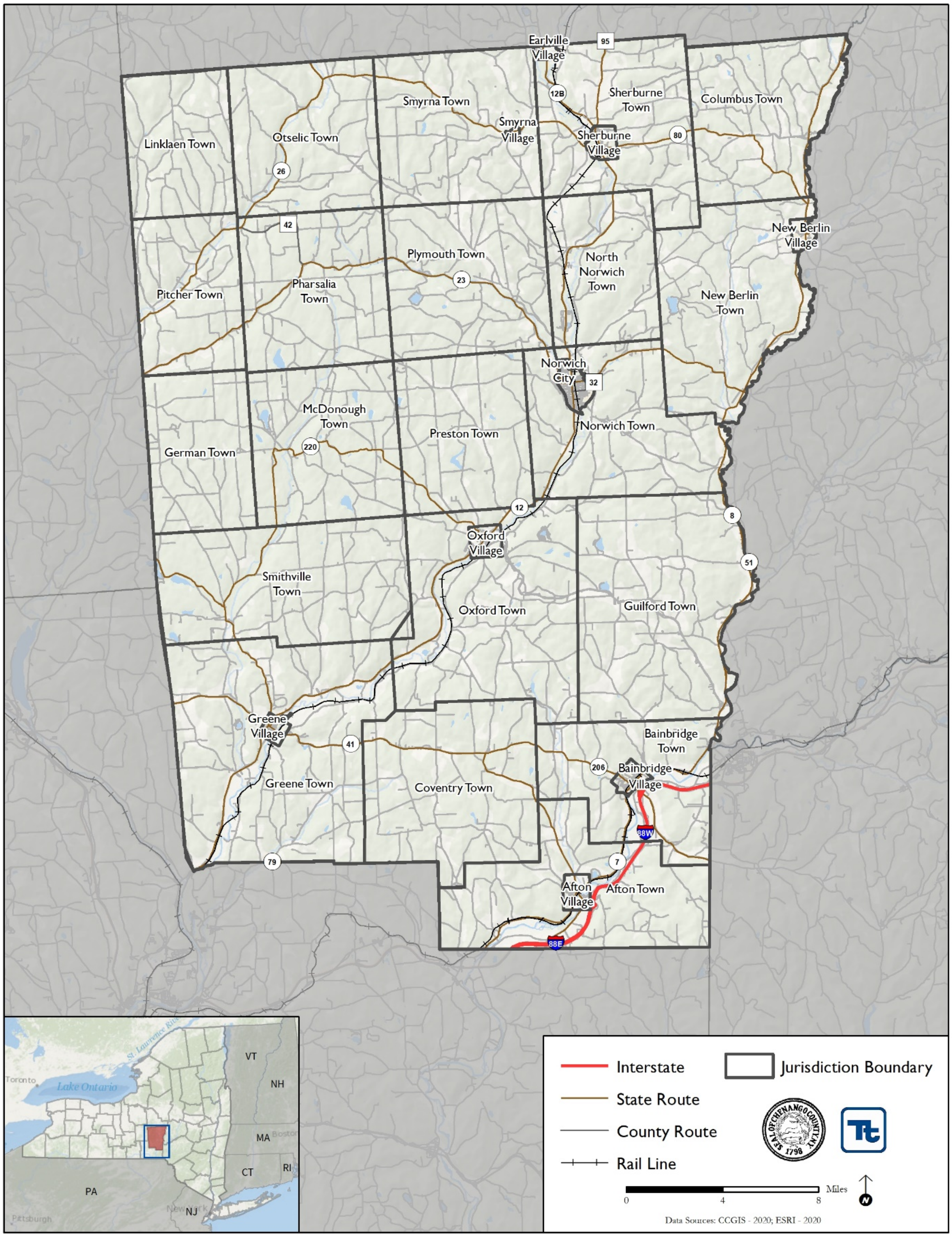
In addition to Chenango County, 29 municipal governments in the County have participated in the 2021 planning process as indicated in Table 1-1 below. A map of the Chenango County HMP planning area is provided in

Figure 1-1 following the table. While Chenango County made every effort to get all jurisdictions to participate during the planning process, numerous factors including the current COVID-19 pandemic, made it difficult for all jurisdictions to commit to full participation. Throughout the planning process, many jurisdictions were functioning with limited staff resources and modified schedules, preventing several jurisdictions from participating in the 2021 HMP update.

Table 1-1. Participating Chenango County Jurisdictions

Jurisdictions		
Chenango County		
Afton (T)	Guilford (T)	Oxford (V)
Afton (V)	Lincklaen (T)	Pharsalia (T)
Bainbridge (T)	McDonough (T)	Pitcher (T)
Bainbridge (V)	New Berlin (T)	Plymouth (T)
Columbus (T)	New Berlin (V)	Preston (T)
Coventry (T)	North Norwich (T)	Sherburne (T)
Earlville (V)	Norwich (C)	Sherburne (V)
German (T)	Norwich (T)	Smithville (T)
Greene (T)	Otselic (T)	Smyrna (T)
Greene (V)	Oxford (T)	

Figure 1-1. Chenango County, New York Mitigation Planning Area



Multiple Agency Support for Hazard Mitigation

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

Additional input and support for this planning effort was obtained from a range of agencies and through public involvement (as discussed in Section 3). Under the project management of the Chenango County Department of Planning and Development (CCDPD), oversight for the preparation of this plan was provided by the Chenango County Hazard Mitigation Steering Committee and Planning Committees. While participating municipalities were asked to identify a primary and alternate local Point of Contact (POC), broad participation by municipal representatives was encouraged and supported throughout the planning process. A list of Steering Committee and municipal POCs is provided in Section 3 (Planning Process), while Appendix B (Participation Matrix) provides further documentation of the broader level of municipal involvement.

This HMP was prepared in accordance with the following regulations and guidance:

- FEMA *Local Mitigation Planning Handbook*, March 2013.
- FEMA *Integrating Hazard Mitigation into Local Planning*, March 1, 2013.
- FEMA *Plan Integration: Linking Local Planning Efforts*, July 2015.
- *Local Mitigation Plan Review Guide*, October 1, 2011.
- DMA 2000 (Public Law 106-390, October 30, 2000).
- 44 Code of Federal Regulations (CFR) Parts 201 and 206 (including: Feb. 26, 2002, Oct. 1, 2002, Oct. 28, 2003, and Sept. 13, 2004 Interim Final Rules).
- FEMA *How-To Guide for Using HAZUS-MH for Risk Assessment* FEMA Document No. 433, February 2004.
- FEMA *Mitigation Planning How-to Series* (FEMA 386-1 through 4, 2002), available at: http://www.fema.gov/fima/planhowto.shtm.
- FEMA *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, January 2013.
- NYS DHSES *Hazard Mitigation Planning Standard*, 2017.
- NYS DHSES *Hazard Mitigation Planning Standard Guide*, 2017.
- NYS Hazard Mitigation Plan, 2019.

Table 1-2 summarizes the requirements outlined in the DMA 2000 Interim Final Rule and provides the section where each is addressed in this HMP.

Table 1-2. FEMA Local Mitigation Plan Review Crosswalk

Plan Criteria	Primary Location in Plan
Prerequisites	
Adoption by the Local Governing Body: §201.6(c)(5)	Section 2.0; Appendix A
Planning Process	
Documentation of the Planning Process: §201.6(b) and §201.6(c)(1)	Section 3.0
Risk Assessment	
Identifying Hazards: §201.6(c)(2)(i)	Sections 5.2
Profiling Hazards: §201.6(c)(2)(i)	Section 5.4
Assessing Vulnerability: Overview: §201.6(c)(2)(ii)	Section 5.4
Assessing Vulnerability: Identifying Structures: §201.6(c)(2)(ii)(A)	Section 4.0 Section 5.4
Assessing Vulnerability: Estimating Potential Losses: §201.6(c)(2)(ii)(B)	Section 5.4
Assessing Vulnerability: Analyzing Development Trends: §201.6(c)(2)(ii)(C)	Section 4.0; Section 9 Annexes
Mitigation Strategy	
Local Hazard Mitigation Goals: §201.6(c)(3)(i)	Section 6.0; Section 9 Annexes
Identification and Analysis of Mitigation Actions: §201.6(c)(3)(ii)	Section 6.0; Section 9 Annexes
Implementation of Mitigation Actions: §201.6(c)(3)(iii)	Section 6.0; Section 9 Annexes
Multi-Jurisdictional Mitigation Actions: §201.6(c)(3)(iv)	Section 6.0; Section 9 Annexes
Plan Maintenance Process	
Monitoring, Evaluating, and Updating the Plan: §201.6(c)(4)(i)	Section 7.0
Incorporation into Existing Planning Mechanisms: §201.6(c)(4)(ii)	Section 7.0; Section 9 Annexes
Continued Public Involvement: §201.6(c)(4)(iii)	Section 7.0

1.1.4 Organization

The Chenango County HMP update is organized as a two-volume plan. Volume I provides information on the overall planning process and natural hazard profiling and vulnerability assessments, which serve as a basis for understanding risk and identifying appropriate mitigation actions. As such, Volume I is intended for use as a resource for on-going mitigation analysis. Volume II provides an annex dedicated to each participating jurisdiction. Each annex summarizes the jurisdiction's legal, regulatory, and fiscal capabilities; identifies vulnerabilities to natural hazards; records status of past mitigation actions; and presents an individualized mitigation strategy. The annexes are intended to provide an expedient resource for each jurisdiction for implementation of mitigation projects and future grant opportunities, as well as place for each jurisdiction to record and maintain their local aspect of the countywide plan.

Goals and Objectives

The planning process included a review and update of the prior mitigation goals and the addition of all new objectives as a basis for the planning process and to guide the selection of appropriate mitigation actions addressing all hazards of concern. Further, the goal development process considered the mitigation goals expressed in the New York State HMP, as well as other relevant county and local planning documents, as discussed in Section 6 (Mitigation Strategy).

The 7 Goals of the Chenango County HMP

1. Protect Life
2. Protect Property
3. Protect Economic Viability and Increase Resiliency of Residents and Businesses
4. Protect the Environment and Promote Mitigation Actions that Emphasize Sustainable Construction and Design Measures
5. Promote Hazard Mitigation Awareness and Education
6. Develop and Implement Mitigation Strategies that use Public Funds in an Efficient and Cost-Effective Way
7. Build Regional, County, and Local Collaborations across Mitigation Strategies to Develop Stronger Emergency Management Capabilities

Hazards of Concern

Chenango County and participating jurisdictions reviewed the natural hazards that caused measurable impacts based on events, losses, and information available since the development of the Chenango County HMP Update (2015) and the New York State Hazard Mitigation Plan - 2021 Update. Chenango County and participating jurisdictions evaluated the risk and vulnerability due to each of the hazards of concern on the assets of each participating jurisdiction. While the overall hazard rankings were calculated for the county and each participating municipality, the overall hazard rankings displayed in each annex reflect municipal input. The hazard risk rankings were used to focus and prioritize individual jurisdictional mitigation strategies.

Plan Integration into Other Planning Mechanisms

Effective mitigation is achieved when hazard awareness and risk management approaches and strategies become an integral part of public activities and decision-making. Within the county there are many existing plans and programs that support hazard risk management, and thus it is critical that this HMP integrates, coordinates with, and complements those mechanisms. Comprehensive plans, codes and ordinances, local watershed plans are among the sources of information to update the county and municipal capabilities, to identify mitigation strategies, and to develop integration actions.

The "Capability Assessment" section of Section 6 (Mitigation Strategy) 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").

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 9 (Jurisdictional Annexes).

1.1.5 Implementation of Prior and Existing Local Hazard Mitigation Plans

Section 6 (Mitigation Strategy) and Section 9 (Jurisdictional Annexes) of the plan present the status of the mitigation projects identified in the 2015 Chenango County HMP. Numerous projects and programs have been implemented that have reduced hazard vulnerability to assets in the planning area. The county and municipal annexes, as well as plan maintenance procedures in Section 7 (Plan Maintenance), were developed to include specific, implementable activities. Future actions include integrating hazard mitigation goals into comprehensive plan updates; reviewing the HMP during updates of codes, ordinances, zoning, and development; and ensuring a more thorough integration of hazard mitigation, with its related benefits, will be completed within the upcoming five-year planning period.

1.1.6 Implementation of the Planning Process

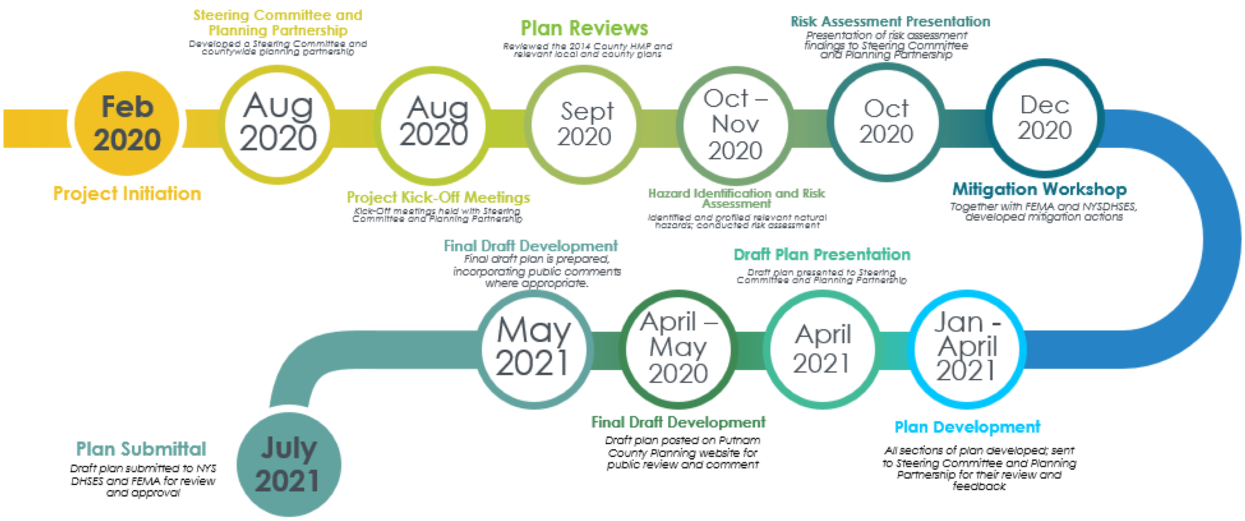
The planning process and findings are required to be documented in local HMPs. To support the planning process in developing this HMP, Chenango County and the participating jurisdictions have accomplished the following:

- Developed a Steering Committee and countywide planning partnership with municipalities and stakeholders.
- Reviewed the December 2015 *Chenango County Hazard Mitigation Plan Update*.
- Identified and reviewed those natural hazards that are of greatest concern to the community (hazards of concern) to be included in the plan.
- Profiled the relevant natural hazards.
- Estimated the inventory at risk and potential losses associated with the relevant hazards.
- Reviewed and updated the hazard mitigation goals and added new objectives.
- Reviewed mitigation strategies identified in the 2015 Chenango County HMP.
- Developed new mitigation actions to address reduction of vulnerability of hazards of concern.
- Involved a wide range of stakeholders and the public in the plan process.
- Developed mitigation plan maintenance procedures to be executed after obtaining approval of the plan from NYS DHSES and FEMA.

As required by the DMA 2000, Chenango County and participating jurisdictions have informed the public and provided opportunities for public comment and input. Numerous agencies and stakeholders have participated as core or support members by providing input and expertise throughout the planning process. Refer to Appendix D (Public and Stakeholder Outreach) for copies of public service announcements, newspaper articles, and social media posts.

This HMP update documents the process and outcomes of Chenango County and the jurisdictions' efforts. Section 2 (Plan Adoption) includes documentation that the prerequisites for plan approval have been met. Section 3 (Planning Process) includes additional information on the process to develop this plan.

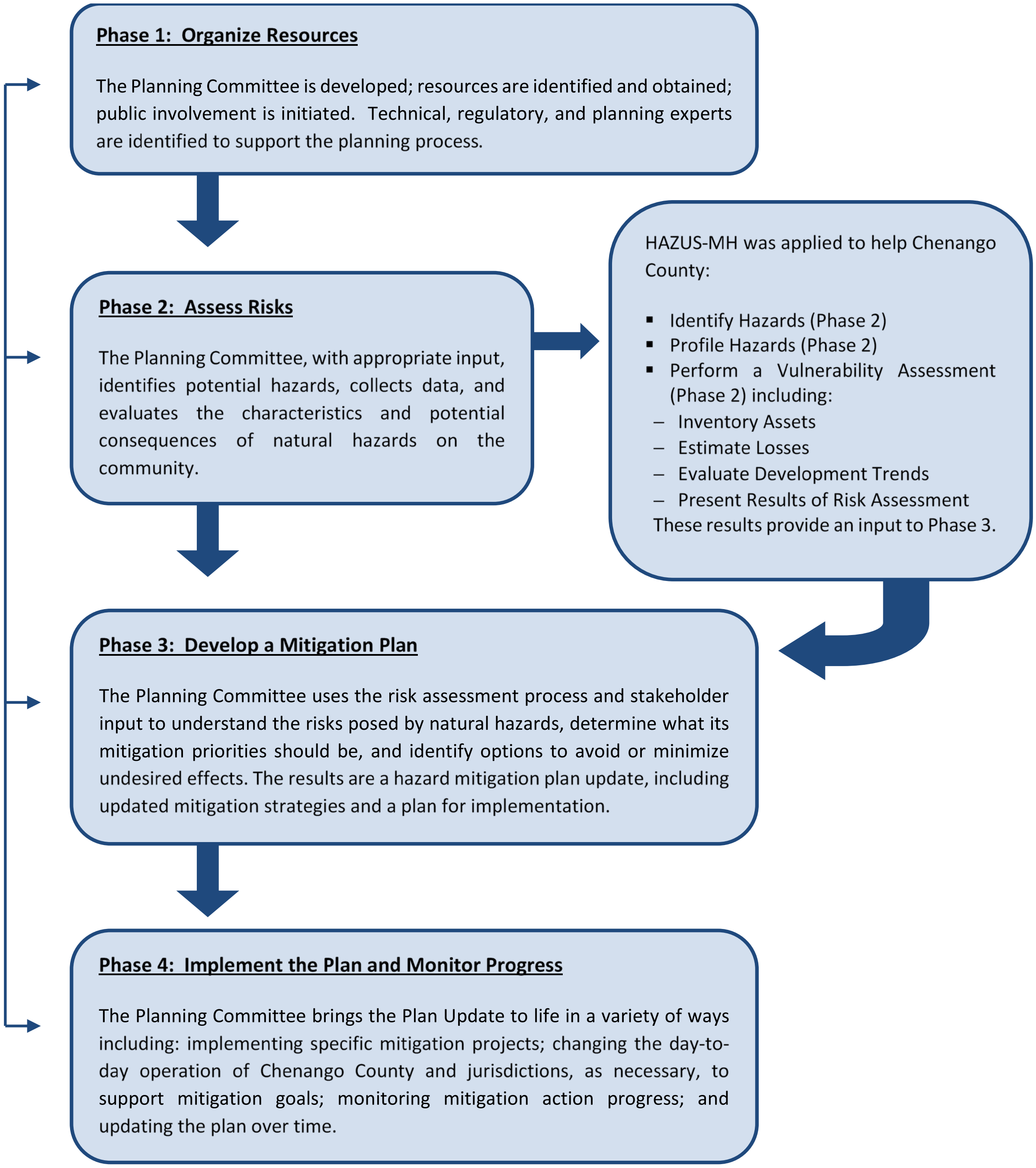
Figure 1-2. Planning Process Roadmap



1.1.7 Organization of This Mitigation Plan

This HMP is organized in accordance with FEMA and NYS DHSES guidance. The structure of this HMP follows the four-phase planning process recommended by FEMA and summarized in Figure 1-3.

Figure 1-3. Chenango County Hazard Mitigation Planning Process



As noted earlier, the HMP is organized into two volumes: Volume I includes all information that applies to the entire planning area (Chenango County) and Volume II includes participating jurisdiction-specific information.

Volume I of this Plan includes the following sections:

Section 1: Introduction: Overview of participants and planning process.

Section 2: Plan Adoption: Information regarding the adoption of the HMP by Chenango County and each participating jurisdiction.

Section 3: Planning Process: A description of the HMP methodology and development process; Steering Committee, Planning Committee and stakeholder involvement efforts; and a description of how this HMP will be incorporated into existing programs.

Section 4: County Profile: An overview of Chenango County, including: (1) general information, (2) economy, (3) land use trends, (4) population and demographics, (5) general building stock inventory, and (6) critical facilities.

Section 5: 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 and 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 6: Mitigation Strategies: Information regarding the mitigation goals and objectives identified by the Steering Committee in response to priority hazards of concern and the process by which county and local mitigation strategies have been developed or updated.

Section 7: Plan Maintenance Procedures: System established by the Steering Committee to continue to monitor, evaluate, maintain and update the HMP.

Volume II of this plan includes the following sections:

Section 8: Planning Partnership: Description of the planning partnership, their responsibilities, and jurisdictional annexes.

Section 9: Jurisdictional Annexes: A jurisdiction-specific annex for Chenango County and each participating jurisdiction containing their hazards of concern, hazard risk ranking, capability assessments, mitigation actions, action prioritization specific only to Chenango County or that jurisdiction, progress on prior mitigation activities (as applicable), and a discussion of prior local hazard mitigation plan integration into local planning processes.

Appendices include the following:

Appendix A: Resolution of Plan Adoption: Resolutions from the county and each jurisdiction will be included as they formally adopt the HMP update.

Appendix B: Participation Matrix: A matrix is presented to give a broad overview of who attended meetings and when input was provided to the HMP update. Letters of Intent to Participate as described in Section 3 are also included in this appendix.

Appendix C: Meeting Documentation: Agendas, attendance sheets, minutes, and other documentation (as available and applicable) of planning meetings convened during the development of the plan.

Appendix D: Public and Stakeholder Outreach Documentation: Documentation of the public and stakeholder outreach effort including webpages, informational materials, public and stakeholder meetings and presentations, surveys, and other methods used to receive and incorporate public and stakeholder comment and input to the plan process.

Appendix E: County Profile and Risk Assessment Supplementary Data: Details regarding critical facilities from Section 4 (County Profile) and vulnerability assessments conducted for the hazards of concern (Section 5 – Risk Assessment).

Appendix F: Critical Facilities: Critical facilities included in the risk assessment.

Appendix G: FEMA Plan Review Tools: Examples of plan review templates available to support annual plan review.

Appendix H: Linkage Procedures: Details procedures for non-participating jurisdictions to join the HMP to gain eligibility for programs under the DMA.

Appendix I: Plan Review Summary: An overview of municipal plans reviewed to identify current integration and future integration opportunities with the HMP.

Appendix J: NYS DHSES Planning Standards: Includes planning standards and guidelines for hazard mitigation planning.

Appendix K: Dam Supplementary Data: Details regarding dams from Section 4 (County Profile) and Section 5.4.4 (Flood).

1.2 The Plan Update – What is Different?

Chenango County's initial HMP was initially approved by FEMA and adopted by participating jurisdictions in 2008. The plan was subsequently updated, approved by FEMA and adopted by participating jurisdictions in December 2015. The 2021 update builds on the 2015 plan and specifically includes the following changes or enhancements. This plan differed from its predecessor for a variety of reasons:

- This plan was prepared in accordance with the 2017 NYS DHSES guidance which provided a framework for a more concise and focused mitigation plan.
- Updated data and tools provided for a more detailed and accurate risk assessment. Building footprint data was now available to provide a more accurate flood vulnerability assessment. The risk assessment was prepared to better support future grant applications by providing risk and vulnerability information that would directly support the measurement of "cost-effectiveness" required under FEMA mitigation grant programs.
- There was a strong desire on the part of Chenango 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.
- The plan identified implementable actions rather than strategies, with enough information to serve as the basis for policy and funding decisions and represent measurable impacts on resiliency and mitigation progress. Strategies provide direction, but actions are fundable under grant programs.

Table 1-3. Plan Changes Crosswalk

44 CFR Requirement	2015 Plan	2021 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: *(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;*	The 2015 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.	Building upon the success of the 2015 plan, the 2021 planning effort deployed the same public engagement methodology. The plan included the following enhancements: • Using social media. • Web-deployed survey.

44 CFR Requirement	2015 Plan	2021 Updated Plan
(2) 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 *(3) Review and incorporation, if appropriate, of existing plans, studies, reports and technical information.*	• 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 team.	• Informational brochure. • Public website specific to the HMP planning process. As with the 2015 plan, the 2021 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 team.
§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 2015 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 planning area. 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 2021 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 2015 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 2021 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 2015 plan. • Identified issues have been documented in each hazard profile.
§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	The same methodology was deployed for the 2021 plan update, using new and updated data. Additional hazards of concern include the following: • Disease Outbreak • Harmful Algal Bloom • Invasive species. • Wildfire

44 CFR Requirement	2015 Plan	2021 Updated Plan
	to an asset inventory extracted from HAZUS-MH-MH.	
§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 2021 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 planning area, and these were inventoried by exposure. Each hazard profile provides a discussion on future development trends.	The same methodology was deployed for the 2021 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 2021 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 2021 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.]	The 2015 plan contained a mission statement, goals, objectives and actions. The mission statement, goals and objectives were regional and covered all planning partners. Each planning partner identified actions that could be implemented within their 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.	The same methodology for setting goals, objectives, and actions was applied to the 2021 plan update. The Steering Committee reviewed and reconfirmed the mission statement, goals, and objectives for the plan. Each planning partner used the progress reporting from the plan maintenance and evaluated the status of actions identified in the 2015 plan. Actions that were completed or no longer considered to be feasible were removed. The balance of the actions was carried over to the 2021 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 Steering Committee identified a mission statement, goals, and objectives targeted specifically for this hazard mitigation plan. These planning components supported the actions identified in the plan.	The same methodology for setting goals, objectives, and actions was applied to the 2021 plan update. 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.
Requirement §201.6(c)(3)(ii): [The mitigation strategy shall include a] section	The 2015 plan includes a hazard mitigation catalog that was developed	The mitigation catalog was reviewed and updated by the Steering

44 CFR Requirement	2015 Plan	2021 Updated Plan
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.	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.	Committee for the 2021 update. As with the 2015 plan, the catalog has been included in the 2021 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 and using new and updated data was used for the 2021 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 2015 plan details steps for monitoring, evaluating, and updating the mitigation plan set forth in *44 CFR § 201.6.*	The 2021 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 2015 plan details recommendations for incorporating the plan into other planning mechanisms.	The 2021 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 2015 plan details a strategy for continuing public involvement.	The 2015 plan maintenance strategy was carried over to the 2021 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 30 planning partners participated in the 2015 planning process.	The 2021 plan achieves DMA compliance for 29 planning partners. Resolutions for each partner adopting the plan can be found in Appendix A of this volume.

SECTION 2. PLAN ADOPTION

2.1 Overview

This section contains information regarding adoption of the plan by Chenango County and each participating jurisdiction.

2.1.1 Plan Adoption by Local Governing Bodies

Adoption by the local governing bodies such as the County Board of Supervisors, City Council or Town/Village Board demonstrates the commitment of Chenango County and each participating jurisdiction to fulfill the mitigation goals and strategies outlined in the plan. Adoption of the plan via a municipal resolution legitimizes the HMP and authorizes responsible agencies to execute their responsibilities.

The County and all participating jurisdictions will proceed with formal adoption proceedings when FEMA has completed review of the plan and provides conditional approval of this HMP update, known as Approval Pending Adoption (APA).

The County and all participating jurisdictions will proceed with formal adoption proceedings when FEMA provides conditional approval of this plan. Following adoption or formal action on the plan, the jurisdiction must submit a copy of the resolution or other legal instrument showing formal adoption (acceptance) of the plan to NYS DHSES. This will then be submitted to FEMA with the resolution in Appendix A of this Plan. The jurisdictions understand that FEMA will transmit acknowledgement of verification of formal plan adoption and the official approval of the plan to the mitigation plan coordinator.

The resolutions issued by each jurisdiction to support adoption of the plan will be included in Appendix A.

In addition to being required by DMA 2000, adoption of the plan is necessary because:

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

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

SECTION 3. PLANNING PROCESS

3.1 INTRODUCTION

This section includes a description of the planning process used to update the 2015 *Chenango County Hazard Mitigation Plan Update* (HMP, also referred herein as the *Hazard Mitigation Plan* or *the plan*), including how it was prepared, who was involved in the process, and how the public was involved.

To ensure that the plan meets requirements of the DMA 2000 and that the planning process would have the broad and effective support of the participating jurisdictions, regional and local stakeholders, and the public, an approach to the planning process and plan documentation was developed to achieve the following:

- The plan will be multi-jurisdictional, with the intention of including all municipalities in the County. Chenango County invited all jurisdictions to join with them in the planning process. To date, 29 local municipal governments in the county participated in the 2020-2021 planning process as indicated in Table 3-1. Jurisdictions that have not met participation requirements during this process will not be able to seek FEMA or NYS DHSES approval at the time of plan submittal nor will they be eligible to obtain FEMA mitigation grant funding. Those jurisdictions can choose to complete their annex and adopt at a later time, working with Chenango County and NYS DHSES to ensure completeness. Any non-participating local government within the Chenango County planning area can "dock" to this plan in the future following the linkage procedures defined in Appendix H (Linkage Procedures).

Table 3-1. Participating Chenango County Jurisdictions

Jurisdictions		
Chenango County		
Afton (T)	Guilford (T)	Oxford (V)
Afton (V)	Lincklaen (T)	Pharsalia (T)
Bainbridge (T)	McDonough (T)	Pitcher (T)
Bainbridge (V)	New Berlin (T)	Plymouth (T)
Columbus (T)	New Berlin (V)	Preston (T)
Coventry (T)	North Norwich (T)	Sherburne (T)
Earlville (V)	Norwich (C)	Sherburne (V)
German (T)	Norwich (T)	Smithville (T)
Greene (T)	Otselic (T)	Smyrna (T)
Greene (V)	Oxford (T)	

- The plan will consider all-natural hazards of concern facing the area, thereby satisfying the natural hazards mitigation planning requirements specified in DMA 2000.
- The plan will be developed following the process outlined by the DMA 2000, FEMA regulations, prevailing FEMA guidance and the 2017 NYS DHSES hazard mitigation planning standard. Following this process ensures that all the requirements are met and support HMP review.

The Chenango County HMP update was written using the best available information obtained from a wide variety of sources. Throughout the HMP update process, a concerted effort was made to gather information from municipal and regional agencies and staff, as well as stakeholders, federal and state agencies, and the residents of the county. The HMP Steering Committee solicited information from local agencies and individuals with specific knowledge of certain natural hazards and past historical events. In addition, the Steering and Planning Committees took into consideration planning and zoning codes, ordinances, and recent land use planning decisions. The hazard mitigation strategies identified in this HMP update were developed through an extensive planning process involving local, county and regional agencies, residents, and stakeholders.

This section of the plan describes the mitigation planning process, including (1) Organization of the Planning Process; (2) Stakeholder Outreach and Involvement; (3) Integration of Existing Data, Plans, and Technical Information; (4) Integration with Existing Planning Mechanisms and Programs; and (5) Continued Public Involvement.

3.2 ORGANIZATION OF THE PLANNING PROCESS

This section of the plan identifies how the planning process was organized with the many planning partners involved and outlines the major activities that were conducted in the development of this HMP update.

3.2.1 Organization of Planning Partnership

Chenango County applied for and was awarded a multi-jurisdictional planning grant under the FEMA Pre-Disaster Mitigation program (PDMC PL- 02 - NY-2018-010), which supported the development of this update of this multi-jurisdictional HMP.

A contract planning consultant (Tetra Tech, Inc. referred herein as *Tetra Tech*) was selected to guide the county and participating jurisdictions through the HMP update process. A contract between Tetra Tech and Chenango County was executed in February 2020. Specifically, Tetra Tech, the *contract consultant*, was tasked with the following:

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

> The goal of the **PDM** program is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding in future disasters. This program awards planning and project grants and provides opportunities for raising public awareness about reducing future losses before disaster strikes. Mitigation planning is a key process used to break the cycle of disaster damage, reconstruction, and repeated damage. PDM grants are funded annually by Congressional appropriations and are awarded on a nationally competitive basis.
>
> *Source: FEMA, 2020*

In 2020, the County notified all perspective municipalities of the pending planning process and invited them to formally participate. Jurisdictions were asked to formally notify the county of their intent to participate (via a Letter of Intent to Participate) and to identify planning points of contact (POCs) to facilitate municipal participation and represent the interests of their respective communities. Completed Letters of Intent to Participate are provided as Appendix B (Participation Matrix), as available.

To facilitate plan development, Chenango County developed a Steering Committee to provide guidance and direction to the HMP update effort and to ensure the resulting document will be embraced both politically and by the constituency within the planning area (refer to Table 3-2). All municipalities participating in the plan update authorized the Steering Committee to perform certain activities on their behalf, via the Letter of Intent to Participate (FEMA mitigation planning *combination model*). Specifically, the Steering Committee was charged with the following:

- Providing guidance and oversight of the planning process on behalf of the general planning partnership.
- Attending and participating in Steering Committee meetings.
- Assisting with the development and completion of certain planning elements, including:
  - Reviewing and updating the hazards of concern.
  - Developing a public and stakeholder outreach program.
  - Assuring that the data and information used in the plan update process are the best available.
  - Reviewing and updating the hazard mitigation goals.
  - Identifying and screening of appropriate mitigation strategies and activities.
- Reviewing and commenting on plan documents prior to submission to NYS DHSES and FEMA.

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

Table 3-2. Chenango County Hazard Mitigation Steering Committee Members

Affiliation	Name	Title
Chenango County Department of Planning and Development (CCDPD)	Shane H. Butler	Director of Planning
Chenango County Department of Planning and Development (CCDPD)	Rena M. Doing	Senior Planner
Chenango County Department of Planning and Development (CCDPD)	Colleen Bradley	Planner
Chenango County Department of Planning and Development (CCDPD)	Corey Katusha	Planner
Chenango County Board of Supervisors	George Seneck	Chairman
Chenango County Emergency Services	Matthew L. Beckwith	Fire Coordinator- Car 1, Office of the Fire Coordinator
Chenango County Sherriff's Office	A. Wesley Jones	Chief Dispatcher
Chenango County Board of Supervisors	Lawrence Wilcox	Chairman
Chenango County Department of Public Works	Shawn Fry, PE, LS	Director
Chenango County Soil & Water Conservation District	Jennifer Kelly	District Technician
Chenango County Soil & Water Conservation District	Lance Lockwood	District Manager
Chenango County Information Technology	Herman Ericksen	Director
Chenango County Public Health - Environmental Health Division	Isaiah Sutton	Director
Chenango County Public Health - Code Enforcement Division	Steve Fox	County Code Enforcement and Floodplain Administrator
Commerce Chenango	Kerri Green	President & CEO

Each municipality received a copy of the *Planning Partner Expectations*, outlining the responsibilities of the participants and the agreement of the partners to authorize the Steering Committee to represent the jurisdiction in the completion of certain planning elements as noted above. Table 3-3 lists the current municipal members of the Planning Committee at the time of this HMP's publication. Please note that the Steering Committee members also are part of the overall project Planning Committee, fulfilling these responsibilities on behalf of Chenango County. This *Planning Partnership* (Steering and Planning Committees) were charged with the following:

- Represent their jurisdiction throughout the planning process.
- Assure participation of all department and functions within their jurisdiction that have a stake in mitigation (e.g., planning, engineering, code enforcement, police and emergency services, public works).
- Assist in gathering information for inclusion in the HMP update, including the use of previously developed reports and data.
- Support and promote the public involvement process.
- Report on progress of mitigation actions identified in prior or existing HMPs, as applicable.
- Identify, develop, and prioritize appropriate mitigation initiatives.
- Report on progress of integration of prior or existing HMPs into other planning processes and municipal operations.
- Develop and author a jurisdictional annex for their jurisdiction.
- Review, amend, and approve all sections of the plan update.
- Adopt, implement, and maintain the plan update.

Table 3-3. Chenango County Hazard Mitigation Planning Partnership Members *

Jurisdiction	Primary Point of Contact	Title	Alternate Point of Contact	Title
Chenango County	Shane H. Butler	Director of Planning	Colleen Bradley	Planner
Afton (T)	John Lawrence	Town Supervisor	None Identified	-
Afton (V)	Robert Humphrey Jr.	Village Trustee/Planning Board	Jeffrey Butler	Village Code Enforcement Officer
Bainbridge (T)	Gary Richman	Highway Superintendent	Dolores Nabinger	Town Supervisor
Bainbridge (V)	Philip Wade	Mayor	Jay Campbell	Deputy Mayor
Columbus (T)	Kevin Cross	Highway Superintendent	Thomas Grace	Town Supervisor
Coventry (T)	Jennifer Boudreau	Town Supervisor	None Identified	-
Earlville (V)	Dale Wissenbach	DPW	Gerald Hayes	Trustee
German (T)	Daniel Jack	Town Supervisor		
Greene (T)	Joseph M. Henninge	Town Supervisor	Nick Drew	Highway Superintendent
Greene (V)	Phillip E. Brown	Mayor	Karen Tuttle	Trustee
Guilford (T)	George Seneck	Town Supervisor	Robert Fleming	Highway Superintendent
Lincklaen (T)	Wayne Outwater	Town Supervisor	Travis Hull	Superintendent of Highways
McDonough (T)	Raymond Wakefiled	Town Supervisor	Glen Naber	Highway Superintendent
New Berlin (T)	Robert Starr	Town Supervisor	Daniel Nielsen	Highway Superintendent
New Berlin (V)	Terry Potter	Mayor	Carol Riley	Trustee

Jurisdiction	Primary Point of Contact	Title	Alternate Point of Contact	Title
North Norwich (T)	Joseph Eldred	Highway Superintendent	Timothy Brown	Town Supervisor
Norwich (C)	A. Wesley Jones	Emergency Management Officer	Jan Papelino	Fire Chief
Norwich (T)	Barry Christophersen	Highway Superintendent	Stanley D. Foulds	Town Supervisor
Otselic (T)	Marjorie Davis	Town Supervisor	Louise Perry	Town Clerk
Oxford (T)	Roger Barrows Jr.	Planning Board	Paul Romahn	Planning Board
Oxford (V)	Terry M. Stark	Mayor	Shelly Marks	Village Clerk/Treasurer
Pharsalia (T)	Jeremiah Micklas	Town Supervisor	Tom Slate	Superintendent of Highways
Pitcher (T)	Brad Hotaling	Highway Superintendent	Jeffrey B. Blanchard	Town Supervisor
Plymouth (T)	Rodney Oakley	Highway Superintendent	Grace Nucero-Alger	Town Supervisor
Preston (T)	Peter C. Flanagan	Town Supervisor	Dan Macintosh	Highway Superintendent
Sherburne (T)	Chase Winton	Highway Superintendent	Charles Mastro	Town Supervisor
Sherburne (V)	Travis DuBois	Superintendent	William Acee	Mayor
Smithville (T)	John Cammarata	Town Supervisor	Vince Witkowiski	Road Supervisor
Smyrna (T)	Michael R. Khoury	Town Supervisor	Chris Cook	Highway Superintendent
Smyrna (V)	Lindsay Hodge	Village Clerk	Robert Wright	Mayor

**Refer to Section 9 (Jurisdictional Annexes) for updated points of contact for the municipalities.*

The jurisdictional Letter of Intent to Participate identifies the above *Planning Partner Expectations* as serving to identify those activities comprising overall participation by jurisdictions throughout the planning process. The jurisdictions in Chenango County have differing levels of capabilities and resources available to apply to the plan update process, and further, have differing exposure and vulnerability to the natural hazard risks being considered in this plan. Chenango County's intent was to encourage participation by all-inclusive jurisdictions and to accommodate their specific needs and limitations while still meeting the intents and purpose of plan update participation. Such accommodations have included the establishment of a Steering Committee, engaging a contract consultant to assume certain elements of the plan update process on behalf of the jurisdictions, and the provision of additional and alternative mechanisms to meet the purposes and intent of mitigation planning.

Ultimately, jurisdictional participation is evidenced by a completed municipal annex to the HMP (Section 9) 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 mitigation initiatives, actions, and projects to mitigate their hazard risk; and eventually, adopted the updated plan via resolution.

Appendix B (Participation Matrix), identifies those individuals who represented the municipalities during this planning effort and indicates how they contributed to the planning process.

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 *Points of Contact* and *Administrative and Technical Capabilities* portions of the jurisdictional annexes in Section 9.

3.2.2 Planning Activities

Members of the municipal and county planning partnership (individually and as a whole), as well as key stakeholders, convened and/or communicated regularly to share information and participate in workshops to identify hazards; assess risks; review existing inventories of and identify new critical facilities; assist in updating and developing new mitigation goals and strategies; and provide continuity through the process to ensure that natural hazards vulnerability information and appropriate mitigation strategies were incorporated. All members of the Steering and Planning Committees had the opportunity to review the draft plan and supported interaction with other stakeholders and assisted with public involvement efforts.

A summary of Planning and Steering Committee meetings held, and key milestones met during the development of the HMP update is included in Table 3-4 that also identifies which DMA 2000 requirements the activities satisfy. Documentation of meetings (agendas, sign-in sheets, minutes, etc.) are in Appendix C (Meeting Documentation). Table 3-4 identifies only the formal meetings held during plan development and does not reflect the planning activities conducted by individuals and groups throughout the planning process. In addition to these meetings, there was a great deal of communication between the county, committee members, and the contract consultant through individual local meetings, electronic mail (email), and by phone.

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

This table summarizes a list of mitigation planning activities and meetings and their respective participants. A more detailed list of participants for each meeting is provided in Appendix C. Refer to DMA 2000 (Public Law 106-390) for details on each of the planning requirements (https://www.fema.gov/media-library-data/20130726-1524-20490-1790/dma2000.pdf).

Table 3-4. Summary of Mitigation Planning Activities / Efforts

Date	DMA 2000 Requirement	Description of Activity	Participants
February 13, 2020	2	Pre-Project Meeting (conference call)	Shane Butler – Chenango County Department of Planning and Development (CCDPD)
February 28 – July 20, 2020	1c, 2	Interested jurisdictions submit Letters of Intent to Participate in this planning process, acknowledging municipal participation requirements and identifying planning point(s) of contact.	Municipalities and CCDPD
August 5, 2020	1b, 1c, 2, 3a, 3b, 3c, 4a	Steering Committee Meeting: Review project schedule; review municipal participation, discuss municipal Kick Off meeting and local data collection; review and discuss sources and availability of county and regional data; discuss public and stakeholder outreach efforts; review prior plan and needed/desired areas for updating.	Steering Committee members; Contract Consultant. See Appendix B.
August 12, 2020	1b, 1c, 2, 3a, 3b, 3c, 4a	Municipal Kick-Off Meeting: Complete overview of planning process, plan participant expectations, review of hazards and hazards of concern identification, discussion of data needs and data collection process explaining all provided worksheets (hard copy and on	County and municipal representatives and stakeholders. See Appendix B

Date	DMA 2000 Requirement	Description of Activity	Participants
		resource CD), discussion of public and stakeholder outreach efforts	
Bi-Weekly and As Needed from July 2020 – Project Completion	1b, 2, 3a, 3c	Management Team Meeting	See Appendix B
August 10, 2020	1b, 2	Online Public Hazard Preparedness and Mitigation Survey launched for Citizens of Chenango County.	Public (see Appendix D)
August 19, 2020	1b, 2	Project website updated, including links to citizen and stakeholder surveys	Tetra Tech, Inc. and CCDPD
August 25, 2020	2	Article on project in The Evening Sun newspaper (Norwich).	Public and Stakeholders (see Appendix D)
August 26, 2020	2, 3a, 4a	Steering Committee Meeting #2 – Hazards of Concern, Goals and Objectives	Steering Committee members (see Appendix B)
September 4, 2020	1b, 2	Neighboring Counties and Stakeholder Hazard Mitigation surveys launched.	Public and Stakeholders and Neighboring County Representatives (see Appendix D)
September 23, 2020	2, 3a, 3b, 3c, 3d	Steering Committee Meeting – Reviewing Risk Assessment and Ranking	Steering Committee members (see Appendix B)
October 7, 2020	2, 3a, 3b, 3c, 3d	Steering Committee Meeting #3 / Planning Partnership Meeting #2 – Risk Assessment Presentation	Steering and Planning Committee members (see Appendix B)
November 12, 2020	4a, 4b, 4c, 5a	Steering Committee Meeting #4 – Plan Updates and Maintenance Procedures	Steering Committee members (see Appendix B)
December 9, 2020	4a, 4b, 4c	Planning Partnership Meeting #3 – Mitigation Brainstorming and Development Workshop	Steering and Planning Committee members (see Appendix B)
January 13, 2021	2, 4a, 4b, 4c, 5b	FEMA Mitigation Strategy Workshop	Steering and Planning Committee members (see Appendix B)
April 9, 2021	1b	Complete draft plan posted to public website, advertised on the County homepage, and at local meetings.	Chenango County and participating jurisdictions; public and stakeholders
April 14, 2021	2	Article on project in The Evening Sun, announcing project and plan finalization	Public and Stakeholders (see Appendix C)
May 2021	2, 4a, 4b, 4c, 5b	County and contract consultant work with County and municipalities in the development and finalization of annexes, focusing on updating local mitigation strategies	County and municipal planning partnership
TBD	2	Draft of final plan submitted to NYS DHSES and FEMA for review and approval	Chenango County and participating jurisdictions; NYS DHSES; FEMA Region II
TBD	2, 4a, 4b, 4c, 5b	County and contract consultant work with County and municipalities to finalize plan, including addressing NYS DHSES comments to the draft plan	County and municipal planning partnership
TBD	2	Final plan submitted to NYS DHSES and FEMA for review and approval	Chenango County and participating jurisdictions; NYS DHSES; FEMA Region II

Date	DMA 2000 Requirement	Description of Activity	Participants
TBD	1a	Plan adoption by resolution by the governing bodies of all participating jurisdictions	Chenango County and participating local governments

Note: TBD = to be determined.
Each number in column 2 identifies specific DMA 2000 requirements, as follows:
1a – Prerequisite – Adoption by the Local Governing Body
1b – Public Participation
2 – Planning Process – Documentation of the Planning Process
3a – Risk Assessment – Identifying Hazards
3b – Risk Assessment – Profiling Hazard Events
3c – Risk Assessment – Assessing Vulnerability: Identifying Assets
3d – Risk Assessment – Assessing Vulnerability: Estimating Potential Losses
3e – Risk Assessment – Assessing Vulnerability: Analyzing Development Trends
4a – Mitigation Strategy – Local Hazard Mitigation Goals
4b – Mitigation Strategy – Identification and Analysis of Mitigation Measures
4c – Mitigation Strategy – Implementation of Mitigation Measures
5a – Plan Maintenance Procedures – Monitoring, Evaluating, and Updating the Plan
5b – Plan Maintenance Procedures – Implementation through Existing Programs
5c – Plan Maintenance Procedures – Continued Public Involvement

3.3 STAKEHOLDER OUTREACH AND INVOLVEMENT

This section details the outreach to and involvement of the many agencies, departments, organizations, non-profits, districts, authorities, and other entities that have a stake in managing hazard risk and mitigation, commonly referred to as *stakeholders*.

Diligent efforts were made to assure 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 Steering and Planning Committees. Stakeholder outreach was performed early and throughout the planning process. This HMP update includes information and input provided by these stakeholders where appropriate, as identified in the references.

The following is a list of the various stakeholders that were invited to participate in the development of this plan, along with a summary of how these stakeholders participated and contributed. This summary discusses the various stakeholders that were invited to participate in the development of this HMP update and how they participated and contributed to the HMP. It should be noted that this summary listing cannot represent the sum total of stakeholders that were aware of and contributed to this HMP update, as outreach efforts were being made, both formally and informally, throughout the process by the many planning partners involved in the effort, and documentation of all such efforts is impossible. Instead, this summary is intended to demonstrate the scope and breadth of the stakeholder outreach efforts made during the plan update process.

3.3.1 Federal Agencies

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

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

- National Centers for Environmental Information (NCEI)
- National Hurricane Center (NHC)
- National Oceanic and Atmospheric Administration (NOAA)

- National Weather Service (NWS)
- Storm Prediction Center (SPC)
- U.S. Army Corps of Engineers (USACE)
- U.S. Census Bureau

3.3.2 State Agencies

NYS DHSES: Headquarters and Region II: Administered planning grant and facilitated FEMA review, provided updated planning guidance, attended meetings, presented at the Mitigation Strategy Workshop in January 2021, and provided review of draft and final HMP.

New York State Department of Environmental Conservation (NYSDEC): Provided data and information and supported the identification of mitigation projects, and supported the identification of high-hazard dams, in accordance with NYSDEC Dam Safety classifications and maintenance standards.

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.

The NYSDEC's Dam Safety Section is concerned with the protection of the health, safety and welfare of the people of the State of New York and the conservation and protection of its natural resources. The functions of the 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. 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 Chenango County.

3.3.3 Chenango County Departments

Several County departments were represented on the Steering Committee and involved in the HMP update planning process. Appendix B (Participation Matrix) provides further details regarding regional and local stakeholder agencies. All responses to the stakeholder surveys are in Appendix D (Public and Stakeholder Outreach).

Chenango County Bureau of Fire & Emergency Management

The Director of Emergency Management and Fire Coordinator, Matt Beckwith, served on the Steering Committee and provided information about County Critical Facilities, hazard risk, and County-wide mitigation projects. Chenango County Emergency Management manages the Hyper-Reach and Notify Chenango emergency notification systems, through which residents can receive emergency information regarding road closures and weather events via email, text message, or phone call. The Bureau also assists dam owners with the development of Emergency Action Plans (EAP) and keeps the EAPs and inundation maps on record for the County.

Chenango County Department of Public Works

The Director of Public Works, Shawn Fry, represented the Department on the Steering Committee, providing information about hazard risk and input on mitigation projects. The Chenango County DPW oversees the Highway Department, including highways and bridges, and snow and ice removal throughout the County.

Chenango County Soil & Water Conservation District

Representatives from the Chenango County SWCD, including the District Technician, Jennifer Kelly, and District Manager, Lance Lockwood, participated on the Steering Committee and provided information about hazard risk and mitigation projects for the County, as well as within specific jurisdictions.

Chenango County Division of Public Health – Fire and Building Code Enforcement

Steve Fox, the Chenango County Code Enforcement Officer, is the floodplain administrator (FPA) for the majority of municipalities within Chenango County. In addition to the FPA information provided for each jurisdiction, Mr. Fox served on the Steering Committee and provided additional data and information regarding hazard risk throughout the County.

Chenango County Information Technology

The Director of Information Technology, Herman Erickson, represented the department on the Steering Committee. In addition to attending meetings and providing data and information regarding hazard risk and mitigation projects, Mr. Erickson supported outreach postings on the County webpage and the development of the hazard mitigation website.

Commerce Chenango

Kerri Greene, President and CEO of Commerce Chenango, represented the agency on the Steering Committee, attending meetings, providing data and information regarding hazard risk and future developments and business outlooks, and supported the development of mitigation projects and initiatives for the County. Commerce Chenango also supports grant applications for development projects throughout the County.

3.3.4 Regional and Local Stakeholders

Appendix B (Participation Matrix) provides further details regarding regional and local stakeholder agencies. The stakeholders listed below were directly contacted by Chenango County to take a stakeholder survey, which included the identification of specific mitigation actions and projects and/or review of the draft HMP Invitations to complete the survey were sent via email in September 2020. Results of the surveys are in Appendix D (Public and Stakeholder Outreach). Feedback was reviewed by the Steering Committee and integrated where appropriate in the plan.

Academia

Many municipalities directly involved school district representatives in the planning process. All local school districts, as well as higher education and many technical/vocational institutions were provided the stakeholder survey. Responses were received from the following:

- Otselic Valley Central School
- Oxford Academy and Central School
- Unadilla Valley Central School District
- SUNY Morrisville Norwich Campus

Hospitals and Healthcare Facilities

The Chenango Memorial Hospital and Chenango Health Network were both contacted to provide input the planning process, specifically through the stakeholder survey.

Emergency Services

All state, county and local emergency service providers (police, fire, and EMS) were notified of the stakeholder survey and invited to provide input on the draft HMP. In addition, many of the participating municipalities had representatives from their emergency services providers representing them on the planning partnership. The following provided input to the planning process via the County online stakeholder survey:

- NYS DHSES - OEM

Utilities

Utilities serving the county were provided the stakeholder survey. No responses have been received to date.

Business and Commercial Interests

Businesses and commercial industries in Chenango County were notified of the stakeholder survey and invited to provide input on the draft HMP. The following provided input to the planning process via the county online stakeholder survey:

- Laral Management

Additional Stakeholders

Non-profit and regional organizations in Chenango County were notified of the stakeholder survey and invited to provide input on the draft HMP. The following provided input to the planning process via the county online stakeholder survey:

- Impact Project
- Chenango United Way
- Catholic Charities of Chenango County
- Southern Tier 8 Regional Board

3.3.5 Adjacent Counties

The following adjoining and nearby County representatives were contacted in September 2020 to inform them about the availability of the project website, draft plan documents and surveys, and invited to provide input to the planning process:

- Broome County (NY)
- Cortland County (NY)
- Delaware County (NY)
- Madison County (NY)
- Otsego County (NY)

Responses were received from Cortland County Planning Department, Delaware County Department of Planning & Watershed Affairs, Otsego County Emergency Services, and Madison County Office of Emergency Management.

3.3.6 Stakeholder and Neighboring County Survey Summaries

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

Stakeholder Survey

The stakeholder survey was designed to help identify general needs for hazard mitigation and resiliency within Chenango County from your perspective, as well as to identify specific projects that may be included in the mitigation plan. It was distributed to identified stakeholders, including the various county and municipal departments and agencies in the County. As of January 2021, 12 stakeholders completed the survey.

The Stakeholder Survey was broken down into four sections: Hazard and Damage Identification, Community Preparedness, Project Identification, and COVID-19, each detailed below. Survey results were shared with the Steering Committee and Planning Partnerships in scheduled meetings for consideration in the development of mitigation strategies.

Hazard and Damage Identification

A third of survey respondents (33.3%) indicated that buildings and facilities belonging to their organization have been impacted by a natural hazard, specifically by flooding, flash flooding, and snow events. All areas of the county, including school facilities and grounds, State Route 8, rural areas, agricultural lands, the valleys, and the railroads, were identified by stakeholders are vulnerable to flooding and other natural disasters. Chenango County incorporated this feedback into their mitigation strategy to relocate structures outside of the floodplain and initiatives to stabilize the streambanks of the Susquehanna River that are prone to erosion, flooding, and overtopping.

While not many facilities have been previously impacted by hazard events, half (50%) of respondents indicated that their facilities and transportation infrastructure are adequately prepared for withstanding natural disasters. Some respondents (42%) also indicated that their utility infrastructure and service were adequately equipped to withstand disasters and have the ability to provide interrupted service to the facilities, although washed out roads, as well as electrical outages pose a problem. Five respondents indicated that they were aware of the number and location of vulnerable populations in their community, and respondents from business and school representatives indicated a desire for additional information about these populations.

Community Preparedness

The majority of respondents (75%) believe that local public education and awareness programs are effective at informing residents about disasters and preparedness and reducing personal risk. Half (50%) of respondents think that the public, particularly vulnerable populations are aware of, understand, and take advantage of emergency warning systems, including the Hyper-Reach system.

> 75% of respondents believe that local public education and awareness programs are effective at informing residents about disasters, preparedness, and reducing personal risk.

Less than half (41.6%) of respondents believe that local government understand, support, and possesses adequate resources for hazard risk reduction efforts in their community, noting that more funding is needed to do so. For the majority of respondents (66.6%), private businesses play a direct role in daily operations throughout the year. The majority (74.9%) of respondent's organizations are part of, or have their own, Emergency Response Plan, with each organization having a direct role or responsibility within the plan. Only one responding organization is part of a Continuity of Operations Plan. Most (41.7%) are part of an Emergency Operations Plan.

Project Identification

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

- Refurbishing older facilities
- Flash flood mitigation planning, including drainage improvements to reduce flooding
- A Coordinated Housing Emergency Plan
- Enhanced community broadband access
- Adding generators to buildings to reduce electrical shut-downs.

The following were identified as recently implemented projects that reduced vulnerabilities to hazard events:

- Updating roof systems, HVAC systems, and utility infrastructure
- Improved cloud IT operations, providing laptops for employees and the use of cell phones
- Adding a new generator to power a building, and updating existing fuel tanks
- The creation of the Chenango County Assistance Response Team (CART).

COVID-19

Respondents were also asked to detail how their organization has been involved in response to the ongoing COVID-19 pandemic. Respondents detailed the following:

Chenango United Way raised over $102,000 for COVID-19 Response in the County

- Multiple respondents have been involved with county-wide food distribution, feeding and educating families, childcare, as well as providing emergency housing and utility assistance throughout the duration of the pandemic.
- Respondents also noted that they raised over $102,000 for COVID-19 response and relief, and others have helped coordinate delivery of over $70,000 worth of NYS agricultural products to bring fresh, local dairy and produce to Chenango County residents.
- Developing re-opening plans for schools and businesses
- Providing and sharing of resources, including drafting resiliency plans

Respondents also answered with the following about how they believed the COVID-19 pandemic will reshape their organization's practices and business framework:

- Multiple respondents noted the continued use of PPE (masks), remote/safe work and learning practices, limiting customer interactions, increased sanitation practices, and shifts in capabilities towards remote delivery.
- Responses from academia noted that COVID-19 has reshaped education, through technological challenges at home to virtual meetings in school buildings. Hand sanitizing and cleaning practices are emphasized using CDC and State guidelines. There is a greater emphasis on disease transmission and a consensus that there will be a lasting change in education. Scheduling for both students and families is also a challenge for schools.
- A response from Higher Education noted that the pandemic "will require the college to become active in seeking out resources available in the community while at the same time, the college providing resources as we are able to." It is also important to note that college students "deal with a multitude of

issues outside of their academic arena including access to secure housing, childcare, and employment" which has become increasingly difficult for some to access.
- Increases in security in buildings.

The following services and infrastructure needs were identified by respondents as needing to be built or improved upon within their communities in order to mitigate damages experienced by the pandemic:

- More walk-in clinics
- Large outdoor classrooms
- Redundant broadband infrastructure, expanding County IT services and cloud services
- Improved access to PPE, healthcare, food resources, childcare and remote learning centers
- Improved transportation systems, and coordinated community service efforts
- Increased services for ALICE (Asset Limited, Income Constrained, Employed) population

Respondents also identified the following challenges and obstacles their organization is facing due to the COVID-19 pandemic:

- Clear Messaging (54.5%)
- Contingency Plan or Back-up Plan for Staffing (45.5%)
- Availability of Cleaning Supplies (45.5%)
- Availability of PPE (45.5%)
- Receiving accurate information regarding the current situation and available resources (36.4%)
- Tracking Information (36.4%)

Neighboring County Survey

The neighboring county survey was sent via email in September 2020 to the surrounding counties of Chenango County due to their proximity to the County and due to the fact that effects of hazard events that impact Chenango County would be similar to that of their neighbors. As of January 2021, four counties completed the survey.

The Neighboring County Survey was broken down into five sections: Emergency Operations and Continuity of Operations Planning, Risk and Vulnerability, Evacuation and Sheltering, Information Sharing, and Projects, Grants, Education and Outreach, each detailed below.

Emergency Operations and Continuity of Operations Planning

All respondents indicated that Chenango County is not involved in their own county's comprehensive emergency operations, continuity of operations planning, nor are they involved in Chenango County's emergency operations planning or continuity of operations planning. Respondents did note, however, that there is an existing working relationship between all counties and Chenango County Emergency Management officials, and Emergency Services Coordinators and Emergency Response Departments.

Risk and Vulnerability

Two respondents indicated that their county would share risk and vulnerability assessments, including flood mapping, and HAZUS data, with Chenango County, if requested.

Evacuation and Sheltering

Respondents indicated that there are no existing collaborations with Chenango County on establishing evacuation routes and alternative evacuation routes. Respondents did however, indicate that if collaboration would take place on evacuation decisions that would impact one another, including significant evacuations into other counties. This has not been an issue in the past, but respondents would be open to collaborating before making evacuation decisions if necessary. Respondents also indicated that there has been no collaboration on establishing cross-county shelters, but would be open to if necessary and appropriate, based on location, particularly in bordering municipalities.

Information Sharing

Respondents indicated that they have access to contact information for Chenango County Emergency Operations Centers and that working relationships with the Emergency Management Offices is established. While information regarding mitigation planning is not shared across counties, appropriate coordination for eligible projects, including joint mitigation projects, could be a possibility in the future.

Projects, Grants, Education and Outreach

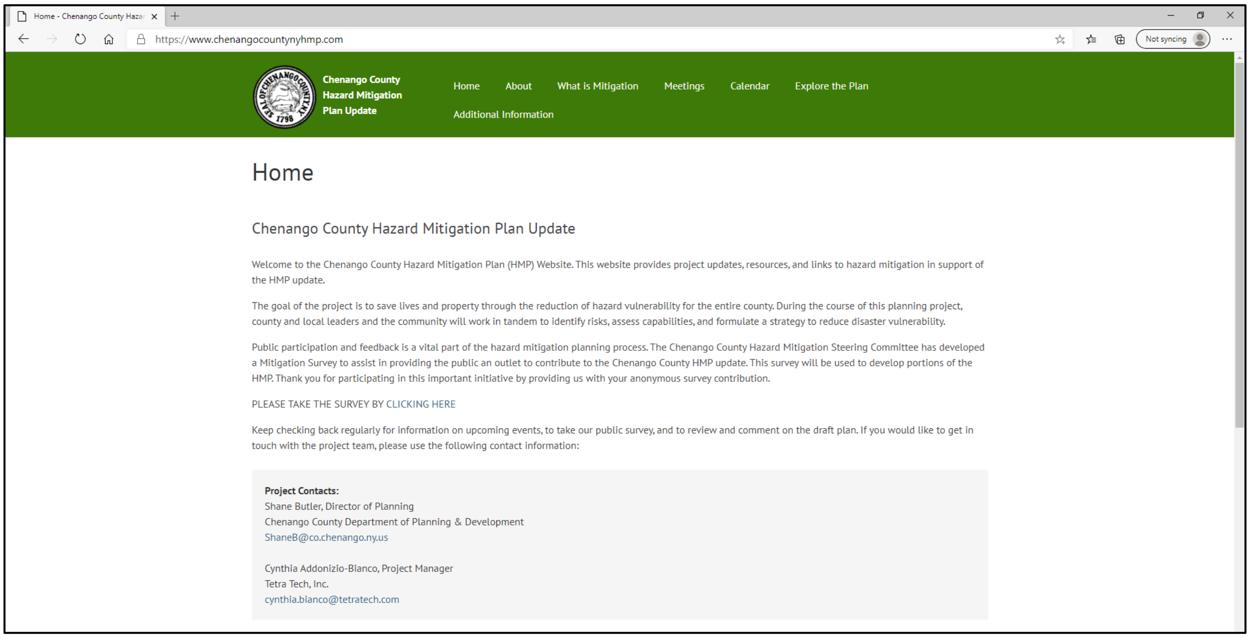
Respondents did not identify any projects as requiring cross-collaboration between county boundaries and were unaware of any mutual aid agreements between their own and Chenango County.

3.3.7 Public Outreach

The Steering Committee and Planning Committee have made the following efforts toward public participation in the development and review of the HMP:

- A public project website was developed and is being maintained to facilitate communication between the Steering Committee, planning partnership, public and stakeholders (https://www.chenangocountynyhmp.com). The website contains a project overview, county and local contact information, access to the citizen's survey and various stakeholder surveys, mitigation information, the project calendar, and sections of the HMP for public review and comment. Figure 3-1 is a screenshot of the Chenango County Hazard Mitigation Page as of November 2020.
- The County's Hazard Mitigation Plan website, developed for the 2014 planning process, has been maintained and updated for the 2020 plan update process. The public website contains a project overview, County and local contact information, access to the citizen's survey and various stakeholder surveys, and draft sections of the HMP for public review and comment.

Figure 3-1. Chenango County HMP Webpage



- All hazard mitigation planning meetings that were open to the public were advertised on the Chenango County HMP website.

- The public was further informed of the hazard mitigation planning effort through press releases, news articles, and public service announcements released throughout the planning process. The Evening Sun ran articles on the project on August 25, 2020 (see Appendix D), which included the link to the project webpage.

- An on-line natural hazards preparedness citizen survey was developed to gauge household preparedness that may impact Chenango County and to assess the level of knowledge of tools and techniques to assist in reducing risk and loss of those hazards (see Appendix D). The questionnaire asked quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs.

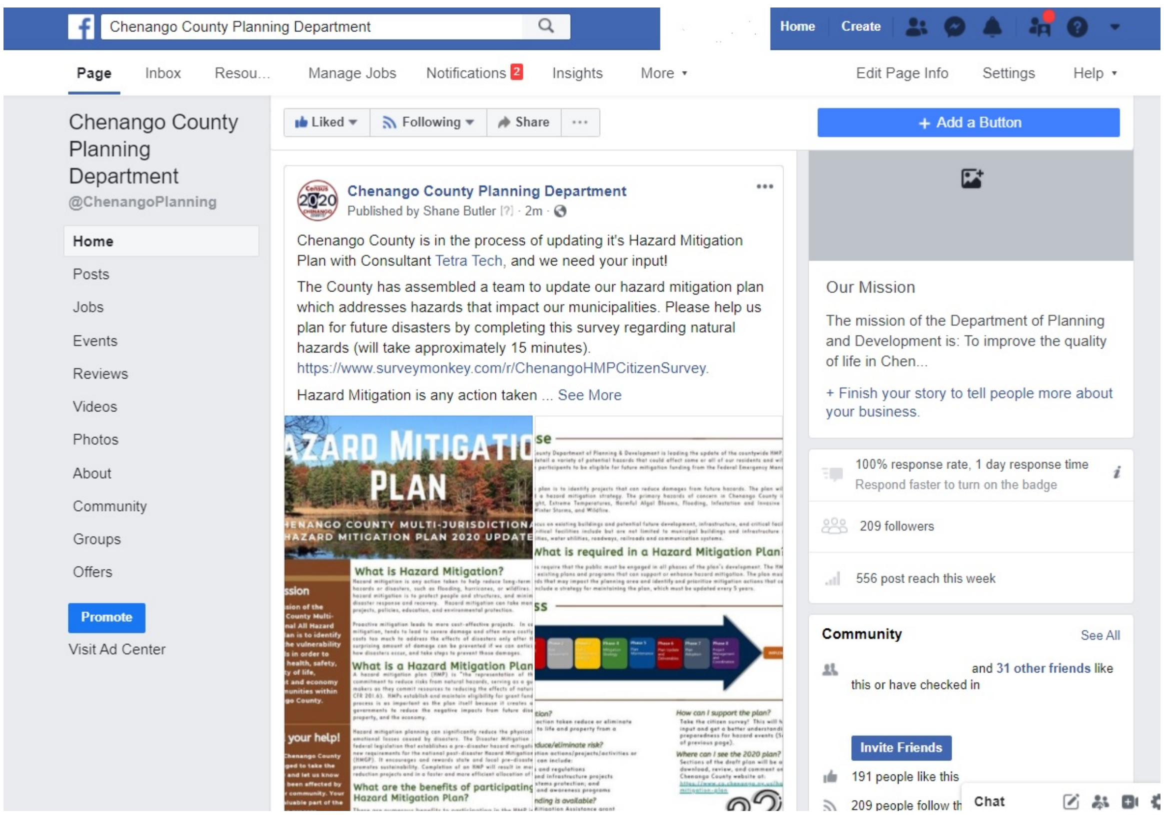
  The questionnaire was opened to the public on August 10, 2020, with direct links through the HMP website and through a banner on the Chenango County homepage. All participating municipalities have been requested to advertise the availability of the survey via local homepage links, and other available public announcement methods (e.g. Facebook, Twitter, email blasts, etc.) As of February 2021, 185 Chenango County residents completed the survey. A summary of survey results is provided below in section 3.3.3, with full results located in Appendix D of this plan.

  To incorporate this public input, plan participants were provided with summary survey results throughout the planning process. Further, as respondents provided specific input through "open-ended" questions, that input was forwarded directly to the appropriate jurisdictional Point-Of-Contact for action.

- Directed response surveys were distributed to Academia, Fire Departments, Emergency Medical Services (EMS), Hospitals and Healthcare Organizations, Utilities, Business and Commercial interests, and Law Enforcement stakeholders as detailed in the Stakeholder Outreach subsection of this chapter. A summary of survey results is provided above in Section 3.3.1, with full results located in Appendix D of this plan.

- In order to facilitate coordination and communication between the Planning Committee and citizens and further involve the public in the planning process, the draft Plan was made available to the public through a variety of venues, including the project website. A printed version of the Plan will be maintained at the Chenango County Department of Planning and Development.
- Sections of the 2021 Update of the HMP, as available, have been posted to the public website since February 2021 for public review. The complete 2021 Update draft was posted on April 9, 2021, including all draft municipal annexes. This was an opportunity for public comment on the draft plan update before it went under review by NYS DHSES and FEMA Region II. All public comments were directed to the Chenango County Department of Planning and Development for collection and review by the Planning Committee. Any public comments received have been incorporated into the final plan as appropriate.

Figure 3-2. Chenango County Planning Department Facebook Post



3.3.8 Citizen Survey Summary

Those that live and work in Chenango County were given the opportunity to be involved in the planning process. One opportunity was the citizen survey. As stated above, the survey was developed to assess the level of knowledge of tools and techniques to assist in reducing risk and loss of those hazards. It asked quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. The County advertised the survey on their website

> Nearly 80% of respondents receive news and information about Chenango County through Facebook.

and social media accounts. As of February 2021, the survey received 185 responses.

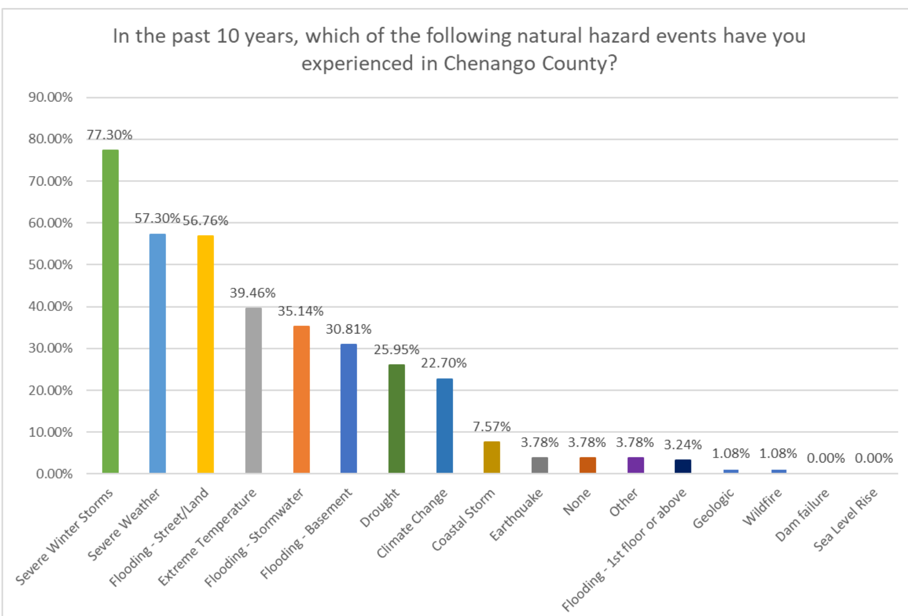
Demographically, survey respondents were from 26 municipalities within Chenango County, the majority (62.94%) have lived in the county for 20 years or more, and nearly all (92.36%) own their own home. Over half (57.75%) of respondents self-identified as being over the age of 61. The majority (79.86%) of respondents receive general news and information about Chenango County through Facebook, or Local News (75.69%). Over half of respondents (54.86%) receive information through email and/or text messages, while only a quarter (24.31%) indicated that they receive community and weather alerts through Hyper-Reach.

Survey respondents identified the following as the top 5 most frequently occurring natural hazard events within Chenango County in the past 10 years, as shown in Figure 3-3:

> The highest hazards of concern (>50% of respondents reporting concerned, very concerned, or extremely concerned) include: Severe Winter Storms, Severe Storms, Extreme Temperatures, Climate Change, and Stormwater Flooding.

- Severe Winter Storms – blizzard, heavy snow, ice (77.30%)
- Severe Weather – thunderstorms, tornadoes, hail (57.30%)
- Flooding – street/land (56.76%)
- Extreme Temperature – heat and cold (39.46%)
- Flooding – stormwater (35.14%)

Figure 3-3. Most frequently occurring natural hazard events in Chenango County



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

- Enhance stream maintenance programs/projects (61.11%)
- Retrofit infrastructure, such as elevating roadways and improving drainage systems (60.42%)
- Work on improving the damage resistance of utilities (electricity, communications, water/wastewater facilities etc.) (54.17%)
- Assist vulnerable property owners with securing funding to mitigate their properties (41.67%)

- Inform property owners of ways they can mitigate damage to their properties (40.28%)

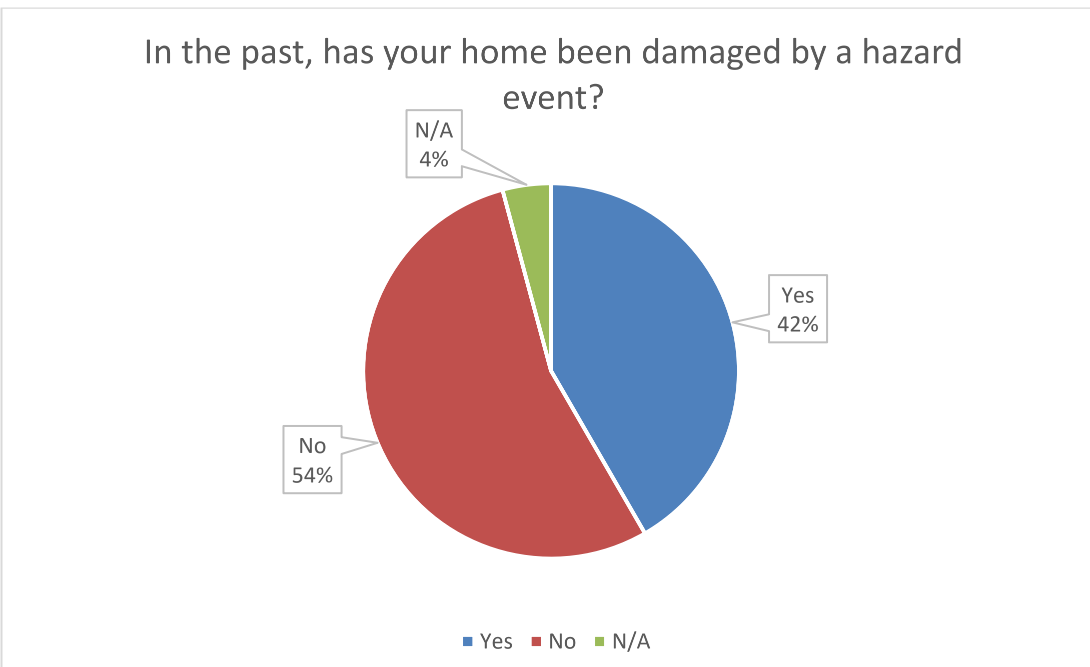
In terms of personal preparedness, nearly half (48.91%) of respondents indicated that their household would only be "somewhat prepared" to get along without electricity or natural gas for up to five days. Respondents also indicated their households having taken the following steps to prepare for hazard events:

- Installed smoke detectors on each level of home (89.13%)
- Stored flashlights and batteries (77.72%)
- Stored a fire extinguisher (67.93%)
- Stored medical supplies (60.33%)
- Stored food and water (54.35%)
- Identified utility shutoffs (52.26%)
- Registered to receive emergency alerts (48.37%)

Personal Preparedness for Chenango County residents includes storage of supplies, identifying utility shutoffs, and receiving emergency alerts.

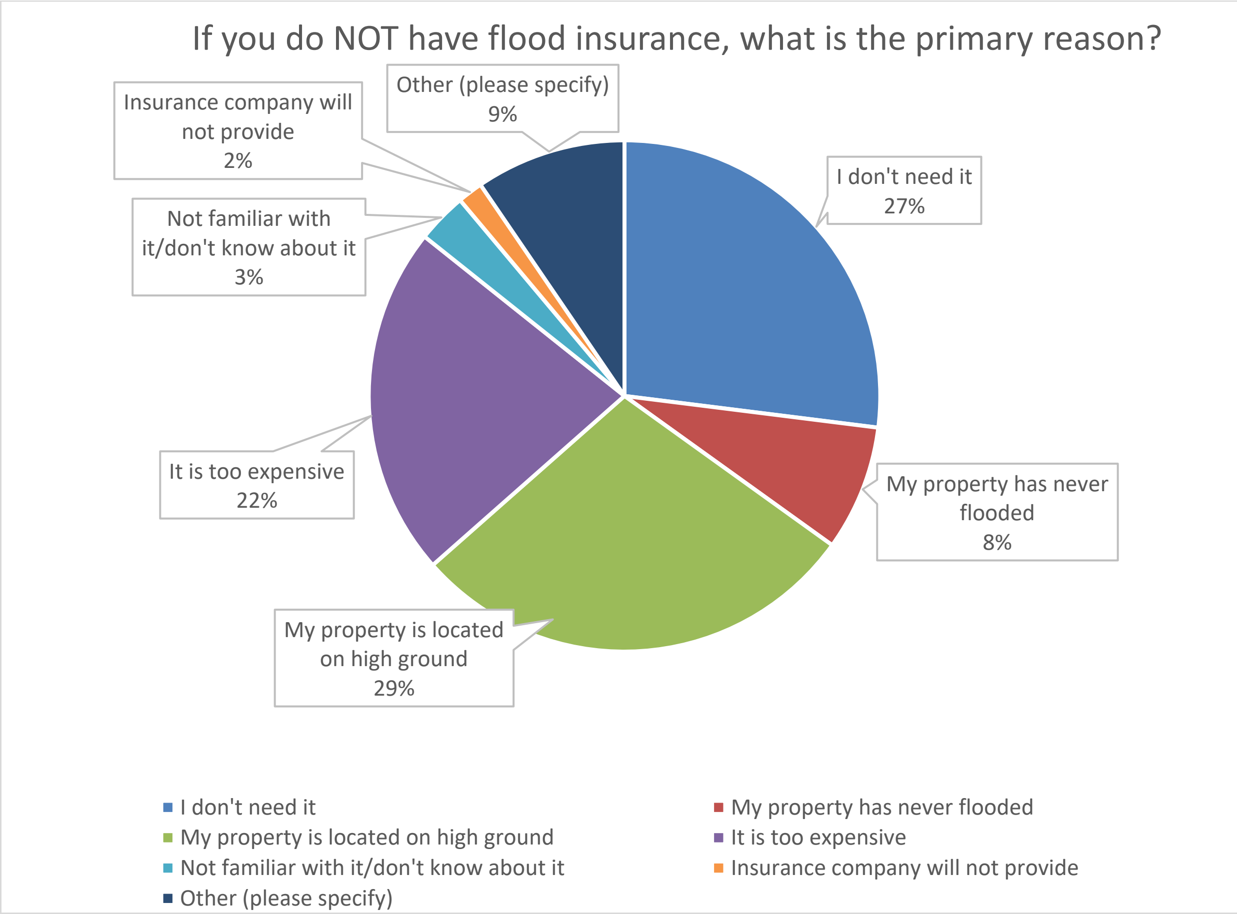
Respondents were also asked if their homes had ever been damaged by a hazard event in the past. Of the 48 respondents who answered this question, over half (54.17%) indicated "no" damages. Of those that did report damages, the most common responses included flooded basements, flood damages to water heaters and replacement costs, frozen water lines, and roof damages from falling trees.

Figure 3-4. Percent of respondents' homes damaged by hazard events



Respondents were also asked about their property's location within the floodplain, and if they have flood insurance. Of the 48 respondents who answered this series of questions, only 7 (14.58%) indicated that their property is located in a designated floodplain. Of those, only 3 respondents (7.32%) indicated that their home is covered by flood insurance. Reasons respondents gave for not having flood insurance include not needing it (39.53%), expensive costs (32.56%), or their property being located on high ground (41.86%). Responses to this question are shown below in Figure 3-5. Of those that responded "Other," responses include cost and being unable to afford flood insurance, statements that flood insurance is not required for their property, or respondents that were unsure if they had flood insurance or not.

Figure 3-5. Reasons given by respondents who do not have flood insurance



About half (45.04%) of respondents felt that their municipality was doing "enough" towards flood prevention and mitigation, or prevention and mitigation from other hazards. The most self-selected jurisdictions respondents indicated that they live in, include the Town of Norwich, City of Norwich, Town of Plymouth, Town of Coventry, and Village of Greene. Municipality-specific responses can be found in Section 9 (Jurisdictional Annexes).

Less than half (45%) of respondents believe that their municipality is doing "enough" towards flood prevention and mitigation from other hazards.

Refer to Appendix D (Public and Stakeholder Outreach) for the full list of survey questions and responses.

3.3.9 Draft Review Public Feedback

Chenango County provided a wide variety of social media outreach on the draft plan review including announcements on the County website, Facebook, and other formats. Chenango County staff further discussed the mitigation plan update process with members of communities county-wide as well as a broad range of stakeholders.

During the 30-day public review period, comments and feedback was received from members of the public and/or stakeholders. Each comment was reviewed by the Chenango County Department of Planning and Development and the consultant to determine how best to incorporate the comments into the plan. As a result of the feedback, additional information was included in Volume 1 sections to clarify hazard characteristics and impacts, and additional projects were included in municipal annexes.

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

The Chenango County HMP update strives to use 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.

The asset and inventory data used for the risk and vulnerability assessments are presented in the County Profile (Section 4). 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 5), specifically within Section 5.3 (Data and Methodology), as well as throughout the hazard profiles in Section 5.4 (Hazard Profiles). Further, the source of technical data and information used can be found within the References Section.

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 updating the inventory of their Planning and Regulatory capabilities in Section 9 (Capability Assessment of each jurisdictional annex) and 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 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
- Emergency Action Plans
- New York State Standard Multi-Hazard Mitigation Plan, 2019

A partial listing of the plans, reports, and technical documents reviewed in the preparation of this plan is included in Table 3-5. Refer to Appendix G (Plan Review Tools) for a detailed review of all plans listed below.

Table 3-5. Record Review (Municipalities) - Record of the review of existing programs, policies, and technical documents for participating jurisdictions (all)

Existing plan, program or technical documents	Date	Jurisdictional Applicability
Economic Development Strategic Plan	2006	Chenango County
Flood Insurance Study	2010	Chenango County
Agriculture and Farmland Protection Plan	August 2012	Chenango County
Recycling Agricultural Plastics Project	March 2013	Chenango County
Fair Housing Plan	July 2018	Chenango County
2020 Vision Report	January 1992	Chenango County
Comprehensive Plan	January 2016	Chenango County
Coordinated Transportation Plan	December 9, 2019	Chenango County
Mandatory Routing of All Wireless 911 Calls	July 22, 1999	Chenango County
Emergency Action Plan – Balsam Swamp Dam	September 2019	Chenango County and McDonough (T)
Emergency Action Plan – Glenn Lake Dam	November 29, 2012	Chenango County and Norwich (T)
Emergency Action Plan – Guilford Lake Dam	September 8, 2011	Chenango County and Guilford (T)
Emergency Action Plan – Long Pond Dam	March 2019	Chenango County and Smithville (T)
Emergency Action Plan – Mill Brook Dam	April 18, 2012	Chenango County and New Berlin (T)
Emergency Action Plan – Peckham Dam	August 24, 2010	Chenango County and Bainbridge (T)
New York State Inventory of Dams	February 2021	Countywide
Flood Damage Prevention Law	2010	Afton, Town of
Site Plan Review	2002	Afton, Town of
Strategic Plan	May 2018	Afton, Village of
Waterfront Revitalization Plan	March 2018	Afton, Village of
Flood Damage Prevention Law	2010	Afton, Village of
Subdivision Regulations	1998	Bainbridge, Town of
Site Plan Review Law	1998	Bainbridge, Town of
Flood Damage Prevention Law	November 7, 2014	Bainbridge, Town of
Comprehensive Plan	2015	Bainbridge, Village of
Subdivision of Land	2019	Bainbridge, Village of
Flood Damage Prevention Law	2010	Bainbridge, Village of
Planning Board Town Survey	2005	Columbus, Town of
Comprehensive Plan	February 8, 2007	Columbus, Town of
Site Plan Review Law	2014	Columbus, Town of
Building Code	1987	Columbus, Town of
Flood Damage Prevention Law	1989	Columbus, Town of
Salvage Yard Regulation	1966	Columbus, Town of

Existing plan, program or technical documents	Date	Jurisdictional Applicability
Right to Farm Law	1990	Columbus, Town of
Subdivision of Land	2020	Columbus, Town of
Road Preservation Law	2012	Columbus, Town of
Wind Power Facilities Law	2015	Columbus, Town of
Right to Farm Law	2009	Coventry, Town of
Flood Damage Prevention Law	2010	Coventry, Town of
Site Plan Review	2019	Coventry, Town of
Comprehensive Plan	November 2016	Greene, Town of
Puckett Solar Project Plan	2019	Greene, Town of
Wind Energy Facility Law	2010	Greene, Town of
Flood Damage Prevention Law	2010	Greene, Town of
Siting of Solar Energy Installations	June 28, 2018	Greene, Town of
Flood Damage Prevention Law	2010	Greene, Village of
Comprehensive Plan	December 2014	Guilford, Town of
Comprehensive Plan Update	April 2019	Guilford, Town of
Environmental Review of Actions	1979	Guilford, Town of
Flood Damage Prevention Law	2010	Guilford, Town of
Renewable Energy Systems Law	2019	Guilford, Town of
Right to Farm Law	2019	Guilford, Town of
Subdivision of Land	2015	Guilford, Town of
Flood Damage Prevention Law	September 3, 2010	Lincklaen, Town of
Junk Law	2018	Lincklaen, Town of
Road Preservation Law	2009	McDonough, Town of
Comprehensive Emergency Management Plan	July 2008	New Berlin, Town of
Right to Farm Law	1990	New Berlin, Town of
Subdivision of Land	1990	New Berlin, Town of
Water District Regulations	1994	New Berlin, Town of
Site Plan Review	2000	New Berlin, Town of
Flood Damage Prevention Law	2010	New Berlin, Town of
Fire Prevention and Building Code	2006	New Berlin, Town of
Flood Damage Prevention Law	October 26, 2010	New Berlin, Village of
Mill Brook Site 1 Dam Inundation Map	February 2012	New Berlin, Village of and Chenango County
Flood Damage Prevention Law	2010	North Norwich, Town of
Comprehensive Plan	May 20, 2014	Norwich, City of
Brownfield Opportunity Area Revitalization Plan	January 2018	Norwich, City of
Zoning Regulations	1997	Norwich, City of
Flood Damage Prevention Law	2010	Norwich, City of
Freshwater Wetlands	1976	Norwich, City of
Subdivision of Land	1962	Norwich, City of
Business Improvement District Plan	September 2005	Norwich, City of
Reservoir 1 and 2 Inundation Map – Sunny Day Scenario	July 2021	Norwich, City of and Chenango County

Existing plan, program or technical documents	Date	Jurisdictional Applicability
Subdivision Regulations	2006	Norwich, Town of
Renewable Energy Systems Law	2020	Norwich, Town of
Flood Damage Prevention Law	2010	Norwich, Town of
Abandoned Vehicles, Junked Vehicles and Vehicles Obstructing Traffic in an Emergency	November 20, 2018	Norwich, Town of
Flood Damage Prevention Law	2010	Otselic, Town of
Subdivision Regulations	2007	Oxford, Town of
Zoning Ordinance	2015	Oxford, Town of
Flood Damage Prevention Law	2010	Oxford, Town of
Vision Plan	2012	Oxford, Town of & Oxford, Village of
Clarks Creek Dam Inundation Map	February 2012	Oxford, Town of; Oxford, Village of; and Chenango County
Flood Damage Prevention Law	2010	Oxford, Village of
Subdivision of Land	1969	Oxford, Village of
Zoning Regulations	1973	Oxford, Village of
Flood Damage Prevention Law	2010	Pharsalia, Town of
Subdivision Regulations	1989	Pitcher, Town of
Flood Damage Prevention Law	2010	Pitcher, Town of
Junk Storage Law	2004	Preston, Town of
Flood Damage Prevention Law	2010	Preston, Town of
Flood Damage Prevention Law	2013	Sherburne, Town of
Site Plan Review	2017	Sherburne, Town of
Flood Damage Prevention Law	2010	Sherburne, Village of
Site Plan Review	2015	Smithville, Town of
Junk Law	1968	Smithville, Town of
Comprehensive Plan	2017	Smithville, Town of
Environmental Quality Review Act	1981	Smithville, Town of
Flood Damage Prevention Law	2010	Smithville, Town of
Right to Farm Law	2019	Smithville, Town of
Subdivision Regulations	1990	Smithville, Town of
Genegantslet Creek 2A Dam Inundation Map	2012	Smithville, Town of and Chenango County
Flood Damage Prevention Law	2010	Smyrna, Town of
Subdivision Regulations	2007	Smyrna, Town of
Flood Damage Prevention Law	2010	Smyrna, Village of

3.5 INTEGRATION WITH EXISTING PLANNING MECHANISMS AND PROGRAMS

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

The *Capability Assessment* section of Section 6 (Mitigation Strategy) 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, the county and each participating jurisdiction identified how they integrated 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).

3.6 CONTINUED PUBLIC INVOLVEMENT

Chenango 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 https://www.chenangocountynyhmp.com/ and municipalities will be encouraged to maintain links to the plan website. Further, the county will make hard copies of the HMP available for review at public locations as identified on the website.

Each jurisdiction's governing body shall be responsible for receiving, tracking, and filing public comments regarding this plan.

The public will have an opportunity to comment on the plan as a part of the annual mitigation planning evaluation process and the next five-year mitigation plan update. The HMP Coordinator is responsible for coordinating the plan evaluation portion of the meeting, soliciting feedback, collecting and reviewing the comments, and ensuring their incorporation in the five-year plan update as appropriate; however, members of the Planning Committee will assist the HMP Coordinator. Additional meetings may be held as deemed necessary by the Planning Committee. The purpose of these meetings would be to provide the public an opportunity to express concerns, opinions, and ideas about the plan.

Further details regarding continued public involvement are provided in Section 7 (Plan Maintenance).

After completion of this plan, implementation and ongoing maintenance will continue to be a function of the Planning Committee. The Planning Committee will review the plan and accept public comment as part of an annual review and as part of five-year mitigation plan updates.

A notice regarding annual updates of the plan and the location of plan copies will be publicized annually after the HMP Committee's annual evaluation and posted on the public web site.

Shane Butler is identified as the Chenango County HMP Coordinator in Section 7 (Plan Maintenance), and is responsible for receiving, tracking, and filing public comments regarding this plan. Contact information is:

Shane H. Butler, Director of Planning
Chenango County Department of Planning and Development
5 Court Street, Norwich, NY 13815
(607) 337-1640
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SECTION 4 COUNTY PROFILE

This profile provides general information for Chenango County's physical setting, population and demographics, general building stock, land use and population trends, and critical facilities located within the county. Analyzing this information leads to an enhanced understanding of the study area. The economic, structural, and demographic contexts can be related to hazards analyzed later in this plan.

4.1 GENERAL INFORMATION

Chenango is a word from Oneida tribal language name meaning "pleasant river flowing through the land of the bull thistle". Chenango County was named after the Chenango River, which runs through the County (McFee, 2000). This largely rural and wooded county is located within the "Southern Tier Region" of New York State and was established on March 15, 1798, which included all of Madison County and Chenango County (Chenango County Visitors Guide, 2005, NYGenWeb, 2007). Today's boundaries were established on March 21, 1806 (Sullivan, 1927). According to the American Community Survey, the 2018 estimated population for Chenango County is 48,348 (U.S. Census, 2018).

Currently, Chenango County comprises 899 square miles and includes numerous state forests, rural landscapes, residential areas, business districts, over 103,000 acres of agricultural land, four rivers, various transportation systems, natural features, over 112,700 acres of forested land, and educational facilities (Draft Chenango Comprehensive Plan, 2013). This combination of natural and developed features lays the foundation for Chenango County's vulnerability to natural hazards, both in terms of exposure to a hazard event and the potential impact of hazard events.

Chenango County is comprised of 21 towns, 8 villages, and 1 city as described in the table below.

Towns		Villages	City
Afton	Norwich	Afton	Norwich
Bainbridge	Otselic	Bainbridge	
Columbus	Oxford	Earlville*	
Coventry	Pharsalia	Greene	
German	Pitcher	New Berlin	
Greene	Plymouth	Oxford	
Guilford	Preston	Sherburne	
Lincklaen	Sherburne	Smyrna	
McDonough	Smithville		
New Berlin	Smyrna		
North Norwich			

*Note: * Earlville is located in both Chenango and Madison Counties*

4.2 MAJOR PAST HAZARD EVENTS

Presidential disaster declarations are usually issued for hazard events that cause more damage than local and state governments can handle without federal government assistance, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration puts federal recovery programs into motion to assist disaster victims, businesses and public entities. Some programs are matched by state programs. Review of presidential disaster declarations helps establish the probability of reoccurrence for each hazard and identify targets for risk reduction. Table 4-1 shows FEMA disaster declarations that included Chenango County through 2020 (records date back to 1954).

Table 4-1. History of Hazard Events in Chenango County, New York

Disaster Number	Event Date	Declaration Date	Incident Type	Title
DR-4480	January 20, 2020 – Ongoing	3/20/2020	Biological	COVID-19 Pandemic
EM-3434	January 20, 2020 – Ongoing	3/13/2020	Biological	COVID-19
DR-4472	October 31 – November 1, 2019	12/19/2019	Severe Storm(s)	Severe Storms, Straight-Line Winds, and Flooding
DR-4397	August 13 – August 15, 2018	10/1/2018	Flood	Severe Storms and Flooding
DR-4322	March 14 – March 15, 2017	7/12/2017	Snow	Severe Winter Storm and Snowstorms
DR-4129	June 26 – July 10, 2013	7/12/2013	Flood	Severe Storms and Flooding
EM-3351	October 27 – November 8, 2012	10/28/2012	Hurricane	Hurricane Sandy
DR-4031	September 7 – September 11, 2011	9/13/2011	Severe Storm(s)	Remnants of Tropical Storm Lee
EM-3341	September 7 – September 11, 2011	9/8/2011	Severe Storm(s)	Remnants of Tropical Storm Lee
DR-1993	April 26 – May 8, 2011	6/10/2011	Flood	Severe Storms, Flooding, Tornadoes, and Straight-Line Winds
DR-1857	August 8 – August 10, 2009	9/1/2009	Severe Storm(s)	Severe Storms and Flooding
EM-3299	December 11 – December 31, 2008	12/18/2008	Severe Storm(s)	Severe Winter Storm
DR-1670	November 16 – November 17, 2006	12/12/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1650	June 26 – July 10, 2006	7/1/2006	Severe Storm(s)	Severe Storms and Flooding
EM-3262	August 29 – October 1, 2005	9/30/2005	Hurricane	Hurricane Katrina Evacuation
DR-1589	April 2 – April 4, 2005	4/19/2005	Severe Storm(s)	Severe Storms and Flooding
DR-1565	September 16 – September 24, 2004	10/1/2004	Severe Storm(s)	Tropical Depression Ivan
DR-1534	May 13 – June 17, 2004	8/3/2004	Severe Storm(s)	Severe Storms and Flooding
EM-3186	August 14 – August 16, 2003	8/23/2003	Other	Power Outage
DR-1467	April 3 – April 5, 2003	5/12/2003	Severe Ice Storm	Ice Storm
EM-3184	February 17 – February 18, 2003	3/27/2003	Snow	Snow
EM-3173	December 25 – January 4, 2002	2/25/2003	Snow	Snowstorms
DR-1391	11-Sep-01	9/11/2001	Fire	Fires and Explosions
EM-3155	May 22 – November 1, 2000	10/11/2000	Other	West Nile Virus
DR-1335	May 3 – August 12, 2000	7/21/2000	Severe Storm(s)	Severe Storms and Flooding
DR-1222	May 31 – June 2, 1998	6/16/1998	Severe Storm(s)	Severe Storms and Tornadoes
DR-1095	January 19 – January 30, 1996	1/24/1996	Flood	Severe Storms and Flooding
EM-3107	March 13 – March 17, 1993	3/17/1993	Snow	Severe Blizzard
DR-338	June 23, 1972	6/23/1972	Flood	Tropical Storm Agnes

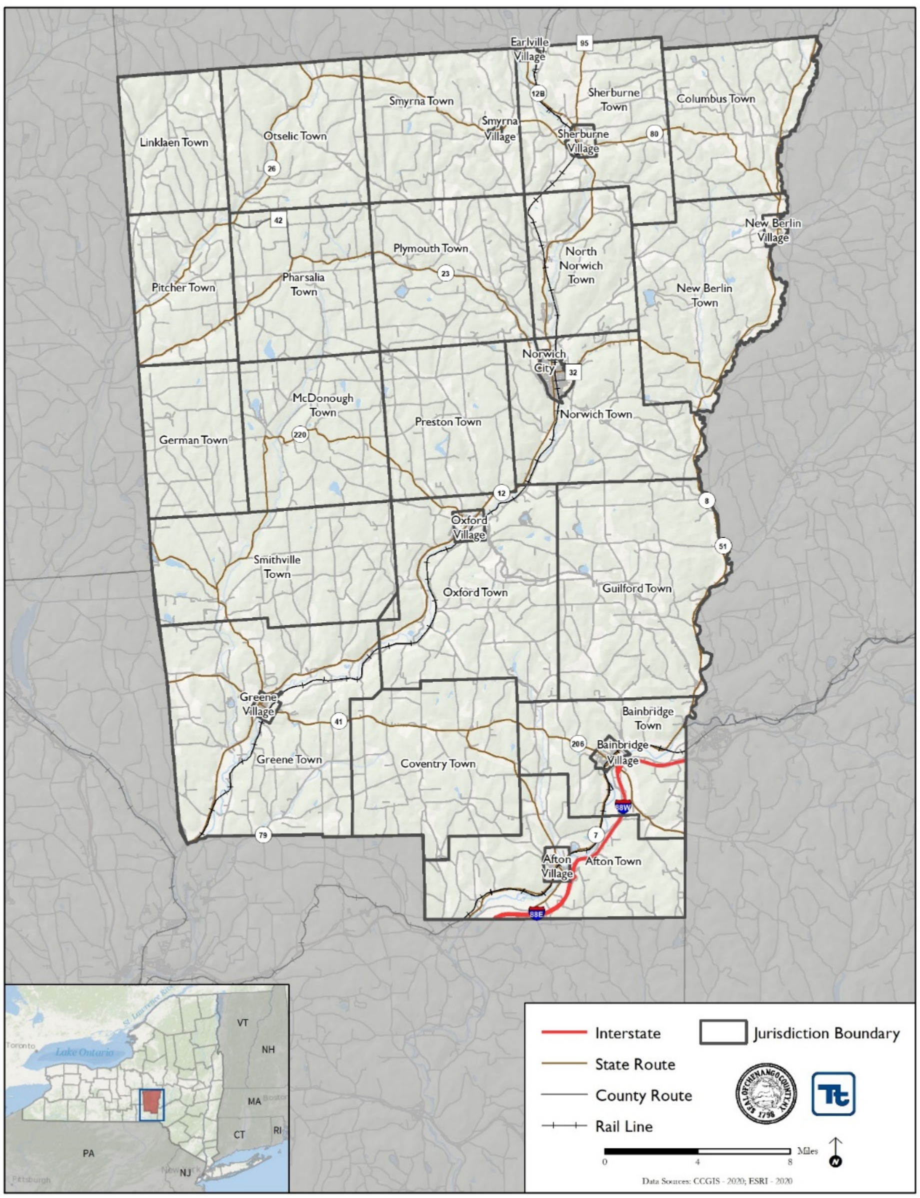
4.3 PHYSICAL SETTING

This section presents the physical setting of the county, including location, hydrography and hydrology, topography and geology, climate, and land use/land cover.

4.3.1 Location

Chenango County lies on the northern edge of the Southern Tier Region of New York State, approximately 50 miles southeast of Syracuse. Chenango County has an area of approximately 903 total square miles (Draft Chenango County 2016). The County is bordered by Madison County to the north, Otsego and Delaware Counties to the east, Broome County to the south, and Cortland County to the west. Chenango County itself is divided into 21 towns, 8 villages, and 1 city (Figure 4-1).

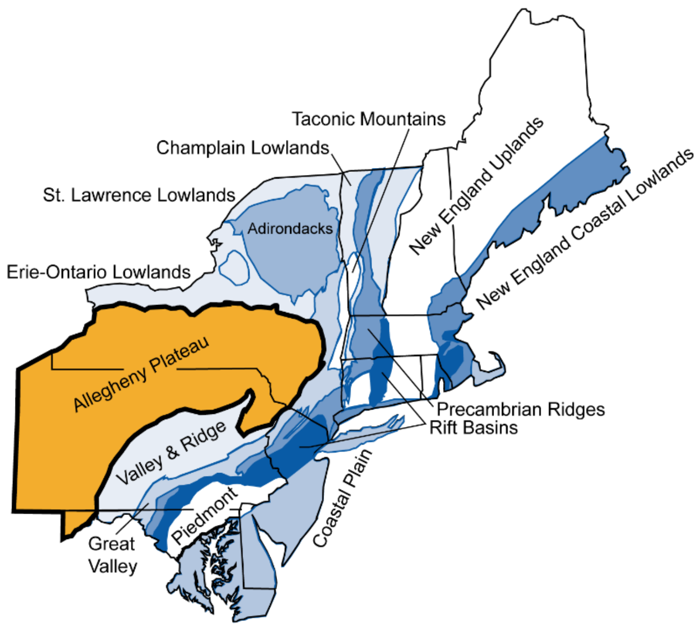
Figure 4-1. Location of Chenango County, New York



4.3.2 Topography and Geology

Chenango County is located within the Alleghany Plateau which extends from the southern tier of New York State through Pennsylvania and Maryland to Alabama. The area was once flat, like a typical plateau, but it uplifted 400 million years ago and is now deeply dissected by streams, making the area hilly, and in some places mountainous (Paleontological Research Institution, 2020). The Plateau is mainly covered by hardwood forests, bounded by the Catskill and Appalachian Mountain ranges.

Chenango County is hilly with many creeks and streams; hills lay in parallel ridges running from the northern section to the southern section of the county (Bainbridge Chamber of Commerce 2006). Elevations within Chenango county average around 900-1,000 feet above seal level, with upland areas reaching 1,500 feet or more. The highest point in Chenango County is approximately 2,000 feet above sea level, just west of the City of Norwich. The lowest point in the Chenango Valley is near the Chenango River in Greene (Chenango County 2016). The majority of land area within Chenango Coutny lies within the 3-8% slope, or 8-15% slope categories, which determines the land use and settlement patterns of the county as well as natural drainage and run-off patterns.



Source: Palentological Research Institution, 2020

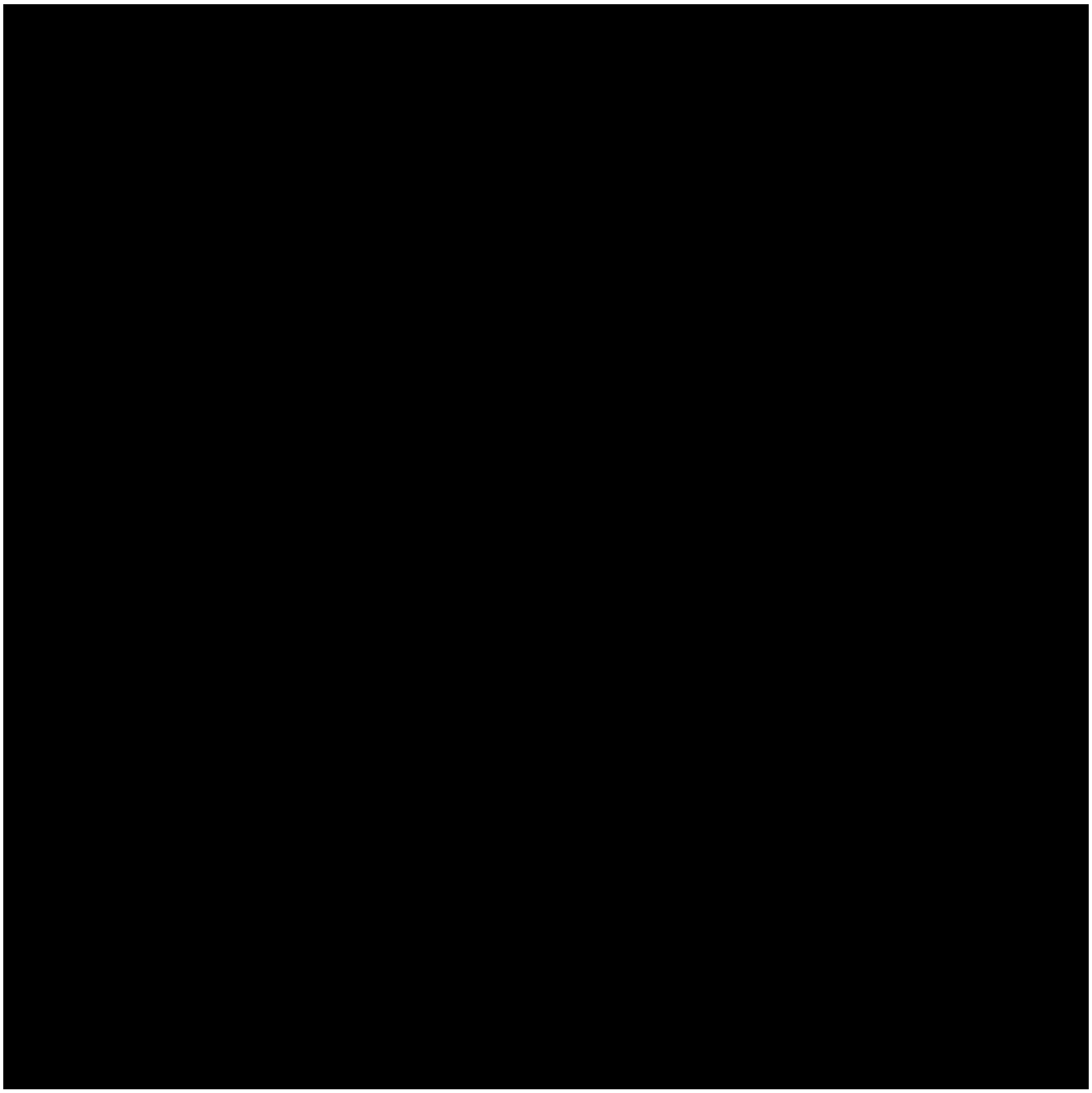
4.3.3 Hydrography and Hydrology

Chenango County lies almost entirely within the Upper Susquehanna Subbasin of the Susquehanna River Basin (Figure 4-2). The Susquehanna River Basin, comprised of six major subbasins, drains more than 27,500 square miles, including half the land area of Pennsylvania and portions of New York and Maryland, and is considered one of the most flood prone areas in the country. The drainage area for the Upper Susquehanna Subbasin is approximately 4,944 square miles. The area of the Upper Susquehanna Subbasin is mainly sloped steeply with hills and ridges and dominated by forest land; agricultural areas are found in the areas that are less steep. The three major tributaries for this Subbasin are the Chenango, Tioughnioga, and Unadilla Rivers (Susquehanna River Basin Commission [SRBC] 2006).

The major rivers of Chenango County include the Otselic, Susquehanna, Unadilla, and the Chenango Rivers. The Otselic River extends from the north to southwest and eventually joins with the Tioughnioga River, located in Broome County. The Susquehanna River is extends from the north to south, and is located in the southeast corner of Chenango County. The Susquehanna River joins with the Unadilla River in Sidney and the Chenango River in Binghamton. The Chenango River is centrally located in the county and is a tributary of the Susquehanna River. The Unadilla River flows south along the eastern border of Chenango County and into the Susquehanna River.

The major creeks within Chenango County include the Genegantslet, Canasawacta, Oquaga Creeks and Kelsey Brook. The Genegantslet Creek extends from the north to south and eventually joins with the Chenango River. The Canasawacta Creek is centrally located, and extends to the southeast before flowing into the Chenango River. The Oquaga Creek is located in the southeast corner of the county in Afton, and flows southeast into the Cannonsville Reservoir, located in Delaware County. Kelsey Brook flows south out of the Town of Oxford through the Towns of Afton and Bainbridge.

Figure 4-2. Upper Susquehanna Subbasin



4.3.4 Climate

The climate of New York State is very similar to most of the Northeast U.S. and is classified as Humid Continental. Differences in latitude, character of topography, and proximity to large bodies of water all have an effect on the 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 will move up from southern coastal areas and produce large quantities of rain. Both types of storms typically are characterized by relatively short periods of intense precipitation that produce large amounts of surface runoff and little recharge (Cornell, Date Unknown).

The cool season (October through March) is characterized by large, low-pressure systems moving northeastward along the Atlantic coast or the western side of the Appalachian Mountains. Storms forming in these systems are characterized by long 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 Unknown).

Chenango County generally experiences seasonable weather patterns characteristic of the northeastern U.S. Warm summers are typically experienced, with occasional high temperatures and humidity. Midsummer temperatures range in the middle and upper 70s°F (Fahrenheit). The winters of Chenango County are long and cold. Winter high temperatures are usually in the middle to upper 20s°F, with temperatures of -15°F expected. During the winter, temperatures are cooler than the temperatures in areas located near large bodies of water. Snow accumulates to an average depth of 40-80 inches each year (Chenango County 2016).

4.3.5 Land Use and Land Cover

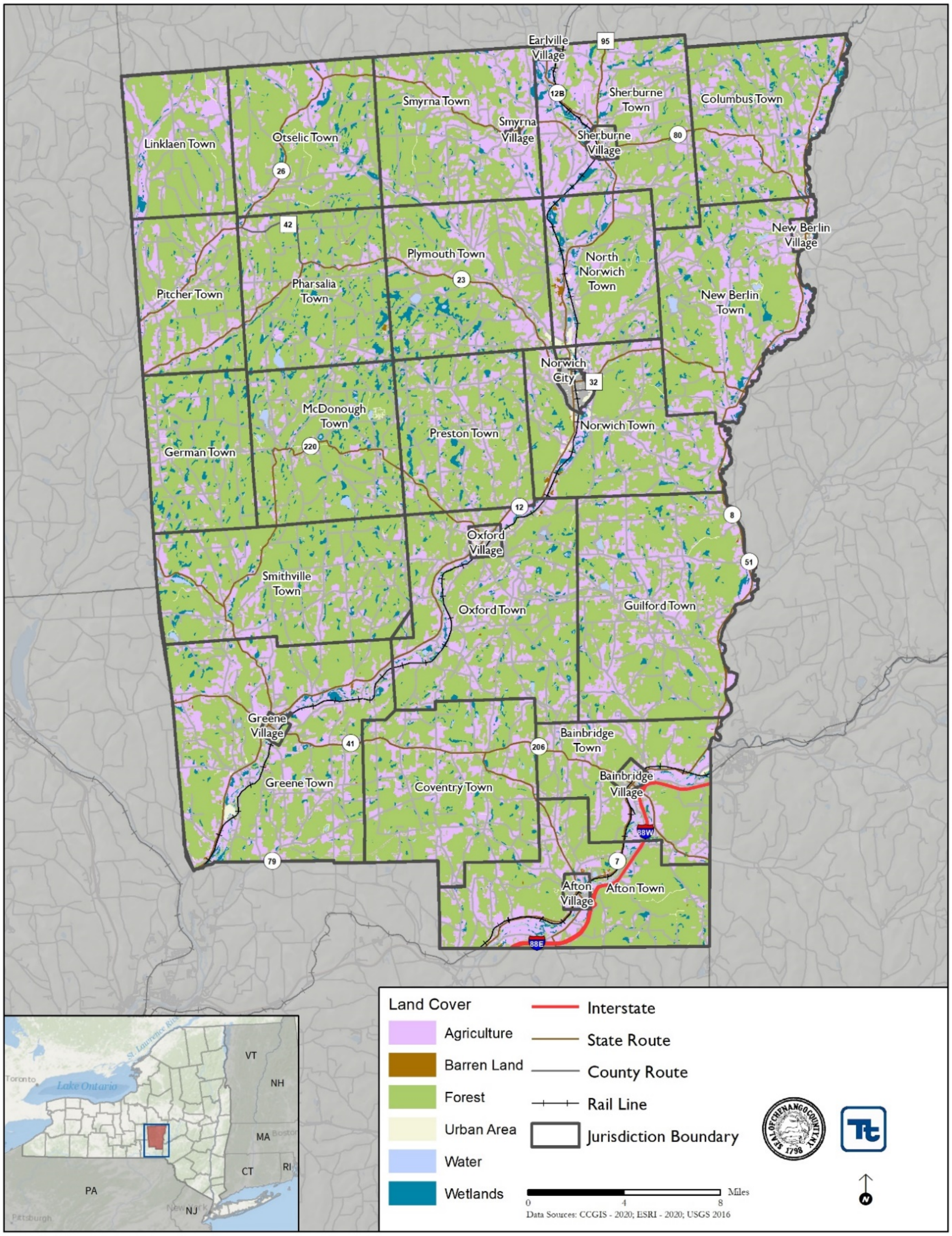
Chenango County is predominantly rural with 17.73% of the land used for agriculture, 19.36% is forested, less than 1% of the County's total land area is developed in commercial and industrial, and approximately 34.98% of the land is residential (Chenango County 2016) (Figure 4-3).

Table 4-2. Land Use in Chenango County (2016)

Land Use	Total Acreage	Total Area (sq. mi.)	Percent of County (%)
Agricultural	150,820.3	235.7	26.2
Barren Land	568.9	.9	0.1
Developed	31,937.6	49.9	5.6
Forest	365,534.0	571.1	63.5
Water	4,013.2	6.3	0.7
Wetlands	22,262.9	34.8	3.9
Chenango County:	**575,136.9**	**898.7**	**100**

Source: USGS, 2016
Note: sq. mi. = square miles

Figure 4-3. Land Use in Chenango County



4.4 POPULATION AND DEMOGRAPHICS

An understanding of the planning area population characteristics provides a foundation for deciphering the impacts of natural hazards in the county. As noted in Section 5.1 (Methodology) of this plan, modeling of the impacts of natural hazards on the population was performed using FEMA's Hazards U.S. Multi-Hazard (HAZUS-MH) in which the available population information includes the 2010 U.S. Decennial Census data, which indicates a county population of 50,477. However, more current data, according to the 2018 American Community Survey 5-Year Estimate, estimates a county population of approximately 48,348, which is a 4.4% decrease from the 2010 population. A detailed population table for the 2000, and 2010 Census are shown below in Table 4-3. A detailed table for the 2018 American Community Survey is included in Appendix E. Table 4-3 illustrates the population of each municipality as a total percentage of the county population. Figure 4-4 shows the distribution of the 2010 U.S. Census general population density (persons per square mile) by census block. Both sets of statistics are provided for context, but for the purposes of this plan, the data available in HAZUS-MH v4.2 are used (representing 2010 data) to support the analysis so the more recent data does not significantly skew the analysis.

Various Census Bureau products were used as sources for the population trends section. The Decennial Census is the official population count taken every 10 years. American Community Survey 5-Year Estimates are used to show annual population changes, but it is not an official population county. 5-Year Estimates are used because they are the most accurate form of American Community Survey with the largest sample size which allows for greater accuracy at smaller geographic areas. The American Community Survey 5-Year Estimate products were used to establish annual changes in population. The numbers provided are not official census counts, but are official estimates provided to communities so that they may have a greater understanding in population changes within their jurisdictions.

According to the 2010 U.S. Census, the County had a population of 50,477 people. Table 4-3 presents the population statistics for Chenango County based on the 2000 and 2010 U.S. Census data, and the 2018 American Community Survey 5-Year Estimate. While it is recognized that the population of Chenango County has slightly decreased in the last 10 years, the decline is not uniform across the county as there are areas that have experienced an increase. Please note that the population documented in each jurisdiction does not include the population of villages within the town limits; the village populations are shown separately on the table.

Table 4-3. Chenango County Population Statistics

Municipality	2018 ACS Estimated Population	U.S. Census 2010			U.S. Census 2000				
		Total	65+ Pop.	% of 65+ Pop. of Total	Total	65+ Pop.	% of 65+ Pop. of Total	Low-Income Pop. **	% Low-Income Pop. of Total
Town of Afton	1,767	2,029	342	16.9	2,141	268	12.5	273	12.7
Village of Afton	986	822	157	19.1	836	172	20.6	77	9.8
Town of Bainbridge	1,756	1,953	354	18.1	2,036	284	13.9	199	10.1
Village of Bainbridge	1,442	1,355	216	15.9	1,365	206	15.1	160	12
Town of Columbus	903	975	165	16.9	931	105	11.3	199	21.3
Town of Coventry	1,601	1,655	234	14.1	1,589	151	9.5	250	14.9
Town of German	385	370	56	15.1	378	32	8.5	90	21.2
Town of Greene	3,526	4,024	587	14.6	4,028	476	11.8	388	9.5
Village of Greene	1,704	1,580	316	20.0	1,701	296	17.4	197	11.8
Town of Guilford	2,834	2,922	463	15.8	3,046	418	13.7	365	12
Town of Lincklaen	366	396	55	13.9	416	47	11.3	73	17

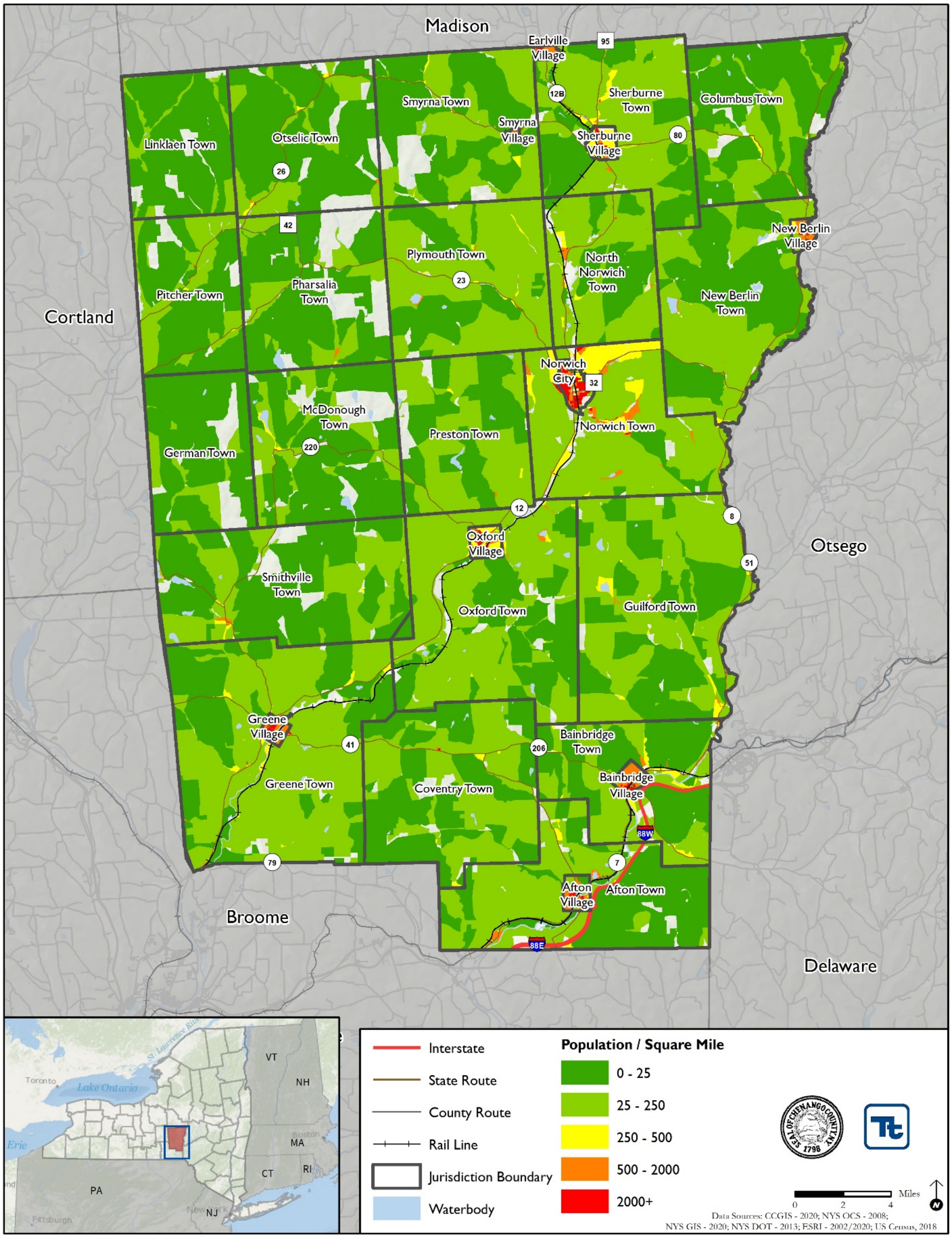
Municipality	2018 ACS Estimated Population	U.S. Census 2010 Total	U.S. Census 2010 65+ Pop.	U.S. Census 2010 % of 65+ Pop. of Total	U.S. Census 2000 Total	U.S. Census 2000 65+ Pop.	U.S. Census 2000 % of 65+ Pop. of Total	U.S. Census 2000 Low-Income Pop. **	U.S. Census 2000 % Low-Income Pop. of Total
Town of McDonough	773	886	161	18.2	870	138	15.9	87	9.8
Town of New Berlin	1,618	1,654	279	16.9	1,674	215	12.8	238	14.6
Village of New Berlin	927	1,028	273	26.6	1,129	261	23.1	194	18.5
Town of North Norwich	1,558	1,783	257	14.4	1,966	223	11.3	317	16.1
City of Norwich	6,813	7,190	1,259	17.5	7,355	1,556	21.2	1,294	18.7
Town of Norwich	3,802	3,998	593	14.8	3,836	546	14.2	502	13.1
Town of Otselic	910	1,054	133	12.6	1,001	105	10.5	156	16
Town of Oxford	2,325	2,451	586	23.9	2,408	520	21.6	270	13.1
Village of Oxford	1,430	1,450	232	16.0	1,584	276	17.4	223	14.3
Town of Pharsalia	632	593	89	15.0	542	60	11.1	112	22.1
Town of Pitcher	708	803	110	13.7	848	95	11.2	141	17
Town of Plymouth	1,806	1,804	292	16.2	2,049	197	9.6	250	14.3
Town of Preston	1,089	1044	162	15.5	928	125	13.5	109	11.5
Town of Sherburne	1,320	1,809	257	14.2	1,733	246	14.2	287	16.5
Village of Sherburne	1,414	1,367	240	17.6	1,455	267	18.4	268	18.6
Village of Earlville*	1,153	872	140	16.1	791	106	13.4	87	11.8
Town of Smithville	1,451	1,330	207	15.6	1,347	137	10.2	125	9.7
Town of Smyrna	1,119	1,067	157	14.7	1,177	99	8.4	236	18.9
Village of Smyrna	230	213	31	14.6	241	27	11.2	28	12
Chenango County (Total)	48,348	50,477	8,403	16.6	51,401	7,654	14.9	7,195	14.4

Source(s): U.S. Census Bureau, 2000 and 2010; HAZUS-MH; American Community Survey 5-Year Estimate, 2018
Pop. = Population
** The Village of Earlville is located in both Chenango County and Madison County. The population shown is a total of the persons residing in both Chenango and Madison Counties.*
*** Individuals below poverty level in 1999 (Census poverty threshold for a three-person family unit is approximately $14,000).*

It is noted that the census data for household income provided in HAZUS-MH includes two ranges ($0-$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 U.S. Census Bureau, which identifies households with an annual household income below $15,000 per year as "low income" for this region. This difference is not believed to be significant for the purposes of this planning effort.

The 2010 Census data also identified 3,790 households as having an annual income of $15,000 or less. The 2010 U.S. Census data indicates a total of 14.4% of all persons living in households fall below the poverty level. Figure 4-4 shows the distribution of the general population density (persons per square mile).

Figure 4-4. Distribution and Density of General Population for Chenango County, New York



4.4.1 Vulnerable Populations

DMA 2000 requires that HMPs consider socially vulnerable populations. These populations can be more susceptible to hazard events, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. For the purposes of this study, vulnerable populations shall include (1) the elderly (persons aged 65 and over) and (2) low-income (household annual income below $20,000 per year).

Populations with a higher level of vulnerability can be more seriously affected during the course of an emergency or disaster. Vulnerable populations have unique needs that need to be considered by public officials to help ensure the safety of demographics with a higher level of risk.

Age

Children are considered vulnerable to hazard events because they are dependent on others to safely access resources during emergencies and may experience increased health risks from hazard exposure. The elderly is more apt to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences. Those living on their own may have more difficulty evacuating their homes. The elderly are also more likely to live in senior care and living facilities where emergency preparedness occurs at the discretion of facility operators. According to the 2018 American Community Survey 5-Year Estimates, the median age in Chenango County was 44.7 years.

Income

The 2018 American Community Survey 5-Year Estimates provides that the median household income in Chenango County was $50,595, and the per capita income was $26,717 The U.S. Census Bureau identifies households with two adults and two children with an annual household income below $25,465 per year as *low income* (U.S. Census 2018) . The 2018 American Community Survey 5-Year Estimates indicates a total of 15.1 percent persons below the poverty level within the county.

The spatial U.S. Census data for household income provided in HAZUS-MH 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 2016 U.S. Census Bureau data. This difference is not believed to be significant for the purposes of this planning effort; therefore, for the exposure and loss estimations in the risk assessment, the 2010 U.S. Census data in HAZUS-MH is reported. Refer to Figure 4-5 below which illustrates the low-income population density in Chenango County.

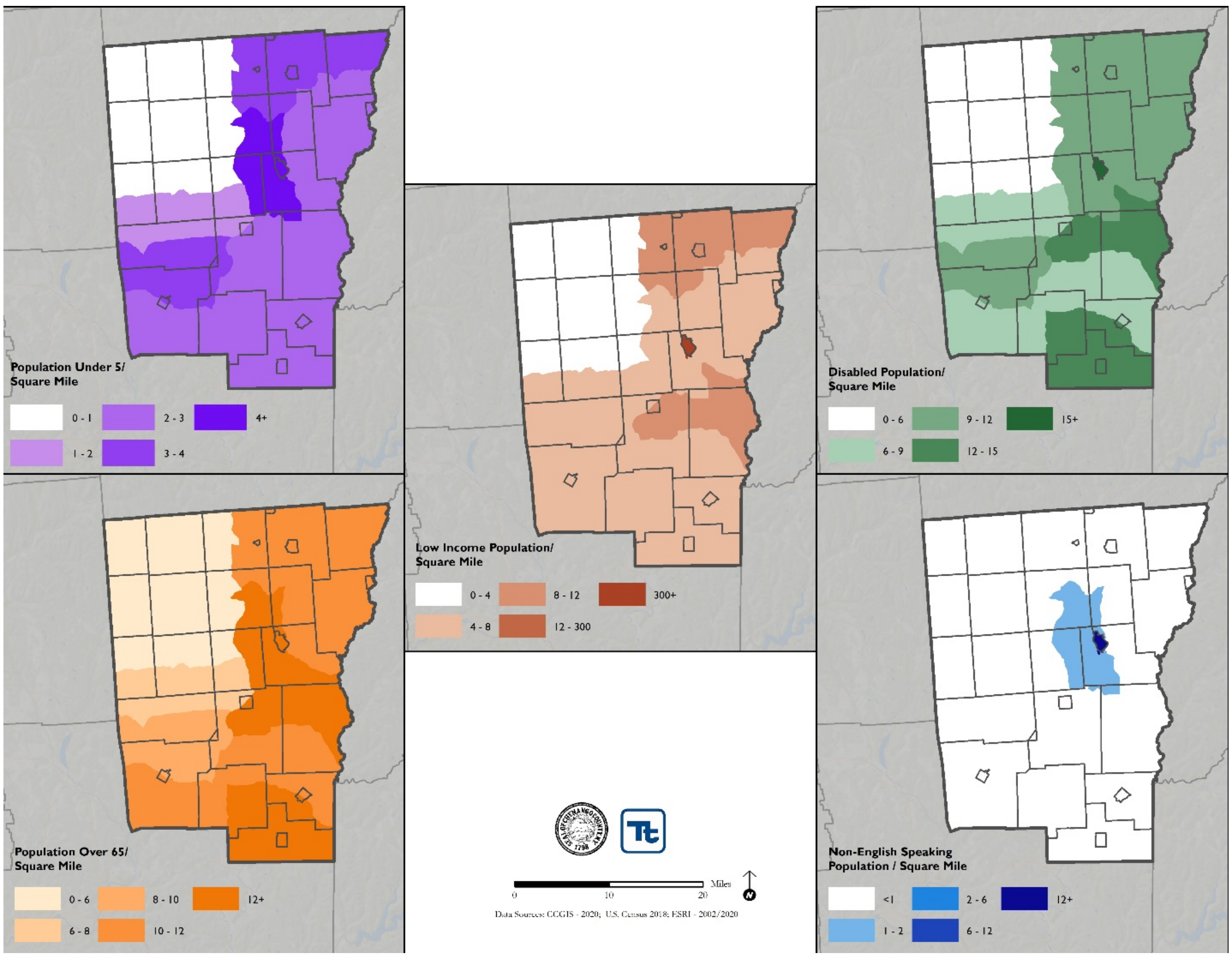
Physically or Mentally Disabled

According to the Centers for Disease Control, "Persons with a disability include those who have physical, sensory, or cognitive impairment that might limit a major life activity (Centers for Disease Control 2015)." Cognitive impairments can increase the level of difficulty that individuals might face during an emergency and reduce an individual's capacity to receive, process, and respond to emergency information or warnings. Individuals with a physical or sensory disability can face issues of mobility, sight, hearing, or reliance on specialized medical equipment. According to the 2018 American Community Survey, 19.2 percent of residents in Chenango County are living with a disability. Figure 4-5 shows the geographic distribution of disabled individuals throughout Chenango County, including individuals living with hearing, vision, cognitive, ambulatory, self-care, and independent living difficulties.

Non-English Speakers

Individuals who are not fluent or working proficiency in English are vulnerable because they can have difficulty with understanding information being conveyed to them. Cultural differences also can add complexity to how information is being conveyed to populations with limited proficiency of English (Centers for Disease Control 2015). According to the 2018 American Community Survey, 3.7 percent of the county's population over the age of 5 primarily speaks a language other than English at home; within that group approximately 369 individuals are reported as speaking English "less than very well." Of the county's population, 1.9 percent speak Spanish and 1.4 percent speak other Indo-European languages. Figure 4-5 shows the geographic distribution of individuals who speak English less than "very well."

Figure 4-5. Vulnerable Population Densities, Chenango County, New York



4.4.2 General Building Stock

The 2010 Census data identifies 20,436 households in Chenango County. A household includes all the people who occupy a housing unit as their usual residence. The Census data identified 24,710 housing units in Chenango County, an increase of 3.43% from 2000; this includes single family homes as well as multi-family units. A housing unit is a house, apartment, mobile home or trailer, a group of rooms, or a single room occupied as separate living quarters, or if vacant, intended for occupancy as separate living quarters. The median price of a single-family home in Chenango County was estimated at $88,200 in 2010 (Census, 2010).

For the purposes of this HMP, a custom general building stock was created using 2018 Microsoft building footprints, 2019 NYS GIS Program Office and NYS Department of Taxation and Finance's Office of Real Property Tax Services (ORPTS) tax records and parcel data and replaced the default database in Hazus v4.2. The updated building inventory contains 31,120 buildings with a total building replacement value (structure and content) of greater than $13 billion. This inventory was incorporated into FEMA Hazus at the structure and aggregate level. Approximately 83.5% of the buildings (25,993 buildings) and 46.5% of the building stock replacement value (or $10.7 Billion) are associated with residential housing. Commercial buildings make up the second building classification at approximately 7.9% of the buildings and 29.3% of the total building replacement value. The Town of Greene has the greatest number of structures at with 2,711 and the Village of Smyrna has the smallest number of structures with 99. Table 4-4 below shows the percentage of total building replacement value by occupancy.

The 2010 Census data identify that the majority of housing units (78.5% or 24,419 units) in Chenango County are single-family detached units and mobile homes (10% or 3,111 units).

Figure 4-6 shows the distribution and density of residential building value in Chenango County. The density is the dollar value of structures per unit area, exclusive of the building content value. The densities are shown in units of $1,000 ($K) per square mile.

Figure 4-7 shows the distribution and value density of buildings in the commercial occupancy category. The 2017 U.S. Census Bureau's County Business Patterns data identified 916 business establishments employing 13,853 people in Chenango County.

Figure 4-8 shows the distribution and value density of industrial buildings in Chenango County. The density is the dollar value of structures per unit area, exclusive of the building content value. The densities are shown in units of $1,000 ($K) per square mile.

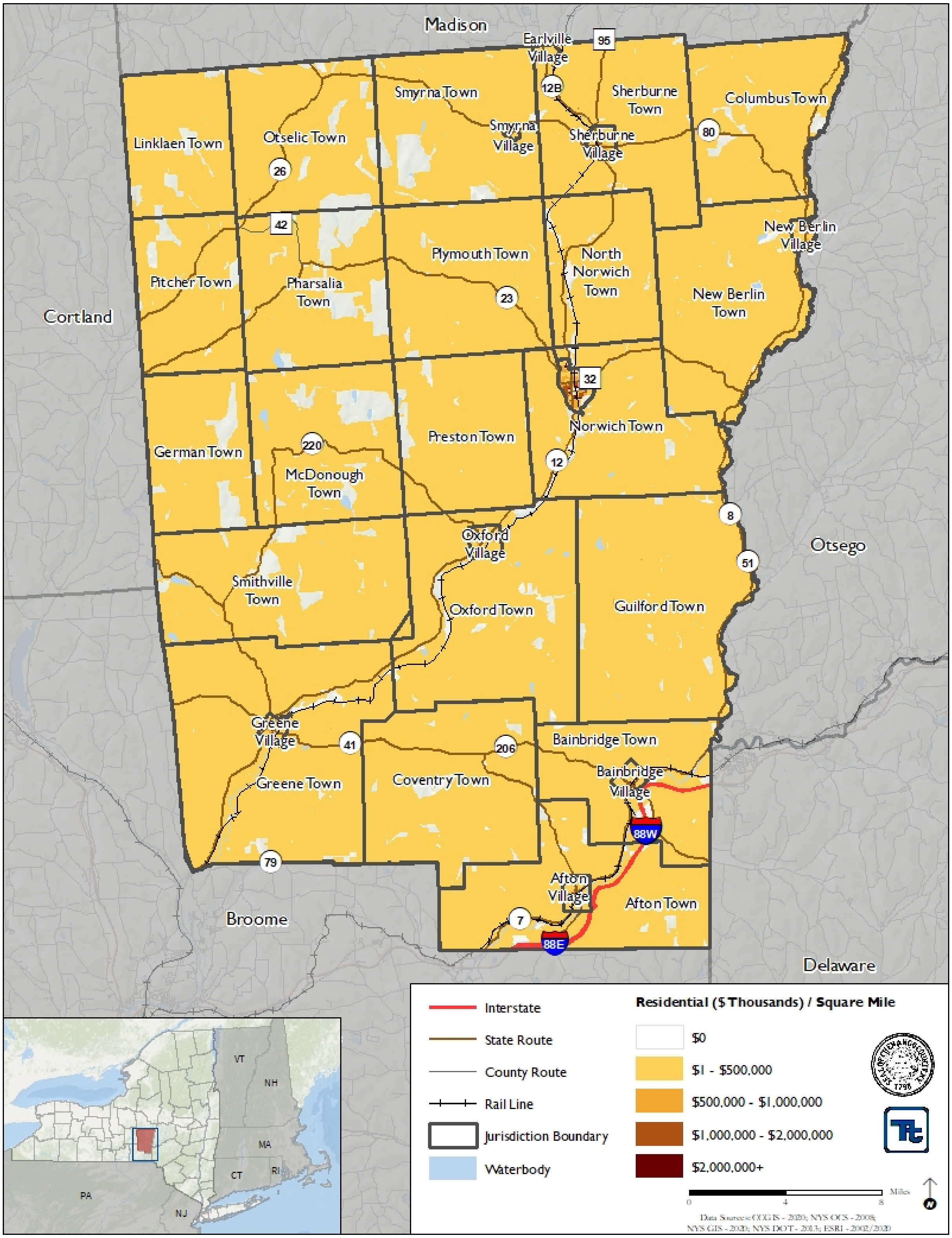
Table 4-4. Building Stock Replacement Value by Occupancy Class (Structure and Contents)

Municipality	All Occupancies				Residential		Commercial		Industrial	
	Count	Replacement Cost Value (Structure Only)	Replacement Cost Value (Contents Only)	Total Replacement Cost Value (Structure + Contents)	Count	Total Replacement Cost Value (Structure + Contents)	Count	Total Replacement Cost Value (Structure + Contents)	Count	Total Replacement Cost Value (Structure + Contents)
Afton (T)	1,609	$521,121,238	$343,578,461	$864,699,700	1,331	$532,628,331	178	$224,686,376	1	$1,677,600
Afton (V)	531	$551,676,566	$467,512,238	$1,019,188,804	467	$252,492,985	46	$626,789,923	1	$1,104,041
Bainbridge (T)	1,493	$533,629,097	$381,900,673	$915,529,770	1160	$455,185,271	278	$382,755,751	5	$6,065,019
Bainbridge (V)	697	$336,420,607	$248,536,576	$584,957,184	611	$263,652,093	70	$227,455,479	4	$6,179,012
Columbus (T)	748	$459,290,997	$403,063,997	$862,354,994	446	$168,681,001	228	$307,604,344	9	$261,658,830
Coventry (T)	1,255	$403,970,706	$299,266,665	$703,237,371	875	$314,112,125	294	$291,804,567	4	$6,233,650
Earlville (V)	155	$52,892,635	$34,260,725	$87,153,360	137	$55,895,731	15	$24,418,874	0	$0
German (T)	395	$128,697,115	$74,409,810	$203,106,925	350	$162,861,915	3	$1,570,759	0	$0
Greene (T)	2,711	$817,852,368	$501,883,723	$1,319,736,091	2,498	$947,905,937	87	$134,744,128	14	$21,029,556
Greene (V)	700	$392,090,447	$294,663,874	$686,754,321	587	$292,279,720	77	$193,731,718	16	$75,065,470
Guilford (T)	1,963	$611,982,875	$399,004,345	$1,010,987,220	1,719	$638,935,588	70	$110,600,841	7	$5,988,241
Linklaen (T)	398	$138,832,746	$90,838,976	$229,671,722	332	$143,981,313	3	$4,739,651	0	$0
McDonough (T)	807	$206,486,750	$132,602,802	$339,089,552	674	$221,651,844	91	$87,272,473	0	$0
New Berlin (T)	1,225	$459,561,738	$319,151,787	$778,713,525	1,017	$421,229,852	49	$52,373,678	1	$5,232,994
New Berlin (V)	411	$245,530,367	$187,075,404	$432,605,770	350	$175,364,889	43	$193,638,738	1	$410,905
North Norwich (T)	1,121	$470,562,339	$352,492,387	$823,054,726	949	$354,209,855	55	$115,449,824	15	$184,312,426
Norwich (C)	2,503	$1,773,960,078	$1,366,999,020	$3,140,959,099	2,258	$1,220,883,174	192	$1,532,435,436	13	$104,189,315
Norwich (T)	2,013	$1,152,570,810	$927,859,990	$2,080,430,801	1,638	$674,132,460	178	$929,743,052	19	$152,092,232
Otselic (T)	741	$267,690,532	$193,682,719	$461,373,250	587	$222,023,439	36	$54,493,865	1	$25,694,557
Oxford (T)	1,731	$570,965,024	$387,365,856	$958,330,880	1,432	$550,797,506	21	$27,632,031	3	$4,926,853
Oxford (V)	648	$387,073,484	$292,294,294	$679,367,779	579	$284,337,570	45	$284,832,722	1	$3,475,428
Pharsalia (T)	583	$224,584,665	$165,279,287	$389,863,952	446	$177,916,135	12	$19,289,849	0	$0
Pitcher (T)	609	$190,794,165	$124,550,365	$315,344,531	526	$198,731,400	8	$12,758,503	0	$0
Plymouth (T)	1,244	$322,263,869	$188,565,777	$510,829,645	1,140	$401,094,276	18	$19,198,236	0	$0
Preston (T)	782	$219,259,016	$129,689,410	$348,948,426	705	$268,708,818	3	$2,898,859	0	$0
Sherburne (T)	1,463	$628,071,329	$485,150,409	$1,113,221,738	1,194	$428,762,759	61	$184,539,835	5	$27,371,513

Municipality	All Occupancies				Residential		Commercial		Industrial	
	Count	Replacement Cost Value (Structure Only)	Replacement Cost Value (Contents Only)	Total Replacement Cost Value (Structure + Contents)	Count	Total Replacement Cost Value (Structure + Contents)	Count	Total Replacement Cost Value (Structure + Contents)	Count	Total Replacement Cost Value (Structure + Contents)
Sherburne (V)	611	$438,226,063	$330,559,616	$768,785,678	489	$322,999,342	93	$227,814,037	10	$173,767,839
Smithville (T)	1,032	$396,670,788	$294,312,828	$690,983,617	844	$307,073,880	21	$133,179,524	0	$0
Smyrna (T)	842	$293,719,687	$226,139,220	$519,858,907	577	$202,741,399	181	$188,213,419	0	$0
Smyrna (V)	99	$86,092,230	$75,364,721	$161,456,951	75	$32,182,528	22	$125,807,922	0	$0
Chenango County	**31,120**	**$13,282,540,334**	**$9,718,055,955**	**$23,000,596,289**	**25,993**	**$10,693,453,136**	**2478**	**$6,722,474,412**	**130**	**$1,066,475,483**

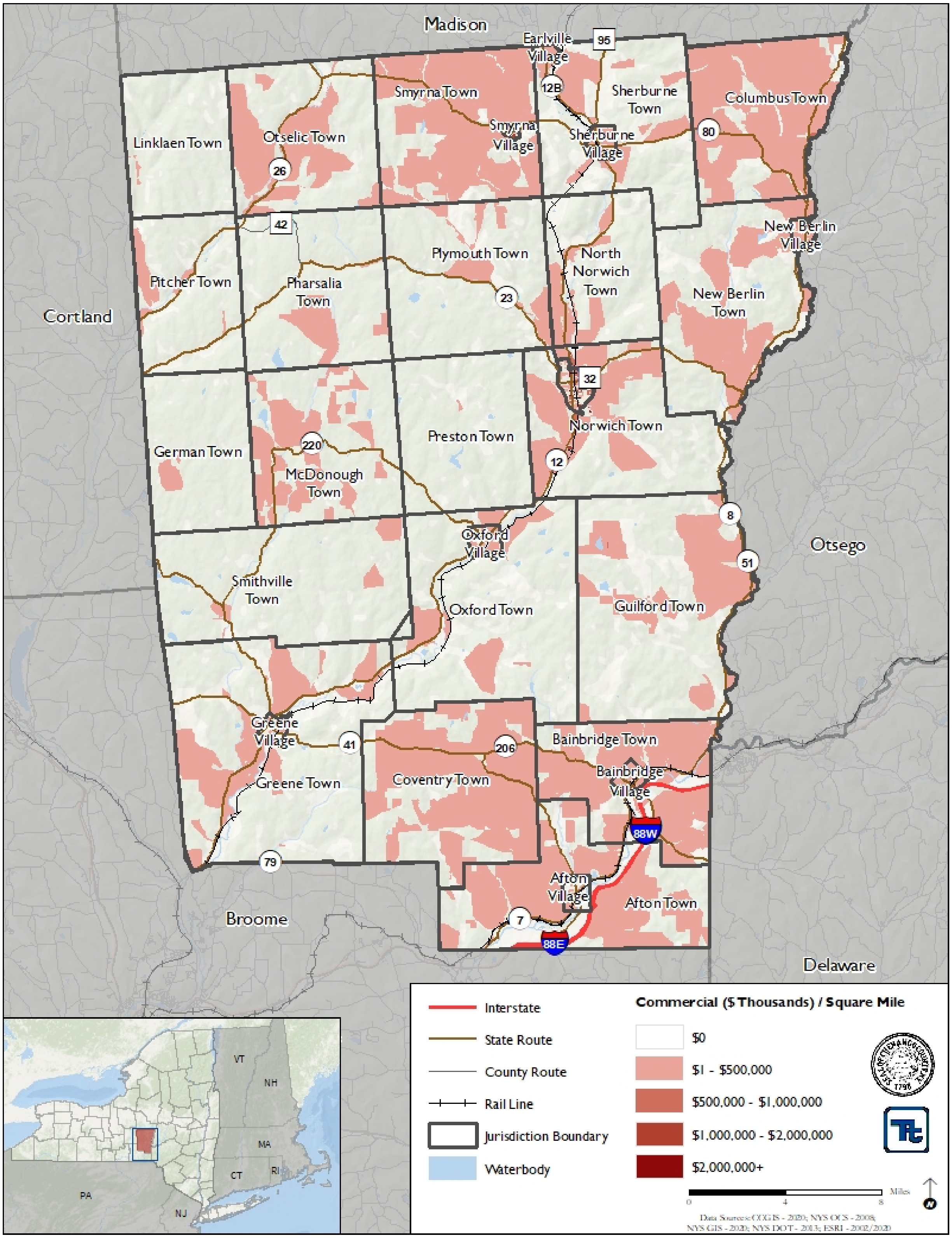
Source: Chenango County Office of GIS – 2020, New York State Department of Taxation and Finances Office of Real Property Tax Services (ORPTS) – 2019; RS Means 2019
Note:
C = City, T= Town, V = Village
All occupancies represent residential, commercial, industrial, agriculture, religious, government and education classes

Figure 4-6. Distribution of Residential Building Stock and Value Density in Chenango County, New York



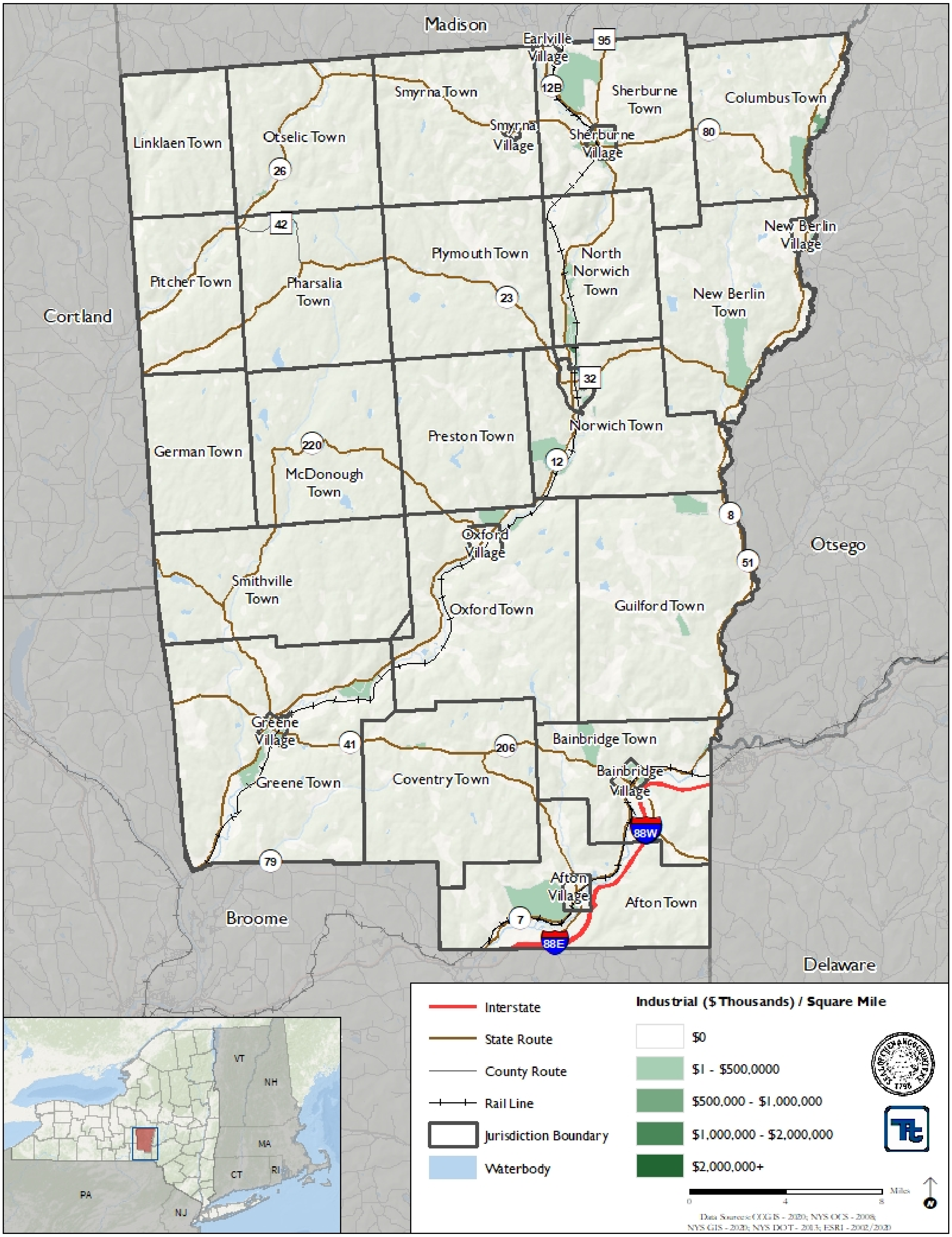
Source: HAZUS-MH 4.2

Figure 4-7. Distribution of Commercial Building Stock and Value Density in Chenango County, New York



Source: HAZUS-MH 4.2

Figure 4-8. Distribution of Industrial Building Stock and Value Density in Chenango County, New York



Source: HAZUS-MH 4.2

4.5 LAND USE AND POPULATION TRENDS

Land use regulatory authority is vested in New York State's towns, villages, and cities. However, many development and preservation issues transcend location political boundaries. DMA 2000 requires that communities 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.

This plan provides a general overview of population, land use, and types of development occurring within the study area. An understanding of these development 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.

4.5.1 Land Use Trends

Economy

Commerce Chenango, Inc. serves as the Economic Development Agency for Chenango County. Throughout the recent pandemic, they served on the front lines of business advocacy and education, a liaison with the state, shut down and reopening support, vaccinations and recovery strategies. The COVID-19 pandemic shed light on inequities throughout Chenango County, but also spotlighted some opportunities (2021+):

- **Broadband Access:** The inequity of broadband service and access throughout the county has been a hindrance to economic development projects, attracting new investments from businesses and the attraction of new residents. In addition to these initiatives, the lack of broadband access points and spotty service put an additional strain on our education system and health services.

  A coalition began meeting in the spring of 2020 to identify funding opportunities, work on education and advocacy and possible collaborations to find ways to bring broadband to rural communities in Chenango County. Independently a small coalition from Chenango County has been simultaneously working on grants, advocacy and education surrounding this equity issue.

- **Hotel and Lodging:** The limited availability of adequate and attractive lodging is a problem for our tourism industry. As the county begins reopening, the Development Chenango Corporation is working with local developers to acquire a site to open a hotel, which will add to the business development of Chenango County and help our tourism industry. In addition, the approval of the Occupancy Tax by the Chenango County Board of Supervisors (March 2020) will add a much needed infusion of revenue into the tourism program, which is administered by Commerce Chenango.

- **Business Development and Attraction of Large-Scale Industry:** The Development Chenango Corporation has made a significant financial investment into marketing tools for the attraction of developers, projects and large-scale industries to Chenango County. This endeavor will be made possible through targeted marketing and a new GIS system for project development. With this sophisticated digital platform, the County will be able to target developers, industries, and feature available properties and development sites to those seeking to bring their business to Chenango County.

- **Green Initiatives:** The Climate Leadership and Community Protection Act of 2019 establishes certain emission reduction limits as well as additional goals to address climate change. These requirements and goals include:

  - Limit statewide greenhouse gas emissions to 40% of 1990 levels by 2030 and 85% by 2050
  - A plan to achieve net zero greenhouse gas emissions across New York State's economy

  - 70% renewable electricity by 2030
  - 100% zero emission electricity by 2040

The Chenango County IDA (Industrial Development Agency) has seen a significant increased number of solar and wind projects in Chenango County. The Chenango County IDA approved one (1) project in Norwich in 2018, one (1) project in the Town of Greene in 2020, one (1) project in North Norwich in 2021, and has multiple proposals that they expect to become full applications in 2021 and 2022.

As part of the green initiative, Chenango County is including a mitigation strategy in the 2021 HMP Update to help achieve the initiative. Refer to Section 9.1 for details on the mitigation strategy.

There are currently no wind energy projects, but on March 11, 2021 the New York State Board on Electric Generation Siting and the Environment approved an environmental study for a wind project in the Town of Guilford. The CCIDA expects a PILOT application in 2021 for the project, however it is unclear what the final outcome will be.

- **Railroad**: The CCIDA, is working with FEMA and the NYS&W Railway on improvements needed to the 42 miles of track throughout Chenango County. In the previous report, it was noted that an effort was being made to bring the rail back online after washouts in 2006. This project was completed in 2019, and in the fall of 2019 another series of washouts occurred, putting an immediate stop to the use of the track once again.

  In addition it was discovered that some of the bridges in Chenango County were unpassable by the train, and these needed improvements were not part of the EDA application or improvements. Currently the Chenango County IDA is working with FEMA on an application to address the October 31, 2019 washouts, and working with NYS&W to determine any possible next steps to bringing the rail back online, and/or pursuing other opportunities.

- **NYS DRI, CFA and other funding opportunities:** The 2019 DRI Application was unsuccessful, and the Development Chenango Corporation formed a DRI Steering Committee in January 2020 to pursue a new application, with feedback received on our first attempt. In the spring of 2020, with the COVID-19 pandemic freezing all new spending, the DRI application process did not come to fruition, and our efforts were put on hold.

  Commerce Chenango, and DCC are currently waiting for the new Consolidated Funding Application terms and programs to open for 2021 project inquiries and if/when the DRI program begins again the County will plan to apply.

  With the help of Chenango County Planning and Southern Tier 8, Commerce Chenango is currently vetting and reviewing all possible grant and funding opportunities that will support the economic development goals of Chenango County.

U.S. Census Bureau's County Business Patterns for Chenango County

The U.S. Census Bureau's County Business Pattern provides an annual series of sub-national economic data by industry covering the majority of the country's economic activity. According to the 2017 Chenango County Business Pattern, the county had a total of 916 business establishments. Altogether, these establishments employed 13,853 workers and generated $636 million in annual payroll.

The manufacturing sector employs the largest segment of the County's workforce, providing nearly 4,500 jobs and generating $247.7 million in annual payroll. This represents 32% of all jobs and 39% of annual payroll. The healthcare and social assistance field provides the second-most number of jobs in the County, as well as $72.8

million in annual payroll. The retail trade comprised the largest share of businesses. Table 4-5. provides 2017 industry and employment information in Chenango County.

Table 4-5. 2017 Economic Census for Chenango County, New York

Meaning of NAICS code	Number of establishments	Number of employees	Annual payroll ($1,000)
Total for all sectors	916	13,853	$ 636,754
Agriculture, forestry, fishing and hunting	10	26	$ 931
Construction	92	284	$ 14,136
Manufacturing	62	4,478	$ 247,785
Wholesale trade	27	262	$ 11,501
Retail trade	159	1,703	$ 42,825
Transportation and warehousing	21	223	$ 8,863
Information	25	588	$ 22,398
Finance and insurance	45	1,195	$ 87,105
Real estate and rental and leasing	25	99	$ 3,246
Professional, scientific, and technical services	54	241	$ 9,631
Management of companies and enterprises	4	e	S
Administrative and support and waste management and remediation services	24	764	$ 36,598
Educational services	11	52	$ 1,372
Health care and social assistance	112	1,963	$ 72,865
Arts, entertainment, and recreation	25	200	$ 3,070
Accommodation and food services	101	841	$ 13,341
Other services (except public administration)	116	408	$ 9,970

Source: U.S. Census, County Business Pattern 2017
** = This number only includes paid employees*
E = 250-499 employees
S= Withheld because estimate did not meet publication standards. Employment or payroll field set to zero.

Agriculture

According to the USDA 2017 NASS, there are 770 farms occupying 148,982 acres of land in Chenango County. In 2017, the highest sales by dollar amount is for "other crops and hay", followed by grains, oilseeds, dry beans, and dry peas. Milk from cows represents the largest share of sales by dollar volume, comprising 83% of the $50 million in agricultural products in 2017. In total, the County generated $67.9 million in agricultural sales, approximately 26% of which comes from cops and of which 74% comes from livestock and related products. The number of farms and acreage of land used for farming has decreased significantly since 1940. The number of farms decreased by 77%, and the total acreage of farmland decreased by 67%. Table 4-6 shows the number of farms and land use in Chenango County.

Table 4-6. Farms and Land Use in Chenango County

Year	Number of Farms	Land in Farms (acres)	Total Cropland (acres)	Permanent Pasture (acres)	Total Woodland (acres)	Other Land (acres)
1940	3,371	450,226	NA	NA	86,430	NA
1950	2,689	416,052	163,949	137,969	99,438	14,696
1959	1,889	375,581	148,700	117,972	96,048	12,861
1969	1,196	273,750	132,604	NA	75,236	NA
1978	1,054	254,549	126,891	41,739	66,672	19,247

Year	Number of Farms	Land in Farms (acres)	Total Cropland (acres)	Permanent Pasture (acres)	Total Woodland (acres)	Other Land (acres)
1982	1,006	230,069	116,794	32,970	63,367	16,938
1987	1,040	231,500	119,700	29,200	65,300	17,300
1992	935	206,700	112,500	26,400	53,600	14,200
1997	960	197,000	109,800	24,600	48,600	14,000
1998	970	199,800	112,500	24,500	48,400	14,400
1999	995	201,300	115,400	23,400	47,500	15,000
2000	970	200,100	NA	NA	NA	NA
2001	960	195,300	NA	NA	NA	NA
2002	955	190,000	100,601	19,401	53,162	16,636
2003	955	189,800	NA	NA	NA	NA
2007	908	177,267	86,719	24,690	50,146	NA
2012	828	167,226	79,255	21,572	52,341	13,879
2017	770	148,982	77,079	17,878	40,255	10,429

Source: USDA NASS, 2020

According to the 2012 Chenango County Agriculture and Farmland Protection Plan, the County Agriculture and Farmland Protection Board (AFPB) established four goals:

1. Promote agricultural economic development
2. Assist agricultural producers with cost-control measures
3. Encourage the proper use of land and the monitoring/reporting of changes
4. Educate producers, consumers, and policy makers

The County is working with the Agriculture and Farmland Protection Board to update the Agriculture and Farmland Protection Protection plan currently.

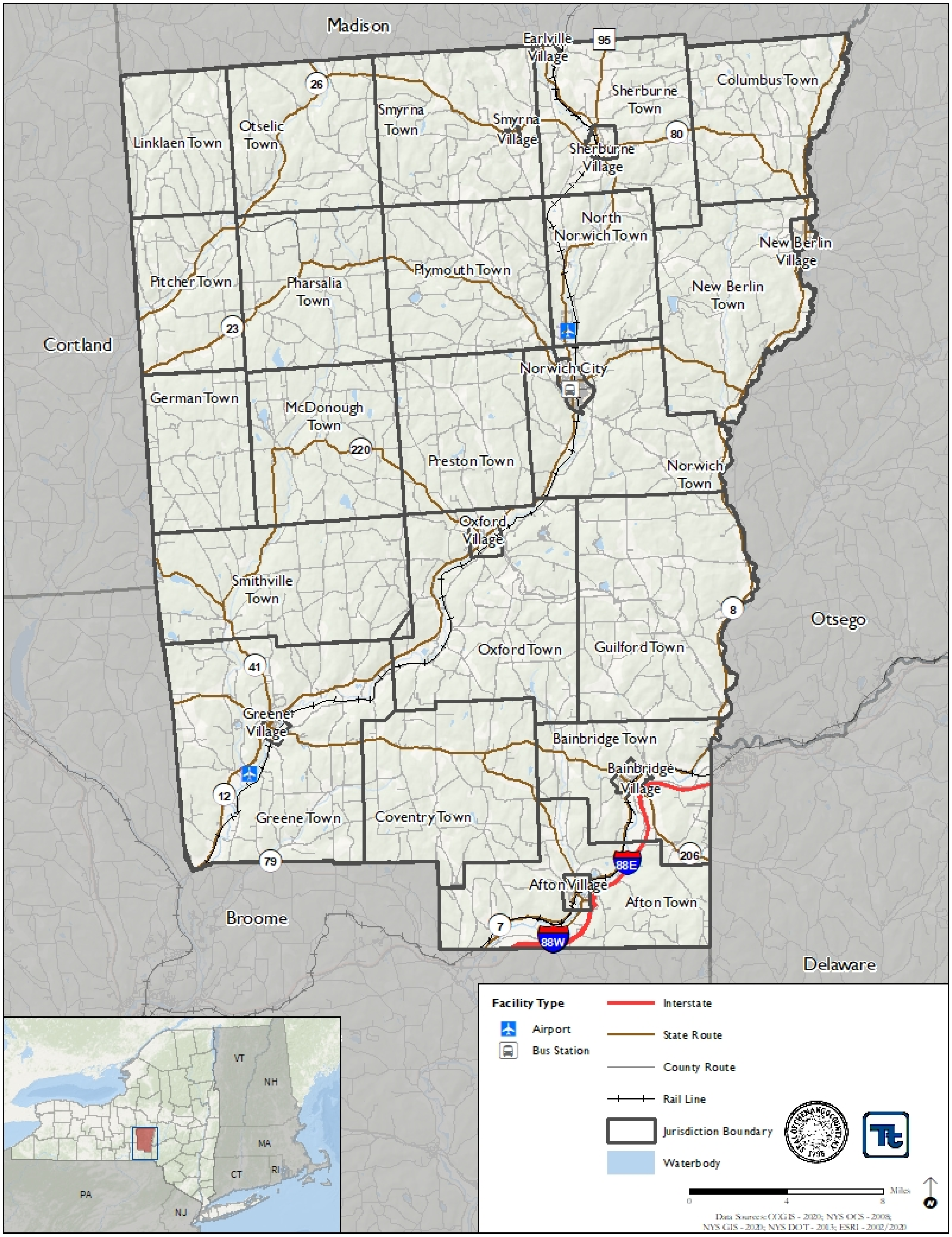
Corridors and Gateways

The transportation routes in Chenango County are networks of corridors and gateways that impact land use patterns. The major route in the County is Interstate 88, which passes through the southeast corner of the County and connects it to Interstates 81 and 90. These primary corridors are defined as those roadways that have a NYSDOT functional classification of interstate or expressway. Figure 4-15 illustrates the transportation corridors in Chenango County.

The secondary corridors of the county experience lower traffic volumes but are still heavily traveled. In the county, the secondary corridors have a NYSDOT functional classification of principal or minor arterial. Many local and regional travelers use these corridors and merit special attention. These secondary corridors include the following:

NYS Route 7	NYS Route 8
NYS Route 12	NYS Route 23
NYS Route 41	NYS Route 80
NYS Route 206	

Figure 4-9. Transportation Corridors of Chenango County, New York



Source: HAZUS-MH 4.2

4.5.2 Population Trends

Chenango County's population has decreased slightly since 2010. Figure 4-11.   below, which shows the annual population estimate from the 2010 to the 2018 American Community Survey 5 Year Estimates. Two Census Bureau products were used in the population trends section. The 2010 Census is the official population count of a municipality, performed each decade. The American Community Survey is performed on a more frequent basis to provide updated population and demographics information to communities.

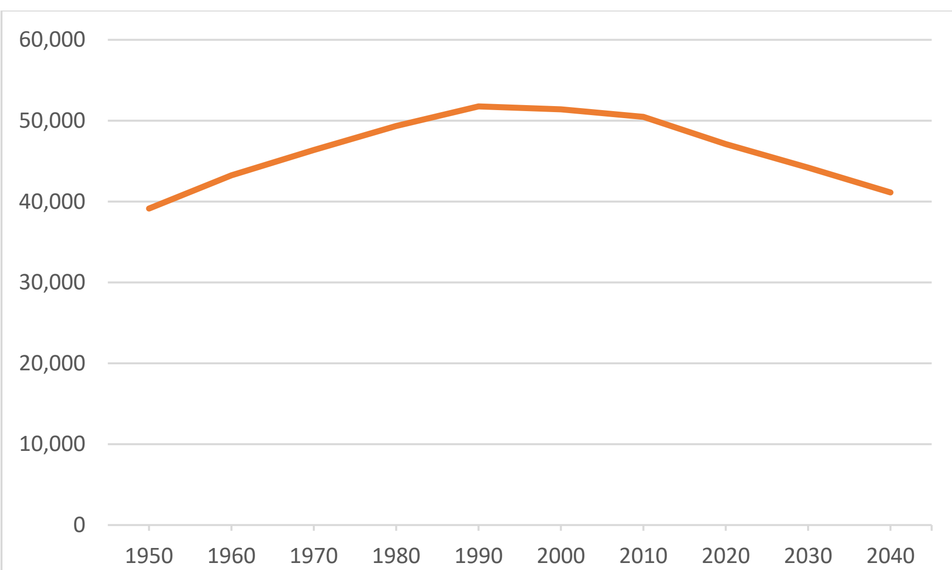
The majority of communities in Chenango County saw decreased populations between 2010 and 2018. Based on historical data, population projections from the Cornell University Program on Applied Demographics have been created which show Chenango County's population will continue to decrease over time (Cornell University 2018).

Chenango County's elderly population has increased significantly (by approximately 17%), whereas the County's population and its population of children under five years old has decreased by 5.3% and 6.7%, respectively.

The 2006 Economic Development Strategy Plan noted that the aging of the County's population represented an economic issue of improtantce to the County. The decrease of residents under the age of five and the increase of residents over the age of 65 indicate that slow or negative population growth may continue into the future. This is reflected in Figure 4-16, which shows population projections from Cornell University. By 2040, the population is expected to decrease to levels last seen in 1950.

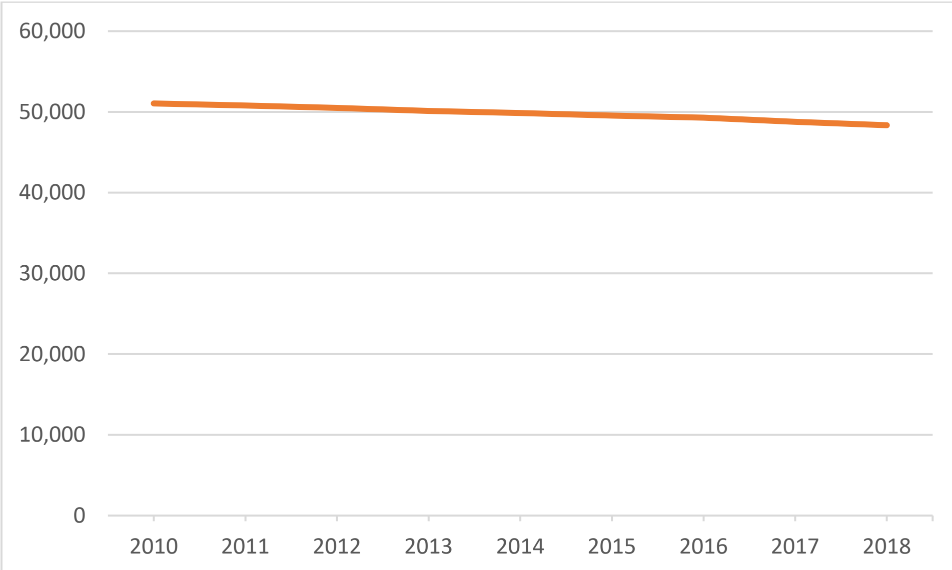
The U.S. Census Bureau estimates that Chenango County's population in 2018 was 48,348 a 5.3 percent decrease from 2010 population of 50,477 (U.S. Census Bureau 2010). Between 1950 and 1990, the county experienced growth in population, and ultimately reached peak population in 1990. The biggest increase was seen between 1950 and 1960, when the population increased 10.5% or by 4,105 residents. Figure 4-10.   shows the county population and projected population from 1950 to 2040, while Figure 4-11.   indicates the annual estimated population change from 2010 to 2018. Refer to Appendix E (Supplementary Data) for the municipal population change over this period.

Figure 4-10. Population Change 1950 to 2040 in Chenango County, New York



Source: U.S. Census Bureau; Cornell University 2018

Figure 4-11. Annual Population Change, 2010 to 2018 American Community Survey Estimates in Chenango County, New York

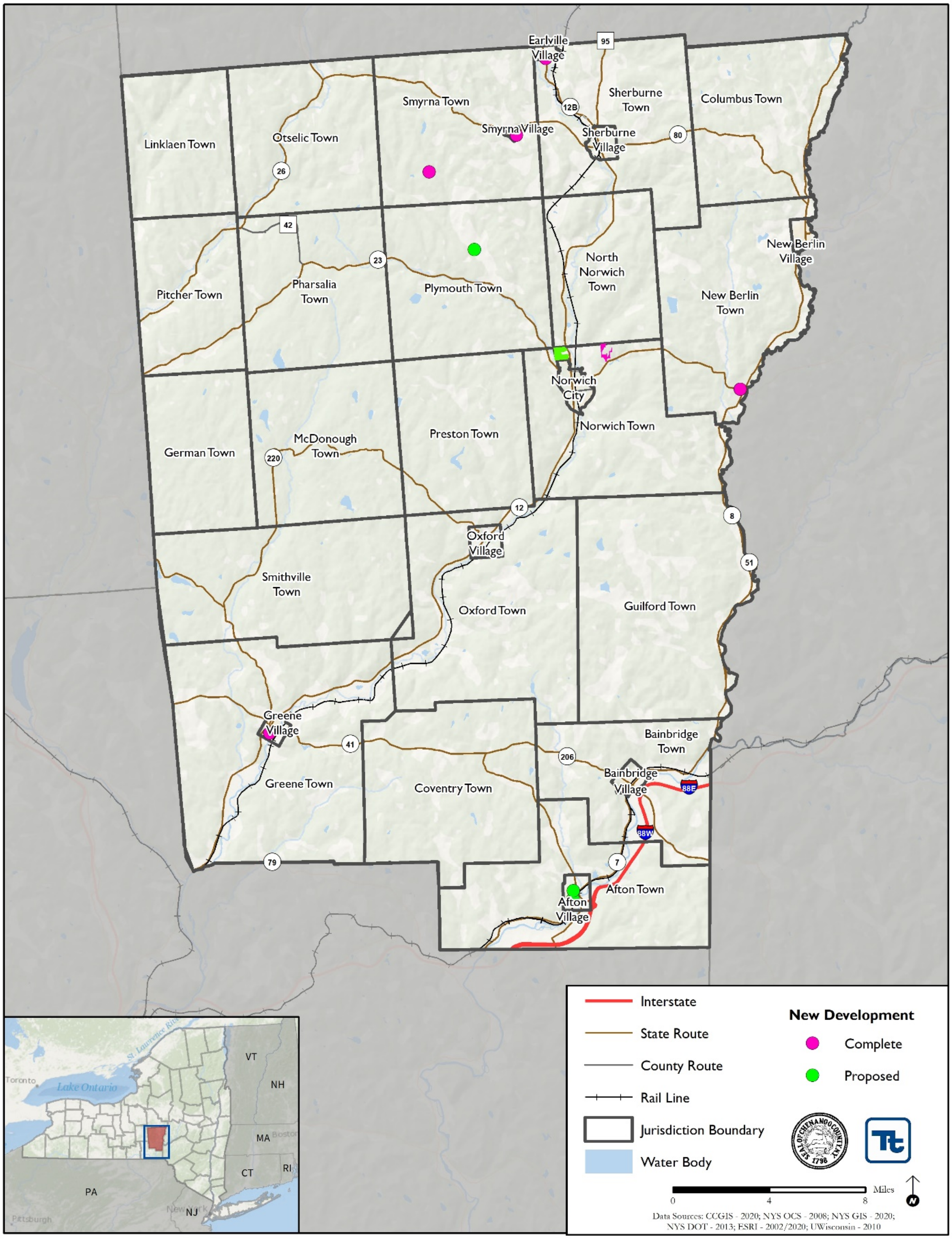


Source: U, S. Census Bureau American Community Survey; 5 Year Estimates 2010-2018

4.5.3 Future Growth and Development

A summary of development planned within Chenango County is provided in the Figure 4-12. below. Municipalities that did not identify any significant residential/commercial, or infrastructure development within the next 5 years are not included in the figure. Details regarding development specific to each participating municipality is provided in Appendix E. Locations of planned developments are indicated on the Hazard Area Extent and Location Maps included in Section 9 (Jurisdictional Annexes).

Figure 4-12. Planned Development in Chenango County, New York



4.6 CRITICAL FACILITIES AND LIFELINES

Critical facilities and infrastructure are those that are essential to the health and welfare of the population. These become especially important after any hazard event. Critical facilities are typically defined to include police and fire stations, schools, and emergency operations centers. Critical infrastructure can include the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need and the utilities that provide water, electricity, and communication services to the community. Also included are Tier II facilities (hazardous materials) and rail yards; rail lines hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event.

> ***Critical Facilities*** are those facilities considered critical to the health and welfare of the population and that are especially important following a hazard. As defined for this HMP, critical facilities include essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities, and hazardous material facilities.
>
> ***Essential facilities*** are a subset of critical facilities that include those facilities that are important to ensure a full recovery following the occurrence of a hazard event. For the county risk assessment, this category was defined to include police, fire, EMS, schools/colleges, shelters, senior facilities, and medical facilities.
>
> ***Lifelines*** enable the continuous operation of critical business and government functions and are essential to human health and safety or economic security.

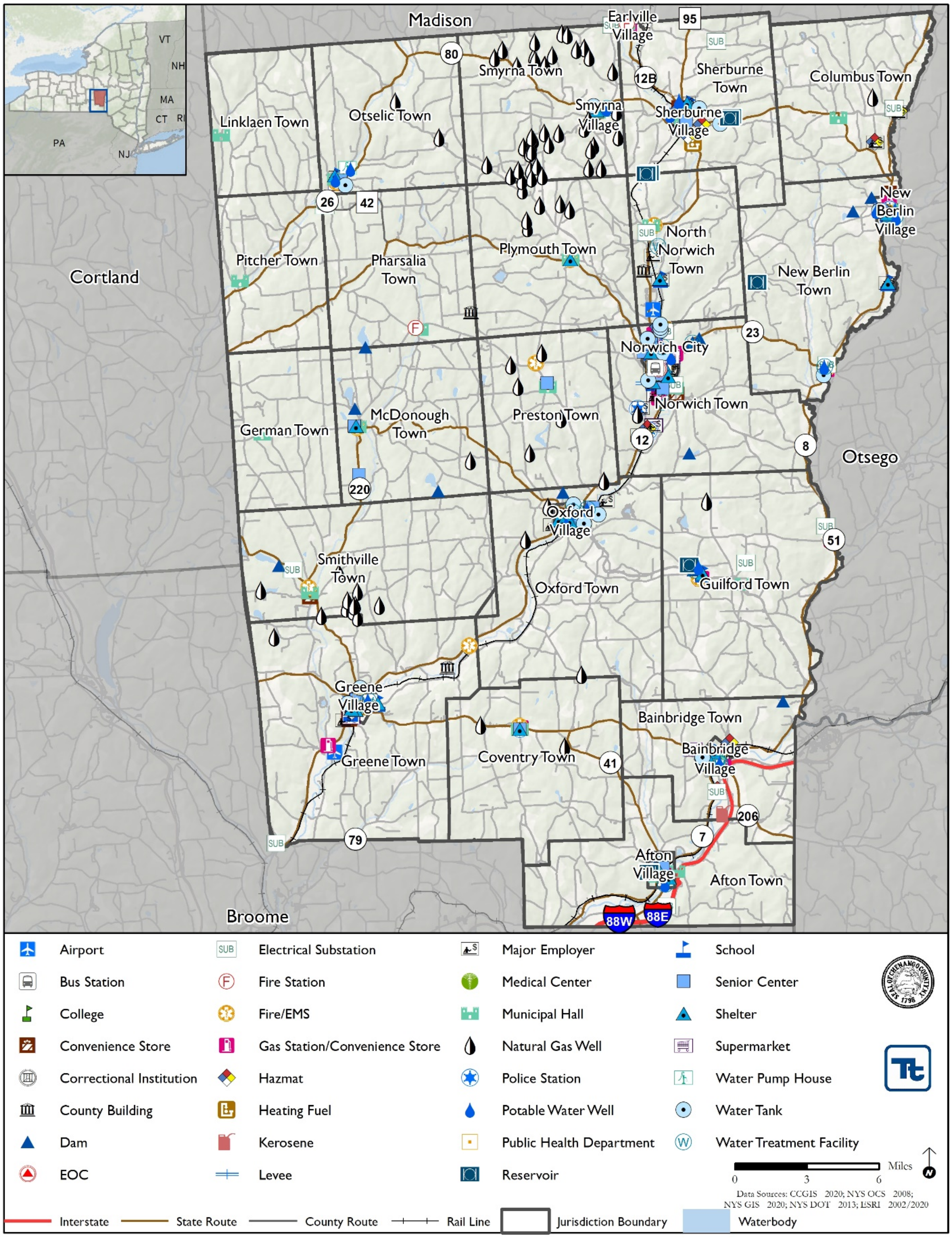
Beginning in 2017, FEMA developed a new construct to increase effectiveness for disaster operations and position response to catastrophic incidents. This construct, known as “community lifelines”, represents the most fundamental services in the community that, when stabilized, enable all other aspects of society. Following a disaster event, intervention is required to stabilize community lifelines. Lifelines are divided into seven categories which include:

- Safety and Security
- Food, Water, Shelter
- Health and Medical
- Energy (Power and Fuel)
- Communications
- Transportation
- Hazardous Materials

To facilitate consistency with the National Response Framework, FEMA Strategic Plan, and guidance for the Building Resilient Infrastructure and Communities grant program, critical facilities in Chenango County are discussed in terms of lifelines.

A comprehensive inventory of critical facilities in Chenango County was developed from various sources, including Chenango County and input from the Steering and Planning Committees. The inventory of critical facilities presented in this section represents the current state of this effort at the time of publication of the draft HMP and used for the risk assessment in Section 5 (Risk Assessment). The number and type of critical facilities and infrastructure identified for this plan are indicated in Figure 4-13.   and summarized in Appendix E (Supplemental Data). A complete listing of the inventory used for analysis in this plan is provided in Appendix F (Critical Facilities).

Figure 4-13. Lifelines in Chenango County, New York



4.6.1 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 plan, safety and security facilities include: police departments, fire departments, emergency services, and dams. This is shown in Figure 4-15.

Police Departments

There are 11 police stations located in Chenango County, consisting of local, county and state police. The Chenango County Sheriff's Office is divided into six divisions: K-9 unit, detectives, Hazardous Entry & Arrest Team, marine patrol, road patrol, and snowmobile patrol.

Fire Departments

According to the Chenango County Fire Mutual Aid Plan, a mutual aid agreement is maintained with all fire departments within the County. Mutual aid is provided to, and received from, adjacent counties (Madison, Otsego, Delaware, Broome and Cortland) through their respective County Fire Control Centers under the direction of their respective Fire Coordinator or legally appointed deputies. The Chenango County Fire Control Center is located on County Road 46 in Norwich. The Fire Coordinator is responsible for all activities of the Chenango County Fire Control Center (Chenango County Bureau of Fire, 2006). There are three fire stations located throughout Chenango County; however, there are 18 fire/EMS facilities in the County which provide both fire and EMS services.

Emergency Services

Chenango County also maintains an Emergency Services Mutual Aid Plan. In accordance with the New York State Department of Health, every certified ambulance or EMS provider signs, and operates in accordance with, a mutual aid plan. Each EMS provider in Chenango County must adopt the County plan, or write one of their own and obtain approval through both the County and State. Chenango County has also provided a copy of its Emergency Services Mutual Aid Plan to neighboring EMS agencies that service the County (Beckwith, 2007). Central dispatch for EMS is through Chenango County Fire Control (Chenango County EMS Advisory Board, 2002). Overall, there are 18 fire/EMS facilities in the County.

Dams

For the purpose of this hazard mitigation plan, dams and levees are considered community lifelines. A summary of the dams in the county is presented in this section to provide an awareness of the number and types of these structures within the county.

According to the NYSDEC Division of Water Bureau and Flood Protection and Dam Safety, there are three hazard classifications of dams in New York State. The dams are classified in terms of potential for downstream damage if the dam were to fail. The hazard classifications are as follows:

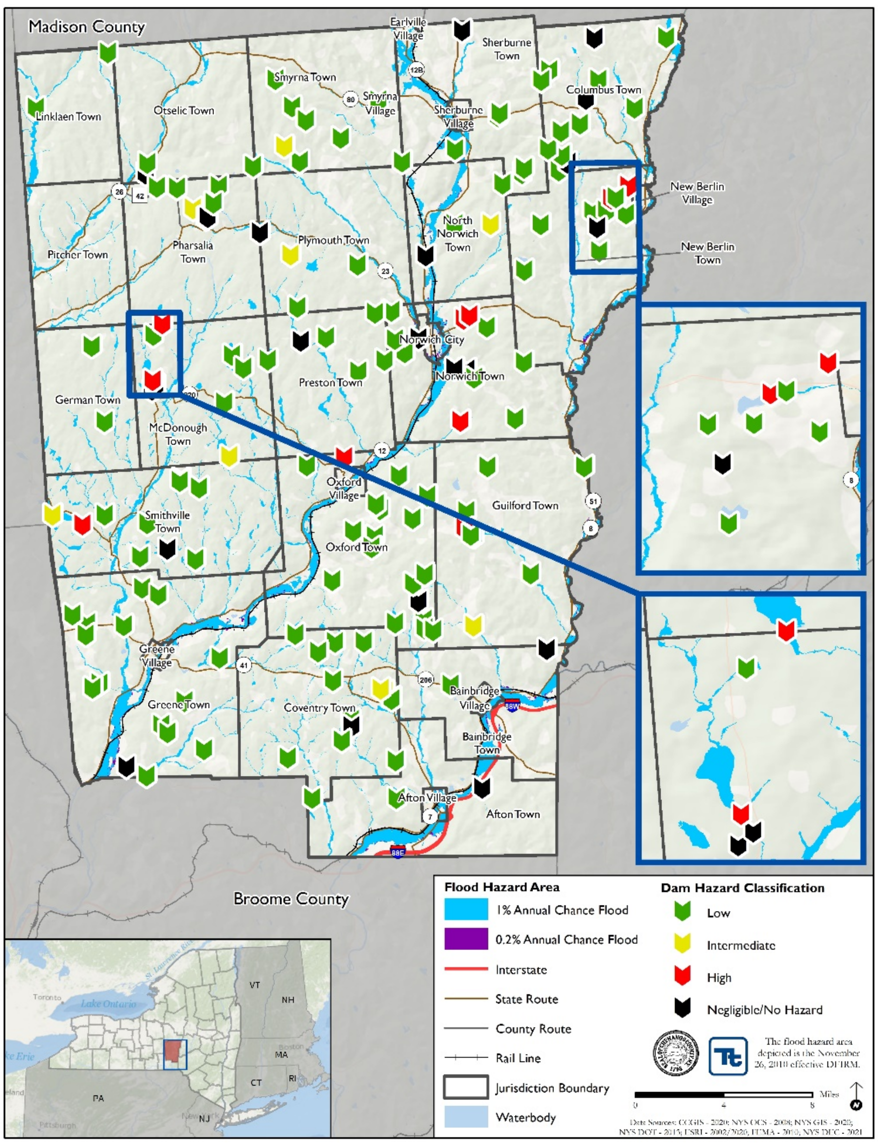
- *Low Hazard (Class A)* is a dam located in an area where failure will damage nothing more than isolated buildings, undeveloped lands, or township or county roads and/or will cause no significant economic loss or serious environmental damage. Failure or operation problems would result in no probable 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 could 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 operation problems would result in no probable loss of human life but can cause economic loss, environmental damage, disruption of

lifeline facilities, or impact other concerns. Class B dams often are located in predominantly rural or agricultural areas but also can be located in areas with population and significant infrastructure.

- *High Hazard (Class C)* is a dam located in an area where failure might 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.

The New York State Inventory of Dams, identifies 158 dams in Chenango County: 118 low hazard, 9 intermediate hazard, 10 high hazard, 18 negligible or no hazard classification, and 3 with an unknown classification (NYS DEC 2021). Figure 4-14 shows the dams in the County. Table 4-7 provides the list of dams located in Chenango County and associated information.

Figure 4-14. Dams Located in Chenango County



Source: *NYSDEC 2021*

Table 4-7. Dams Located in Chenango County

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
Mill Brook Site 1 Dam	Town of New Berlin	CHENANGO COUNTY	Flood Control and Storm Water Management	Class C - High Hazard	On File	7/9/2020	No deficiencies noted
Glenn Lake Dam	Town of Norwich	KERT STEWARD	Recreation	Class C - High Hazard	On File	5/15/2019	Deficiently maintained
Guilford Lake Dam	Town of Guilford	TOWN OF GUILFORD	Water Supply - Primary	Class C - High Hazard	On File	5/15/2019	Unsound - Deficiency Recognized
Mill Brook Site 2 Dam	Town of New Berlin	TOWN OF NEW BERLIN	Flood Control and Storm Water Management	Class C - High Hazard	On File	7/9/2020	Unsound - More Analysis needed
Norwich Reservoir #1 Dam	Town of Norwich	CITY OF NORWICH	Water Supply - Primary	Class C - High Hazard	On File	7/9/2020	Unsound - More Analysis needed
Norwich Reservoir #2 Dam	Town of Norwich	CITY OF NORWICH	Water Supply - Primary	Class C - High Hazard	On File	7/9/2020	Unsound - More Analysis needed
Genegantslet Lake Dam	Town of McDonough	GENEGANTSLET LAKE ASSOC.	Recreation	Class C - High Hazard	On File	7/9/2020	Unsound - More Analysis needed
Balsam Swamp Dam	Town of Pharsalia	NYS DEC DIVISION OF LANDS & FORESTS	Fish and Wildlife Pond, Recreation	Class C - High Hazard	On File	7/15/2019	Deficiently maintained
Clarks Creek Dam	Town of Oxford	CHENANGO COUNTY	Flood Control and Storm Water Management	Class C - High Hazard	On File	7/9/2020	No deficiencies noted
Long Pond Dam	Town of Smithville	NYS DEC DIVISION OF LANDS & FORESTS	Fish and Wildlife Pond, Recreation	Class C - High Hazard	On File	9/25/2020	Unsound - Deficiency Recognized
Howard Jeffrey Dam	Town of North Norwich	NYS DEC DIVISION OF LANDS & FORESTS	Other	Class B - Intermediate Hazard	On File	7/15/2019	Deficiently maintained
Bainbridge Reservoir Dam	Town of Guilford	FRANCIS COWEN	Water Supply - Primary	Class B - Intermediate Hazard	None	5/15/2019	Unsound - Deficiency Recognized
Jackson Pond Dam	Town of Pharsalia	NYS DEC - DIVISION OF FISH AND WILDLIFE	Other	Class B - Intermediate Hazard	On File	7/15/2019	Deficiently maintained
Norwich Ymca Recreation Pond Dam	Town of Smyrna	NORWICH YMCA	Recreation	Class B - Intermediate Hazard	On File	7/15/2019	Unsound - More Analysis needed
Plymouth Reservoir Dam	Town of Plymouth	PLYMOUTH RESERVOIR ASSOCIATION	Recreation	Class B - Intermediate Hazard	On File	5/15/2019	Deficiently maintained
Lake Ludlow Club Dam	Town of McDonough	LAKE LUDLOW CLUB INC	Recreation	Class B - Intermediate Hazard	On File	10/17/2018	Deficiently maintained
Genegantslet Creek Project Dam 2a	Town of Smithville	To Be Determined – privately owned	Flood Control and Storm Water Management, Recreation	Class B - Intermediate Hazard	On File	5/15/2019	Unsound - More Analysis needed

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
James Vance Wildlife Dam	Town of Coventry	JAMES VANCE	Recreation	Class B - Intermediate Hazard	On File	1/7/2021	Not Rated
Vanista Hollow Pond Dam	Town of Coventry	JAMES VANCE	Fish and Wildlife Pond, Recreation	Class B - Intermediate Hazard	On File	1/7/2021	Not Rated
Walter H Clark Marsh Dam	Town of Columbus	WALTER H CLARK	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Ransford Angell Wildlife Pond Dam	Town of New Berlin	RANSFORD ANGELL	Recreation	Class A - Low Hazard	None	7/12/1999	Not Rated
Walter Whitney Pond Dam	Town of New Berlin	WALTER WHITNEY	Fire Protection, Stock, Or Small Farm Pond, Recreation	Class A - Low Hazard	None	5/15/1975	Not Rated
Robert C Vester Pond Dam	Town of Columbus	ROBERT C VESTER	Recreation	Class A - Low Hazard	None	5/8/1997	Not Rated
J Ellsworth Rowe Farm Pond Dam	Town of New Berlin	J ELLSWORTH ROWE	Fire Protection, Stock, Or Small Farm Pond, Recreation	Class A - Low Hazard	None	5/15/1975	Not Rated
John Panaro Pond Dam	Town of Sherburne	JOHN PANARO	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Greville Haslam Wildlife Marsh Dam	Town of Columbus	GREVILLE HASLAM	Other	Class A - Low Hazard	None	4/30/1975	Not Rated
John W Scheurman Farm Pond Dam	Town of Columbus	JOHN SCHEUERMAN	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Charles Husted Pond Dam	Town of North Norwich	CHARLES HUSTED	Recreation	Class A - Low Hazard	None	5/15/1975	Not Rated
Chenango Lake Dam	Town of New Berlin	CITY OF NORWICH	Recreation, Water Supply - Secondary	Class A - Low Hazard	None	7/14/1999	Not Rated
Hunts Pond Dam	Town of New Berlin	NYS PARKS & RECREATION CENTRAL NEW YORK	Recreation	Class A - Low Hazard	None	8/26/2003	Not Rated
Jeffrey Kramer Pond Dam	Town of Columbus	JEFFREY KRAMER	Recreation	Class A - Low Hazard	None	10/1/1996	Not Rated
Whites Pond Dam	Town of New Berlin	MASON WHITE	Recreation	Class A - Low Hazard	None	6/3/1999	Not Rated
Rockwell Mills Dams	Not Found	I ROCKWELL	Hydroelectric	Class A - Low Hazard	None	12/31/1901	Not Rated
Richard Goodwin Wildlife Pond Dam	Town of Guilford	RICHARD GOODWIN	Recreation	Class A - Low Hazard	None	5/16/1975	Not Rated
Theodore J Roodhof Farm Pond Dam	Town of Norwich	THEODORE J ROODHOF	Other	Class A - Low Hazard	None	5/7/1997	Not Rated
Robert Wahlberg Dam	Town of Guilford	MIBY KIM	Recreation	Class A - Low Hazard	None	5/8/1997	Not Rated
Donald Brown Wildlife Pond Dam	Town of Columbus	DONALD BROWN	Fire Protection, Stock, Or Small Farm Pond, Recreation, Water Supply - Primary	Class A - Low Hazard	None	4/30/1975	Not Rated
Rufus C Wells Pond Dam	Town of Norwich	RUFUS C WELLS	Recreation, Water Supply - Primary	Class A - Low Hazard	None	6/3/1999	Not Rated

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
Rocky Postglion Pond Dam	Town of Columbus	ROCKY POSTGLION	Fire Protection, Stock, Or Small Farm Pond, Water Supply - Primary	Class A - Low Hazard	None	7/12/1999	Not Rated
Charles Brunschmid Wildlife Pond Dam	Town of Columbus	CHARLES BRUNSCHMID	Recreation	Class A - Low Hazard	None	7/22/1999	Not Rated
Orvell Presnell Wildlife Marsh Dam	Town of Sherburne	ORVELL PRESNELL	Recreation	Class A - Low Hazard	None	6/24/1999	Not Rated
Hill, Winton & Bagnall Marsh Dam	Town of Columbus	DONALD HILL	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Moses Bros Dam	Town of Guilford	MOSES BROTHERS	Hydroelectric	Class A - Low Hazard	None	12/31/1901	Not Rated
Moses Bros Dam #2+	Town of Guilford	MOSES BROTHERS	Hydroelectric	Class A - Low Hazard	None	12/31/1901	Not Rated
Sheldons Dam	Town of Guilford	MR SHELDON	Hydroelectric	Class A - Low Hazard	None	12/31/1901	Not Rated
Sidney Water Co Dam	Town of Guilford	SIDNEY WATER COMPANY	Other	Class A - Low Hazard	None	12/31/1901	Not Rated
Sherburne Lower Reservoir Dam	Town of Sherburne	VILLAGE OF SHERBURNE	Water Supply - Secondary	Class A - Low Hazard	On File	7/15/2019	Unsound - Deficiency Recognized
Sherburne Upper Reservoir Dam	Town of Sherburne	VILLAGE OF SHERBURNE	Water Supply - Secondary	Class A - Low Hazard	On File	7/15/2019	Unsound - Deficiency Recognized
New Berlin Dam	Town of New Berlin	Village of New Berlin	Recreation	Class A - Low Hazard	None	10/18/2018	Deficiently maintained
John Scheuerman Wildlife Area Dam	Town of Columbus	JOHN SCHEUERMAN	Other	Class A - Low Hazard	None	4/30/1975	Not Rated
Andrew Buckley Dam	Town of New Berlin	ANDREW BUCKLEY	Other	Class A - Low Hazard	None	5/8/1997	Not Rated
John Micha Dam	Town of Greene	SHIRLEY MICHA	Other	Class A - Low Hazard	None	10/3/1996	Not Rated
Wilburs Dam	Town of Preston	J E WILBUR	Other	Class A - Low Hazard	None	9/16/1975	Not Rated
B F Gladding Dam	Town of Pharsalia	B F GLADDING & COMPANY INC	Irrigation	Class A - Low Hazard	None	4/30/1975	Not Rated
Sherburne Four Corners Dam	Town of Smyrna	STANDARD DAIRY COMPANY	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Peter Greseck Pond Dam	Town of Sherburne	PETER GRESECK	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Francis J Oates Wildlife Dam	Town of Otselic	FRANCIS J OATES	Recreation	Class A - Low Hazard	None	12/31/1901	Not Rated
Norwich High School Wildlife Pond Dam	Town of Norwich	NORWICH HIGH SCHOOL	Recreation	Class A - Low Hazard	None	7/14/1999	Not Rated
Gordon Symonds Wildlife Pond Dam	Town of Smyrna	GORDON SYMONDS	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Pharsalia Game Mgt Marsh Dam	Town of Pharsalia	NYS DEC	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
L Shaffer & S Coy Marsh Dam	Town of McDonough	LEROY SHAFFER	Recreation	Class A - Low Hazard	None	4/17/1975	Not Rated
Chenango State Land Marsh Dam #2	Town of Smyrna	NYS DEC	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Pharsalia Refuge Marsh Dam #2	Town of Pharsalia	NYS DEC	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Lost Pond Wildlife Marsh Dam	Town of Preston	LOST POND INC	Recreation	Class A - Low Hazard	None	4/17/1975	Not Rated
Chenango 1 Wildlife Marsh Dam	Town of McDonough	NYS DEC	Recreation	Class A - Low Hazard	None	11/20/2012	Not Rated
Bowman Creek Dam	Town of McDonough	NYS PARKS & RECREATION BOWMAN	Recreation	Class A - Low Hazard	None	7/2/2001	Not Rated
Boy Scouts Troop #67 Pond Dam	Town of Smyrna	BOY SCOUTS OF AMERICA TROOP #67	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Rev Woodrow Brown Dam	Town of Smyrna	George & Sharon Fidler, Evan Stieglitz	Recreation	Class A - Low Hazard	None	9/5/2019	Not Rated
Harold C Miller Recreational Pond Dam	Not Found	HAROLD C MILLER	Recreation	Class A - Low Hazard	None	7/2/1998	Not Rated
Richard A Hamstra Recreational Pond Dam	Not Found	RICHARD A HAMSTRA	Recreation	Class A - Low Hazard	None	5/8/1997	Not Rated
Steer Pond Dam	Town of Preston	LAKE STEER CLUB	Recreation	Class A - Low Hazard	None	5/8/1997	Not Rated
Triah Lake Dam	Not Found	GARY JAKE BAYS	Fish and Wildlife Pond	Class A - Low Hazard	None		Not Rated
Bennettville Milk Dam	Not Found	BRITON NORTON	Other	Class A - Low Hazard	None	12/31/1901	Not Rated
Truitt Bros Dam	Not Found	WILLIAM H WEBER	Recreation	Class A - Low Hazard	None	7/1/1998	Not Rated
J P Mclaughlin Dam	Not Found	J P MCLAUGHLIN	Recreation	Class A - Low Hazard	None	12/31/1901	Not Rated
Charles Lay Wildlife Area Dam	Not Found	CHARLES LAY	Recreation	Class A - Low Hazard	None	4/17/1975	Not Rated
Albert Hill Wildlife Marsh Dam	Not Found	ALBERT HILL	Recreation	Class A - Low Hazard	None	5/15/1975	Not Rated
Woods Brothers Farm Pond Dam	Not Found	WOODS BROTHERS	Fire Protection, Stock, Or Small Farm Pond, Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated
George Comings Wildlife Pond Dam	Not Found	GEORGE COMINGS	Fire Protection, Stock, Or Small Farm Pond, Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated
George Cummings Farm Pond Dam	Not Found	GEORGE CUMMINGS	Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated
Harry Holgerson Wildlife Pond Dam	Not Found	ROBERT PLACE	Recreation	Class A - Low Hazard	None	6/23/1999	Not Rated
Clifford Frank Wildlife Pond Dam	Not Found	CLIFFORD FRANK	Recreation	Class A - Low Hazard	None	5/16/1975	Not Rated
Thomas L Ryan Pond Dam	Not Found	THOMAS L RYAN	Fire Protection, Stock, Or Small Farm Pond, Recreation	Class A - Low Hazard	None	5/16/1975	Not Rated

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
Fred J Schiedegger Marsh Dam	Not Found	FRED J SCHIEDEGGER	Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated
Claud Beckwith Dam	Town of McDonough	CLAUD BECKWITH	Hydroelectric, Recreation	Class A - Low Hazard	None	12/31/1901	Not Rated
Knapp Pond Dam	Town of Lincklaen	BOY SCOUTS OF AMERICA TIOUGHNIOGA COUNCIL	Recreation	Class A - Low Hazard	None	12/31/1901	Not Rated
John Washburn Farm Pond Dam	Not Found	JOHN WASHBURN	Recreation	Class A - Low Hazard	None	5/6/1975	Not Rated
Henry Drexler Farm Pond Dam	Not Found	HENRY DREXLER	Fire Protection, Stock, Or Small Farm Pond, Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Louis Dunckel Dam	Not Found	LOUIS DUNCKEL	Fire Protection, Stock, Or Small Farm Pond	Class A - Low Hazard	None	10/2/1996	Not Rated
Edmund K Willcox Pond Dam	Not Found	EDMUND K WILLCOX	Fire Protection, Stock, Or Small Farm Pond, Recreation	Class A - Low Hazard	None	5/15/1975	Not Rated
Lake Lorraine Dam	Town of Preston	Lake Lorraine Property Owners Association, Lake Lorraine Property Owners Association	Recreation	Class A - Low Hazard	None	10/17/2018	Not Rated
Leon Kramnich Wildlife Dam	Not Found	LEON KRAMNICH	Other	Class A - Low Hazard	None	5/6/1980	Not Rated
Maurice Ireland Marsh Dam	Not Found	MAURICE IRELAND	Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated
Michael Mader Pond Dam	Not Found	MICHAEL MADER	Fire Protection, Stock, Or Small Farm Pond	Class A - Low Hazard	None	5/16/1975	Not Rated
Aubrey Elliot Wildlife Dam	Not Found	AUBREY ELLIOT	Recreation	Class A - Low Hazard	None	5/6/1980	Not Rated
Thomas L Ryan Dam	Not Found	THOMAS L RYAN	Other	Class A - Low Hazard	None	5/6/1980	Not Rated
Green & Wilbur Wildlife Pond Dam	Town of Coventry	FOSTER & DEBORAH CRUM	Recreation	Class A - Low Hazard	None	8/25/2003	Not Rated
E Hosher Wildlife Pond Dam	Not Found	EVERETT HOSHER	Recreation	Class A - Low Hazard	None	4/17/1975	Not Rated
Theodore Ruck Pond Dam	Not Found	THEODORE RUCK	Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated
Walter Elson Pond Dam	Not Found	WALTER ELSON	Recreation	Class A - Low Hazard	None	7/1/1998	Not Rated
Leon Davis Wildlife Pond Dam	Town of Pharsalia	LEON DAVIS	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Chenango 17 Wildlife Pond Dam	Town of German	NYS DEC	Fish and Wildlife Pond	Class A - Low Hazard	None	6/28/2011	Not Rated
Emory East Farm Pond Dam	Town of Lincklaen	EMORY EAST	Recreation	Class A - Low Hazard	None	4/30/1975	Not Rated
Mccomb, Bottle & Bottle Wl Marsh Dam	Town of Smithville	CHARLES MCCOMB	Recreation	Class A - Low Hazard	None	5/7/1975	Not Rated
Greene Rod & Gun Club Wildlife Pnd Dam	Town of Greene	GREENE ROD & GUN CLUB	Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated

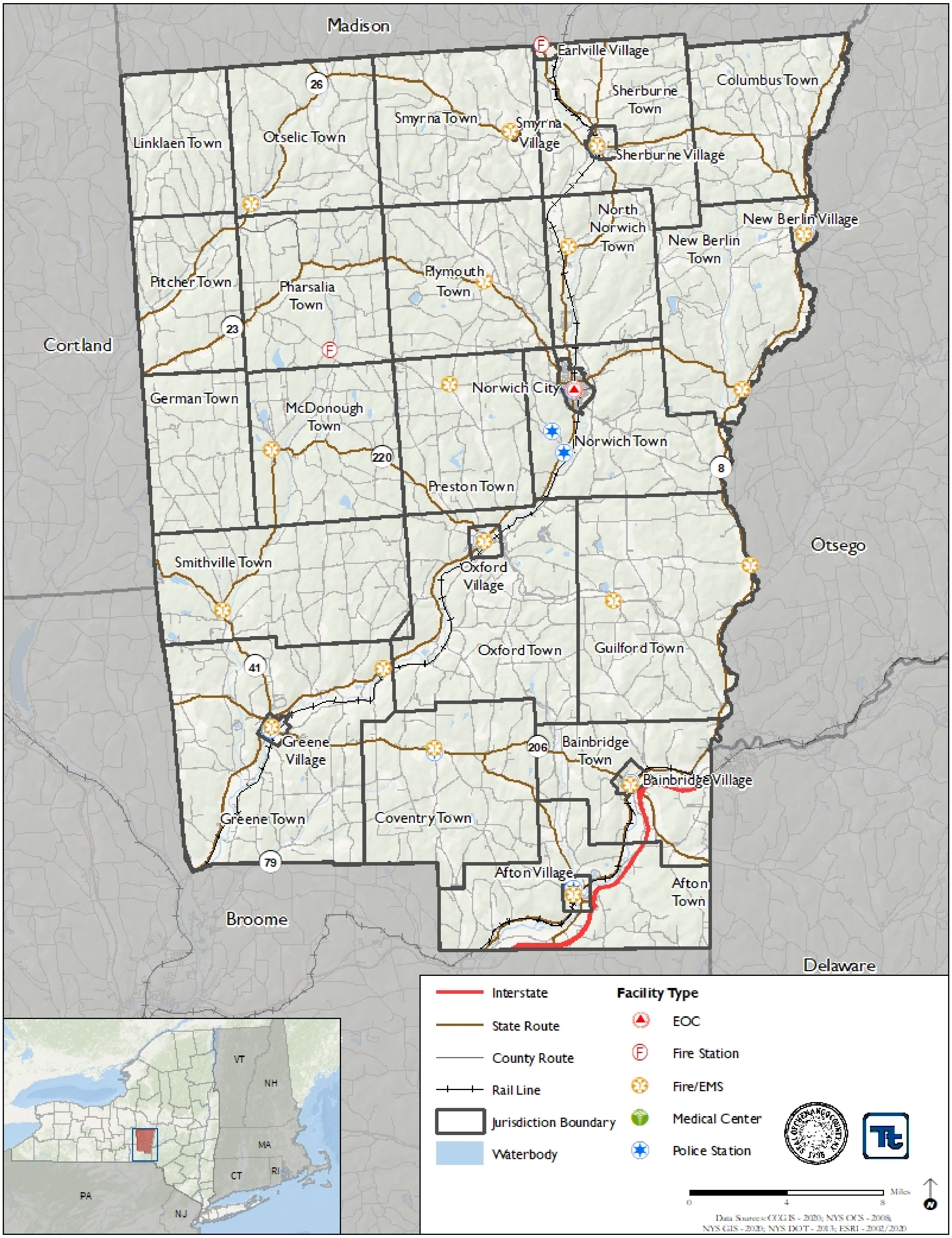
Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
Chenango 19 Wildlife Marsh Dam	Town of German	NYS DEC	Recreation	Class A - Low Hazard	None	4/16/1975	Not Rated
Marshall Seymour Pond Dam	Not Found	MARSHALL SEYMOUR	Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated
William Happich Farm Pond Dam	Not Found	WILLIAM HAPPICH	Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated
Otto K Nelson Pond Dam	Not Found	Not Found	Recreation	Class A - Low Hazard	None	5/7/1997	Not Rated
Douglass S Muzzy Pond Dam	Not Found	DOUGLASS S MUZZY	Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated
Leonard Lee Recreational Pond Dam	Not Found	BETINA THOMAS	Recreation	Class A - Low Hazard	None	5/7/1997	Not Rated
Dr Erwin Centerwall Rec Pond Dam	Not Found	DR ERWIN CENTERWALL	Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated
Y CAMP DAM	Town of Pharsalia	NYS DEC	Fish and Wildlife Pond	Class A - Low Hazard	None	11/20/2012	Not Rated
Chenango County Pond Dams A & B	Not Found	CHENANGO COUNTY	Recreation	Class A - Low Hazard	None	7/1/1998	Not Rated
George S Ryan Farm Pond Dam	Not Found	GEORGE S RYAN	Fire Protection, Stock, Or Small Farm Pond, Recreation	Class A - Low Hazard	None	4/16/1975	Not Rated
Richard Ryan Farm Pond Dam	Not Found	RICHARD RYAN	Recreation	Class A - Low Hazard	None	5/16/1975	Not Rated
Vincent Weidman Pond Dam	Not Found	TESSIE WEIDMAN	Fire Protection, Stock, Or Small Farm Pond	Class A - Low Hazard	None	7/1/1998	Not Rated
Maurice B Ireland Farm Pond Dam	Not Found	MAURICE B IRELAND	Fire Protection, Stock, Or Small Farm Pond	Class A - Low Hazard	None	5/1/1975	Not Rated
Robert F Howe Wildlife Marsh Dam	Not Found	ROBERT F HOWE	Recreation	Class A - Low Hazard	None	5/6/1975	Not Rated
Francis G Stehli Recreational Dam	Not Found	FRANCIS G STEHLI	Recreation	Class A - Low Hazard	None	5/8/1975	Not Rated
Francis Stehli Fish Pond Dam	Not Found	FRANCIS G STEHLI	Recreation	Class A - Low Hazard	None	12/31/1901	Not Rated
Berry Hill Hunting Club Dam	Not Found	BERRY HILL HUNTING CLUB	Recreation	Class A - Low Hazard	None	7/1/1998	Not Rated
Echo Lake Dam	Town of Coventry	THE AMANY CORPORATION	Recreation	Class A - Low Hazard	None	12/27/2019	Not Rated
Brackett Lake Dam	Town of Oxford	JOSEPH ST LAWRENCE	Recreation	Class A - Low Hazard	None	8/21/2012	Not Rated
Lake Gerry Dam	Not Found	LARRY SAYLES	Recreation	Class A - Low Hazard	None	5/31/1994	Not Rated
Trestle Lake Dam	Not Found	CARL MARRONE	Recreation	Class A - Low Hazard	None	8/18/1995	Not Rated
Smith Pond Dam	Town of Coventry	Jean and Matthew Wichlinski, William Manning & Juliza Manrique	Recreation	Class A - Low Hazard	None	11/26/2019	Not Rated
Echo Lake Dam #2	Town of Coventry	THE AMANY CORPORATION	Other	Class A - Low Hazard	None	12/31/1901	Not Rated

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
George & Karen Lowe Pond Dam	Town of Smithville	GEORGE & KAREN LOWE	Fish and Wildlife Pond	Class A - Low Hazard	None		Not Rated
Tank Pond Dam	Not Found	MICHAEL LANGE	Recreation	Class A - Low Hazard	None		Not Rated
Clifford Taft Pond Dam	Not Found	CLIFFORD TAFT	Recreation	Class A - Low Hazard	None	5/10/1975	Not Rated
William Fairchild Wildlife Pond Dam	Town of Smithville	WILLIAM FAIRCHILD	Recreation	Class A - Low Hazard	None	5/7/1975	Not Rated
Swift Tarbell Wildlife Pond Dam	Town of Smithville	SWIFT TARBELL	Recreation	Class A - Low Hazard	None	5/7/1975	Not Rated
D H Herbert Wildlife Marsh Dam	Not Found	D H HERBERT SR	Recreation	Class A - Low Hazard	None	5/1/1975	Not Rated
William Gruhler Farm Pond Dam	Not Found	WILLIAM GRUHLER	Recreation	Class A - Low Hazard	None	5/6/1975	Not Rated
WILLOW KEEP DAM	Town of Coventry	JAMES BISSETT	Recreation	Class A - Low Hazard	None	10/17/2018	Not Rated
SOUTH OTSELIC DAM	Town of Otselic	NYS DEC - DIVISION OF FISH AND WILDLIFE	Water Supply - Primary	Class A - Low Hazard	None		Not Rated
Lewis N Austin Wildlife Pond Dam	Town of New Berlin	LEWIS N AUSTIN	Fire Protection, Stock, Or Small Farm Pond, Recreation, Water Supply - Primary	Unknown	None	5/15/1975	Not Rated
Paino, Baker & Glider Marsh Dam	Town of Pharsalia	FRANK PAINO	Fish and Wildlife Pond	Unknown	None	4/30/1975	Not Rated
Clayton Hadley Farm Pond Dam	Not Found	CLAYTON HADLEY	Fire Protection, Stock, Or Small Farm Pond	Unknown	None	4/30/1975	Not Rated
Sidney Reservoir Dam	Town of Bainbridge	VILLAGE OF SIDNEY	Water Supply - Secondary	Class D - Negligible or No Hazard	On File	9/4/2019	Unsound - Deficiency Recognized
Leafland Inc Recreational Pond Dam	Not Found	LEAFLAND INC	Recreation	Class D - Negligible or No Hazard	None	5/14/1980	Not Rated
Richard Hillebrand Pond Dam	Not Found	RICHARD HILLEBRAND	Recreation	Class D - Negligible or No Hazard	None	5/15/1975	Not Rated
Walter Hart Marsh Dam	Not Found	WALTER HART	Recreation	Class D - Negligible or No Hazard	None	5/6/1988	Not Rated
Raymond Merrill Wildlife Pond Dam	Not Found	RAYMOND MERRILL	Recreation	Class D - Negligible or No Hazard	None	7/12/1999	Not Rated
(117-0604)	Not Found	Not Found	Other	Class D - Negligible or No Hazard	None	4/16/1975	Not Rated
(117-0706)	Not Found	Not Found	Other	Class D - Negligible or No Hazard	None	4/30/1975	Not Rated

Dam Name	Location	Owner	Purpose	Classification	EAP?	Last Inspected	Condition
(105-0555)	Not Found	Not Found	Other	Class D - Negligible or No Hazard	None	4/16/1975	Not Rated
(105-0600)	Not Found	Not Found	Other	Class D - Negligible or No Hazard	None		Not Rated
(105-0622)	Not Found	Not Found	Other	Class D - Negligible or No Hazard	None	5/15/1975	Not Rated
American Legion Pool Dam	Town of Norwich	AMERICAN LEGION NORWICH POST	Recreation	Class D - Negligible or No Hazard	None	4/17/1975	Not Rated
Chenango 7 Wildlife Pond Dam	Town of Oxford	NYS DEC	Recreation	Class D - Negligible or No Hazard	None	7/16/2013	Not Rated
(094-0490)	Town of McDonough	Not Found	Other	Class D - Negligible or No Hazard	None	4/17/1975	Not Rated
Purdy Dam	Town of McDonough	CHARLES PURDY	Other	Class D - Negligible or No Hazard	None	4/16/1975	Not Rated
(094-0570)	Town of Otselic	Not Found	Other	Class D - Negligible or No Hazard	None	4/30/1975	Not Rated
Carl L Sirianni Pond Dam	Town of Smithville	CARL SIRIANNI	Recreation	Class D - Negligible or No Hazard	None	5/7/1975	Not Rated
Geoffrey M Gear Recreational Lake Dam	Town of Greene	GEOFFREY M GEAR	Other	Class D - Negligible or No Hazard	None	4/29/1980	Not Rated
Walter Gorman Pond Dam	Town of Coventry	WALTER GORMAN	Recreation	Class D - Negligible or No Hazard	None	5/6/1975	Not Rated

Source: NYSDEC 2021

Figure 4-15. Emergency Facilities in Chenango County



4.6.2 Food, Water, and Shelter

Food, water, and shelter community lifelines include facilities related to food services, water supply, sheltering facilities, and agriculture. For the purpose of this plan, food, water and shelter facilities include: schools, shelters, potable water, and wastewater facilities. This is shown in Figure 4-16 through Figure 4-18.

Schools

According to the New York State Education Department there are nine (9) public school districts that serve the County with a total enrollment of 6,955 students. This represents a decrease from the 2012-2013 school year, when there were 7,523 students. One of the nine school districts is located outside of the County (Gilbertsville-Mt. Upton). In addition, Chenango County is home to a campus of SUNY Morrisville in Norwich. The Delaware, Chenango, Madison, Otsego Board of Cooperative Educational Services (BOCES), located in North Norwich, provides services to area school districts including adult and continuing education and training programs for area businesses. Chenango County also offers nursery school, pre-school and after-school programs. There are 20 schools located in Chenango County. Figure 4-16 displays the locations of these schools.

Shelters

With support and cooperation of the American Red Cross and local jurisdictions, the County references an inventory of suitable shelter locations and can assist with the coordination and communication of shelter availability as necessitated by the execution of local municipal emergency operation plans. Figure 4-17 displays the location of these facilities.

Potable Water

According to the Chenango County's Department of Environmental Health, the following maintain public water systems: Villages of Afton, Bainbridge, Greene, New Berlin, Oxford, Sherburne, and Smyrna; City of Norwich; and Guilford, Mount Upton, South New Berlin, and South Otselic water districts. Due to heightened security concerns, the locations of the groundwater wells and surface water sources for municipal water supplies were not provided. However, based on the approximate population serviced by municipal water sources, at least 31,000 residents obtain water from private water supplies (Sutton, 2007).

Wastewater Facilities

Chenango County has six public waste discharge and sewage treatment facilities. They are located in the City of Norwich, and the Villages of Bainbridge, Greene, Oxford, Sherburne, and Smyrna. There are six wastewater treatment facilities and 21 wastewater pump stations in Chenango County. Figure 4-18 maps these facilities.

Figure 4-16. Schools in Chenango County, New York

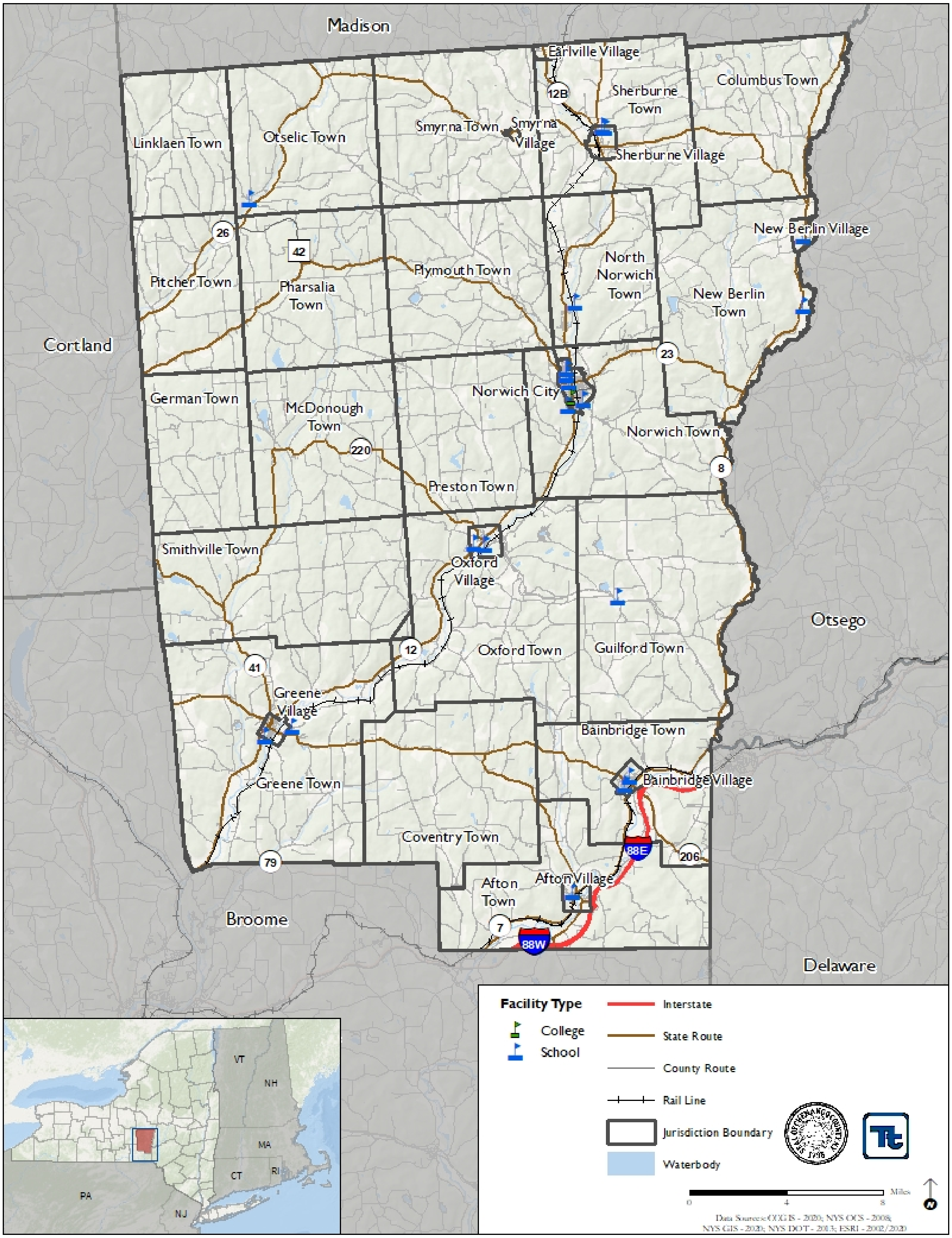


Figure 4-17. Senior Facilities and Shelters in Chenango County, New York

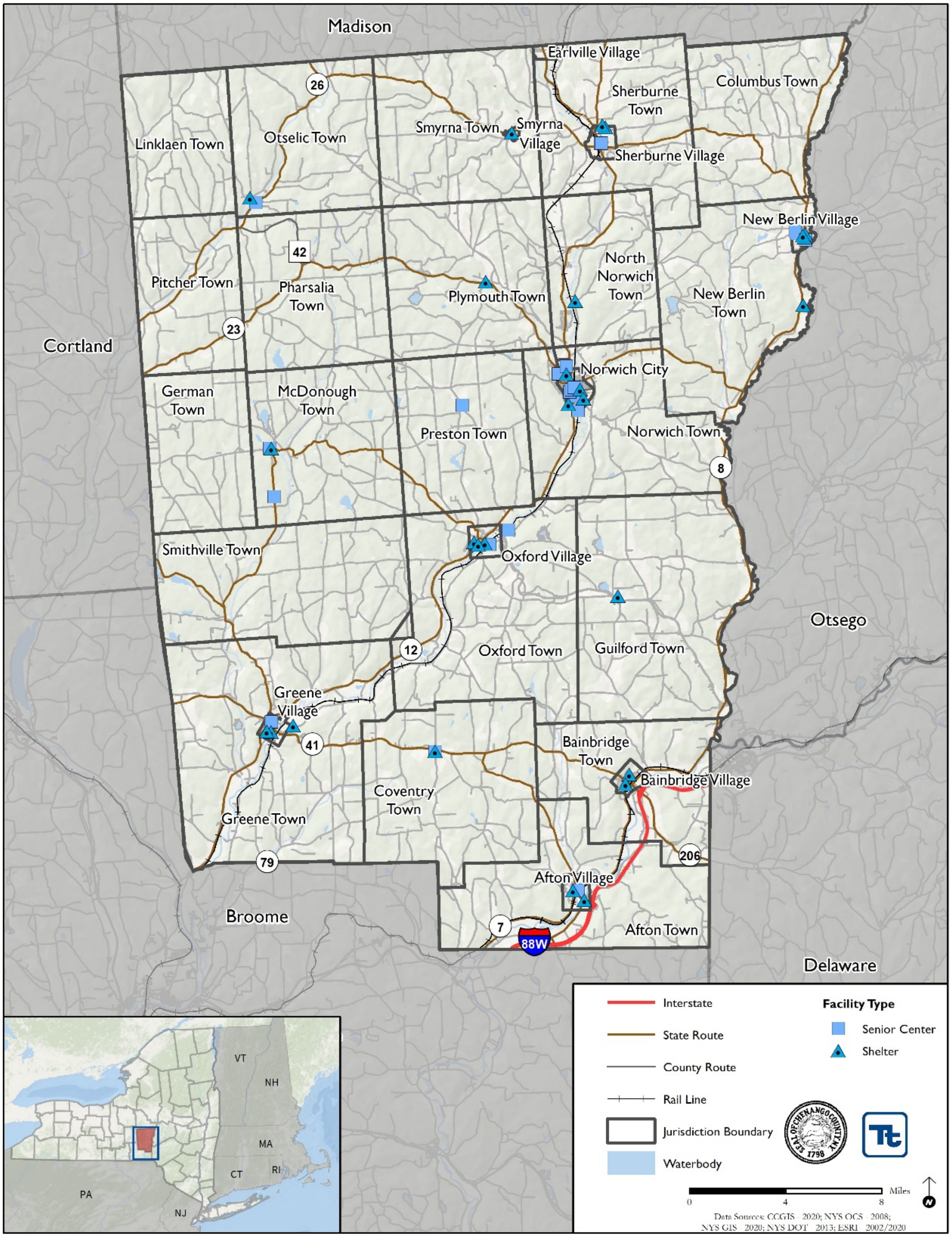
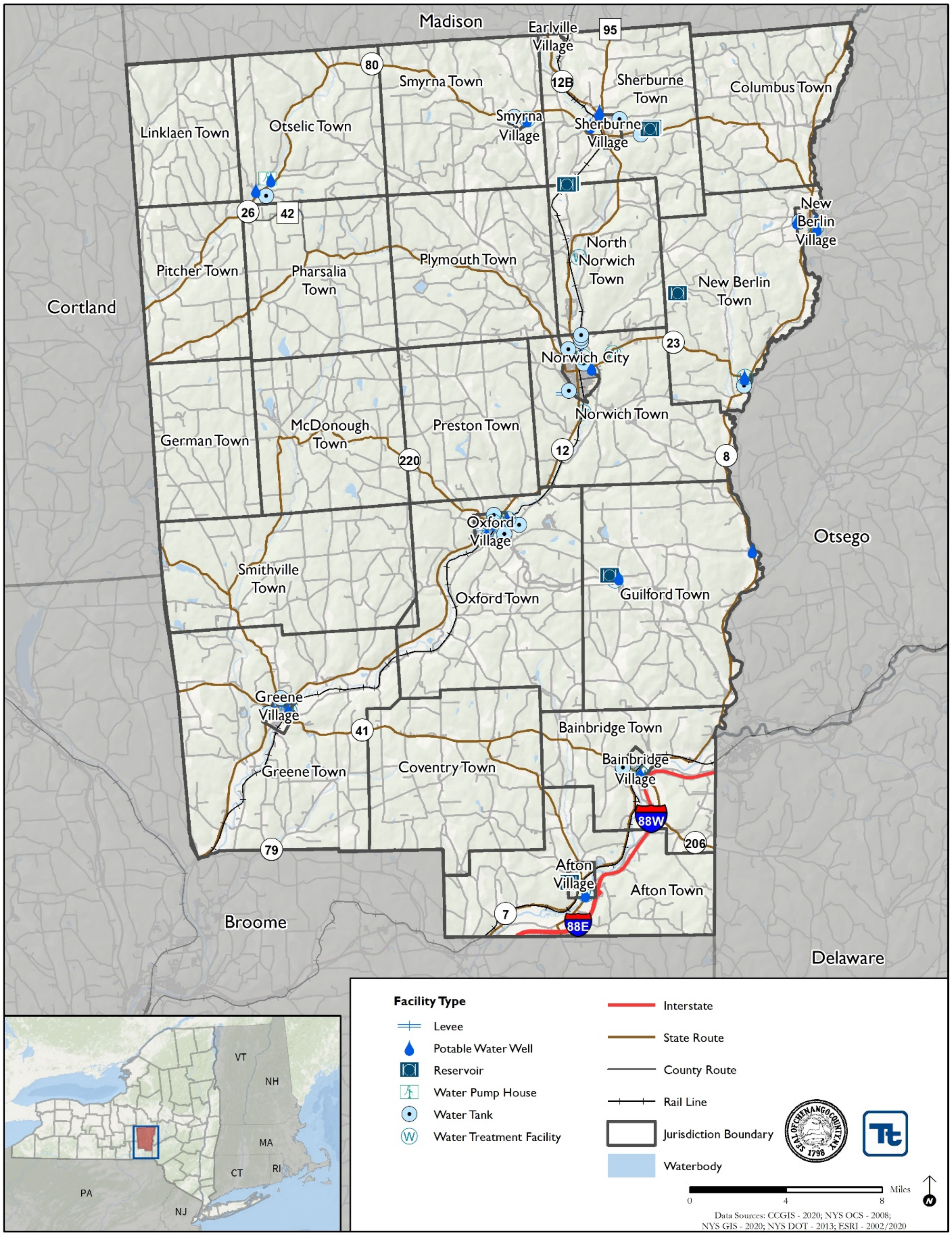


Figure 4-18. Water Utilities in Chenango County



4.6.3 Health and Medical

Health and medical community lifelines include facilities related to medical care, patient moving, public health, fatality management, and medical supply chain. For the purpose of this plan, health and medical facilities include: hospitals and medical facilities.

Hospitals and Medical Facilities

There are nine medical facilities located in Chenango County, include UHS Chenango Memorial Hospital.

4.6.4 Energy (Power and Fuel)

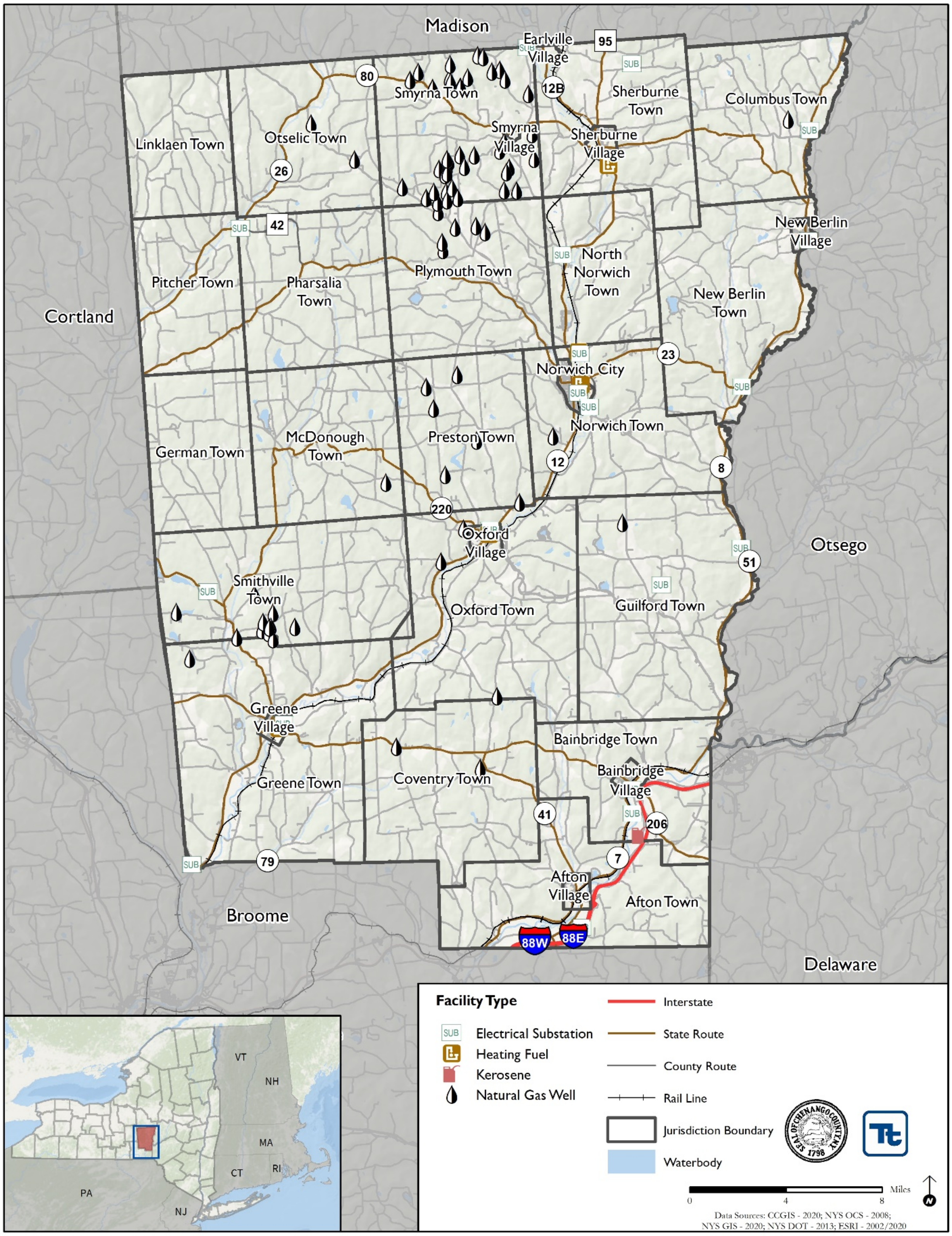
Energy community lifelines include facilities related to power and fuel. For the purpose of this plan, energy facilities include: energy resources. Due to heightened security concerns, local utility lifeline data needed to complete the analysis were only partially obtained.

Energy Resources

New York State Electric & Gas (NYSEG) is the primary electric and gas utility in Chenango County. In addition, the Village of Greene has two municipal electric power plants and NYSEG maintains a substation and compressor in the Town of Norwich. Electrical Substation, Natural Gas Well, and other energy resource locations are displayed in Figure 4-19. Additionally, there are the following natural gas resources within the County:

- Texas Eastern Products Pipeline Company (TEPPCO) pipeline runs east to west across Chenango County, through the Towns of McDonough, Preston, Oxford and Norwich (Planning Committee, 2007).
- The New York State Department of Environmental Conservation reports 43 active natural gas wells in the County. There are 201 wells in the database, with the remainder being cancelled, abandoned, having an expired permit, or other issues.
- EmKey Resources, LLC at this time operates a low-pressure natural gas gathering pipeline system connecting natural gas wells in the towns of Smyrna, Plymouth and Preston.
- EmKey Resources, LLC planned to construct a high-pressure pipeline from Madison County through the center of Chenango County into Broome County, in 2012. This would serve as future infrastructure to service additional natural gas wells in Chenango County and as a potential north/south connection to the east/west interstate natural gas lines in NYS. However, this project was halted shortly after the proposal.
- Construction was proposed for the interstate 30 inch, “Constitution” Natural Gas pipeline that would pass through the towns of Afton and Bainbridge from Pennsylvania connecting with the Iroquois Transmission pipeline in Schoharie County. The project has since been halted by the company proposing it.

Figure 4-19. Energy Utility Facilities in Chenango County



4.6.5 Communications

Communications community lifelines include facilities related to infrastructure; alerts, warnings and messages; 911 and dispatch; responder communications; and finance. For the purpose of this plan, communication facilities include: telephone and wireless communication services and public alert systems. Due to heightened security concerns, local utility lifeline data needed to complete the analysis were only partially obtained.

Communication Services

Telephone and wireless communication services are available in the County through a range of providers; specific information on these resources (wireless towers, providers, etc.) is not included in this plan because of the volume of information and diverse sources; also, emergency communications systems are maintained separately to support critical facility communications. Radio service is provided by Banjo Communications Group Inc. (Banjo Communications) and WCDO. Banjo Communications maintains three broadcast facilities within the Town of Norwich (Commerce Chenango, 2007; HAZUS-MH, 2005).

According to the Chenango County Comprehensive Emergency Management Plan, information and warnings to the public can be accomplished through the use of: NY Alert, the Emergency Alert System (EAS) (formerly known as Emergency Broadcast System), Hyper-Reach, NOAA Weather Radio (NWR), stationary fire sirens, and the Notify Chenango Emergency Notifications mobile app. EAS utilizes television, radio, and cable TV, to issue emergency warnings. NWR is the "All Hazards Radio Network" of the National Weather Service that provides continuous 24-hour radio broadcasts of the latest weather information including severe weather warnings directly from the Weather Service office in Binghamton. NWR will also broadcast emergency warnings and post event information, for all types of hazards, both natural and environmental, such as hazardous materials spills. NWR broadcasts on seven high-band FM frequencies, the local frequency being 162.525 Megahertz. Radios with NWR frequencies, automated alarm capabilities, and Specific Area Message Encoding (SAME) technology are generally available.

4.6.6 Transportation

Transportation community lifelines include facilities related to highway/roadways, mass transit, railway, aviation, and maritime. For the purpose of this plan, transportation facilities include: highways, roadways, airports, heliports, bus and other transit facilities, and railroads. These facilities are shown in Figure 4-20.

Highway, Roadways and Associated Systems

The Chenango County highway network encompasses approximately 304 miles including interstate, state, county and local highways, routes, and roads. The County's only interstate is Interstate Route 88 (I-88), which runs northeast-southwest through the Towns of Afton and Bainbridge in the southeast portion of the County. Major New York State Routes include Routes 7, 8, 12, 23, 41, 80 and 206 (Laberge Group, 2006; Long, 2007). Major County Routes that have been identified as possible evacuation routes include Routes 5, 7, 8, 10, 12, 13, 20, 29, 30, 32, and 39.

According to the Chenango County Economic Strategic Plan, other than I-88, the most important road in the County is New York State Route 12. This highway is a major north-south corridor that runs through the County providing easy access to the New York State Thruway, Interstates Routes 81, 88, and 86, and several of the larger communities, including Sherburne, Norwich, Oxford, and Greene (Laberge Group, 2006).

New York State Route 8 runs north to south along the County's eastern border. New York State Route 23 runs east to west through the County's center; New York State Route 80 runs east to west through the northern half of the County; and New York State Route 206 runs east to west through the southern half of the County. State roads generally have 55 mile per hour (mph) speed limits, except where they traverse populated areas and villages and the speed limit is lower (Laberge Group, 2006).

HAZUS-MH indicates there are 239 highway bridges present in the County.

Airports and Heliports

Chenango County includes 6 small airports and airfields. The Lt. Warren Eaton Airport is a county-owned general aviation airport located in the Town of North Norwich. Services provided at this airport include t-hangars, a jet hangar, fuel sales, and repairs (private company). In addition, there are five private airfields and landing areas located in the towns of: Afton, Columbus, Coventry, Greene and Sherburne. A small portion of the Sidney Airport is also located in the County. Public airports located within an hour's drive include the Binghamton Regional Airport in Binghamton, the Oneida City Airport in Utica, and the Hancock International Airport in Syracuse.

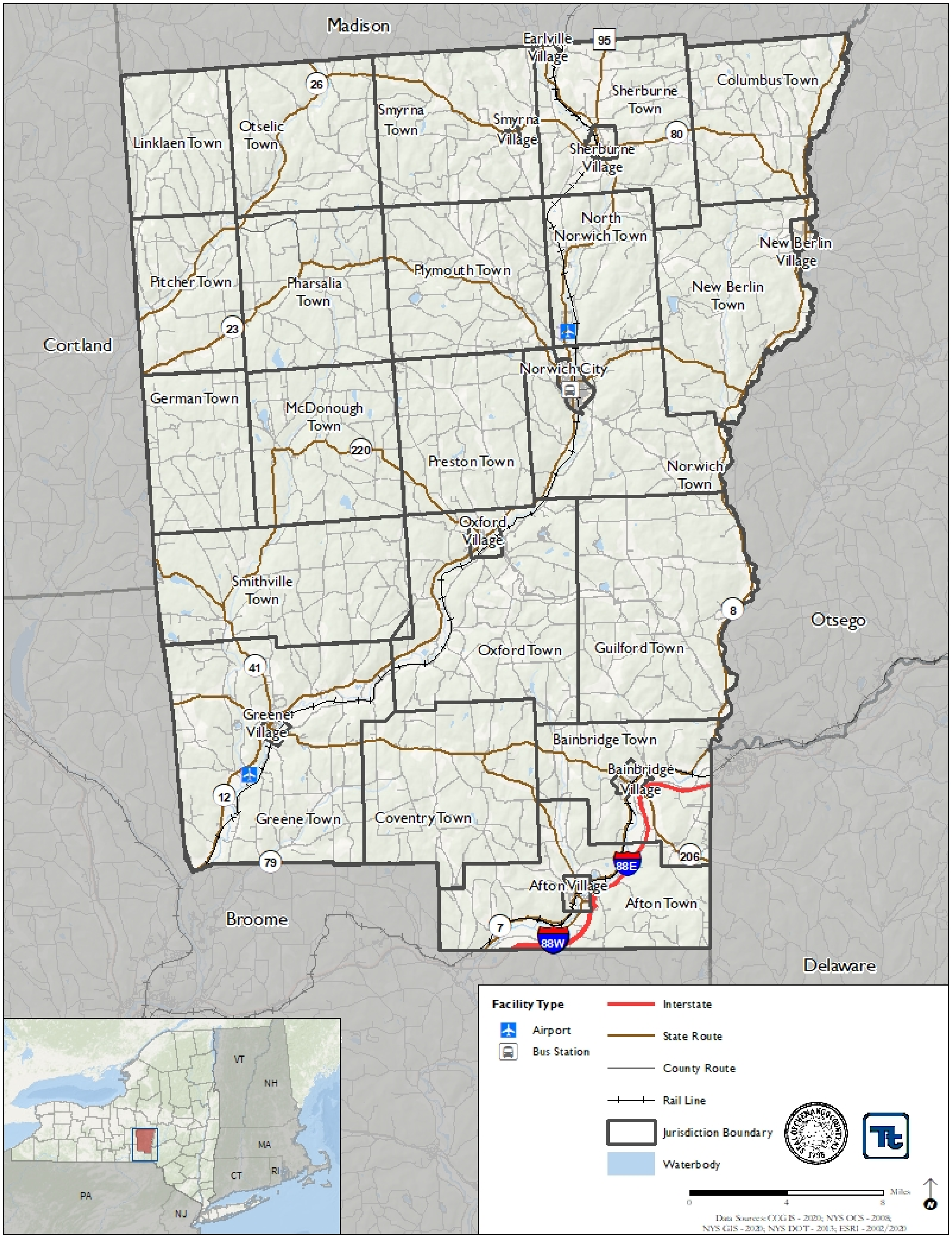
Bus and Other Transit Facilities

Chenango County Public Transit (CCPT) operated by First Transit provides fixed bus services to 15 of the 21 towns of Chenango County. Lincklaen, Pitcher, German, McDonough, and Smithville in the western section of the County do not have fixed service. Services provided by Christian Cares, American Cancer Society, Coach USA, Medicaid, and 511NY Rideshare service provide transportation services on a limited basis (Chenango County Coordinated Transportation Plan, 2019).

Railroad Facilities

Rail transportation in the County is used for freight only and is served by the New York Susquehanna & Western Railroad and the Delaware and Hudson Railway. Freight service is maintained on the New York Susquehanna and Western Railway between Binghamton and Utica. Connections are available to CSX Transportation in Syracuse and North Bergen, New Jersey; the Canadian Pacific Railway in Binghamton; and Norfolk Southern are in Binghamton, New York and Passaic Junction, New Jersey (Laberge Group, 2006). In addition, the Canadian Pacific Railway (Norfolk Southern Railway Co. owns the tracks) is a freight rail line that runs the Towns of Afton and Bainbridge (Long, 2007). In 2018, the rail lines along the Chenango River from Chenango Forks to Norwich that had been closed due to damage incurred in 2006 flooding events was reopened. On January 7, 1966, a mechanical flaw caused 39 rail cars to derail in the center of the Village of Bainbridge, causing extensive damages including two deaths, and property damages to four cars, the fire department and homes throughout the area.

Figure 4-20. Transportation Features in Chenango County, New York



4.6.7 Hazardous Materials

Hazardous material community lifelines include facilities related to hazardous material facilities or any type of hazardous materials, pollutants or contaminants. For the purpose of this plan, this includes: facilities that contain hazardous materials.

HAZMAT Facilities

A Superfund site consists of land in the United States that has been contaminated by hazardous waste and 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. These sites are placed on the National Priorities List (NPL), the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide EPA in determining which sites warrant further investigation.

Abandoned hazardous waste sites placed on the federal NPL include those that EPA has determined present *a significant risk to human health or the environment*, with the sites being eligible for remediation under the Superfund Trust Fund Program. As of 2018, Chenango County hosts one hazardous sites in the federal Superfund Program that is listed as on the NPL (CERCLIS 2018).

The EPA Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) (Superfund) Public Access Database (CPAD) reports that there are currently nine archived Superfund sites located in Broome County (CERCLIS 2018). An archived Superfund site is one that has no further interest under the Federal Superfund Program based on available information and is no longer part of the CERCLIS inventory. Archived and active Superfund sites are accessible through the same database but are differentiated by status.

In addition to the hazardous waste sites, there are numerous hazardous facilities in Chenango County cataloged by the NYSDEC's Bulk Storage Program Database. The Bulk Storage Program includes three types of facilities; Petroleum Bulk Storage (PBS), and Chemical Bulk Storage (CBS) that require registration with NYSDEC for all facilities with a total storage capacity of petroleum products of the following:

- PBS—1,100 gallons or more
- CBS underground tanks and all stationary aboveground tanks—185 gallons or more

As of April 2020, there are 1,520 sites listed in the NYSDEC's Bulk Storage Program Database in Chenango County, New York (NYSDEC 2020). The vast majority (95%) of these sites are petroleum bulk storage sites. The remaining 5% are chemical bulk storage sites.

4.6.8 Housing and Relocation

Chenango County and municipalities recognize the need to identify potential sites for temporary housing and relocation and ensuring residents are aware of these facilities is critical.

Temporary Housing

Chenango County has identified potential locations to be used as temporary housing for residents displaced by a disaster. Table 4-8 lists the locations of the potential temporary housing locations identified by each municipality. Municipalities that did not identify any temporary housing locations are not included in the table.

Table 4-8. Potential Temporary Housing Locations in Chenango County

Municipality	Location Name	Location Address
Chenango County	Super 8 Motel	6067 NY-12, Norwich, NY 13815
Chenango County	Norwich Motor Lodge	2-6 E Main St, Norwich, NY 13815
Chenango County	Red Roof Inn Hotel	75 N Broad St, Norwich, NY 13815
Afton (T)	Empty Lot Behind Town Hall	204 County Rd 39, Afton, NY 13730
Bainbridge (V)	Mobile Home Park	120 Paddock Park, Bainbridge, NY 13733
Greene (T)	Fire Station Parking Lot	8 N Canal St, Greene, NY 13778
Greene (T)	School Parking Lot	40 South Canal Street Greene, NY 13778
Guilford (T)	Town Hall/Highway Garage Parking Lot	223 Marble Road, Guilford, NY 13780
Guilford (T)	Mount Upton Park	1683 NY-8, Guilford, NJ 13809
Lincklaen (T)	Town Hall/Town Barn	651 Union Valley Lincklaen Rd, Deruyter, NY 13052
Lincklaen (T)	Lincklaen Mobile Park	Not Indicated
Oxford (V)	Oxford High School Parking Lot	50 S Washington Ave, Oxford, NY 13830
Plymouth (T)	Fields behind Firehouse	3461 State RTE 23 South Plymouth, NY 13844
Sherburne (V)	Sherburne Earlville School Field	15 School St, Sherburne, NY 13460
Smithville (T)	Eagle Scout Park	Eagle Scout Park Smithville Flats, NY 13841
Smyrna (T)	School House Apartments	2 E School St, Smyrna, NY 13464

Source: Chenango County Planning Partnership Input

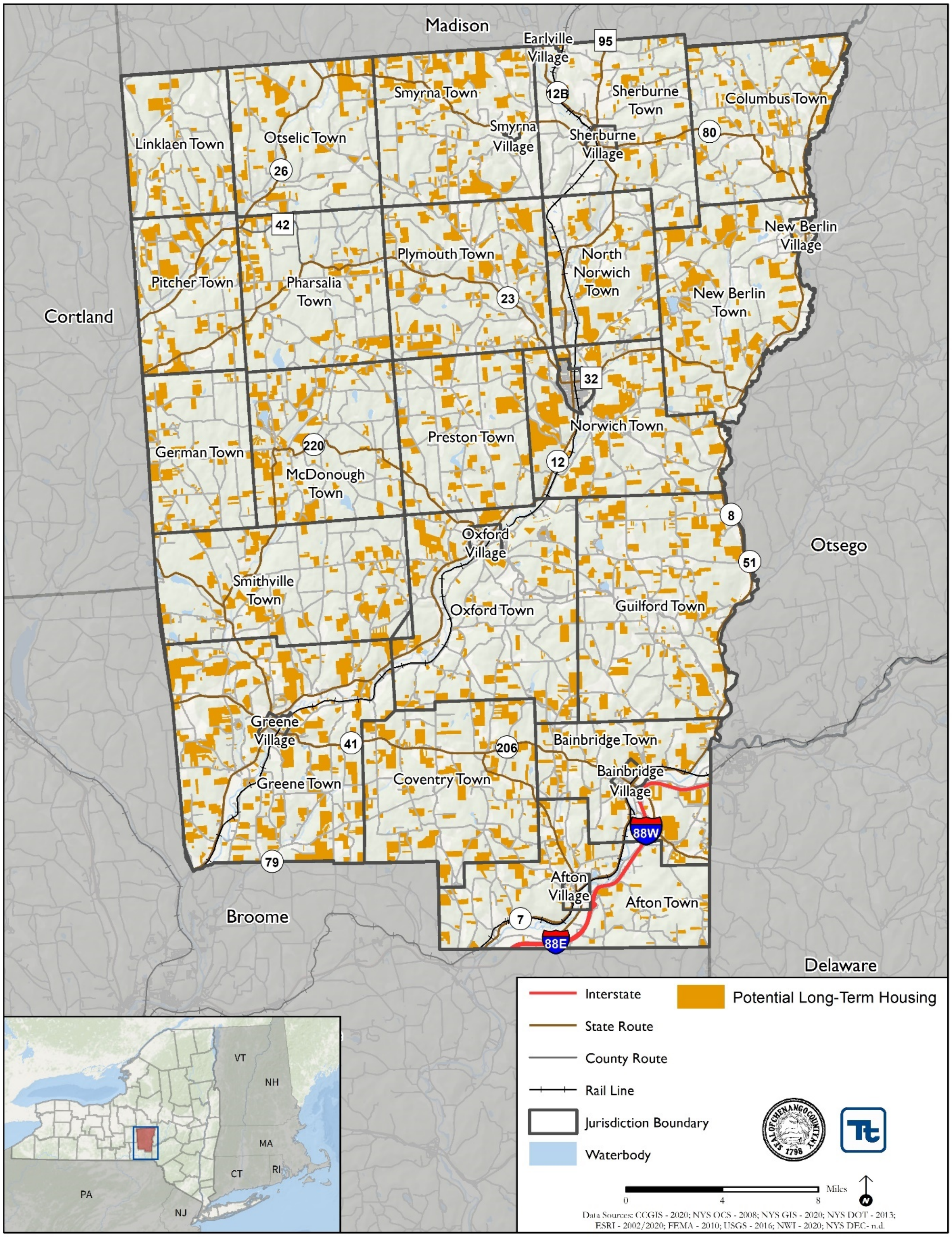
Long-Term Housing

To support identification of potential sites suitable for relocating houses out of hazard areas (i.e., the floodplain) or building new homes once properties in hazard areas or the floodplain are acquired, the County performed a buildable parcel analysis. The analysis identified potential areas for post-disaster development in accordance with the 2017 NYSDHSES Hazard Mitigation Planning Standards Guide requirement "to identify long-term housing options for relocating displaced residents to maintain post-disaster social and economic stability". The County analysis provides an indication of vacant land suitable for development. In this case, vacant land is defined as a parcel that is classified as vacant and is located outside the following hazard areas:

1) FEMA floodplain.
2) wetlands.
3) federal, state and county park land.
4) utility public land.
5) land that has steep slopes (>15% gradient) without consideration of ownership or availability.

Figure 4-21 provides potential long-term housing locations in Chenango County.

Figure 4-21. Potential Long-Term Housing Locations in Chenango County



Evacuation Routes

Chenango County Emergency Management notes that there are no specific evacuation routes identified in the County, as hazard conditions (e.g. flooding) are unpredictable. As such Hyper-Reach and Notify Chenango alerts are sent to residents advising them of evacuations, as necessary, along with routes to travel. Similarly, residents should obtain real-time information through such sources in the event that sheltering is needed, as shelters are opened on an event-specific basis.

While there are no specific evacuation routes, municipalities were asked to identify potential routes that could be used for evacuations during a disaster. Table 4-9 lists the locations of the potential evacuation routes identified by each municipality. Municipalities that did not identify any evacuation routes are not included in the table.

Table 4-9. Evacuation Routes in Chenango County

Municipality	Evacuation Routes
Chenango County	SR-23, SR-26, SR-206, SR-12, CR 32
Afton (T)	I-88, SR-41, CR-7
Afton (V)	I-88, SR-7, SR-41, CR-30, CR-39
Bainbridge (V)	SR-206, CR-7
Coventry (T)	SR-235
Greene (T)	SR 41, SR-206
Lincklaen (T)	CR-12, CR-13
McDonough (T)	NY-220, CR-7, CR-5
New Berlin (T)	NY-80, CR-29, NY-8, NY-80
New Berlin (V)	NY-80, CR-29, NY-8, NY-81
North Norwich (T)	NY-12
Norwich (C)	NY-12, NY-23
Norwich (T)	NY-12, NY-23, NY-8, CR-33, CR-36, CR-10A
Otselic (T)	SR-80, SR-26
Oxford (T)	NY-12 NY-220
Oxford (V)	SR-12, SR-220
Pharsalia (T)	NY-23, CR-10
Pitcher (T)	NY-26, NY-23
Plymouth (T)	NY-23, SR-16
Sherburne (T)	SR-12, SR-12B, SR-80
Sherburne (V)	NY-12, NY-80
Smyrna (T)	CR-20, NY-80, local roads
Smyrna (V)	NY-80

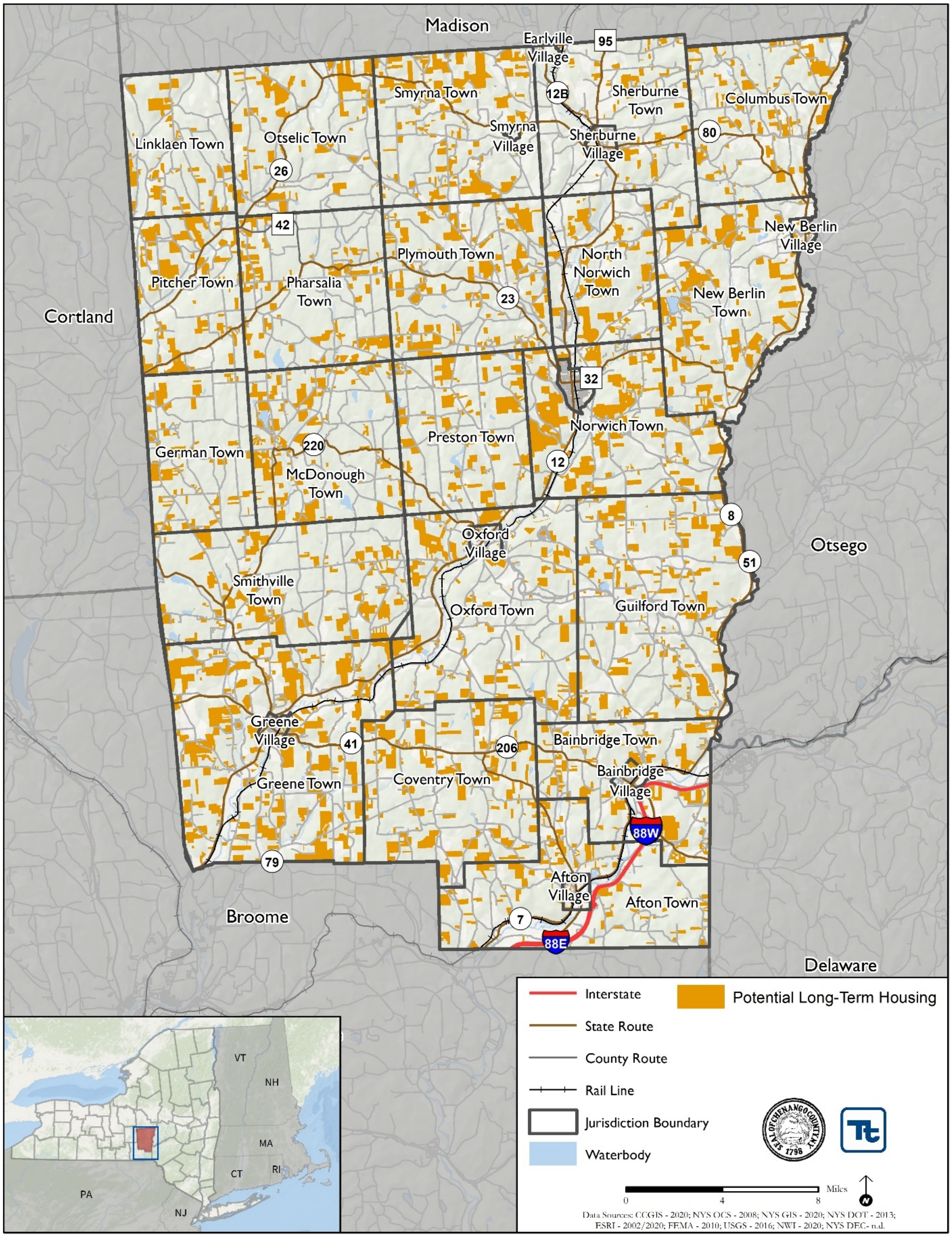
To support public notification during emergency situations (including evacuation and sheltering instructions) Chenango County Emergency Management works closely with the City of Norwich, as together have developed a smart phone emergency management application (app), designed as a one-stop resource for emergency preparedness and response. The application allows for push notifications to reach people quickly during an emergency situation, and includes the following features:

- Notify Chenango alerts of road closures, emergency evacuations (both locations where evacuations are being ordered, as well as specified evacuation routes), shelter information and more.
- Live weather conditions direct from the weather station at the joint City/County Emergency Operations Center.
- Local National Weather Service forecasts, including hour-by-hour information.
- Weather camera of downtown Norwich, updated every several minutes.
- River and stream gauge information for all local rivers running through Chenango County, plus the Canasawacta Creek in Norwich and South Plymouth.

- Countywide school closings, as reported to The Evening Sun.
- A link to NYSEG power outages for Chenango County, broken down by town and road.
- Road work updates from the NY-511 system.
- Live NOAA Weather Radio feed from the Norwich transmitter.
- Emergency preparedness information.

The City of Norwich Emergency Management Office, working with the Binghamton Office of the National Weather Service, monitors regional and national weather information for its potential impact on the City. This is particularly true during flooding and severe storm seasons.

Figure 4-22. Evacuation Routes in Chenango County



5.1 METHODOLOGY AND TOOLS

2021 HMP Changes

- The risk assessment was updated using best available information.
  - 2014-2018 American Community Survey 5-year estimates were utilized.
  - An updated general building stock inventory was generated using 2018 Microsoft building footprints, updated parcels and tax assessor information from the 2019 New York State Public Parcel dataset created by NYS Office of Information Technology Services GIS Program Office (GPO) and NYS Department of Taxation and Finance's Office of Real Property Tax Services (ORPTS), tax assessor information provided by County jurisdictions, and RS Means 2019-dollar values were used to develop a structure-level building inventory and estimate replacement cost value for each building.
  - The 2014 critical facility was reviewed and updated by the Planning Partnership and County jurisdictions.
  - Lifelines were identified in the critical facility inventory to align with FEMA's lifeline definition.
  - HAZUS-MH v4.2 was used to estimate potential impacts to the flood, wind and seismic hazards.
  - Best available hazard data was used as described in this section.

The following summarizes the asset inventories, methodology and tools used to support the risk assessment process.

5.1.1 Asset Inventories

Chenango County assets were identified to assess potential exposure and loss associated with the hazards of concern. For the HMP update, Chenango County assessed exposure vulnerability of the following types of assets: population, buildings and critical facilities/infrastructure, new development, and the environment. Some assets may be more vulnerable because of their physical characteristics or socioeconomic uses. To protect individual privacy and the security of critical facilities, information on properties assessed is presented in aggregate, without details about specific individual personal or public properties.

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

Population

Total population statistics from the 2014-2018 American Community Survey 5-year estimate were used to estimate the exposure and potential impacts to the County's population in place of the 2010 U.S. Census block estimates. Population counts at the jurisdictional level were averaged among the residential structures in the County to estimate the population at the structure level. The population statistics from the 2014-2018 American Community Survey 5-year estimates were modified for population exposure to reflect the total population reported for the county of Chenango; village populations were subtracted from towns populations. This estimate is a more precise distribution of population across the County compared to only using the Census block or Census tract boundaries. Limitations of these analyses are recognized, and thus the results are used only to provide a general estimate for planning purposes.

As discussed in Section 4 (County Profile), research has shown that some populations are at greater risk from hazard events because of decreased resources or physical abilities. Vulnerable populations in Chenango County included in the risk assessment are children, elderly, population below the poverty level, non-English speaking individuals, and persons institutionalized with a disability.

Buildings

The building stock inventory was updated using County and jurisdiction spatial data. To develop the building inventory, parcels from the 2019 NYS GIS Program Office and NYS Department of Taxation and Finance's Office of Real Property Tax Services (ORPTS) and Microsoft Bing 2018 building footprints were used. Tax assessor records were joined to the spatial files to further define each structure in terms of occupancy class, construction type, year built, foundation type, etc. Default information was used to fill in the gaps for buildings that could not be assigned attributes from the assessor's data or from the data provided by the County and jurisdictions. The centroid of each building footprint was used to estimate the building location. If a building footprint was not located due to limited spatial data, parcels that had assessor's information supporting the presence of a building were given a centroid to represent the location of a structure. Structural and content replacement cost values (RCV) were calculated for each building utilizing available assessor data and RS Means 2019 values; a regional location factor for Chenango County was applied (0.99 for residential structured and 1.0 for all other structure types). Replacement cost value is the current cost of returning an asset to its pre-damaged condition, using present-day cost of labor and materials. Total replacement cost value consists of both the structural cost to replace a building and the estimate value of contents of a building. The occupancy classes available in HAZUS-MH v4.2 were condensed into the following categories (residential, commercial, industrial, agricultural, religious, governmental, and educational) to facilitate the analysis and the presentation of results. Residential loss estimates address both multi-family and single-family dwellings.

Critical Facilities and Lifelines

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

The 2015 HMP critical facility inventory, which includes essential facilities, utilities, transportation features and user-defined facilities was updated by the Planning Partnership and County jurisdictions. The update involved a review for accuracy, additions or deletions of new/moved critical assets, identification of backup power for each asset (if known) and whether the critical facility is considered a lifeline in accordance with FEMA's definition; refer to Appendix J (Planning Guidance). To protect individual privacy and the security of assets, information is presented in aggregate, without details about specific individual properties or facilities.

Environment and Land Use Area

National land use land cover data created by the U.S. Geological Survey (USGS) in 2016 was used to assess land use characteristics of the County. This dataset was converted from a raster to a vector polygon, which informed spatial areas of residential, non-residential, and natural land use areas. Residential land-use types incorporated all classes listed as developed land use, except for those identified as vacant (i.e., Developed – Low Intensity, Developed – Medium Intensity, Developed – High Intensity). Non-residential land-use types included all other classes. Within non-residential land-use types, natural land areas were extracted into a new category, which includes forest and wetlands. The natural land areas were referenced to calculate the total acres of natural land area exposed to hazard areas of concern.

New Development

In addition to summarizing the current vulnerability, Chenango County examined recent and anticipated new development that can affect the County's vulnerability to hazards. Identifying these changes and integrating into the risk assessment ensures they are considered when developing the mitigation strategy to reduce these vulnerabilities in the future. An exposure analysis was conducted using anticipated and recent new development provided by each jurisdiction. The development is presented in Section 9, as a table in each annex.

5.1.2 Methodology

To address the requirements of the DMA 2000 and better understand potential vulnerability and losses associated with hazards of concern, Chenango County used standardized tools, combined with local, state, and federal data and expertise to conduct the risk assessment. Three different levels of analysis were used depending upon the data available for each hazard as described below. Table 5.1-1 summarizes the type of analysis conducted by hazard of concern.

Historic Occurrences and Qualitative Analysis – This analysis includes an examination of historic impacts to understand potential impacts of future events of similar size. In addition, potential impacts and losses are discussed qualitatively using best available data and professional judgement.

Exposure Assessment – This analysis involves overlaying available spatial hazard layers, or hazards with defined extent and locations, with assets in GIS to determine which assets are located in the impact area of the hazard. The analysis highlights which assets are located in the hazard area and may incur future impacts.

Loss estimation — The FEMA HAZUS modeling software was used to estimate potential losses for the following hazards: flood, earthquake, hurricane. In addition, an examination of historic impacts and an exposure assessment was conducted for these spatially-delineated hazards.

Table 5.1-1. Summary of Risk Assessment Analyses

Hazard	Population	General Building Stock	Critical Facilities	New Development
Drought	Q	Q	Q	Q
Extreme Temperature	Q	Q	Q	Q
Flood	E, H	E, H	E, H	E
Severe Storm	Q	Q	Q	Q
Severe Winter Storm	Q	Q	Q	Q
Wildfire	E	E	E	E

E – Exposure analysis; H – HAZUS analysis; Q – Qualitative analysis

Hazards U.S. – Multi-Hazard (HAZUS-MH)

In 1997, FEMA developed a standardized model for estimating losses caused by earthquakes, known as Hazards U.S. or HAZUS. HAZUS was developed in response to the need for more effective national-, state-, and community-level planning and the need to identify areas that face the highest risk and potential for loss. HAZUS was expanded into a multi-hazard methodology, HAZUS-MH with new models for estimating potential losses from wind (hurricanes) and flood (riverine and coastal) hazards. HAZUS-MH is a Geographic Information System (GIS)-based software tool that applies engineering and scientific risk calculations, which have been developed by hazard and information technology experts, to provide defensible damage and loss estimates. These methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards. The GIS framework also supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards.

HAZUS-MH uses GIS technology to produce detailed maps and analytical reports that estimate a community's direct physical damage to building stock, critical facilities, transportation systems and utility systems. To generate this information, HAZUS-MH uses default HAZUS-MH provided data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. Damage reports can include induced damage (inundation, fire, threats posed by hazardous materials and debris) and direct economic and social losses (casualties, shelter requirements, and economic impact) depending on the hazard and available local data. HAZUS-MH'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. More information on HAZUS-MH is available at http://www.fema.gov/hazus.

In general, modeled losses were estimated in the program using user-defined flood depth grids for the flood analysis and probabilistic analyses were performed to develop expected/estimated distribution of losses (mean return period losses) for hurricane wind and seismic hazards. The probabilistic model generates estimated damages and losses for specified return periods (e.g., 100- and 500-year). Table 5.1-2 displays the various levels of analyses that can be conducted using the HAZUS-MH software.

Table 5.1-2. Summary of HAZUS-MH Analysis Levels

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

Disease Outbreak

Disease outbreak is a new hazard of concern for Chenango County. All of Chenango County is exposed to disease outbreak events. A qualitative assessment was conducted for the disease outbreak hazard. Research from the Centers for Disease Control, New York State Department of Health, New York State Department of Environmental Conservation, and the World Health Organization was utilized to determine hazard risk and exposure within the County.

Drought

To assess the vulnerability of Chenango County to drought and its associated impacts, a qualitative assessment was conducted. The United States Department of Agriculture (USDA) Census of Agriculture 2017 was used to estimate economic impacts. Information regarding the number of farms, land area in farms, etc. was extracted from the report and summarized in the vulnerability assessment. Additional resources from Chenango County's Office of Water Resources, New York State's 2019 Hazard Mitigation Plan, Chenango County's 2015 Comprehensive Water Resources Management Plan, Centers for Disease Control and Prevention and the U.S. Environmental Protection Agency were used to assess the potential impacts to the population from a drought event.

Extreme Temperatures

All of Chenango County is exposed to extreme temperature events. A qualitative assessment was conducted for the extreme temperatures hazard. Information from the Centers for Disease Control and Prevention, stakeholder plans/reports, the 2019 New York City Hazard Mitigation Plan, and the Planning Partnership were used to assess the potential impacts to the County's assets.

Flood

The 1- and 0.2-percent chance flood events were examined to evaluate Chenango County's risk and vulnerability to the riverine flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as the NFIP.

The effective Chenango County FEMA Digital Flood Insurance Rate Map (DFIRM) published in 2010 was used to evaluate exposure and determine potential future losses. A depth grid was generated in the 2015 HMP using the base flood elevations and 1-percent annual chance floodplain polygons identified in the Digital Flood Insurance Rate Map (DFIRM) and an elevation dataset from USGS. The final depth grid was integrated into the HAZUS-MH v4.2 riverine flood model used to estimate potential losses for the 1-percent annual chance flood events.

To estimate exposure to the 1-percent- and 0.2-percent annual chance flood events, the DFIRM flood boundaries were overlaid on centroids of updated assets (population, building stock, critical facilities, and new development). Centroids that intersected the flood boundaries were totaled to estimate the building replacement cost value and population vulnerable to the flood inundation areas. A Level 2 HAZUS-MH v4.2 riverine flood analysis was performed. Both the critical facility and building inventories were formatted to be compatible with HAZUS-MH v4.2 and its Comprehensive Data Management System (CDMS). Once updated with the inventories, the HAZUS-MH v4.2 riverine flood model was run to estimate potential losses in Chenango County for the 1-percent annual chance flood events. 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-MH v4.2 calculated the estimated potential losses to the population (default 2010 U.S. Census data), potential damages to the general building stock, and potential damages to critical facility inventories based on the depth grids generated and the default HAZUS-MH v4.2 damage functions in the flood model.

Areas of forests, wetlands, and critical habitat landscapes located within the 1- and 0.2-percent annual chance flood event boundaries were calculated to estimate impacts on the environment. The boundaries of these areas were intersected with the floodplains in ArcGIS to calculate the areas exposed to the 1- and 0.2-percent annual chance flood events.

Harmful Algal Bloom

All of Chenango County's waterbodies are vulnerable to HAB events, however exposure is higher for those jurisdictions where confirmed blooms have been recorded. A qualitative assessment for the HAB hazard was conducted using data from the New York State Department of Health (NYSDOT), New York State Department of Environmental Conservation (NYSDEC) Lakes Monitoring Program, NYSDEC HABS Notifications Page, and the Environmental Protection Agency (EPA).

Invasive Species

A qualitative analysis was conducted for the invasive species hazard. All of Chenango County is considered exposed due to the historical existence and evidence of invasive species in New York State and Chenango County. Data from The Finger Lakes Partnership for Regional Invasive Species Management (PRISM), United States Department of Agriculture, New York Department of Environmental Conservation, the New York State Invasive Species Program, and the Cornell Cooperative Extension of Chenango County was used to develop the hazard profile and to determine risk and exposure.

Natural Gas Incidents

Due to the statewide ban of fracking in New York, the exposure and risk from natural gas incidents has lowered since previous versions of this HMP; however, all of Chenango County is still considered exposed due to the nature of existing wells and widespread use of natural gas in heating and electricity in the County. Communities with active wells are considered to have increased exposure and risk to natural gas incidents. Geologic data, and information from New York State Energy Planning Board, New York State Electric and Gas, New York Department of Environmental Conservation, and the Steering Committee were utilized to develop the hazard profile and examine exposure and risk. Further information from the Union of Concerned Scientists and United States Department of Transportation was utilized to determine effects of climate change on natural gas incidents, and exposure risk to health and safety of Chenango County residents.

Severe Storm

A HAZUS-MH v4.2 probabilistic analysis was performed to analyze the wind hazard losses for Chenango County for the 100- and 500-year mean return period events. The probabilistic HAZUS-MH hurricane model activates a database of thousands of potential storms that have tracks and intensities reflecting the full spectrum of Atlantic hurricanes observed since 1886 and identifies those with tracks associated with Chenango County. HAZUS-MH contains data on historic hurricane events and wind speeds. It also includes surface roughness and vegetation (tree coverage) maps for the area. Surface roughness and vegetation data support the modeling of wind force across various types of land surfaces. Default demographic and updated building and critical facility inventories in HAZUS-MH v4.2 were used for the analysis. Although damages are estimated at the census tract level, results were presented at the municipal level. Since there are multiple census tracts that contain more than one jurisdiction, an area analysis was used to extract the percent of each tract that falls within individual jurisdictions. The percentage was multiplied against the results calculated for each tract and summed for each jurisdiction.

Severe Winter Storm

All of Chenango County is exposed and vulnerable to the 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 this hazard. A percentage of the custom-building stock structural replacement cost value was utilized to estimate damages that could result from winter storm conditions (i.e., 1-percent, 5-percent, and 10-percent of total replacement cost value). Given professional knowledge and currently available information, the potential losses for this hazard are considered to be overestimated; hence, providing a conservative estimate for losses associated with winter storm events.

Wildfire

The Wildland-Urban Interface (Interface and Intermix) obtained through the SILVIS Laboratory, Department of Forest Ecology and Management, University of Wisconsin – Madison, was referenced to delineate wildfire hazard areas. The University of Wisconsin – Madison wildland fire hazard areas are based on the 2010 Census and 2006 National Land Cover Dataset and the Protected Areas Database. For this risk assessment, the high-, medium-, and low-density interface areas were combined and used as the "Interface" hazard area, and the high-, medium-, and low-density intermix areas were combined and used as the "Intermix" hazard areas.

Asset data (population, building stock, critical facilities, and new development) were used to support an evaluation of assets exposed and potential impacts and losses associated with 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 totals and values exposed to a wildfire event.

Considerations for Mitigation and Next Steps

The following items are to be discussed for considerations for the next plan update to enhance the vulnerability assessment:

- All Hazards
  - Utilize updated and current demographic data. If 2020 U.S. Census demographic data is available at the U.S. Census block level during the next plan update, use the census block estimates and residential structures for a more precise distribution of population, or the current American Community Survey 5-Year Estimate populations counts at the Census tract level.
- 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.
  - Conduct a HAZUS-MH loss analysis for more frequent flood events (e.g., 10 and 50-year flood events).
  - Use FEMA's Flood Assessment Structure Tool (FAST) tool for a quicker, simpler flood analysis at the structure level.
  - Further refine the repetitive loss area analysis.
  - Continue to expand and update urban flood areas to further inform mitigation.
- Extreme Temperatures
  - Track extreme temperature data for injuries, deaths, shelter needs, pipe freezing, agricultural losses, and other impacts to determine distributions of most at risk areas.
- Hurricane Winds
  - The general building stock inventory can be updated to include attributes regarding protection against strong winds, such as hurricane straps, to enhance loss estimates.
  - Estimate storm surge related losses using the HAZUS-MH flood model if the data is available.
  - If available during the next plan update, update the risk assessment using a comprehensive coastal erosion hazard area map and updated sea level rise inundation areas.
  - Collect data on historic costs incurred to reconstruct buildings, cultural resources and/or infrastructure due to coastal erosion impacts.
  - Integrate evacuation route data that is currently being developed.
- 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.

5.1.3 Data Source Summary

Table 5.1-3 summarizes the data sources used for the risk assessment for this plan.

Table 5.1-3. Risk Assessment Data Documentation

Data	Source	Date	Format
Population data	U.S. Census Bureau; American Community Survey 5-Year Estimates	2010; 2018	Digital (GIS) format
Building footprints	Microsoft	2018	Digital (GIS) format
Tax Assessor data	NYS Office of Information Technology Services GIS Program Office (GPO) and NYS Department of Taxation and Finance's Office of Real Property Tax Services (ORPTS)	2019	Digital (GIS/Tabular) format

Data	Source	Date	Format
Critical facilities	Chenango County Steering Committee and Planning Committee	2019/2020	Digital (GIS) format
Digitized Effective FIRM maps (2010)	FEMA	2010	Digital (GIS) format
Wildfire Fuel Hazard	University of Wisconsin - Madison	2010	Digital (GIS) format
1-Percent Annual Chance Depth Grid	Tetra Tech	2014	Digital (GIS) format
New Development Data	Chenango County Planning Department	2020	Digital (GIS) Format
NY Railroads (Basemap)	New York State Department of Transportation (NYS DOT)	2013	Digital (GIS) Format
NY Road Centerlines (Basemap)	New York State Geospatial Information Systems (NYS GIS)	2020	Digital (GIS) Format
NY Hydrography (Basemap)	New York State Office of Cyber Security (NYS OCS)	2008	Digital (GIS) Format

Limitations

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

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

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. These results do not predict precise results and should be used to understand relative risk. Over the long term, Chenango County will collect additional data to collect additional data, 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 utilizing best available data. The County acknowledges significant impacts may occur to critical facilities and infrastructure as a result of these hazard events causing great economic loss. However, monetized damage estimates to critical facilities and infrastructure, and economic impacts were not quantified and require more detailed loss analyses. In addition, economic impacts to industry such as tourism and the real-estate market were not analyzed.

5.2 IDENTIFICATION OF HAZARDS OF CONCERN

To provide a strong foundation for mitigation actions considered in Sections 6 (Mitigation Strategy) and 9 (Jurisdictional Annexes), Chenango County focused on considering a full range of hazards that could impact the area and then identified and ranked those hazards that presented the greatest concern. The hazard of concern identification process incorporated input from the county and participating jurisdictions; review of the New York State Hazard Mitigation Plan (NYS HMP 2019); review of the 2015 Chenango County HMP (Chenango County HMP 2015); 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 manmade) hazards and the perceived vulnerability of the study area's assets to them. Table 5.2-1 documents the process of identifying the natural hazards of concern for further profiling and evaluation. Specific hazards not identified as a hazard of concern for Chenango County will not be further discussed in detail.

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

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

5.2.1 Changes from 2015 Hazard Mitigation Plan

The 2015 Chenango County Hazard Mitigation Plan identified infestation of plants, animals, and insects and related diseases as a hazard of concern. For the 2021 Hazard Mitigation Plan Update, members of the Steering and Planning Committees identified invasive species and disease outbreak as separate hazards of concern. The invasive species hazard addresses and identifies invasive plants, animals, and insects that can be a risk to the welfare of the public. The disease outbreak hazard addresses and identifies communicable diseases, as well as disease outbreaks related to infectious insects (i.e. mosquitoes and ticks). The 2021 Update also includes the addition of Harmful Algal Blooms (HABs) as a hazard of concern.

Source: NYIS (2019)

The 2021 Chenango County Hazard Mitigation Plan Update includes best available data throughout the plan to present an updated understanding Chenango County's risk.

5.2.2 Hazard Groupings

As per the 2015 Chenango County HMP, the Steering and Planning Committees maintained the grouping of hazards based on the similarity of hazard events, typical concurrence or impacts, consideration of how hazards have been grouped in 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 consideration of hazard grouping in the NYS HMP.

The *Disease Outbreak* hazard profile addresses mosquito-borne, tick borne, and communicable respiratory diseases that occurred in Chenango County or had a considerable impact on the county.

The *Drought* hazard profile specifically addresses drought events that occurred in Chenango County or had a considerable impact on the county.

The *Extreme Temperature* hazard profile specifically addresses periods of extreme temperature that occurred in Chenango County or had a considerable impact on the county.

The *Flood* hazard includes riverine flooding, flash flooding, shallow flooding, ice jam flooding, and dam failure flooding. Inclusion of the various forms of flooding under a general *Flood* hazard is consistent with that used in FEMA's *Multi-Hazard Identification and Risk Assessment* guidance and the NYS HMP.

The *Harmful Algal Bloom (HABs)* hazard profile specifically addresses confirmed, and suspected HABs that have affected Chenango County and the surrounding region.

The *Invasive Species* hazard profile specifically addresses invasive species that affect Chenango County and the surrounding region.

The *Natural Gas* hazard profile addresses incidents related to natural gas development events that affect Chenango County and the surrounding region.

The *Severe Storm* hazard includes windstorms that often entail a variety of other influencing weather conditions, including thunderstorms, hail, lightning, and tornadoes. Tropical disturbances (hurricanes, tropical storms and tropical depressions) are often identified as a type of severe storm. For this HMP update *Severe Storm* includes thunderstorms, hail, lightning, tornadoes, hurricanes, tropical storms, and Nor'Easters.

The *Severe Winter Storm* hazard includes heavy snowfall, blizzards, freezing rain/sleet, and ice storms. This grouping is consistent with the NYS HMP.

The *Wildfire* hazard profile specifically addresses wildfires that occurred in Chenango County or had a considerable impact on the county.

Technological (e.g., hazardous material incidents) and man-made hazards (e.g., terrorism, man-made dam breaches/failures) are not being addressed in this planning process. The DMA 2000 regulations do not require consideration of such hazards, and due to limited funding, these were not chosen for inclusion in this plan by Chenango County and planning participants. The county can expand the scope of this HMP to include other less frequent natural, technological, and man-made hazards as resources permit.

Table 5.2-1. Identification of Natural Hazards of Concern for Chenango County

Hazard	Is this a hazard that may occur in Chenango County?	If yes, does this hazard pose a significant threat to Chenango County?	Why was this determination made?	Source(s)
Avalanche	No	No	• The NYS HMP identifies avalanche as a hazard of concern. • Avalanches can occur in any situation where snow, slope and weather conditions combine to create proper conditions. About 90 percent of all avalanches start on slopes of 30 to 45 degrees and about 98 percent of all avalanches occur on slopes of 25 to 50 degrees. The topography of Chenango County does not support the occurrence of an avalanche. • New York State, in general, has a very low occurrence of avalanche events based on statistics provided by National Avalanche Center – American Avalanche Association (NAC-AAA) between 1998 and 2020. • Avalanche was identified as a hazard in the NYS HMP and there have been occurrences in the state; however, there were no known occurrences in Chenango County. The Steering and Planning Committees do not consider the hazard to be a significant concern.	• NYS DHSES • NAC-AAA
Coastal Erosion	No	No	• The NYS HMP identifies coastal erosion as a hazard of concern for New York State. Erosion can impact all of the state's coastal counties along: Lake Erie and the Niagara River, Lake Ontario and the St. Lawrence River, Atlantic Ocean and Long Island Sound, Hudson River south of the federal dam in Troy, the East River, the Harlem River, the Kill van Kull and Arthur Kill, and all connecting waterbodies, bays, harbors, shallows and wetlands. • As stated above, coastal erosion is limited to the state's coastal counties. Chenango County is not a coastal county; therefore, the Steering and Planning Committees do not consider the hazard to be a significant concern.	• NYS DHSES • Input from Steering and Planning Committees
Dam Failure	Yes	Yes	• The 2019 NYS HMP identifies dam failure as a hazard of concern for New York State and includes it in the Flood hazard profiles. • According to the NYS DEC there are 158 dams are within Chenango County, as shown in Section 4. Of these 158 dams, 116 are low hazard, 10 are intermediate hazard, 11 are high hazard, and 17 are negligible or have no hazard classification. Four dams have an unknown classification (NYS DEC 2020). • Dam failure is included in the flood profile.	• NYS DHSES • Input from Steering and Planning Committees • NYSDEC • NYS GIS
Disease Outbreak	Yes	Yes	• The 2019 NYS HMP does not identify disease outbreak as a hazard of concern for New York State. • The County has been impacted by the COVID-19 pandemic (DR-4480). Between March 15, 2020 and February 8, 2021, there have been 2,273 confirmed cases of COVID-19, and 47 fatalities in the County.	• NYS DHSES • NYS DEC • Input from Steering and Planning Committees

Table 5.2-1. Identification of Natural Hazards of Concern for Chenango County

Hazard	Is this a hazard that may occur in Chenango County?	If yes, does this hazard pose a significant threat to Chenango County?	Why was this determination made?	Source(s)
			• The County has been impacted by various diseases (COVID-19, West Nile Virus, Lyme disease); therefore, the Steering and Planning Committees identified disease outbreak as a hazard of concern for Chenango County.	
Drought	Yes	Yes	• The NYS HMP identifies drought as a hazard of concern for the state. Chenango County has been impacted by several drought events that have occurred in New York State. • Drought conditions can cause shortages in water for human consumption, impact agricultural production, and lead to reduced local firefighting capabilities. • New York State was included in one FEMA drought-related disaster declaration, which did not include Chenango County. • Chenango County was included in five recent drought-related USDA disaster declarations: o S4031 – Drought – 2016 • According to the NRCC, Chenango County is in the Eastern Plateau Climate Division. This division has been impacted by 27 different periods of severe and extreme drought between 1895 and 2002. Based on previous occurrences, the existence of agricultural assets in the county, and input from the Steering and Planning Committees, drought is identified as a hazard of concern for Chenango County.	• NYS DHSES • FEMA • USDA • Input from Steering and Planning Committees • NOAA-NCEI • NRCC
Earthquake	Yes	No	• The NYS HMP identified earthquake as a hazard of concern for the state. • Chenango County has a PGA below 3%g. According to the FEMA document "Understanding Your Risks: Identifying Hazards and Estimating Losses", areas with 3%g should conduct a risk assessment for earthquakes. • New York State was included in one FEMA earthquake-related disaster declaration (DR-1415); Chenango County was not included in this declaration. • According to the NYS HMP, between 1973 and 2012, there were 189 earthquakes epicentered in the state. Of those 189 events, none had an epicenter in Chenango County. • Based on the potential for significant loss and input from the Steering and Planning Committees, earthquake has not been identified as a hazard of concern for Chenango County.	• NYS DHSES • Input from Steering and Planning Committees • USGS – Earthquake Hazards Program, Review of USGS Seismic Maps
Extreme Temperature	Yes	Yes	• The NYS HMP identified extreme temperatures as a hazard of concern for New York State. • Chenango County was included in one recent USDA disaster declarations related to extreme temperature events: o S4031 – September 2016 – Heat, excessive heat (also included drought) • The Steering and Planning Committees identified extreme temperature as a hazard of concern for Chenango County.	• NYS DHSES • Input from Steering and Planning Committees • NOAA-NCEI • USDA

Table 5.2-1. Identification of Natural Hazards of Concern for Chenango County

Hazard	Is this a hazard that may occur in Chenango County?	If yes, does this hazard pose a significant threat to Chenango County?	Why was this determination made?	Source(s)
Flood (riverine, ice jam, dam failure and flash)	Yes	Yes	• The NYS HMP identified flooding as a hazard of concern for New York State. • Between 1954 and 2020, Chenango County was included in 16 FEMA flood-related declarations. ○ FEMA-DR-338 (Flood) – June 1972 ○ FEMA-DR-1095 (Flood) – January 1996 ○ FEMA-DR-1335 (Severe Storms and Flooding) – Summer 2000 ○ FEMA-DR-1534 (Severe Storms and Flooding) – May-June 2004 ○ FEMA-DR-1565 (Tropical Depression Ivan) – October 2004 ○ FEMA-DR-1589 (Severe Storms and Flooding) – April 2005 ○ FEMA-DR-1650 (Severe Storms and Flooding) – June-July 2006 ○ FEMA-DR-1670 (Severe Storms and Flooding) – November 2006 ○ FEMA-DR-1857 (Severe Storms and Flooding) – August 2009 ○ FEMA-DR-1993 (Severe Storms, Flooding, Tornadoes, and Straight-Line Winds) – April-May 2011 ○ FEMA-EM-3341 (Remnants of Tropical Storm Lee) – September 2011 ○ FEMA-DR-4031 (Remnants of Tropical Storm Lee) – September 2011 ○ FEMA-EM-3351 (Hurricane Sandy) – October 2012 ○ FEMA-DR-4129 (Severe Storms and Flooding) – June-July 2013 ○ FEMA-DR-4397 (Severe Storms and Flooding) – August 2018 ○ FEMA-DR-4472 (Severe Storms, Straight-Line Winds, and Flooding) – November 2019 • Between 1950 and 2020, there have been two ice jam events in the county. • Based on the history of flooding and its impacts on Chenango County and input from the Steering and Planning Committees identified flooding as a hazard of concern for the county.	• NYS DHSES • Input from Steering and Planning Committees • FEMA • NOAA-NCEI • USACE CRREL Ice Jam Database
Hailstorm	Yes	Yes	Please see Severe Storm	
Hurricane	Yes	Yes	Please see Severe Storm	
Ice Jams	Yes	Yes	Please see Flood	
Ice Storm	Yes	Yes	Please see Severe Winter Storm	
Infestation	Yes	No	Please see invasive species	
Invasive Species	Yes	Yes	• The 2019 NYS HMP does not identify invasive species as a hazard of concern for New York State. • New York State has been affected by various instances of invasive ticks and mosquitos.	• NYS DEC • Input from Steering and Planning Committees

Table 5.2-1. Identification of Natural Hazards of Concern for Chenango County

Hazard	Is this a hazard that may occur in Chenango County?	If yes, does this hazard pose a significant threat to Chenango County?	Why was this determination made?	Source(s)
			• The NYS DEC has identified Chenango County to be located within the emerald ash borer restricted zone and identified several known locations of the emerald ash borer within the County. • In addition to the emerald ash borer, several species of animals, insects, and plants have impacted the county. The Chenango County Steering and Planning Committees identified invasive species as a hazard of concern due to previous occurrences of invasive species within Chenango County.	
Land Subsidence	Yes	No	• The 2019 NYS HMP indicates New York State is vulnerable to land subsidence; however, this hazard is “extremely localized” and poses a “very low risk to population and property.” • The Steering and Planning Committees did not identify land subsidence as a hazard of concern for Chenango County.	• NYS DHSES • Input from Steering and Planning Committees • USGS
Landslide	Yes	No	• The 2019 NYS HMP includes landslide as a hazard of concern for New York State. • According to the USGS, the majority of Chenango County is located within a low incidence area. The southwest corner of Chenango County has moderate landslide susceptibility. • Between 1954 and 2020 New York State has included in one landslide-related disaster declaration. This event did not include Chenango County. • Based on previous occurrences and input from the Steering and Planning Committees, the landslide hazard was not identified as a hazard of concern for Chenango County.	• NYS DHSES • Input from Steering and Planning Committees • FEMA
Nor’Easters	Yes	Yes	Please see Severe Storm	

Severe Storm (windstorms, thunderstorms, hurricanes / tropical storms, Nor’Easters, hail and tornados)	Yes	Yes	• The NYS HMP identified severe storm as a hazard of concern for New York State; however, for the state HMP, the hazards were profiled in individual sections thunderstorms, lightning, hail, tornadoes, high winds, and hurricanes/tropical storms. For the Chenango County HMP, the hazards were combined into one profile.
			• Between 1954 and 2020, Chenango County was included in 17 FEMA severe storm-related declarations.
			  ○ FEMA-DR-338 (Tropical Storm Agnes) – June 1972
			  ○ FEMA-DR-1095 (Severe Storms and Flooding) – January 1996
			  ○ FEMA-DR-1222 (Severe Storms and Tornadoes) – May-June 1998
			  ○ FEMA-DR-1534 (Severe Storms and Flooding) – May-June 2004
			  ○ FEMA-DR-1565 (Tropical Depression Ivan) – September 2004
			  ○ FEMA-DR-1589 (Severe Storms and Flooding) – April 2005
			  ○ FEMA-DR-1650 (Severe Storms and Flooding) – June-July 2006
				• NYS DHSES
				• FEMA
				• NOAA-NCEI
				• SPC
				• Input from Steering and Planning Committees

Table 5.2-1. Identification of Natural Hazards of Concern for Chenango County

Hazard	Is this a hazard that may occur in Chenango County?	If yes, does this hazard pose a significant threat to Chenango County?	Why was this determination made?	Source(s)
			○ FEMA-DR-1670 (Severe Storms and Flooding) – November 2006 ○ FEMA-DR-1857 (Severe Storms and Flooding) – August 2009 ○ FEMA-DR-1993 (Severe Storms, Flooding, Tornadoes, and Straight-Line Winds) – April-May 2011 ○ FEMA-EM-3341 (Remnants of Tropical Storm Lee) – September 2011 ○ FEMA-DR-4031 (Remnants of Tropical Storm Lee) – September 2011 ○ FEMA-EM-3351 (Hurricane Sandy) – October-November 2012 ○ FEMA-DR-4129 (Severe Storms and Flooding) – June-July 2013 ○ FEMA-DR-4397 (Severe Storms and Flooding) – August 2018 ○ FEMA-DR-4472 (Severe Storms) – December 2019 • According to the SPC, 13 tornados impacted Chenango County between 1950 and 2020. • Based on previous occurrences and input from the Steering and Planning Committees, severe storms are identified as a hazard of concern for Chenango County.	
Severe Winter Storm (heavy snow, blizzards, ice storms)	Yes	Yes	• The NYS HMP identified severe winter storm as a hazard of concern for New York State. According to Cornell University, Broome County's annual average snowfall is between 60 and 100 inches and its average annual winter storm losses is $19,000 according to the 2019 HMP. • FEMA included Chenango County in six winter storm-related disaster declarations: ○ FEMA-EM-3107 (Severe Blizzard) – March 1993 ○ FEMA-DR-3173 (Snowstorms) – December 2002-January 2003 ○ FEMA-DR-3184 (Snow) – February 2003 ○ FEMA-DR-1467 (Severe Ice Storm) – April 2003 ○ FEMA-EM-3299 (Severe Winter Storm) – December 2008 ○ FEMA-DR-4322 (Severe Winter Storm and Snowstorm) – March 2017 • Based on previous occurrences and input from the Steering and Planning Committees, severe winter storms are identified as a hazard of concern for Chenango County.	• NYS DHSES • FEMA • NOAA-NCEI • Input from Steering and Planning Committees
Tornado	Yes	Yes	Please see Severe Storm	
Tsunami	No	No	• Tsunami is identified as a hazard of concern in the NYS HMP; however, while rare, tsunamis impact the coastal areas of the State. • Due to its inland location and based on input from the Steering and Planning Committees, tsunamis are not identified as a hazard of concern for Chenango County.	• NYS DHSES • Input from Steering and Planning Committees
Volcano	No	No	• The NYS HMP did not identify volcano as a threat for New York State and, therefore, the Steering and Planning Committees does not consider volcano to be a hazard of concern for Chenango County.	• NYS DHSES • Input from Steering and

Table 5.2-1. Identification of Natural Hazards of Concern for Chenango County

Hazard	Is this a hazard that may occur in Chenango County?	If yes, does this hazard pose a significant threat to Chenango County?	Why was this determination made?	Source(s)
				Planning Committees
Wildfire	Yes	No	• The NYS HMP identified wildfire as a hazard of concern for New York State. • Chenango County was not included in any FEMA wildfire-related disaster declarations. • Based on available data, the Steering and Planning Committees identified wildfire as a hazard of concern for Chenango County.	• NYS DHSES • Input from Steering and Planning Committees • FEMA
Windstorm	Yes	Yes	Please see Severe Storm	

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

5.2.3 Summary of Hazards of Concern

In summary, a total of 10 natural hazards of concern were identified as significant hazards affecting the entire planning area, to be addressed at the county level in this plan (shown here in alphabetical order):

- Disease Outbreak
- Drought
- Extreme Temperatures
- Flood (riverine, dam failure, flash, and ice jam)
- Harmful Algal Bloom
- Invasive Species
- Natural Gas
- Severe Storm (thunderstorm, hail, wind, tornado, hurricane/tropical storm, and Nor'Easter)
- Severe Winter Storm
- Wildfire

Other natural hazards of concern that might have occurred in Chenango County but have a low potential to occur or result in significant impacts can be considered in future updates to this plan.

5.3 Hazard Ranking

As discussed in Section 5.2 (Identification of Hazards of Concern), a comprehensive range of natural hazards that pose a significant risk to Chenango County were selected and considered during development of this plan; however, each community in Chenango County has differing levels of exposure and vulnerability to each of these hazards. It is important for each community participating in this plan to recognize those hazards that pose the greatest risk to their community and direct their attention and resources accordingly to most effectively and efficiently manage risk and reduce losses. The hazard ranking for the county and each participating jurisdiction can be found in their jurisdictional annexes in Volume II, Section 9 of this plan.

To this end, a hazard risk ranking process was conducted for Chenango County and its municipalities using the method described below. This method includes four risk assessment categories—probability of occurrence, impact (population, property, and economy), adaptive capacity, and changing future conditions (climate change). Each were assigned a weighting factor to calculate an overall ranking value for each hazard of concern. Depending on the calculation, each hazard was assigned a high, medium, or low ranking. Details regarding each of these categories is described below.

5.3.1 Hazard Ranking Methodology

The methodology used to rank the hazards of concern for Chenango County is described below. Estimates of risk for the county were developed using methodologies promoted by FEMA's hazard mitigation planning guidance, generated by FEMA's HAZUS-MH risk assessment tool, and input from Chenango County and participating jurisdictions. The ranking includes a factor to evaluate capacity of the participating jurisdiction regarding ability to address the hazard through plans, policies, and mitigation strategies. For example, a community participating in the CRS has a high capacity to address and mitigation flooding issues, which will be reflected in the ranking benchmark. In addition, a factor addressing the degree of climate change impact is included in the methodology to adjust rankings for hazards expected to be significantly impacted by climate change. Table 5.3-1 shows the four risk assessment categories' values for each of Chenango County's hazards. Details for each category are further described below.

Table 5.3-1. Summary of Hazard Ranking Approach

Category		Level / Category	Degree of Risk / Benchmark Value	Numeric Value	Weighted Value
Probability of Occurrence		Unlikely	A hazard event is not likely to occur or is unlikely to occur with less than a 1% annual chance probability.	0	30%
		Rare	Between 1 and 10% annual probability of a hazard event occurring.	1	
		Occasional	Between 10 and 100% annual probability of a hazard event occurring.	2	
		Frequent	100% annual probability; a hazard event may occur multiple times per year.	3	
Impact (Sum of all 3)	Population (Numeric Value x 3)	Low	14% or less of population is exposed to a hazard with potential for measurable life safety impact due to its extent and location.	1	30%
		Medium	15% to 29% of population is exposed to a hazard with potential for measurable life safety impact due to its extent and location.	2	
		High	30% or more of population is exposed to a hazard with potential for measurable life safety impact due to its extent and location.	3	
	Property (Numeric Value x 2)	Low	Property exposure is 14% or less of the total number of structures for community.	1	
		Medium	Property exposure is 15% to 29% of the total number of structures for community.	2	

Category		Level / Category	Degree of Risk / Benchmark Value	Numeric Value	Weighted Value
		High	Property exposure is 30% or more of the total number of structures for community.	3	
	Economy (Numeric Value x 1)	Low	Loss estimate is 9% or less of the total replacement cost for community.	1	
		Medium	Loss estimate is 10% to 19% of the total replacement cost for community.	2	
		High	Loss estimate is 20% or more of the total replacement cost for community.	3	
Capability		Low	Weak/outdated/inconsistent plans, policies, codes/ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	3	30%
		Medium	Plans, policies, codes/ordinances in place and meet minimum requirements; mitigation strategies identified but not implemented on a widespread scale; county/jurisdiction can recover but needs outside resources; moderate county/jurisdiction capabilities.	2	
		High	Plans, policies, codes/ordinances in place and exceed minimum requirements; mitigation/protective measures in place; county/jurisdiction has ability to recover quickly because resources are readily available, and capabilities are high.	1	
Climate Change		Low	No local data is available; modeling projects are uncertain on whether there is increased future risk; confidence level is low (inconclusive evidence).	1	10%
		Medium	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change; confidence level is medium to high (suggestive to moderate evidence).	2	
		High	Studies and modeling projections indicate exacerbated conditions/increased future risk due to climate change; very high confidence level (strong evidence, well-documented and acceptable methods).	3	

Probability of Occurrence

The probability of occurrence is the likelihood of a hazard event occurring in any given year. A review of historic events assists with this determination. Each hazard of concern is rated in accordance with the numerical ratings and definitions described in Table 5.3-2. The probability of occurrence is given a weighted value of 30%.

Table 5.3-2. Probability of Occurrence Ranking Factors

Numeric Value	Probability Category	Definition
0	Unlikely	A hazard event is not likely to occur or is unlikely to occur with less than a 1% annual chance probability.
1	Rare	Between 1 and 10% annual probability of a hazard event occurring.
2	Occasional	Between 10 and 100% annual probability of a hazard event occurring.
3	Frequent	100% annual probability; a hazard event may occur multiple times per year.

Impact

The impact of each hazard is considered in three categories: impact on population, impact on property (general building stock including critical facilities), and impact on the economy. Based on documented historic losses and individual assessments by each participating municipality, an impact rating of high, medium, or low is assigned with a corresponding numeric value for each hazard of concern. In addition, a weighting factor is assigned to each impact category: 3 for population, 2 for property, and 1 for economy. This gives the impact on population the greatest weight in evaluating the impact of a hazard. The total of each category is assigned a weighted value of 30%. Table 5.3-3 presents the numerical rating, weighted factor and description for each impact category.

Table 5.3-3. Numerical Values and Definitions for Impacts on Population, Property and Economy

Category	Weighted Value	Low Impact* (1)	Medium Impact (2)	High Impact (3)
Population	3	14% or less of population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	15% to 29% of population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	30% or more of population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.
Property	2	Property exposure is 14% or less of the total number of structures for community.	Property exposure is 15% to 29% of the total number of structures for community.	Property exposure is 30% or more of the total number of structures for community.
Economy	1	Loss estimate is 9% or less of the total replacement cost for community.	Loss estimate is 10% to 19% of the total replacement cost for community.	Loss estimate is 20% or more of the total replacement cost for community.

Note: A numerical value of zero is assigned if there is no impact.

** For the purposes of this exercise, "impacted" means exposed for population and property and loss for economy.*

Additional Impacts

Along with impacts on population, property, and economy, the overall risk ranking looks at two additional impacts that impact the county's vulnerability: capability and climate change. Table 5.3-4 presents the numerical rating and description for each category.

Capability

Capability refers to a jurisdiction's ability to protect the community from or withstand a hazard event. Mitigation measures are already in place, including codes/ordinances, plans, and procedures to withstand hazards due to design or location, deployable resources, or plans and procedures in place to respond to an event. The capability category has a weighted factor of 30%.

Climate Change

Climate change refers to the impact that climate change projections have on increasing or decreasing the severity and frequency of a hazard. The climate change category has a weighted factor of 10%.

Table 5.3-4. Numerical Values and Definitions for Adaptive Capacity and Changing Future Conditions

Category	Low Impact*	Medium Impact	High Impact
Capability	Weak/outdated/inconsistent plans, policies, codes/ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	Plans, policies, codes/ordinances in place and meet minimum requirements; mitigation strategies identified but not implemented on a widespread scale; county/jurisdiction can recover but needs outside resources; moderate county/jurisdiction capabilities.	Plans, policies, codes/ordinances in place and exceed minimum requirements; mitigation/protective measures in place; county/jurisdiction has ability to recover quickly because resources are readily available, and capabilities are high.
Climate Change	No local data is available; modeling projects are uncertain on whether there is increased	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change;	Studies and modeling projections indicate exacerbated conditions/increased future risk due to

Category	Low Impact*	Medium Impact	High Impact
	future risk; confidence level is low (inconclusive evidence).	confidence level is medium to high (suggestive to moderate evidence).	climate change; very high confidence level (strong evidence, well-documented and acceptable methods).

Note: Low impact for adaptive capacity means the jurisdiction does not have the capability to effectively respond, which increases vulnerability; whereas high impact for adaptive capacity means the jurisdiction does have the capability to effectively respond, which decreases vulnerability.

Risk Ranking Value

Each impact was then weighted and the risk ranking for each hazard is then calculated using the following formula:

Example Risk Ranking Equation

Risk Ranking = [(Impact on Population x 3) + (Impact on Property x 2) + (Impact on Economy x 1) x .30] + [Capability x 30%] + [Climate Impact x 10%] + [Probability of Occurrence x 30%]

Based o … ium, or low). Th … 3.9 and 4.9; High …

5.3.2 Hazard Ranking Results

Using the process described above, the risk ranking for the identified hazards of concern was determined for Chenango County. The hazard ranking for Chenango County is detailed in the subsequent tables that present the step-wise process for the ranking. The countywide risk ranking includes the entire planning area and might not reflect the highest risk indicated for any of the participating jurisdictions. The resulting ranks of each municipality indicate the differing degrees of risk exposure and vulnerability. The results support the appropriate selection and prioritization of initiatives to reduce the highest levels of risk for each municipality. Both the county and the participating jurisdictions have applied the same methodology to develop the countywide risk and local rankings to ensure consistency in the overall ranking of risk; jurisdictions had the ability to alter rankings based on local knowledge and experience in handling each hazard.

This hazard ranking exercise serves four purposes: 1) to describe the probability of occurrence for each hazard; 2) to describe the impact each would have on the people, property, and economy; 3) evaluate the capabilities a community has with regards to natural hazards; and 4) to consider changing future conditions (i.e., climate change) in Chenango County. Estimates of risk for Chenango County were developed using methodologies promoted by FEMA's hazard mitigation planning guidance, generated by FEMA's HAZUS-MH risk assessment tool and input from the county and participating municipalities.

Table 5.3-5 shows the county-wide probability ranking assigned for likelihood of occurrence for each hazard.

Table 5.3-5. Probability of Occurrence Ranking for Hazards of Concern for Chenango County

Hazard of Concern	Probability	Numeric Value
Disease Outbreak	Frequent	3
Drought	Occasional	2

Hazard of Concern	Probability	Numeric Value
Extreme Temperatures	Frequent	3
Flood	Frequent	3
Harmful Algal Bloom	Frequent	3
Invasive Species	Frequent	3
Natural Gas	Occasional	2
Severe Storm	Frequent	3
Severe Winter Storm	Frequent	3
Wildfire	Rare	1

Table 5.3-6 shows the impact evaluation results for each hazard of concern, including impact on property, structures, and the economy on the county level. It is noted that several hazards that have a high impact on the local jurisdictional level can have a lower impact when analyzed countywide. Jurisdictional ranking results are presented in each local annex in Section 9 (Jurisdictional Annexes) of this plan. The weighting factor results and a total impact for each hazard also are summarized. Values in red indicate values that were altered by the county based on local knowledge and experience with each hazard.

Table 5.3-6. Impact Ranking for Hazards of Concern for Chenango County

Hazard of Concern	Population			Property			Economy			Total Impact Rating (Population + Property + Economy)
	Impact	Numeric Value	Multiplied by Weighing Factor (3)	Impact	Numeric Value	Multiplied by Weighing Factor (2)	Impact	Numeric Value	Multiplied by Weighing Factor (1)	
Disease Outbreak	Medium	2	6	Low	1	2	Medium	2	2	10
Drought	Medium	2	6	Low	1	2	Medium	2	2	10
Extreme Temperatures	Medium	2	6	Low	1	2	Medium	2	2	10
Flood	Medium	2	6	Medium	2	4	Low	1	1	11
Harmful Algal Bloom	Medium	2	6	Low	1	2	Medium	2	2	10
Invasive Species	Low	1	3	Medium	2	4	Medium	2	2	9
Natural Gas	Medium	2	6	Medium	2	4	Medium	2	2	12
Severe Storm	High	3	9	High	3	6	Low	1	1	16
Severe Winter Storm	Medium	2	6	Low	1	2	Low	1	1	9
Wildfire	Medium	2	6	Medium	2	4	Medium	1	2	12

Table 5.3-7 shows the additional impact rankings for the hazards of concern. This includes the overall capabilities of the county and municipalities and the consideration of changing future conditions, such as climate change.

Table 5.3-7. Additional Impact Ranking for Hazards of Concern for Chenango County

Hazard of Concern	Capabilities	Numeric Value	Climate Change	Numeric Value
Disease Outbreak	Medium	2	Medium	2
Drought	Medium	2	Medium	2
Extreme Temperatures	Medium	2	High	3
Flood	Medium	2	High	3
Harmful Algal Bloom	Medium	2	Medium	2
Invasive Species	Medium	2	Medium	2
Natural Gas	Medium	2	Low	1
Severe Storm	High	1	High	3
Severe Winter Storm	High	1	High	3
Wildfire	Medium	2	Medium	2

Table 5.3-8 presents the total calculations for each hazard ranking value for the hazards of concern.

Table 5.3-8. Total Hazard Ranking Values for the Hazards of Concern for Chenango County

Hazard of Concern	Probability x 30%	Total Impact x 30%	Adaptive Capacity x 30%	Changing Future Conditions x 10%	Total Risk Ranking Value
Disease Outbreak	0.9	3	0.6	0.2	4.7
Drought	0.6	3	0.6	0.2	4.4
Extreme Temperatures	0.9	3	0.6	0.3	4.8
Flood	0.9	3.3	0.6	0.3	5.1
Harmful Algal Bloom	0.9	3	0.6	0.2	4.7
Invasive Species	0.9	2.7	0.6	0.2	4.4
Natural Gas	0.6	3.6	0.6	0.1	4.9
Severe Storm	0.9	4.8	0.3	0.3	6.3
Severe Winter Storm	0.9	2.7	0.3	0.3	4.2
Wildfire	0.3	3.6	0.6	0.2	4.7

Low = values less than 3.9 (yellow); Medium = values between 3.9 and 4.9 (orange); High = values greater than 4.9 (red).

Table 5.3-9 presents the jurisdictional hazard ranking for each hazard. An evaluation of the total risk ranking score determined ranking categories that were grouped into three categories, low, medium, and high. It also includes input by the municipalities. The rankings were categorized as follows: Low = values less than 3.9 colored yellow; Medium = values between 3.9 and 4.9 colored orange; High = values greater than 4.9 colored red.

These rankings have been used as one of the bases for identifying the jurisdictional hazard mitigation strategies included in Section 9 (Jurisdictional Annexes) of this plan. The summary rankings for the county reflect the results of the vulnerability analysis for each hazard of concern and can vary from the specific results of each jurisdiction. For example, the severe storm hazard may be ranked low in one jurisdiction, but due to the exposure and impact countywide, it is ranked as a high hazard and is addressed in the county mitigation strategy accordingly.

Table 5.3-9. Summary of Overall Ranking of Natural Hazards by Jurisdiction

Chenango County Municipalities	Disease Outbreak	Drought	Extreme Temps	Flood	Harmful Algal Bloom	Invasive Species	Natural Gas	Severe Storm	Severe Winter Storm	Wildfire
Afton (T)	Medium	Medium	Medium	High	Low	Medium	Medium	High	Medium	Medium
Afton (V)	High	Medium	High	High	Low	Medium	Low	High	Medium	Medium
Bainbridge (T)	High	Medium	High	High	Low	Medium	Medium	High	Medium	Medium
Bainbridge (V)	Medium	Medium	Medium	High	Low	Medium	Low	High	Medium	Medium
Columbus (T)	Medium	Medium	Medium	Low	Low	Medium	Medium	High	Medium	Medium
Coventry (T)	Medium	Medium	Medium	High	Low	Medium	Low	High	Medium	Medium
Earlville (V)	Medium	Medium	Medium	Low	Low	Medium	Low	High	Medium	Medium
German (T)	Medium	Medium	Medium	Medium	Low	Medium	Medium	High	Medium	Medium
Greene (T)	Medium	Medium	Medium	High	Medium	Medium	Medium	High	Medium	Medium
Greene (V)	Medium	Medium	Medium	High	Low	Medium	Low	High	Medium	Medium
Guilford (T)	Medium	Medium	Medium	High	Medium	Medium	Low	High	Medium	Medium
Lincklaen (T)	Medium	Medium	Medium	Low	Low	Medium	Low	High	Medium	Medium
McDonough (T)	Medium	Medium	Medium	Medium	Low	Medium	Medium	High	Medium	Medium
New Berlin (T)	Medium	Medium	Medium	Medium	Low	Medium	Low	High	Medium	Medium
New Berlin (V)	Low	Medium	Medium	High	Low	Medium	Low	High	Medium	Medium
North Norwich (T)	Medium	Medium	Medium	Medium	Low	Medium	Low	High	Medium	Medium
Norwich (C)	High	Medium	High	High	Low	Medium	Low	High	Medium	Medium
Norwich (T)	Medium	Medium	Medium	Medium*	Medium	Medium	Medium	High	High*	Medium
Otselic (T)	Medium	Medium	Medium	Medium	Low	Medium	Medium	High	Medium	Medium
Oxford (T)	Low	Low	Low	Low	Low	Low	Medium	Medium	Medium	Low
Oxford (V)	Medium	Medium	Medium	High	Low	Medium	Medium*	High	High*	Medium
Pharsalia (T)	Medium	Medium	Medium	Medium	Low	Medium	Low	High	Medium	Medium
Pitcher (T)	Medium	Medium	Medium	Low	Low	Medium	Low	High	Medium	Medium
Plymouth (T)	Medium	Medium	Medium	Medium	Low	Medium	Medium	High	Medium	Medium
Preston (T)	Medium	Medium	Medium	Medium	Low	Medium	Medium	High	Medium	Medium
Sherburne (T)	Medium	Medium	Medium	High	Low	Medium	Low	High	Medium	Medium
Sherburne (V)	Medium	Medium	Medium	High	Low	Medium	Low	High	Medium	Low*
Smithville (T)	Low*	Medium	Medium	High*	Medium	Low*	Low	High	Medium	Low*
Smyrna (T)	Medium	Medium	Medium	High	Low	Medium	Medium	High	Medium	Medium
Smyrna (V)	Medium	Medium	Medium	Low	Low	Medium	Medium	High	Medium	Low
Chenango County	**Medium**	**Medium**	**Medium**	**High**	**Medium**	**Medium**	**Medium**	**High**	**Medium**	**Medium**

** The overall rankings for these communities were adjusted due to community feedback.*
Low = Values less than 3.9; Medium = Values between 3.9 and 4.9; High = Values greater than 4.9.

5.4.1 Disease Outbreak

This section provides a hazard profile and vulnerability assessment of the disease outbreak hazard for the Chenango County Hazard Mitigation Plan (HMP).

5.4.1.1 Hazard Profile

This section presents information regarding the description, extent, location, previous occurrences and losses, and probability of future occurrences for the disease outbreak hazard.

Description

An outbreak or an epidemic occurs when new cases of a certain disease, in a given population, substantially exceed what is expected. An epidemic may be restricted to one locale, or it may be global, at which point it is called a pandemic. Pandemic is defined as a disease occurring over a wide geographic area and affecting a high proportion of the population. A pandemic can cause sudden, pervasive illness in all age groups on a local or global scale. A pandemic is a novel virus to which humans have no natural immunity that spreads from person-to-person. A pandemic will cause both widespread and sustained effects and is likely to stress the resources of both the State and Federal government (NJOEM 2019).

Most disease outbreaks occur due to respiratory viruses. A respiratory virus with pandemic potential is a highly contagious respiratory virus that spreads easily from person to person and for which there is little human immunity. This hazard includes pandemic influenza. This hazard strains the healthcare system, requires school closures, causes high rates of illness and absenteeism that undermine critical infrastructure across the city, and decreases community trust due to social distancing measures interfering with personal movement and being perceived as being ineffectual. Previous events that exemplify this hazard include the 1918 ("Spanish flu") and 2009 ("Swine flu") influenza pandemics and the 2003 SARS outbreak, which had pandemic potential (NYC Emergency Management 2019).

In addition to respiratory viruses, diseases with new or emerging features can challenge control. Emerging diseases are difficult to contain or treat and present significant challenges to risk communication since mechanics of transmission, laboratory identification, and effective treatment protocols may be unknown (NYC Emergency Management 2019).

Of particular concern in Chenango County are arthropod-borne viruses (arboviruses), which are viruses that are maintained in nature through biological transmission between susceptible hosts (mammals) and blood-feeding arthropods (mosquitos and ticks). These infections usually occur during warm weather months, when mosquitoes and ticks are active (NYS Department of Health 2017a).

Mosquito-borne diseases are diseases that are spread through the bite of an infected female mosquito. West Nile Virus (WNV) is the most common mosquito-borne disease recently impacting Chenango County. These diseases rely on mosquitos to spread. They become infected by feeding on birds carrying the virus; and then spread to humans and other animals when the mosquito bites them (NYS Department of Health 2017a).

Tick-borne diseases are bacterial illnesses that spread to humans through infected ticks. These types of diseases rely on ticks for transmission. Ticks become infected by micro-organisms when feeding on small infected mammals (mice and voles). Different tick-borne diseases are caused by different micro-organisms, and it is possible to be infected with more than one tick-borne disease at a time. Anyone who is bitten by an infected tick may get a tick-borne disease. People who spend a lot of time outdoors have a greater risk of becoming infected. The three types of ticks in New York that may carry disease-causing micro-organisms are the Blacklegged Tick

(Ixodes scapularis) (also known as Deer Tick), Lone Star Tick (*Amblyomma americanum*), and the American dog tick (*Dermacentor variabilis*) (NYS Department of Health 2019a). Tick-Borne diseases impacting Chenango County include Anaplasmosis, Babesiosis, Ehrlichiosis, Lyme Disease, and Spotted Fever Rickettsiosis (including Rocky Mountain Spotted Fever) (CDC, 2018). Not all tick-borne diseases are arboviruses. Lyme Disease is a bacterial infection and Babesiosis is a parasitic infection (NYS Department of Health 2017a).

For the purpose of this HMP update, the following diseases will be discussed in further detail: Mosquito borne: West Nile; Tick borne: Lyme Disease; Respiratory Viruses: Influenza, MERS-CoV, SARS, and Coronavirus.

West Nile Virus

West Nile Virus (WNV) encephalitis is a mosquito-borne viral disease, which can cause an inflammation of the brain. WNV is commonly found in Africa, West Asia, the Middle East and Europe. West Nile virus was first found in New York State in 1999. Since 2000, 490 human cases and 37 deaths of WNV have been reported statewide (NYS Department of Health 2019b). In a small number of cases, WNV has been spread by blood transfusion, which has resulted in the screening of blood donations for the virus in the US, or by organ transplantation. WNV can also be spread from mother to baby during pregnancy, delivery, or breast-feeding in a small number of cases. The symptoms of severe infection (West Nile encephalitis or meningitis) 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 3 to 14 days after being bitten by an infected mosquito (NYS Department of Health 2017c).

Lyme Disease

Lyme disease is an illness caused by infection with the bacterium *Borrelia burgdorferi*, which is carried by ticks. The infection can cause a variety of symptoms and, if left untreated, can be severe. Lyme disease is spread to people by the bite of an infected tick. 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 Department of Health 2017b).

Influenza

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

Pandemic influenza is different from seasonal influenza (or "the flu") because outbreaks of seasonal flu are caused by viruses that are already among people. Pandemic influenza is caused by an influenza virus that is new to people and is likely to affect many more people than seasonal influenza. In addition, seasonal flu occurs every year, usually during the winter season, while the timing of an influenza pandemic is difficult to predict. Pandemic influenza is likely to affect more people than the seasonal flu, including young adults. A severe pandemic could change daily life for a time, including limitations on travel and public gatherings (Barry-Eaton District Health Department 2013).

Coronavirus

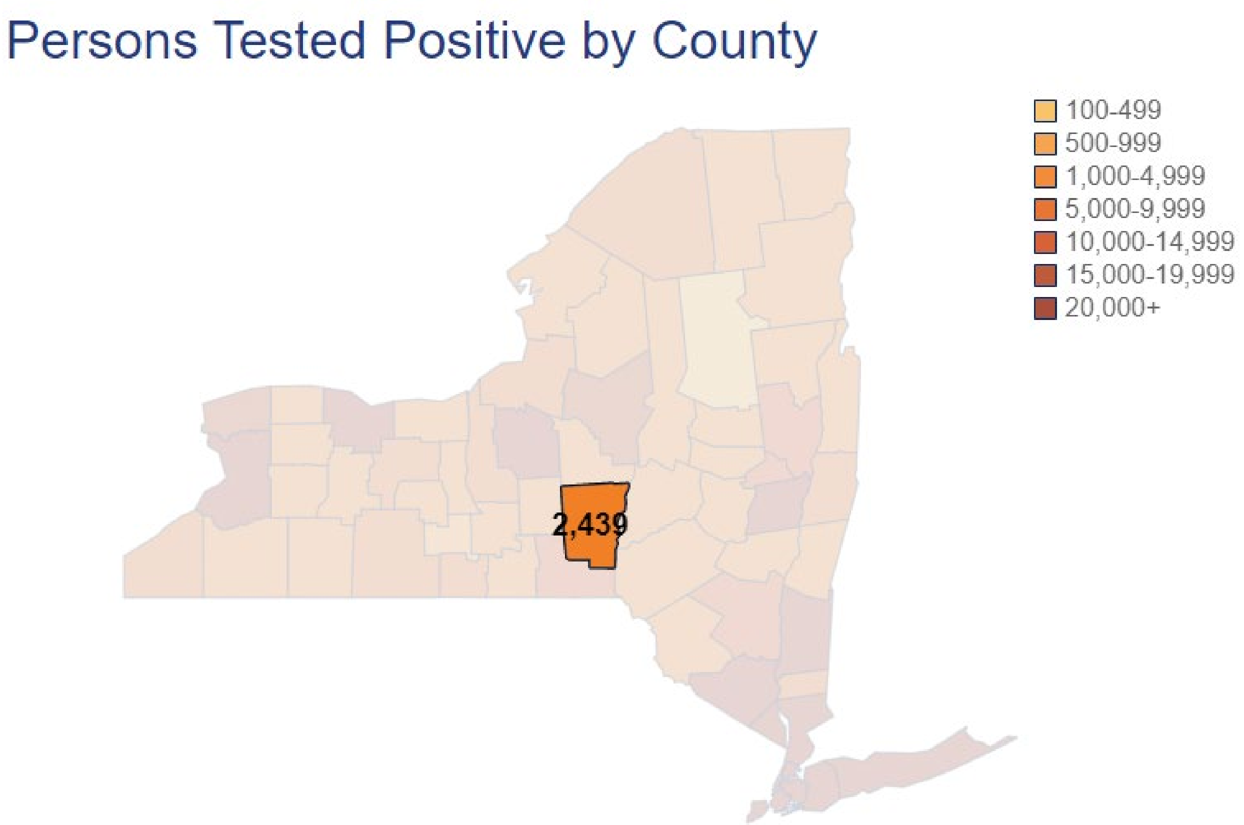
Coronavirus disease (COVID-19) is an infectious disease first identified in 2019. The virus rapidly spread into a global pandemic by spring of 2020. Older people, and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness

(WHO 2020). With the virus being relatively new, information regarding transmission and symptoms of the virus is still new. 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 2-14 days after exposure to the virus (based on the incubation period of MERS-CoV viruses) (CDC 2020)

In an effort to slow the spread of the virus, the federal government and states have urged the public to avoid touching of the face, properly wash hands often, wear a face mask, and use various social distancing measures. At the time of this plan update, there are no specific vaccines or treatments for COVID-19. However, there are many ongoing clinical trials evaluating potential treatments (WHO 2020).

As of February 28, 2021, Chenango County has 2,439 positive cases of COVID-19, as shown in Figure 5.4.1-1.

Figure 5.4.1-1. Positive Cases of COVID-19 in Chenango County



Extent

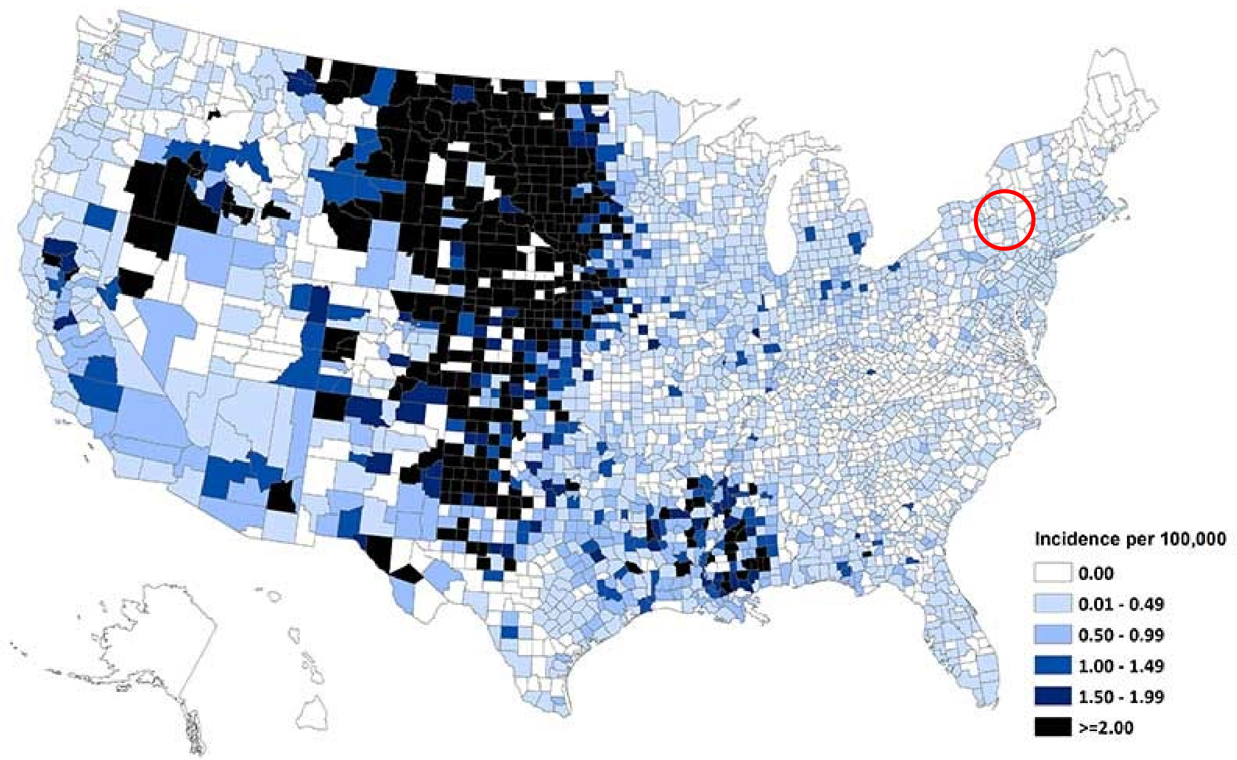
The exact size and extent of an infected population depends on how easily the illness is spread, the mode of transmission, and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in more densely populated areas. The transmission rate of infectious diseases will depend on the mode of transmission of a given illness.

The extent and location 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 species ranges from nuisance to widespread. The threat is typically intensified when the ecosystem or host species is already stressed, such as periods of drought. The already weakened state of the ecosystem causes it to more easily be impacted to an infestation. The presence of disease-carrying mosquitoes and ticks has been reported throughout most of New York and Chenango County.

West Nile Virus

Since it was discovered in the western hemisphere, WNV has spread rapidly across North America, affecting thousands of birds, horses and humans. WNV swept from the New York City region in 1999 to almost all of the continental U.S., seven Canadian provinces and throughout Mexico and parts of the Caribbean by 2004. illustrates WNV activity in the U.S. from 1999-2018.

Figure 5.4.1-2. Average Annual Incidence of West Nile Virus Neuroinvasive Disease Reported to CDC by County, 1999-2018



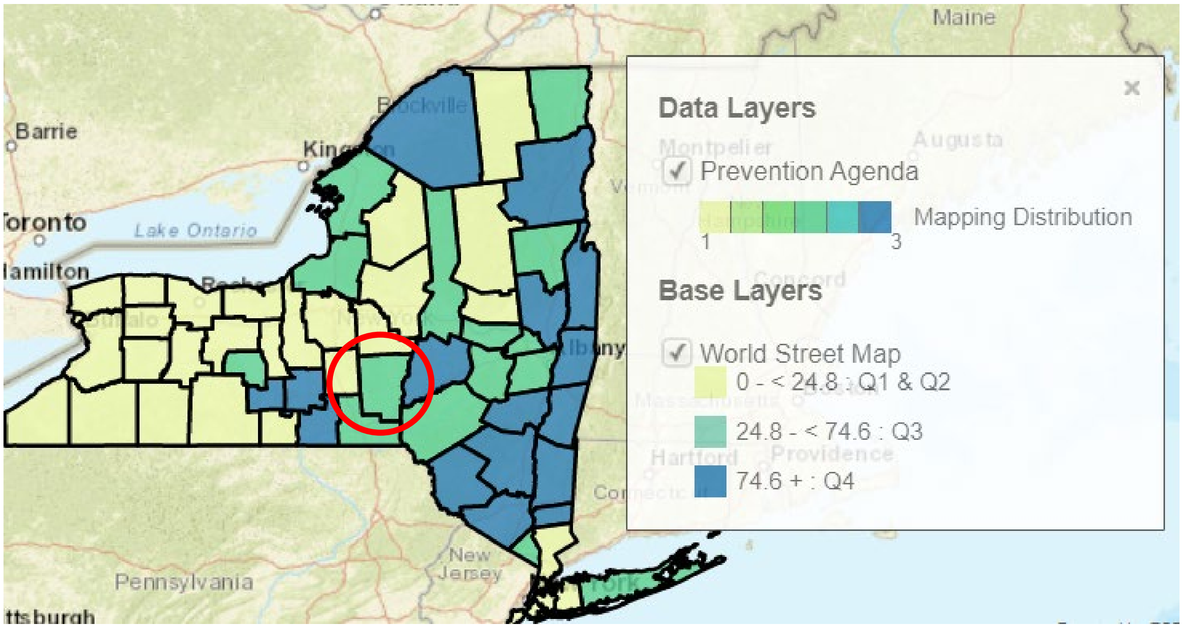
Source: CDC 2019

Note: The circle indicates the approximate location of Chenango County.

Lyme Disease

Lyme disease is the most commonly reported vector borne illness in the U.S. Between 2014 and 2018, there were 354 confirmed cases of Lyme disease in Chenango County, including 127 cases in 2017 alone (NYS Department of Health 2019c). Figure 5.4.1-3 shows the risk of Lyme disease in New York State. The figure indicates that Chenango County has some of the highest incidence of the disease, with a rate of 98.1 persons per 100,000 people between 2014-2016.

Figure 5.4.1-3. Lyme Disease Incidence Rate per 100,000 people, 2014-2016



Source: Health Data NY

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

Influenza and Coronavirus

As noted above, the exact size and extent of an infected population depends 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. The severity and length of the next pandemic cannot be predicted; however, experts expect that its effect on the United States could be severe.

In 1999, the WHO Secretariat published guidance for pandemic influenza and defined the six phases of a pandemic. Updated guidance was published in 2005 to redefine these phases. This schema is designed to provide guidance to the international community and to national governments on preparedness and response for pandemic threats and pandemic disease. Compared with the 1999 phases, the new definitions place more emphasis on pre-pandemic phases when pandemic threats may exist in animals or when new influenza virus subtypes infect people but do not spread efficiently. Because recognizing that distinctions between the two interpandemic phases and the three pandemic alert phases may be unclear, the WHO Secretariat proposes that classifications be determined by assessing risk based on a range of scientific and epidemiological data (WHO 2009). The WHO pandemic phases are outlined in Table 5.4.1-1.

Table 5.4.1-1. WHO Global Pandemic Phases

Phase	Description
Preparedness	
Phase 1	No viruses circulating among animals have been reported to cause infections in humans.
Phase 2	An animal influenza virus circulating among domesticated or wild animals is known to have caused infection in humans and is therefore considered a potential pandemic threat.
Phase 3	An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks. Limited human-to-human transmission may occur under some circumstances, for example, when

Phase	Description
	there is close contact between an infected person and an unprotected caregiver. However, limited transmission under such restricted circumstances does not indicate that the virus has gained the level of transmissibility among humans necessary to cause a pandemic.
Response and Mitigation Efforts	
Phase 4	Human infection(s) are reported with a new subtype, but no human-to-human spread or at most rare instances of spread to a close contact.
Phase 5	is characterized by human-to-human spread of the virus into at least two countries in one WHO region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short.
Phase 6	the pandemic phase is characterized by community level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is under way.

Source: WHO 2009

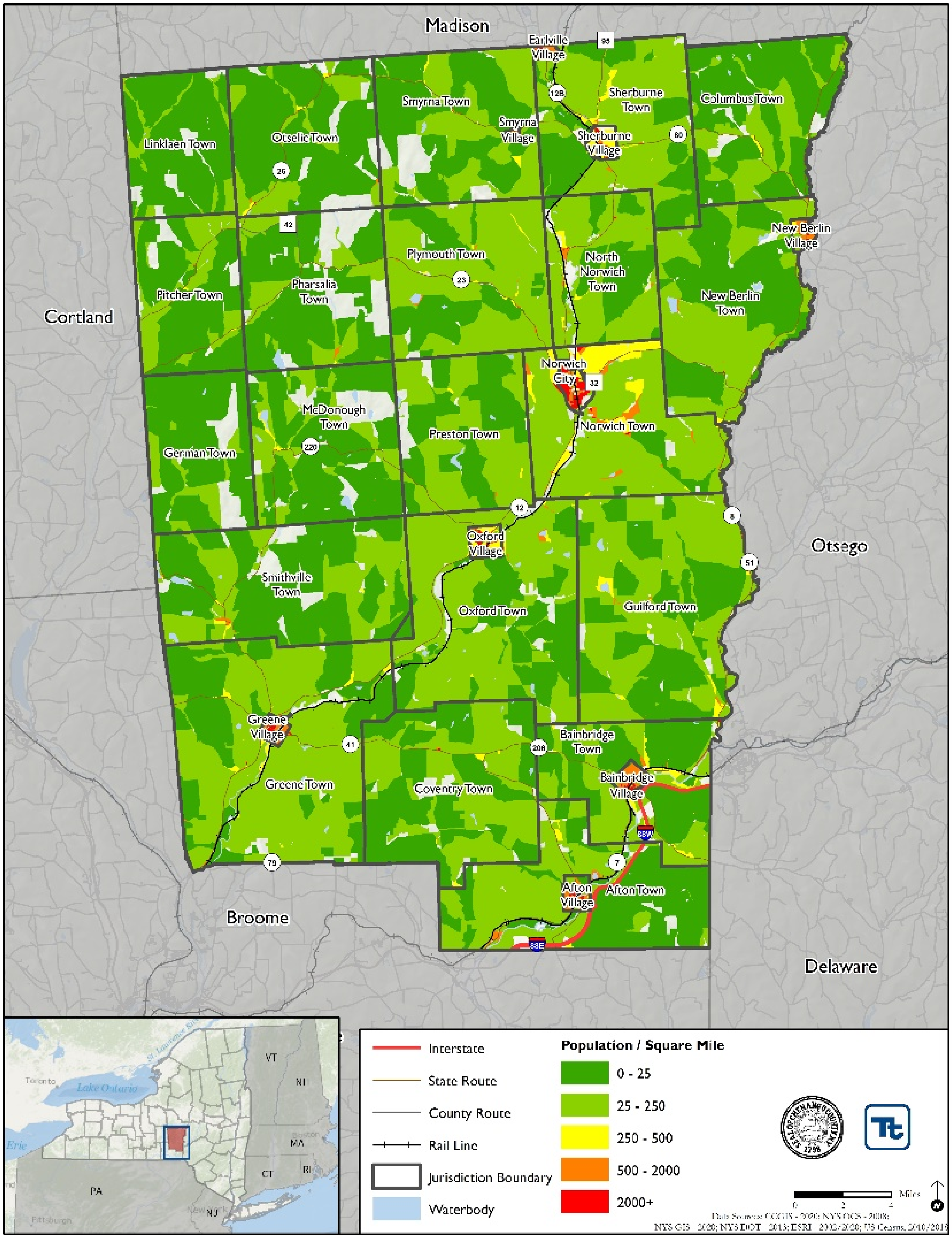
In New York, activities to be undertaken by pandemic period, use the World Health Organization's classification system. The Pandemic Influenza Plan describes activities which are designated as to whether they are the role of the state health department, local health department and/or providers and public health partners (NYS Department of Health 2006).

Between 2014 and 2018, there were 1,765 laboratory confirmed cases on influenza in Chenango County (NYS Department of Health, 2019c). Those most vulnerable to influenza include young children and the elderly, although anyone can become infected.

Location

New York and Chenango County's geographic and demographic characteristics make it particularly vulnerable to importation and spread of infectious diseases. In terms of pandemic influenza, all counties may experience pandemic influenza outbreak caused by factors such as population density and the nature of public meeting areas. Densely populated areas will spread diseases quicker than less densely populated areas. Figure 5.4.1-4. shows population density throughout the County. There are a few densely populated areas throughout the County, mainly in the City of Norwich, and Villages of Oxford, Greene, Bainbridge, and Afton. Additionally, much of the State can experience other diseases such as WNV due to the abundance of water bodies throughout the State and County, which provide a breeding ground for infected mosquitos.

Figure 5.4.1-4. Chenango County Population Density (United States Census, 2010)



Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with disease outbreak events throughout New York and Chenango County. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

FEMA Major Disasters and Emergency Declarations

Between 1954 and 2020, the State of New York was included in two disease outbreak-related emergency (EM) declarations; one for West Nile Virus and one for the coronavirus pandemic. The State was also included in a disaster (DR) declaration for the coronavirus pandemic. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Chenango County was included in both of these declarations (FEMA 2020).

Table 5.4.1-2. Disease Outbreak-Related FEMA Declarations for Chenango County, 1954 to August 2018

Date(s) of Event	Disease Type	FEMA Declaration Number (if applicable)	Chenango County Designated?
May 22-November 11, 2000	West Nile Virus	EM-3155	Yes
January 20, 2020- Present	COVID-19 Pandemic	DR-4480/EM-3434	Yes

Source: New York Department of Health 2020; FEMA 2020, WHO 2020

USDA Declarations

Between 2012 and 2020, Chenango County has not been included in any disease-related disaster events, as declared by the USDA.

Previous Events

For this 2021 HMP update, known disease outbreak events that have impacted Chenango County between 2014 and 2020 are identified in Table 5.4.1-3, below.

Table 5.4.1-3. Major Disease Outbreaks in Chenango County, NY, 2014 – 2020

Date(s) of Event	Disease Type	FEMA Declaration Number (if applicable)	Chenango County Designated?	Description
February 16, 2018	Influenza	N/A	No	The Chenango County Public Health Department issued a press release detailing surging numbers of influenza cases across the state. The New York State Health Department has reported 70,000 cases of laboratory-confirmed influenza and over 14,000 hospitalizations. According to the New York Department of Health, 553 cases of laboratory-confirmed Influenza were recorded in Chenango County in 2018.
January 20, 2020 – Present	COVID-19 Pandemic	DR-4480/EM-3434	Yes	A novel strain of coronavirus (COVID-19) first identified in Wuhan, Hubei Province, China spread throughout the world and was designated as a pandemic by the World Health Organization in March 2020. The virus caused severe impacts across New York State, with New York City commonly identified as the epicenter to the national outbreak. The highly contagious virus particularly impacts human's respiratory

Date(s) of Event	Disease Type	FEMA Declaration Number (if applicable)	Chenango County Designated?	Description
				system. In Chenango County, as of December 31, 2020 there have been 1,179 confirmed cases and 18 deaths.

Source: Chenango County Department of Health; FEMA; New York State Department of Health; CDC

While the above diseases are of high concern and priority in Chenango County, the New York State Department of Health (NYS DOH) reports on all communicable diseases within the County. Some of the following diseases have also been included in the Chenango County Public Health Needs Assessment as diseases that affect the county, however, not all have been profiled in detail based on Steering Committee input. The table below contains reported disease counts of all reported communicable diseases in Chenango County from 2014-2018. Only diseases reported within these years are reflected in the table.

Table 5.4.1-4. Disease Outbreak Events in Chenango County, 2014 to 2018

	AIDS	Anaplasmosis	Brucellosis	Campylo-bacteriosis	Chlamydia	Crypto-sporidiosis	E. Coli Shiga-toxin	EHCEC	Ehrlichiosis	Giardiasis	Gonorrhea	Hemophilus Influenzae	Hemolytic Uremic Syndrome	Hepatitis A	Hepatitis B Chronic	Hepatitis C Acute	Hepatitis C Chronic	Hepatitis C Past/Present	HIV	Influenza	Legionellosis	Listeriosis	Lyme Disease	Meningitis Aseptic	Pertussis
2014	0	1	0	11	135	1	0	1	0	10	2	0	0	0	1	3	0	46	2	178	3	1	37	2	0
2015	1	1	1	12	126	2	0	1	0	4	12	0	0	0	1	3	0	42	3	318	2	0	63	3	0
2016	0	0	0	6	103	1	0	0	0	6	6	1	0	1	3	0	32	0	6	208	0	0	44	1	3
2017	0	1	0	8	116	10	1	0	2	8	8	3	1	0	2	1	41	0	0	508	1	1	127	2	2
2018	0	1	0	8	99	1	5	0	0	8	12	1	0	0	3	0	44	0	0	553	4	0	83	0	3

	RMSF	Salmonellosis	Strep Group A Invasive	Strep Group B Invasive	Strep Pneumo Invasive	Syphilis Early	Syphilis Late	Vibriosis	Yersiniosis
2014	0	10	3	8	6	1	0	0	0
2015	0	2	2	5	5	1	0	0	0
2016	0	10	1	10	10	1	1	0	0
2017	0	4	3	6	6	1	2	0	0
2018	1	7	2	8	9	0	0	1	1

Source: New York Department of Health 2020; FEMA 2020, WHO 2020
N/ANot Available
Note: With disease outbreak documentation for New York and Chenango County being extensive, not all sources have been identified or researched. Therefore, Table 5.4.1-4 may not include all events that have occurred in the County. 2019 and 2020 statistics were not available at the time of the plan update. Statistics from the 2020 Coronavirus pandemic were subject to change day to day.

Probability of Future Occurrences

It is difficult to predict when the next disease outbreak will occur and how severe it will be because viruses are always changing. The United States and other countries are constantly preparing to respond to pandemics. The Department of Health and Human Services and others are developing supplies of vaccines and medicines. In addition, the United States has been working with the WHO and other countries to strengthen detection of disease and response to outbreaks. Preparedness efforts are ongoing via the New York State Department of Health, and local health departments through Community Preparedness programs to empower local health departments and their community partners to promote local readiness, foster community resilience and to ensure comprehensive, coordinated, and effective responses (NYS Department of Health 2010).

In Chenango County, the probability for a future disease outbreak event is dependent on several factors. One factor that influences the spread of disease is population density. Populations that live close to one another are more likely to spread diseases. As population density increases in the County, so too will the probability of a disease outbreak event occurring.

All of the critical components necessary to sustain the threat of mosquito-borne disease in Chenango County have been clearly documented. Instances of the WNV have been generally decreasing throughout the Northeast because of aggressive planning and eradication efforts, but some scientists suggest that as global temperatures rise and extreme weather conditions emerge from climate change, the range of the virus in the United States will grow. While instances of Zika have decreased since the outbreak in 2016, there is still the possibility of an outbreak occurring in the future. Therefore, based on all available information and available data regarding mosquito populations, it is anticipated that mosquito-borne diseases will continue to be a threat to Chenango County.

Disease-carrying ticks will continue to inhabit the northeast, including Chenango County, creating an increase in Lyme disease and other types of infections amongst the county population if not controlled or prevented. Ecological conditions favorable to Lyme disease, the steady increase in the number of cases, and the challenge of prevention predict that Lyme disease will be a continuing public health concern. Personal protection measures, including protective clothing, repellents or acaricides, tick checks, and landscape modifications in or near residential areas, may be helpful. However, these measures are difficult to perform regularly throughout the summer. Attempts to control the infection on a larger scale by the eradication of deer or widespread use of acaricides, which may be effective, have had limited public acceptance. New methods of tick control, including host-targeted acaricides against rodents and deer, are being developed and may provide help in the future (Steere, Coburn, and Glickstein 2004).

Currently and in the future, control of Lyme disease will depend primarily on public and physician education about personal protection measures, signs and symptoms of the disease, and appropriate antibiotic therapy. Based on available information and the ongoing trends of disease-carrying tick populations, it is anticipated that Lyme disease infections and other tick-borne diseases will continue to be a threat to Chenango County.

In Section 5.3, the identified hazards of concern for Chenango 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 Steering and Planning Committees, the probability of occurrence for disease outbreaks in the County is considered ‘occasional’ (between 10 and 100% annual probability of a hazard event occurring).

Climate Change Impacts

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Chenango County is located in Region 3, which includes the Southern Tier. In

Region 3, it is estimated that temperatures will increase by 3.6ºF to 7.1ºF by the 2050s and 4.2ºF to 11.6ºF by the 2080s (baseline of 47.5ºF). Precipitation totals will increase between 2 and 15% by the 2050s and 3 to 16% by the 2080s (baseline of 35.0 inches). Increased rainfall and heavy rainfalls increase the chances of standing water where mosquitos breed.

The relationship between climate change and increase in infectious diseases is difficult to predict with certainty, there are scientific linkages between the two. As warm habitats that host insects such as mosquitoes increase, more of the population becomes exposed to potential virus threats (The Washington Post 2017). The notion that rising temperatures will increase the number of mosquitoes that can transmit diseases such as WNV and Zika among humans (rather than just shift their range) has been the subject of debate over the past decade. Some believe that climate change may affect the spread of disease, while others are not convinced. However, many researchers point out that climate is not the only force at work in increasing the spread of infectious diseases into the future (NJOEM 2019).

5.4.1.2 Vulnerability Assessment

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

Impact on Life, Health and Safety

The entire population of Chenango County 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 to do the closer proximity of population to potentially infected people.

Most recently with COVID-19, the Centers for Disease Control and Prevention have indicated that persons over 65 years and older, persons living in a nursing home or long-term care facility, and persons with underlying medical conditions such as diabetes, severe obesity, serious heart conditions, etc. are at a higher risk of getting severely ill (CDC 2020). Population data from the 2018 5-year American Community Survey indicates that there are 16,053 persons over 65 years old in Chenango County. This age group would be considered at risk for getting severely ill from the COVID-19 virus. 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 percent of illnesses within the mentioned age group and that Chenango County is among the harder hit counties in the State in terms of total COVID-19 cases (New York State Department of Health 2020).

Impact on General Building Stock

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

Impact on Critical Facilities

No critical facilities are anticipated to be affected by disease outbreaks. Hospitals and medical facilities will likely see an increase in patients, but it is unlikely that there will be damages or interruption of services. However, large rates of infection may result in an increase in the rate of hospitalization which may overwhelm hospitals and medical facilities and lead to decreased services for those seeking medical attention. The 2020 coronavirus pandemic has led to overwhelmed hospitals in numerous locations across New York State.

Impact on Economy

The impact disease outbreaks 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 available documentation. Instead, activities and programs implemented by the County to address this hazard are described below, all of which could impact the local economy.

The COVID-19 outbreak in 2020 resulted in significant negative impacts to economic activity in the County, State, and country owing to the identified need to enforce social distancing and quarantine conditions until the disease spread was lessened. Decreased economic activity caused large-scale unemployment throughout the State as well as more than 100,000 businesses to close as of May 2020 (Patch.com 2020). During the height of the COVID outbreak, all non-essential businesses were forced to close. The virus outbreak has also had a deleterious impact on government finances owing to tax delinquency and loss of user fees. Decreased revenues can lead to service cuts and prevent the County and community from procuring necessary supplies to weather the outbreak. Though the full scale of the economic fallout is yet to be quantified, the economic impact from disease outbreak was clearly felt in Chenango County.

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

Impact on Environment

Disease outbreaks may have an impact on the environment if the outbreaks are caused by invasive species. Invasive species tend to be competitive with native species and their habitat and can be the major transmitters of disease like Zika, dengue, and yellow fever (Placer Mosquito and Vector Control District 2019). Secondary impacts from mitigating disease outbreaks could also have an impact on the environment. Pesticides used to control disease carrying insects like mosquitos have been reviewed by the EPA and the New York Department of Environmental Conservation. If these sprays are applied in large concentrations, they could potentially leach into waterways and harm nearby terrestrial species. As a result, pesticides must be registered before they can be sold, distributed, or used in the state (New York Department of Environmental Conservation 2020).

Cascading Impacts on Other Hazards

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

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. The county considered the following factors that may affect hazard vulnerability:

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

Projected Development

As discussed in Section 4 (County Profile), areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by the disease outbreak hazard because the entire planning area is exposed and vulnerable. Additional development of structures in close proximity to waterbodies or areas with high population density are at an increased risk. Please refer to the specific areas of development indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 of this plan.

Projected Changes in Population

According to the Cornell University Program on Applied Demographics, the population of the County is expected to continue to decline through 2040. However, vulnerable populations (i.e., persons over 65) are increasing throughout the County, it can be assumed that more persons are at greater risk of impacts from disease outbreaks. Furthermore, changes in the density of population when households move throughout the County could influence the number of persons exposed to disease outbreaks. Higher density jurisdictions are not only at risk of greater exposure to disease outbreak, density may also reduce available basic services provided by critical facilities such as hospitals and emergency facilities for persons that are not affected by a disease.

Climate Change

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

The relationship between climate change and infectious diseases is somewhat controversial. The notion that rising temperatures will increase the number of mosquitoes that can transmit malaria among humans (rather than just shift their range) has been the subject of debate over the past decade. Some believe that climate change may affect the spread of disease, while others are not convinced. However, many researchers point out that climate is not the only force at work in increasing the spread of infectious diseases into the future. Other factors, such as expanded rapid travel and evolution of resistance to medical treatments, are already changing the ways pathogens infect people, plants, and animals. As climate change accelerates it is likely to work synergistically with many of these factors, especially in populations increasingly subject to massive migration and malnutrition (Harmon 2010).

Change of Vulnerability Since the 2015 HMP

Disease outbreak is a new hazard profile for the 2021 HMP update.

5.4.2 Drought

This section provides a hazard profile and vulnerability assessment of the drought hazard for Chenango County.

5.4.2.1 Hazard Profile

This section presents information regarding the description, extent, location, previous occurrences and losses, climate change projections and probability of future occurrences for the drought hazard.

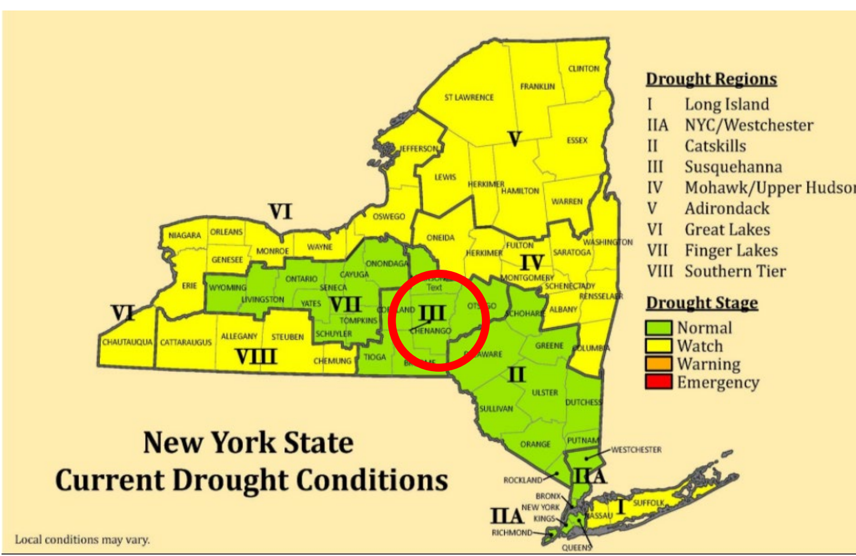
Description

Drought is a period characterized by long durations of below normal precipitation. Drought is a temporary irregularity and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. Drought conditions occur in virtually all climatic zones yet its characteristics vary significantly from one region to another, since it is relative to the normal precipitation in that region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.

Extent

The severity of a drought depends on the degree of moisture deficiency, the duration of the event, 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. New York State applies two methodologies to identify the different drought stages - the Palmer Drought Severity Index (PDSI) and the State Drought Index (SDI). The two different indices inform the agricultural and water supplier sectors, in that the PDSI puts an emphasis on soil moisture and helps the State understand agricultural impacts, whereas the SDI provides guidance to public and private water suppliers and withdrawals (NYSDEC 2020).

Figure 5.4.2-1. NYSDEC Region Map



State Drought Index

The New York State Department of Environmental Conservation (NYSDEC) divides New York State into nine drought management regions, with divisions roughly following drainage basin contours and county lines. Chenango County is located within the Susquehanna Drought Region (Region III). NYSDEC monitors precipitation, stream flow, lake and reservoir levels, and groundwater levels at least monthly in each region and more frequently during periods of drought. NYSDEC uses these data to assess the condition of each region, which can range from *normal* to *drought disaster*.

The State Drought Index compares four parameters to historic or "normal" values to evaluate drought conditions: stream flows, precipitation, lake and reservoir storage levels, and groundwater levels. New York's Drought Management Task Force uses those factors as well as water use, duration of the dry period, and season to assess drought in different parts of the state. (NYSDEC 2020).

New York also uses the Palmer Drought Index, a measure of soil moisture calculated by the National Weather Service. The two indices show us different things about drought. The Palmer Index, with its emphasis on soil moisture, helps us understand agricultural impacts. The State Index helps assess the impact on human welfare and the regional economy (NYDEC 2020).

Figure 5.4.2-2. NYSDEC Drought Stages

Drought Stage	Description
Drought Watch	The least severe of the stages, a drought watch is declared when a drought is developing. Public water suppliers begin to conserve water and urge customers to reduce water use.
Drought Warning	Voluntary water conservation is intensified. Public water suppliers and industries update and implement local drought contingency plans. Local agencies make plans in case of emergency declaration.
Drought Emergency	The Governor may declare emergency. The Disaster Preparedness Commission coordinates response. Mandatory local/county water restrictions may be imposed. Communities may need to tap alternative water sources to avoid depleting water supplies, protect public health and provide for essential uses.
Drought Disaster	Disaster plans are implemented. Water use is further restricted. The Governor may declare disaster and request federal disaster assistance. Emergency legislation may be enacted. The state provides equipment and technical assistance to communities.

Palmer Drought Severity Index

The Palmer Drought Severity Index (PDSI) is primarily based on soil conditions. Soil with decreased moisture content is the first indicator of an overall moisture deficit.

Table 5.4.2-1 lists the PDSI classifications. At the one end of the spectrum, 0 is used as normal and drought is indicated by negative numbers. For example, -2 is moderate drought, -3 is severe drought, and -4 is extreme drought. The PDSI can reflect excess precipitation using positive numbers; however, this is not shown in the table. The PDSI is commonly converted to the Palmer Drought Category (National Drought Mitigation Center [NDMC] 2013).

Table 5.4.2-1. Palmer Drought Category and Palmer Drought Index Descriptions

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

Source:NDMC 2013

Location

Droughts are a regional phenomenon that have the potential to directly or indirectly impact every person in Chenango County. In general, droughts can occur at any given time of the year in the County, though most often occurs late summer to early fall. When compared to other parts of the country, this hazard is relatively less likely to occur in this region and most of New York State (NYSDHSES 2019).

Chenango County is situated between the Great Lakes and the Atlantic Ocean. These water bodies provide significant moisture that generates precipitation throughout the region. The Susquehanna River flows through the southern portion of the County, with the County's tributaries feeding downstream waterways. Drought impacting the County would have impacts downstream of the Susquehanna, including neighboring Broome County in New York and in Pennsylvania.

Previous Occurrences and Losses

Chenango County does not usually experience severe or extreme drought due to its proximity to the Great Lakes and Atlantic Ocean. Based on available historical records, the communities in the planning area are equally susceptible to drought events and should mitigate to an extent of moderate drought.

FEMA Disaster Declarations

Between 1954 and April 2020, FEMA declared that New York State experienced one drought-related disaster (DR) or emergency (EM) that was classified as a water shortage. Generally, drought-related disasters affect a wide region of the state and can impact many counties; however, Chenango County was not included in the disaster declaration.

USDA Agricultural Disaster Declarations

The U.S. Department of Agriculture (USDA) keeps records of agricultural disasters. In 2016, the USDA designed the County's drought as a disaster (S4031) beginning July 2016. The County experienced losses to its corn crop due to the drought.

Previous Events

Table 5.4.2-2 lists known drought events between 2015 and 2020 that impacted Chenango County and its municipalities based on all sources researched.

Table 5.4.2-2. Drought Events in Chenango County, NY between 2015 and April 2020

Dates of Event	Event Details*
May-June 2015	Small portions of Chenango County featured abnormally dry conditions in late May and through June 2015.
Spring-Winter 2016	Beginning in April 2016 and through mid-January of 2017, large portions of Chenango County experienced abnormally dry conditions. Between October 2016 to December 2016, most of the County's land area experienced a moderate drought. The drought was reported to be one of the worst to hit the region in decades, resulting in one of the first designated drought watches in more than a decade. The USDA Farm Service Agency declared most counties in the region to be in a natural disaster area. A Cornell University survey found that nearly three-quarters of unirrigated, rain-fed crops and pasture acreage experienced losses between 30 and 90 percent.
October 2017	October 2017 saw abnormally dry conditions throughout the County.

Dates of Event	Event Details*
Winter 2018	Between December 2017 and early February 2018, significant portions of the County experienced abnormally dry conditions.
June-July 2018	The County experienced abnormally dry conditions in the summer of 2018. This was part of a moderate drought that impacted adjacent northeastern states.

Sources: USDA 2020; NDMC 2020; Cornell University 2017
** Many sources were consulted to provide an update of previous occurrences and losses; event details and loss/impact information may vary and has been summarized in the above table.*

Climate Change Projections

Climate change can contribute to increased chances of drought and its secondary impacts such as decreased water supply and higher threat of wildfires. Temperatures and precipitation amounts are expected to increase within the Southern Tier region. Precipitation totals will change between 4 and 10 percent by the 2050s and between 6 and 14 percent by the 2080s (baseline of 35 inches). Table 5.4.2-3 lists projected seasonal precipitation changes within the Southern Tier ClimAID Region (NYSERDA 2014).

Table 5.4.2-3. Projected Seasonal Precipitation Change in Region 3, 2050s (percent change)

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

Source:NYSERDA 2011

Snowfall rates in Chenango County may increase due to reduced freezing of the Great Lakes as temperatures are predicted to warm. However, as the climate warms, temperatures could rise enough to the point where winter precipitation might fall as rain instead of snow (NYSERDA 2014). These fluctuations in snowfall could result in an increase or decrease in the county's winter snowpack. Reductions in snowpack would increase the possibility of drought.

Extreme heat events are likely to increase throughout New York State, and short-duration warm season droughts will become more common. With the increase in temperatures, heat waves (defined as 3 or more consecutive days with maximum temperatures at or above 90 ˚F) will become more frequent and intense. Summer droughts are projected to increase under these conditions (NYSERDA 2014).

By the end of the 21st century, the number of droughts is likely to increase, as the effect of higher temperatures on evaporation is likely to outweigh the increase in precipitation. Droughts in the northeast United States have been associated with local and remote modes of multi-year, ocean-atmosphere variability that are unpredictable and could change with climate change. Changes in distribution of precipitation throughout the year and in timing of snowmelt could increase frequency of droughts (NYSERDA 2011).

Probability of Future Occurrences

Chenango County has historically experienced a range of drought conditions from *abnormally dry* to *moderate*, or D0 to D1, in accordance with the Palmer Drought Category. Based on the historic record and climate projections for the region, it is anticipated that Chenango County will continue to experience drought events in the future. Based on the periods of time that Chenango spent in at least *abnormally dry* conditions and input from the Planning Committee, the probability for drought in the county is considered 'occasional' (between 10% and 100% annual probability of a hazard event occurring).

5.4.2.2 Vulnerability Assessment

To understand risk, a community must evaluate assets exposed to and vulnerable to the identified hazard. All of Chenango County is exposed to the drought hazard; therefore, all assets within the county (population, structures, critical facilities, and lifelines), as described in Section 4 (County Profile), are potentially vulnerable to a drought event. The following text evaluates and estimates the potential impact of the drought hazard in the county.

Impact on Life, Health, and Safety

The entire population of Chenango County is vulnerable to drought events (2018 American Community Survey 5-Year Estimate: 48,348 people). Drought conditions can affect public health and safety, including reduced local firefighting capabilities, health problems related to low water flows and poor water quality, and health problems related to dust. If droughts are severe enough, these health problems can lead to loss of human life.

Other possible impacts include 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. Due to their age, health conditions, and limited ability to mobilize to shelters, cooling, and medical resources, the infirm, young, and elderly are particularly susceptible to drought and extreme temperatures, sometimes associated with drought conditions. The percent of elderly persons living in Chenango County increased from 16.6% in 2010, to 19.7% (9,539 persons) in 2018 (U.S. Census 2018). Some drought-related health effects are short term, while others can be long term (CDC 2012). Social impacts primarily involve public safety, health, conflicts among water users, reduced quality of life, and inequities in distribution of impacts and disaster relief. Many economic and environmental effects induce social impacts, as well (NYS DHSES 2014).

During dry periods, soil water can deplete quickly. If precipitation deficiencies continue, people who depend on other sources of water will begin to feel impacts of the shortage. Those who rely on surface water (for example, reservoirs and lakes) and subsurface water (for example, groundwater) are usually the last to be affected. A short-term drought that persists for 3 to 6 months might have little impact on these sectors, depending on characteristics of the hydrologic system and intensity of water use (NYS DHSES 2014).

According the USGS Water Science School, groundwater levels are dependent on recharge from infiltration of precipitation, so when a drought hits the land surface, it can impact the water levels below ground. When rainfall is less than normal for several weeks, months, or years, the flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth to water in wells increases. If dry weather persists and water-supply problems develop, the dry period can become a drought.

The water level in the aquifer that supplies a well does not always stay the same. Droughts, seasonal variations in rainfall, and pumping affect the height of the groundwater levels. If a well is pumped at a faster rate than the aquifer feeding it is recharged by precipitation or other underground flow, then water levels in the well can be lowered. This can happen during drought, due to the extreme deficit of rain. The water level in a well can also be lowered if other wells near it are withdrawing too much water (USGS 2019).

The drought hazard is a concern for Chenango County because the majority of water for public use comes from groundwater sources, including aquifers. The major aquifers within Chenango County can provide between 300,000 to 500,000 gallons per day, per well, with minor aquifers yielding 1,000 to 10,000 gallons per day, per well (Chenango County 2016). The major and some minor population centers within the County are located near primary aquifers and have access to an abundant ground water supply during non-drought conditions. Rural residential water supply systems in Chenango County are typically supplied by natural springs and drilled water wells, however, unfortunately these residential properties often have small lots and poor soil and improperly developed water wells that are easily contaminated by wastewater systems or improper drainage systems (Chenango County 2016).

Impact on General Building Stock

A drought event is not expected to directly affect any structures; however, a secondary hazard most commonly associated with drought is wildfire. Prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. Though some structures can become vulnerable to wildfire that are within or near the wildfire urban interface, this is more likely following long periods of drought. Refer to Section 5.4.10 (Wildfire) of the HMP for additional discussion of the wildfire hazard in Chenango County.

Impact on Critical Facilities

Water supply facilities may be affected by drought events. The county's public water supply system is a mix of public and privately-owned water systems, but much of the rural populations are served by private wells and are significantly affected by periods of diminished groundwater resources. A short-term drought that persists for 3 to 6 months could have little impact on surface water and subsurface water, depending on characteristics of the hydrologic system and intensity of water use (NYS DHSES 2014). However, since droughts are often slow-onset hazards, over time, they can severely affect crops, water supply, recreational resources, and wildlife. If drought conditions persist over a number of years, both direct and indirect economic impacts can be significant. Human actions and demands for water resources can accelerate drought-related impacts in the county (NYS DHSES 2019).

Impact on the Economy

Drought events impact the economy, including loss of business function and damage and loss of inventory. Industries that rely on water for business can be impacted the hardest (e.g., agriculture, forestry, fisheries, waterborne activities). In addition to losses in crop yields and livestock production, drought is associated with increased insect infestations, plant diseases, and wind erosion. Drought can lead to reduced income for farmers and reduced business for retailers and others who provide goods and services to farmers, leading to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue. Prices for food, energy, and other products might also increase as supplies decrease (NYS DHSES 2014). In a Socioeconomic Drought, water shortages being to affect the population of an area, both individually and collectively (NYS DHSES 2019). This can include the supply or demand of goods, as well as the economic output of an area.

Direct and indirect losses to agricultural producers, livestock producers, timber producers, fishery producers, and tourism include the following:

- Damage to crop quality and crop losses.
- Insect infestation leading to crop and tree losses.
- Plant diseases leading to loss of agricultural crops and trees.
- Reduced productivity of livestock due to unavailability of feed and mortality rates (i.e., milk production, meat).
- Reduction in tourism and outdoor activities such as hunting, fishing, and boating.
- Increased risk of brush fires and wildfires due to dried crops, grasses, and dying trees.

When a drought occurs, the agricultural industry is most at risk for economic impact and damage. A large majority of the state's agriculture is rain-fed without irrigation; however, summer precipitation currently is not sufficient to fully meet crop water needs during most years (NYSERDA 2011). Based on information from the 2017 Census of Agriculture, 770 farms were present in Chenango County, encompassing 148,982 acres of total farmland. The average farm size was 193 acres. Products sold from Chenango County farms had a total market value of $67.9 million ($41.6 million: milk from cows, $9.3 million: other crops and hay, $6.8 million: cattle and calves, $5.5 million: grains, oilseeds, dry beans, dry peas). The 2017 Agricultural Census indicated that 643 farm operators reported farming as their primary occupation (USDA 2017). Table 5.4.2-4 lists the acreage of agricultural land exposed to the drought hazard.

Table 5.4.2-4. Agricultural Land in Chenango County, NY in 2017

Number of Farms	Land in Farms (acres)	Total Cropland (acres)	Harvested Cropland (acres)
770	148,982	77,079	65,359

Source: USDA 2017

A prolonged drought can have a serious economic impact on a community. Increased demand for water and electricity can result in shortages and higher costs for these resources. Industries that rely on water for business could be impacted the most (e.g., landscaping businesses). Although most businesses will still be operational, they may be impacted aesthetically. These aesthetic impacts are most significant within the recreation and tourism industry. Moreover, droughts within another area could impact the food supply and price of food for residents within the county.

Impact on the Environment

Drought can impact the environment because it can trigger wildfires, increase insect infestations, and exacerbate the spread of disease (NOAA 2020). Drought can also impact water resources that are relied upon by aquatic and terrestrial species. Ecologically sensitive areas, such as wetlands, can be particularly vulnerable to drought periods because they are dependent on steady water levels and soil moisture availability to sustain growth. As a result, these types of habitats can be negatively impacted after long periods of dryness. As a cascading effect of these droughts, wildfires can also have detrimental effects on the environment, including pollution from the smoke of the fire, ecological damage and loss of habitat, and water contamination due to damaged/ burnt vegetative cover (US Forestry Service, 2020).

Cascading Impacts on Other Hazards

As discussed in earlier sections, drought can lead to increasing temperatures and evaporation of moisture, which are ideal dry conditions for wildfire events to occur. Dry, hot, and windy weather combined with dry vegetation is more susceptible to sparking wildfires when met with a spark created by humans or natural events, such as lightning (National Integrated Drought Information System 2020). Refer to Section 5.4.10 (Wildfire) for more information about the wildfire hazard of concern.

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. The county considered the following factors to examine potential conditions that may affect hazard vulnerability:

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

Projected Development

As discussed in Section 4, areas targeted for future growth and development were identified across the county. Any areas of growth could be potentially impacted by the drought hazard because the entire county is exposed and vulnerable to droughts. Future growth and development could impact the amount of potable water available due to a drain on the available water resources. An increased drain on water resources would not only impact the county's population, but it would also exacerbate impacts to other areas of the county as discussed above, including agriculture and recreational facilities. Refer to Section 9 (Jurisdictional Annexes) for a discussion on potential new development.

Projected Changes in Population

According to population projections from the Cornell Program on Applied Demographics, Chenango County will experience a continual population decrease through 2040 (a decline of over 7,500 people in total by 2040). This decrease will reduce the overall vulnerability of the county's population over time. While less people will reside in the county, populations could move into more rural areas of the county, increasing the stress on the water supplies in those locations.

According to the Chenango County Comprehensive Plan (2016), the county has seen an increase in population and development patterns along the Chenango River/NYS Route 12 corridor, as well as the Susquehanna River/NYS Routes 7 and 8 corridor. However, the overall population density of the majority of municipalities, as well as for the County as a whole, has been decreasing. Refer to Section 4.6.2 (Population Trends) in the County Profile for a discussion on trends for the county.

Climate Change

As discussed earlier, summer droughts are projected to increase, which could affect water supply, agriculture and ecosystems (NYSERDA 2014). An increased incidence of drought might impact availability of water supplies, primarily placing an increased stress on the population. It is unlikely that structure exposure and vulnerability would increase as a direct result of drought, although secondary impacts of drought, such as wildfire, could increase and threaten structures. If a wildfire were to occur during a drought, emergency services might face complications from a water shortage depending on their water source, and critical water-related service sectors might need to adjust management practices and actively manage resources. Increased incidence of drought increases the potential for impacts on the local economy, including the production of agricultural products.

Change of Vulnerability Since the 2016 HMP

The 2016 HMP provided a summary of historic loss information and qualitative assessment for the drought hazard. For this HMP Update, a qualitative assessment was conducted for population, buildings and critical facilities using data from the 2017 USDA Census of Agriculture to assess potential economic impacts. According to the U.S. Census Bureau American Community Survey 2018 Population Estimates, the population of Chenango County has decreased by roughly 4.2% since the 2010 Census; therefore, the number of people exposed to the drought hazard has decreased. The number of farms and total acreage of farmland has also decreased from 2012 to 2017; therefore, an decreased area of agricultural land is exposed to the drought hazard. Overall, the entire county will continue to be exposed and vulnerable to drought events.

5.4.3 Extreme Temperature

This section provides a profile and vulnerability assessment for the extreme temperature hazard in Chenango County.

5.4.3.1 Hazard Profile

This section provides profile information including description, extent, location, previous occurrences and losses, and the probability of future occurrences for the extreme temperatures hazard.

Description

Extreme temperature includes both cold and heat events that can have a significant impact to human health, commercial/agricultural businesses and primary and secondary effects on infrastructure such as failing pipes and power failure. E*xtreme cold* or *extreme heat* definitions can vary across the country based upon the temperature to which population is accustomed.

Extreme Cold

Extreme cold events occur when temperatures drop significantly below normal in an area for an extended period of time. No specific definition exists for Extreme Cold, temperatures at or below zero degrees for an extended period of time characterize a cold wave event in New York State (NYS DHSES 2019).

Extreme Heat

Extreme heat is defined as temperatures which hover 10 degrees or more above the average high temperature for a region and that last for several weeks (CDC 2016). An extended period of extreme heat of three or more consecutive days is typically called a heat wave and is often accompanied by high humidity (NWS 2013). Humid or muggy conditions occur when a *dome* of high atmospheric pressure traps hazy, damp air near the ground. Extreme heat days in New York State are defined as individual days with maximum temperatures at or above 90 °F or at or above 95 °F. Heat waves are defined as three consecutive days with maximum temperatures above 90 °F (NYSERDA 2014) Excessive heat is when the heat index reaches 105 °F for at least three hours on two consecutive days, and the nighttime air temperature does not drop below 75 °F (NYS DHSES 2019).

Extent

Extreme Cold

The extent (severity or magnitude) of extreme cold temperatures generally are measured through the Wind Chill Temperature (WCT) Index. The WCT Index uses advances in science, technology, and computer modeling to provide an accurate, understandable, and useful formula for calculating the dangers from wind chill. For details regarding the WCT Index, refer to: http://www.nws.noaa.gov/om/winter/windchill.shtml. The WCT Index is presented in Figure 5.4.3-1. The National Weather Service (NWS) provides alerts when Wind Chill indices approach hazardous levels. Table 5.4.3-1 explains these alerts.

Wind Chill At a Glance

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

Source: The Weather Channel (2019)

Figure 5.4.3-1. 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 5.4.3-1. National Weather Service 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

Additionally, the National Weather Service issues Freeze Watch, Warning, and Frost Advisories. The criteria for these alerts are described in the table below.

Table 5.4.3-2: National Weather Service 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 of time, 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 24-36 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.

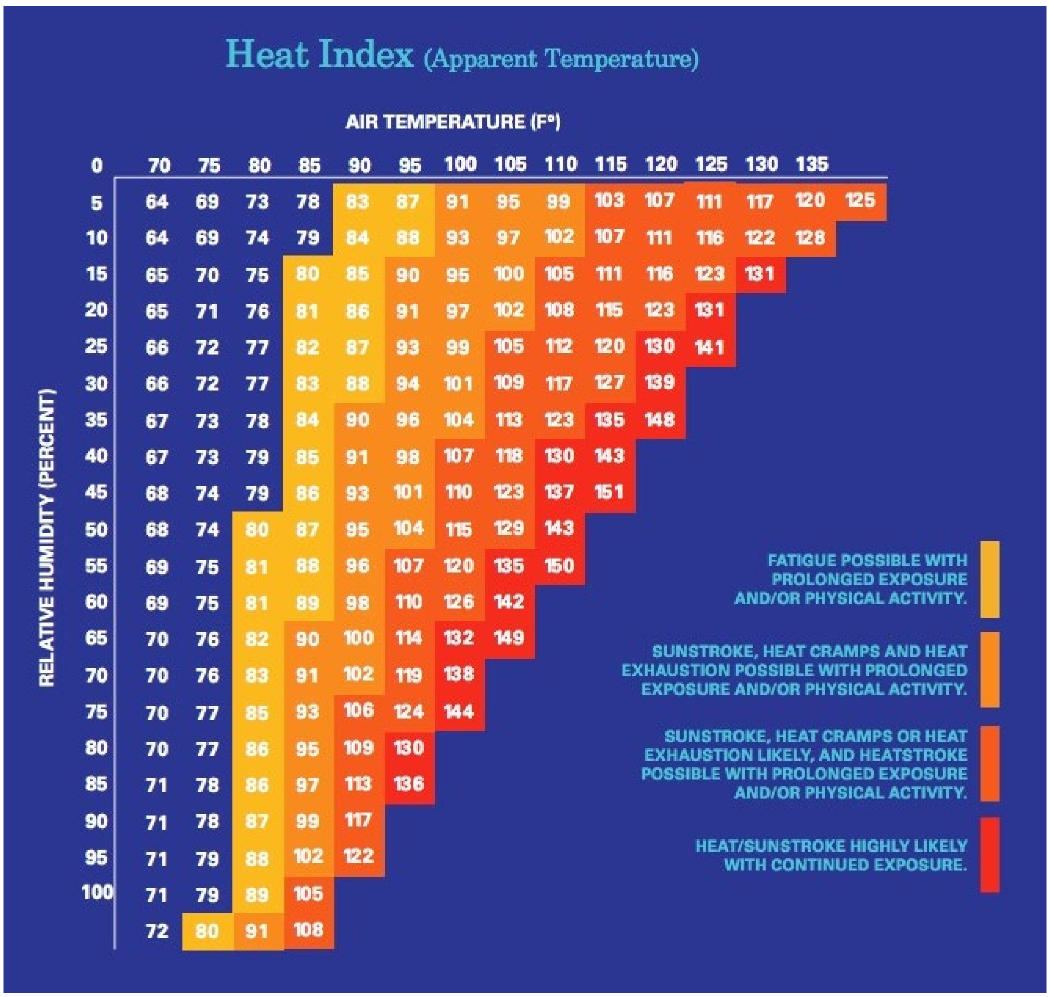
Source: NYS DHSES, 2019

Extreme Heat

The extent of extreme heat temperatures generally is measured through the Heat Index, identified in Table 5.4.3-2. Created by the NWS, the Heat Index is a chart that measures apparent temperature of the air as it increases with the relative humidity. To determine the Heat Index, both the temperature and relative humidity are needed. Once both values are identified, the Heat Index is the corresponding number of both the values, as seen in Figure 5.4.3-2 This provides a measure of how temperatures feel. However, the values are devised for shady, light wind conditions. Exposure to full sun can increase the index by up to 15 degrees (NYS DHSES 2019).

> **Relative Humidity At a Glance**
> Relative humidity is the amount of moisture in the air at a certain temperature compared to what the air can "hold" at that temperature…it is measured as a percentage or ratio of the amount of water vapor in a volume of air RELATIVE to a given temperature and the amount it can hold at that given temperature. Warm air can hold more moisture than cold air.
>
> Source: Molekule, 2020

Figure 5.4.3-2. Heat Index Chart



Source: NYS DHSES, 2019

The NWS provides alerts when Heat Indices approach hazardous levels. Table 5.4.3-2 explains these alerts.

Table 5.4.3-2. National Weather Service Alerts

Alert	Criteria
Heat Advisory	Criteria for a Heat Advisory in New York is a heat index of 95-104 °F. The heat index has to remain at or above criteria for a minimum of 2 hours. Heat advisories are issued by county when any location within that county is expected to reach criteria.
Excessive Heat Watch	Issued when Heat Warning criteria is possible (50-79%) 1 to 2 days in advance.
Excessive Heat Warning	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 county when any location within that county is expected to reach criteria.

Source: NWS, 2020

Location

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

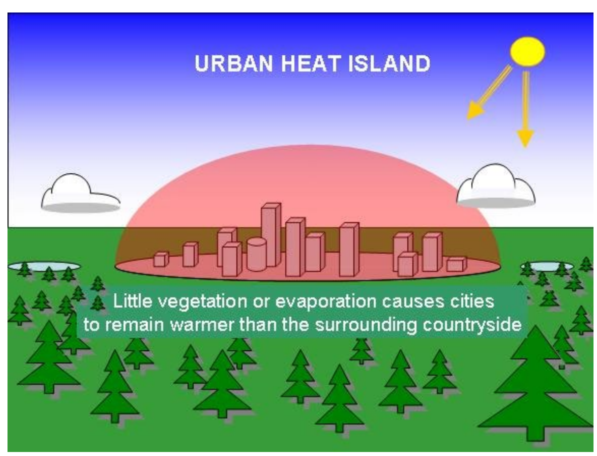
New York State is divided into 10 climate divisions: Western Plateau, Eastern Plateau, Northern Plateau, Coastal, Hudson Valley, Mohawk Valley, Champlain Valley, St. Lawrence Valley, Great Lakes, and central Lakes. According to NCDC, "Climatic divisions are regions within each state that have been determined to be reasonably climatically homogeneous" (CPC 2005). Chenango County is located within the Eastern Plateau Climate Division. Refer to https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/CLIM_DIVS/states_counties_climate-divisions.shtml for a figure showing the climate divisions in New York State.

Extreme Cold

Extreme cold temperatures occur throughout most of the winter season and generally accompany most winter storm events throughout the state. When atmospheric pressures are higher than normal and Arctic air masses enter the area, extreme cold temperatures impact Chenango County, flowing southward from central Canada or the Hudson Bay (NCDC 2006).

Extreme Heat Temperatures

Extreme heat temperatures of varying degrees occur throughout the county for most of the summer season, except for areas with high altitudes. Extreme heat temperatures result from high pressure systems off of the Atlantic Coast remaining in place for several days, causing persistent air flow from the south to bring heat into the area (NCDC 2006). Areas of denser urban development, such as the City of Norwich, are vulnerable to the urban heat island effect phenomenon, which can further raise temperatures.



Source: weatherquestions.com, 2019

Previous Occurrences and Losses

Extreme temperature events occur with some regularity in Chenango County. To identify the events in Chenango 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.

FEMA Disaster Declarations

Between 1954 and 2020, FEMA has not included New York State in any extreme temperature-related disaster declarations. However, Chenango County has been included in six winter storm-related declarations, as shown in Table 5.4.3-3. These are shown because cold temperatures are often associated with these disaster types.

Table 5.4.3-3 Winter Storm Related Disaster (DR) and Emergency (EM) Declarations 1954 – 2020

Disaster Number	Event Date	Declaration Date	Incident Type	Title
EM-3107	March 13 – March 17, 1993	March 17, 1993	Snow	Severe Blizzard
EM-3173	December 25 – January 4, 2002	February 25, 2003	Snow	Snowstorms
EM-3184	February 17 –18, 2003	March 27, 2003	Snow	Snow
DR-1467	April 3 – 5, 2003	May 12, 2003	Severe Ice Storm	Ice Storm
EM-3299	December 11 – 31, 2008	December 18, 2008	Severe Storm(s)	Severe Winter Storm
DR-4322	March 14 – 15, 2017	July 12, 2017	Snow	Severe Winter Storm and Snowstorms

Source:FEMA 2020
DR Major Disaster Declaration (FEMA)
EM Emergency Declaration (FEMA)
FEMA Federal Emergency Management Agency

USDA Disaster Declarations

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2015 and 2020, Chenango County was included in USDA declaration S4031, which occurred in September 2016 and entailed drought and heat/excessive heat.

Previous Events

Information regarding specific details of temperature extremes in Chenango County is scarce; therefore, previous occurrences and losses associated with extreme temperature events are limited. For this 2021 HMP update, no extreme temperature events reported to NOAA-NCEI between 2015 and 2020. For events occurring prior to 2015, refer to Appendix E (Supplementary Data). Table 5.4.3-4 presents the number of extreme temperature events that occurred between 1950 and 2020; however, the events summarized in the table below include events reported to NOAA-NCEI and does not include all events that occurred in Chenango County.

Table 5.4.3-4. Extreme Temperature Events, 1950 – 2020

Hazard Type	Number of Occurrences Between 1950 and 2020	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Cold/Wind Chill	14	0	0	$20,000	$0
Excessive Heat	1	0	0	$0	$0
Extreme Cold/Wind Chill	2	0	0	$5,000	$0
Heat	3	0	0	$0	$0
TOTAL	**20**	**0**	**0**	**$25,000**	**$0**

Source:NOAA-NCEI 2020

Climate Change Projections

The frequency and duration of heat waves, defined as three or more consecutive days with maximum temperatures at or above 90 ˚F, is expected to increase (Table 5.4.3-5). In contrast, extreme cold events, defined both as the number of days per year with minimum temperature at or below 32 ˚F and those at or below 0 ˚F, are expected to decrease as average temperatures rise (NYSERDA 2011). With the increase in temperatures, heat waves will become more frequent and intense, increasing the number of heat-related illness and death and posing new challenges to the energy system, air quality and agriculture. Table 5.4.3-5 displays the projected changes in these events and includes the minimum, central range and maximum days per year.

Table 5.4.3-5. Changes in Extreme Events in Region 3 – Heat Waves and Drought Conditions

Event Type (2020s)	Low Estimate (10th Percentile)	Middle Range (25th to 75th Percentile)	High Estimate (90th Percentile)
Days over 90°F (8 days)	15	17 to 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: NYSERDA 2014

Probability of Future Occurrences

Chenango County is anticipated to experience extreme temperatures annually that could coincide with or induce secondary hazards, such as snow, hail, ice or wind storms, thunderstorms, drought, human health impacts, and utility failures. Table 5.4.3-6 shows the annual number of events, recurrence interval, annual probability, and annual percent chance of occurrence for the hazards associated with extreme temperatures and reported in the NOAA-NCEI Storm Events Database.

Table 5.4.3-6. Probability of Occurrences of Extreme Temperature Events

Hazard Type	Number of Occurrences Between 1950 and 2020	% chance of occurrence in any given year
Cold/Wind Chill	14	20%
Extreme Cold/Wind Chill	2	3%
Heat	3	5%

Hazard Type	Number of Occurrences Between 1950 and 2020	% chance of occurrence in any given year
Excessive Heat	1	1%
TOTAL	**20**	**28%**

Source: NOAA NCEI 2020
Note:Probability was calculated using the available data provided in the NOAA-NCDC storm events database.

Based on historical records and input from the Steering Committee, the probability of occurrence for extreme temperatures in Chenango County is considered *frequent* (100% annual probability; a hazard event may occur multiple times per year).

5.4.3.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable. For the extreme temperature hazard, the entire county has been identified as exposed; therefore, all assets are potentially vulnerable. The following text estimated potential impacts of extreme temperatures on Chenango County.

Impact on Life, Health and Safety

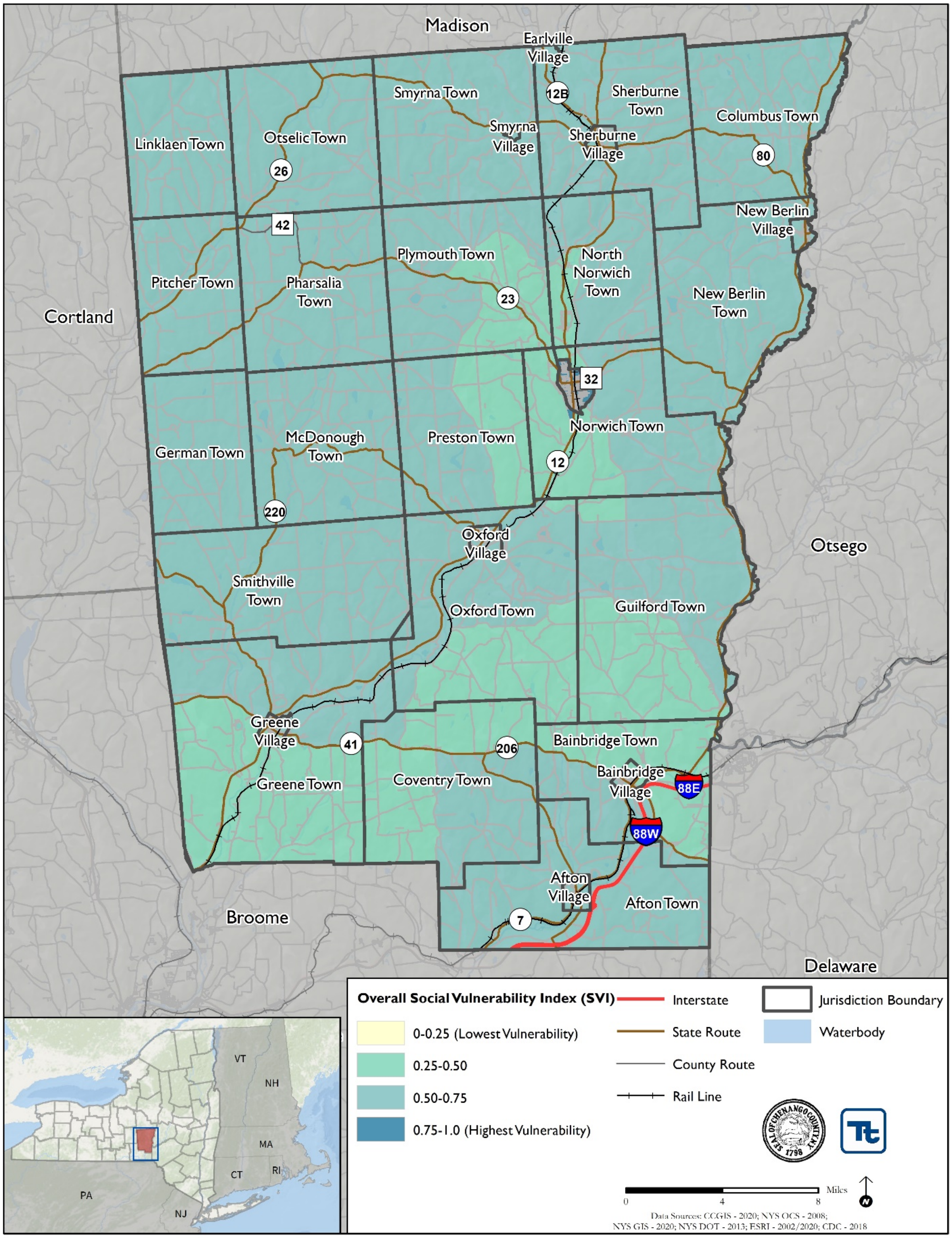
For the purposes of this HMP, the entire population of Chenango County is exposed to extreme temperature events (48,348) (U.S. Census 2018 ACS 5-Year Population Estimate). Extreme temperature events have potential health impacts including injury and death. According to the Centers for Disease Control and Prevention, populations most at risk to extreme cold and heat events include the following: 1) the elderly, who are less able to withstand temperatures extremes due to their age, health conditions, and limited mobility to access shelters; 2) infants and children up to four years of age; 3) individuals with chronic medical conditions (e.g., heart disease, high blood pressure), 4) low-income persons that cannot afford proper heating and cooling; and 5) the general public who may overexert during work or exercise during extreme heat events or experience hypothermia during extreme cold events (CDC 2020).

In Chenango County, the following areas have the highest percentage of elderly population: Village of New Berlin (26.6%), Town of Oxford (23.9%), Village of Greene (20%), Village of Afton (19.1%), and Town of McDonough (18.2%). Refer to Figure 4-5 in Section 4 (County Profile) that displays the densities of populations over 65 in Chenango County.

Residents with low incomes might not have access to housing or their housing can be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). In Chenango County, areas with the highest concentration of low-income populations are very similar to those with the highest concentrations of elderly populations; however, there is fewer high concentrations in the more rural areas of the county's towns. Refer to Figure 4-5 in Section 4 (County Profile) that displays the densities of low-income populations in Chenango County.

According to the Center for Disease Control and Prevention's (CDC) 2016 Social Vulnerability Index, areas within the City of Norwich are the most vulnerable within the County. The average social vulnerability score for Chenango County is 0.5304, indicating moderate to high level of vulnerability. Vulnerable populations throughout the county may be more susceptible to the impacts from extreme temperatures. Figure 5.4.3-4 below displays the CDC 2016 Social Vulnerability Index for Chenango County.

Figure 5.4.3-3. CDC's Social Vulnerability Index 2016



According to NOAA's 2008 *Winter Storms: The Deceptive Killers*, approximately 50 percent of the injuries related to extreme cold temperatures happen to people over 60 years old, more than 75 percent of those injured are male and about 20 percent occur in the home (NOAA 2008). The homeless and individuals who lack proper sheltering and heating are particularly vulnerable to extreme cold and wind chill.

Exposure to excessive heat can pose a number of health risks to individuals. Table 5.4.3-7 and Table 5.4.3-8 identify different health hazards related to extreme heat conditions.

Table 5.4.3-7. Health Effects of Extreme Cold

Health Hazard	Symptoms
Wind Chill	Wind chill is the feel of wind and cold on exposed skin. Body temperature decreases due to heat loss from wind.
Frostbite	Frostbite is damage to body tissue due to extreme cold, and is most prevalent in extremities.
Hypothermia	Hypothermia is characterized by symptoms such as uncontrollable shivering, disorientation, memory loss, drowsiness, and slurred speech. It occurs due to dangerously low body temperature and most often occurs between temperatures of thirty to fifty degrees.

Source:NWS, 2020

Table 5.4.3-8. Health Effects of Extreme Heat

Health Hazard	Symptoms
Sunburn	Redness and pain. In severe cases: swelling of skin, blisters, fevers, and headaches
Dehydration	Excessive thirst, dry lips, and slightly dry mucous membranes
Heat Cramps	Painful spasms, usually in muscles of legs and abdomen, and possible heavy sweating
Heat Exhaustion	Heavy sweating; weakness; cold, pale and clammy skin; weak pulse; possible fainting and vomiting
Heat Stroke	High body temperature (104 ºF or higher), hot and dry skin, rapid and strong pulse, and possible coma

Source: NYS DHSES 2014

In addition, safety issues include not only health-related impacts, but domicile impacts as home fires occur more often in winter than any other season (FEMA, 2019).

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 on those at greatest risk. Adhering to extreme temperature warnings can significantly reduce the risk of temperature-related deaths.

Impact on General Building Stock

All the building stock in the county is exposed to the extreme temperature hazard. Refer to Section 4 (County Profile), which summarizes the building inventory in Chenango County. Extreme heat generally does not impact buildings; however, elevated summer temperatures increase the energy demand for cooling. Losses can be associated with the overheating of heating, ventilation, and air conditioning (HVAC) systems. If warner temperatures are sustained for a longer period, concrete and asphalt roadways can breakdown and cause damage to vehicles and lead to road closures. Extreme cold temperature events can damage buildings through freezing/bursting pipes and freeze/thaw cycles, as well as increasing vulnerability to home fires. Additionally, manufactured homes (mobile homes) and antiquated or poorly constructed facilities can have inadequate capabilities to withstand extreme temperatures.

Impact on Critical Facilities

All critical facilities in the county are exposed to the extreme temperature hazard. Impacts to critical facilities are the same as described for general building stock. Additionally, it is essential that critical facilities remain operational during natural hazard events. Extreme heat events can sometimes cause short periods of utility failures, commonly referred to as *brown-outs*, due to increased usage from air conditioners and other energy-intensive appliances. Similarly, heavy snowfall and ice storms, associated with extreme cold temperature events, can cause power interruption. Backup power is recommended for critical facilities and infrastructure. Extreme temperature events can damage roadways, leading to potential road closures and impacting accessibility to areas around the County. This could disrupt emergency access and response time.

Impact on Economy

Extreme temperature events also have impacts on the economy, including loss of business function and damage to and loss of inventory. Business-owners can be faced with increased financial burdens due to unexpected repairs caused to the building (e.g., pipes bursting), higher than normal utility bills, or business interruption due to power failure (i.e., loss of electricity, telecommunications).

The agricultural industry is most at risk in terms of economic impact and damage due to extreme temperature events. Extreme cold events can result in impact on crops due to a late freeze and facilities such as barns are more vulnerable to fire in the winter. Extreme heat events can result in drought and dry conditions and directly impact livestock and crop production. Based on information from the 2017 Census of Agriculture, 770 farms were present in Chenango County, encompassing 148,982 acres of total farmland. The average farm size was 193 acres. Products sold from Chenango County farms had a total market value of $67.9 million ($41.6 million: milk from cows, $9.3 million: other crops and hay, $6.8 million: cattle and calves, $5.5 million: grains, oilseeds, dry beans, and dry peas). The 2017 Agricultural Census indicated that 643 farm operators reported farming as their primary occupation (USDA 2017).

Impact on the Environment

Extreme temperature events can have a major impact on the environment. For example, freezing and warming weather patterns create changes in natural processes. An excess amount of snowfall and earlier warming periods may affect natural processes such as flow within water resources (USGS 2020). Likewise, rain-on-snow events also exacerbate runoff rates with warming winter weather. 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. Refer to Section 5.4.5 (Harmful Algal Bloom) for more information about the impact of extreme temperatures on HABs in Chenango County.

Cascading Impacts on Other Hazards

Extreme temperature events can exacerbate the drought hazard, increase the potential risk of wildfires, and escalate severe storm and severe winter weather 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 terrestrial species, 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 5.4.2 (Drought), Section 5.4.8 (Severe Storm), Section 5.4.9 (Severe Winter Storm), and Section 5.4.10 (Wildfire) for more information about these hazards of concern.

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. The county considered the following factors to examine potential conditions that may affect hazard vulnerability:

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

Projected Development and Change in Population

The ability of new development to withstand extreme temperature impacts lies in sound 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. Surfaces that were once permeable and moist are now impermeable and dry. These changes cause urban areas to become warmer than the surrounding areas forming an *island* of higher temperatures (U.S. Environmental Protection Agency [EPA] 2019). 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.

According to population projections from the Cornell Program on Applied Demographics, Chenango County will continue to experience a population decrease through 2040 (a decline of over 7,500 people in total by 2040). This decrease will reduce the overall vulnerability of the county's population over time. Refer to Section 4.5.2 (Population Trends) in the County Profile for a detailed discussion on population changes.

Climate Change

As discussed earlier, Chenango County is projected to experience increases in the average annual temperature by 4.4–6.3 ºF by the 2050s and 5.7–9.9 ºF by the 2080s. 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.

Change of Vulnerability Since the 2015 HMP

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

5.4.4 Flood

The following section provides the hazard profile and vulnerability assessment for the flood hazard in Chenango County.

5.4.4.1 Hazard Profile

This section provides information regarding the description, extent, location, previous occurrences and losses, climate change projections and the probability of future occurrences for the flood hazard.

Hazard Description

Floods are one of the most common natural hazards in the country. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states) (FEMA 2007). As defined in the NYS HMP (NYS DHSES 2019), flooding is a general and temporary condition of partial or complete inundation on normally dry land as a result of the following:

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

For the purpose of this HMP and as deemed appropriate by the Chenango County Steering Committee, riverine, flash, stormwater, ice jam, levee failure, and dam failure flooding are the main flood types of concern for the County. These types of flood are further discussed below.

Riverine (Inland) and Flash Flooding

Riverine floods are the most common flood type. They occur along a channel and include overbank and flash flooding. Channels are defined, ground features that carry water through and out of a watershed. They may be called rivers, creeks, streams, or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas (The Illinois Association for Floodplain and Stormwater Management 2006).

Flash floods are defined by the National Weather Service as "A flood 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." (National Weather Service [NWS], n.d.).

Stormwater Flooding

Stormwater flooding described below is due to 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. Shallow street flooding can occur unless channels have been improved to account for increased flows (FEMA 1997).

High groundwater levels can be a concern and cause problems even where there is no surface flooding. Basements are susceptible to high groundwater levels. Seasonally high groundwater is common in many areas, while elsewhere high groundwater occurs only after long periods of above-average precipitation (FEMA 1997).

Urban drainage flooding is caused by increased water runoff due to urban development and drainage systems. Drainage systems are designed to remove surface water from developed areas as quickly as possible to prevent localized flooding on streets and other urban areas. They make use of a closed conveyance system that channels water away from an urban area to surrounding streams. This bypasses the natural processes of water filtration through the ground, containment, and evaporation of excess water. Since drainage systems reduce the amount of time the surface water takes to reach surrounding streams, flooding in those streams can occur more quickly and reach greater depths than prior to development in that area (FEMA 2007).

Ice Jam Flooding

An ice jam occurs when pieces of floating ice are carried with a stream's current and accumulate behind any obstruction to the stream flow. Obstructions may include river bends, mouths of tributaries, points where the river slope decreases, as well as dams and bridges. The water held back by this obstruction can cause flooding upstream, and if the obstruction suddenly breaks, flash flooding can occur as well (NOAA 2013). The formation of ice jams depends on the weather and physical condition of the river and stream channels. They are most likely to occur where the channel slope naturally decreases, in culverts, and along shallows where channels may freeze solid. Ice jams and resulting floods can occur during at 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 (USACE 2002).

Ice Jams At a Glance

- ✓ **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.**

Dam and Levee Failure Flooding

A dam or a levee is an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water (FEMA 2007). Dams are man-made structures built across a stream or river that impound water and reduce the flow downstream (FEMA 2003). They are built for the purpose of power production, agriculture, water supply, recreation, and flood protection. Dam failure is any malfunction or abnormality outside of the design that adversely affects a dam's primary function of impounding water (FEMA 2007). Levees typically are earthen embankments constructed from a variety of materials ranging from cohesive to cohesionless soils (USBR 2019). Dams and levees can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam (inadequate spillway capacity due to uncontrolled release or exceedance of design);
- Prolonged periods of rainfall and flooding;
- Deliberate acts of sabotage (terrorism);

- Structural failure of materials used in dam construction;
- Movement and/or failure of the foundation supporting the dam;
- Settlement and cracking of concrete or embankment dams;
- Piping and internal erosion of soil in embankment dams;
- Inadequate or negligent operation, maintenance and upkeep;
- Failure of upstream dams on the same waterway; or
- Earthquake (liquefaction / landslides) (FEMA 2010).

Flood Control Measures

There are several flood control structures constructed and operated in Chenango County. A trailer park in the Town of Afton has a privately-engineered dike that provides flood protection, but not for the 100-year base flood. In the past, Wylie Brook and Kelsey Brook were considered for reservoirs (FEMA 2010).

The Town and Village of Afton and the Town of North Norwich have actively promoted nonstructural flood protection measures. The Town of Bainbridge enacted a flood hazard regulation law in 1975 (FEMA 2010).

In 1951 in the Town of Greene, a dumped riprap bank protection and levee project was installed along Birdsall Creek. The project included a short section of steel sheet pile wall and was designed with a minimum two feet of freeboard. The freeboard's design assumed a discharge of 1,200 cfs, which exceeded the newly calculated base flood discharge of 710 cfs (FEMA 2010).

Minor flood control structures were installed circa 1982 near the City of Norwich. The improvements entailed channel improvements and a diversion channel near the confluence of Canasawacta Creek with the Chenango River to alleviate flooding resulting from spring ice jams (FEMA 2010).

In the City of Norwich, a levee (not constructed to FEMA freeboard standards) was constructed in 1960 and was extended in 1982 along the Canasawacta Creek between Beebe Avenue and Chenango Avenue. In 1982, fill was placed along the banks of the Chenango River between Olendorf Place and Sheldo Street. Additionally, fill was placed in the park south of the Rexford Street bridge (FEMA 2010).

The USACE conducted a comprehensive Flood Damage Reduction Feasibility Study Report for the Upper Susquehanna River Basin in January 2020, to evaluate flood risk and identify the feasibility of structural and non-structural flood-risk management measures in identified areas. Areas within Chenango County that were included in the study include the Village of Greene, the Village of Bainbridge, and the City of Norwich. Best results for mitigation within all Chenango communities studied include non-structural measures including a combination of elevating structures, acquisitions, and floodproofing of structures, with low impacts likely, and a potential for preliminary federal interest (USACE, 2020a).

Extent

The severity of a flood event is typically determined by a combination of several factors including stream and river basin topography and physiography, precipitation and weather patterns, recent soil moisture conditions, and degree of vegetative clearing and impervious surface. Generally, floods are long-term events that may last for several days.

Regarding the riverine flood hazard, once a river reaches flood stage, flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category is defined as follows, based on property damage and level of 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 (NWS 2011).

According to the NYSDEC Division of Water Bureau of Flood Protection and Dam Safety, the hazard classification of a dam is assigned according to the potential impacts of a dam failure pursuant to 6 New York Codes, Rules, and Regulations (NYCRR) Part 673.3 (NYSDEC 2009). Dams are classified in terms of potential for downstream damage if the dam were to fail. These hazard classifications are identified and defined below:

- *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, minor railroads, interrupt the use of relatively important public utilities, and/or will 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, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification 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/or will cause 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.
- *Negligible or No Hazard (Class D)* is (1) a dam that has been breached or removed, or has failed or otherwise no longer materially impounds waters, or (2) a dam that was planned but never constructed. Class "D" dams are considered to be defunct dams posing negligible or no hazard. The department may retain pertinent records regarding such dams.

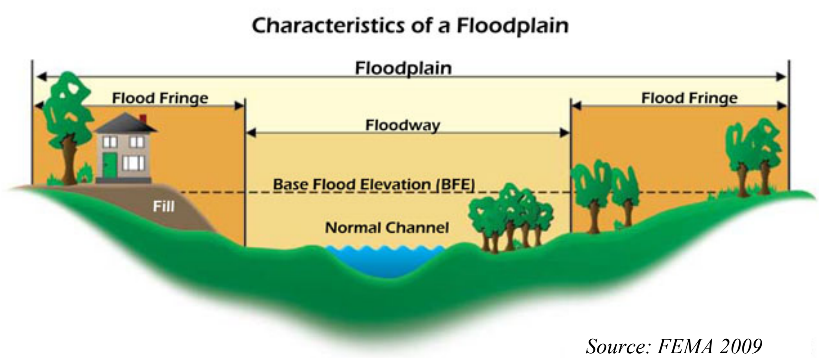
Dam failures cause serious downstream flooding either because of partial or complete dam collapse. Failures are usually associated with intense rainfall and prolonged flood conditions; however, dam breaks may occur during dry periods as a result of progressive erosion of an embankment. The greatest threat from a dam break is to areas immediately downstream. Dam failures may or may not leave enough time for evacuation of people and property, depending on their abruptness. Seepages in earth dams usually develop gradually, and if the embankment damage is detected early, downhill residents have at least a few hours or days to evacuate. Failures of concrete or masonry dams tend to occur suddenly, sending a wall of water and debris down the valley at more than 100 mph. Survival would be a matter of having the good fortune not to be in the flood path at the time of the break. Dam failures due to the overtopping of a dam normally give sufficient lead time for evacuation.

In addition, dam failures can significantly impact the operation and use of the reservoir/pool area, including consequences such as economic, environmental or social impacts of losing the source of drinking water or the recreational use of the pooled water.

The environmental impacts of a dam or levee failure can include significant water-quality and debris-disposal issues. 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 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. In addition, severe erosion is likely; such erosion can negatively impact local ecosystems.

Location

Flooding potential is influenced by climatology, meteorology, and topography (elevations, latitude, and water bodies and waterways). Flooding potential for each type of flooding that affects Chenango County is described in the subsections below.



Source: FEMA 2009

Floodplains

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood. In Chenango County, floodplains are found along rivers and streams. The boundaries of the floodplains become altered as a result of land use changes, obstructions in floodways, and placing impervious surface. This causes changes in precipitation and runoff patterns.

Flood hazard areas are identified as Special Flood Hazard Area (SFHA). SFHA are defined as the area that will be inundated by the "base flood". In other words, the SFHA is anticipated to be flooding during a flood event that has a one percent chance of being equaled to or exceeded in any given year. The 1 percent annual chance flood is also referred to as the 100-year flood. A 100-year floodplain is not an area in which a flood will occur once every 100 years. Rather, the designation indicates that a flood that has a one-percent chance of being equaled or exceeded each year. The 100-year flood can occur more than once in a relatively short period of time. Similarly, the moderate flood hazard area (500-year floodplain) will not occur once every 500 years, but is an event with a 0.2-percent chance of being equaled or exceeded each year (FEMA 2020). The 1-percent annual chance floodplain describes the area that has flood insurance and floodplain management requirements.

Flood Map Terms

- Flood hazard areas identified on the Flood Insurance Rate Map are identified as a Special Flood Hazard Area (SFHA).
- SFHA = the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year.
- 1-percent annual chance flood = the base flood or 100-year flood.
- SFHAs are labeled as Zone A, Zone AO, Zone AH, Zones A1-A30, Zone AE, Zone A99, Zone AR, Zone AR/AE, Zone AR/AO, Zone AR/A1-A30, Zone AR/A, Zone V, Zone VE, and Zones V1-V30.
- Zone B or Zone X (shaded) = Moderate flood hazard areas and are the areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood.
- Zone C or Zone X (unshaded) = Areas of minimal flood hazard, which are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood, are labeled this.

Flood zones in Chenango County are depicted on the FEMA Flood Insurance Rate Map (FIRM). A digital version of the FIRM is illustrated in Figure 5.4.4-1 and the total land area in the floodplain, inclusive of waterbodies, is summarized in Table 5.4.4-1 Refer to Section 9 for a map of each jurisdiction depicting the floodplains. Flood hazard zones occur throughout Chenango County. Floodways and flood zones are most prevalent along the Chenango River. The Digital Flood Insurance Rate Map (DFIRM) data provided by FEMA can be found online on the FEMA website and the Chenango County Planning & Development website (https://www.co.chenango.ny.us/planning/flood-information/). The DFIRMs for Chenango County show the following flood hazard areas:

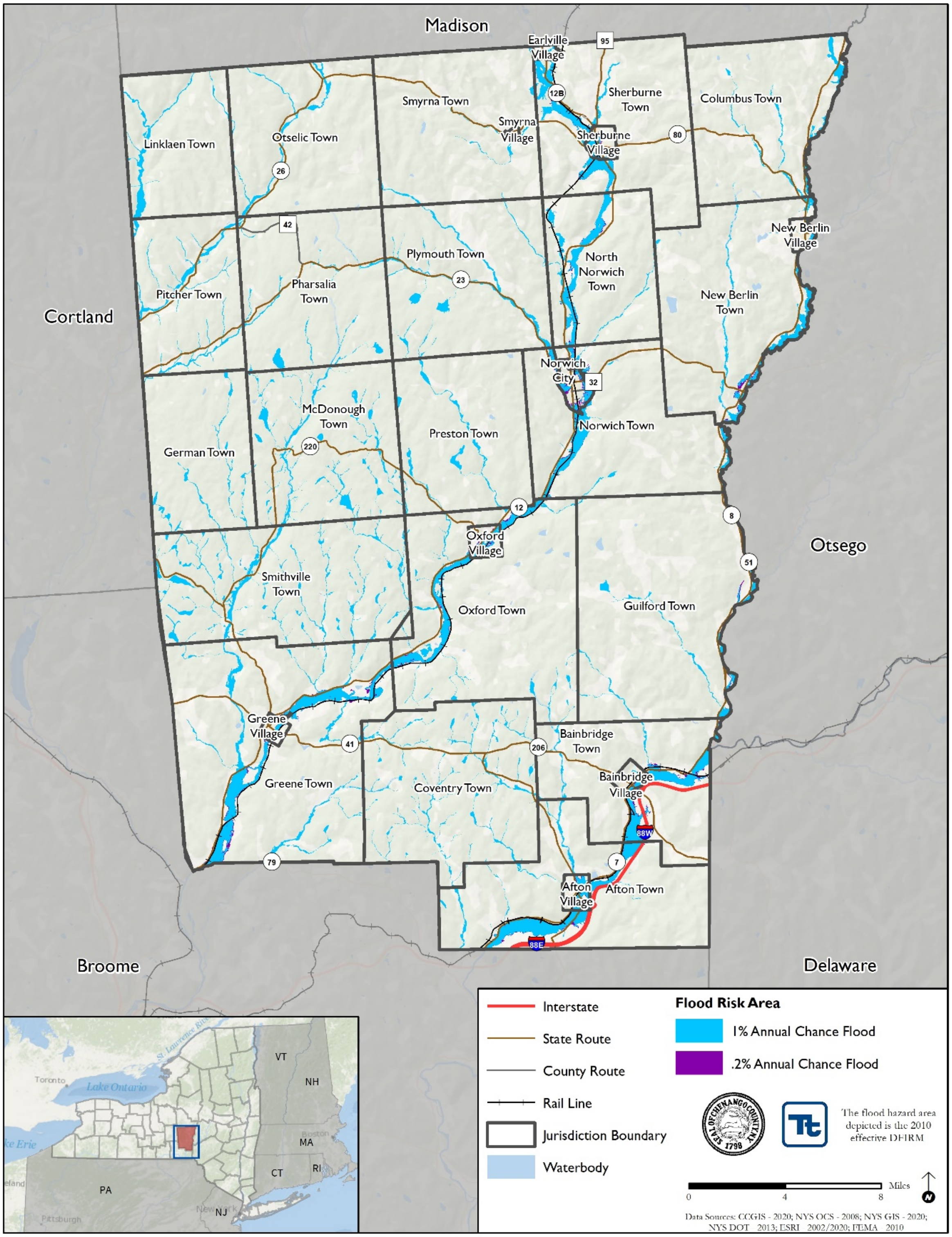
- 1-Percent Annual Chance Flood Hazard: Areas subject to inundation by the 1-percent-annual-chance flood event. This includes Zone A and Zone AE. Mandatory flood insurance requirements and floodplain management standards apply. Base flood elevations are provided in Zone AE. Zone A has no determined flood 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.

Table 5.4.4-1 FEMA Effective DFIRM Flood Hazard Areas in Chenango County

Jurisdiction	Total Area (acres)	1-Percent Annual Chance Flood Event		0.2-Percent Annual Chance Flood Event	
		Area (acres)	Percent of Total	Area (acres)	Percent of Total
Afton (T)	29,021	2,312	7.97%	2,395	8.3%
Afton (V)	1,045	410	39.3%	428	41.0%
Bainbridge (T)	21,420	1,773	8.3%	1,903	8.9%
Bainbridge (V)	843	200	23.7%	211	25.0%
Columbus (T)	23,861	920	3.9%	920	3.9%
Coventry (T)	30,842	1,204	3.9%	1,204	3.9%
Earlville (V)	355	66	18.4%	67	18.7%
German (T)	18,246	538	2.9%	538	2.9%
Greene (T)	47,718	3,707	7.8%	3,921	8.2%
Greene (V)	693	158	22.9%	171	24.7%
Guilford (T)	39,634	999	2.5%	1,048	2.6%
Lincklaen (T)	16,918	753	4.5%	753	4.5%
McDonough (T)	25,379	1,497	5.9%	1,497	5.9%
New Berlin (T)	29,753	1,623	5.5%	1,711	5.8%
New Berlin (V)	686	104	15.2%	108	15.8%
North Norwich (T)	18,092	1,480	8.2%	1,532	8.5%
Norwich (C)	1,264	408	32.3%	513	40.6%
Norwich (T)	29,646	700	2.4%	818	2.8%
Otselic (T)	24,274	613	2.5%	613	2.5%
Oxford (T)	37,979	2,102	5.5%	2,191	5.8%
Oxford (V)	1,108	333	30.1%	375	33.9%
Pharsalia (T)	25,088	622	2.5%	622	2.5%
Pitcher (T)	18,224	990	5.4%	990	5.4%
Plymouth (T)	27,140	1,056	3.9%	1,056	3.9%
Preston (T)	22,438	662	2.9%	662	2.9%
Sherburne (T)	26,557	1,830	6.9%	1,867	7.0%
Sherburne (V)	966	311	32.2%	339	35.1%
Smithville (T)	32,537	2,278	7.0%	2,278	7.0%
Smyrna (T)	26,799	312	1.2%	314	1.2%
Smyrna (V)	142	11	7.7%	11	7.7%
Chenango County (Total)	**578,669**	**29,973**	**5.2%**	**31,055**	**5.4%**

Source: Chenango County GIS 2020; FEMA 2010
Note:The area presented includes the area of waterway.; T = Town, V= Village, C= City

Figure 5.4.4-1. FEMA DFIRM Flood Hazard Areas in Chenango County



Riverine/Flash Flooding/Stormwater Flooding

Flooding in Bainbridge during June 2011 storm.
Source: The Daily Star, 2011

Chenango County's location in the Susquehanna River Basin (the second largest basin east of the Mississippi River) places the County in a vulnerable position to riverine flooding. The vulnerability is enhanced by various streams and rivers such as the Chenango River and Birdsall Brook that pass through the County and serve as tributaries to the Susquehanna River. Its basin encompasses most of the south-central portion of New York State. The drainage area includes most of Chenango, Cortland, Otsego and Broome Counties, portions of Delaware, Madison and Chemung Counties, and small parts of Schuyler, Tompkins, Onondaga, Oneida, Herkimer and Schoharie Counties (NYSDEC 2020). The Susquehanna River, located in the Susquehanna River Basin, is the largest river that flows through the County, and municipalities in Chenango County have experienced extensive damage during flood events.

The 2010 Flood Insurance Study identified flood vulnerabilities in the County. In Afton and Bainbridge, the Susquehanna River can experience flooding at any season, though the majority of recorded floods occur in the early or spring or late winter. Ice jams also cause localized high-water levels. The most recent significant flooding event was the June 2006 flooding resulting from the remnants of Tropical Storm Ernesto, which caused spillway flow at a dam in East Sidney, NY for the first time in its design history. The Bettsburg section of Afton is also impacted by flash flooding due to a tributary of the Susquehanna.

The Village and Town of Greene are vulnerable to flooding from smaller streams that cause highway-embankment and stream-bank erosion as well as inundation from the Chenango River, Genegantslet Creek, and Birdsall Brook. In Greene, the Chenango River's floodplains are wide, which presents impacts to buildings and transportation facilities.

Flood Gages

The United States Geological Survey (USGS) uses stream gages to determine the severity of flood at different points along a body of water.

There are seven gages in Chenango County. The flood stage is identified at each gage except for the gage at the Chenango River at Oxford. The Unadilla River gage and Sidney tide gage are each located near the Chenango County boundary with Otsego and Delaware Counties, respectively. Chenango County and its jurisdictions use gages to determine the height of the rivers during heavy rain events and to determine whether evacuation needs. Table 5.4.4-2 shows the seven gages in the County along with the record flood and flood stages, on April 16,

2020. The USGS website provides details about each of the gages (https://waterwatch.usgs.gov/index.php) and the gage heights of flooding events. The NWS provides different flood stages for the gages (https://water.weather.gov/ahps/).

Table 5.4.4-2. Stream Gage Statistics for Chenango County

Gage Site Number	Site Name	Action Stage (feet)	Minor Flood Stage (feet)	Moderate Flood Stage (feet)	Major Flood Stage (feet)	Record Flood
01502500	Unadilla River at Rockdale*	8	11	12	13	14.22 ft on Sept. 8, 2011
01505000	Chenango River at Sherburne	6.5	8.5	9.5	10.6	13.72 ft on Feb. 17, 1954
-	Canasawacta at Norwich**	19	20	22	24	N/A
01505810	Chenango River at Oxford	N/A	N/A	N/A	N/A	21.8 ft on Sept. 8, 2011
01507000	Chenango River at Greene	11	13	15	18	22 ft on July 8, 1935
-	Susquehanna at Sidney***	970.9	975.5	981.5	984.6	989.7 ft on June 28, 2006
01502632	Susquehanna at Bainbridge	13	15	20	22	27.05 ft on June 29, 2006

Source:USGS 2020
N/A Not Available
** Border of Chenango and Otsego County*
***Gage is no longer active*
**** Border of Chenango and Delaware County*

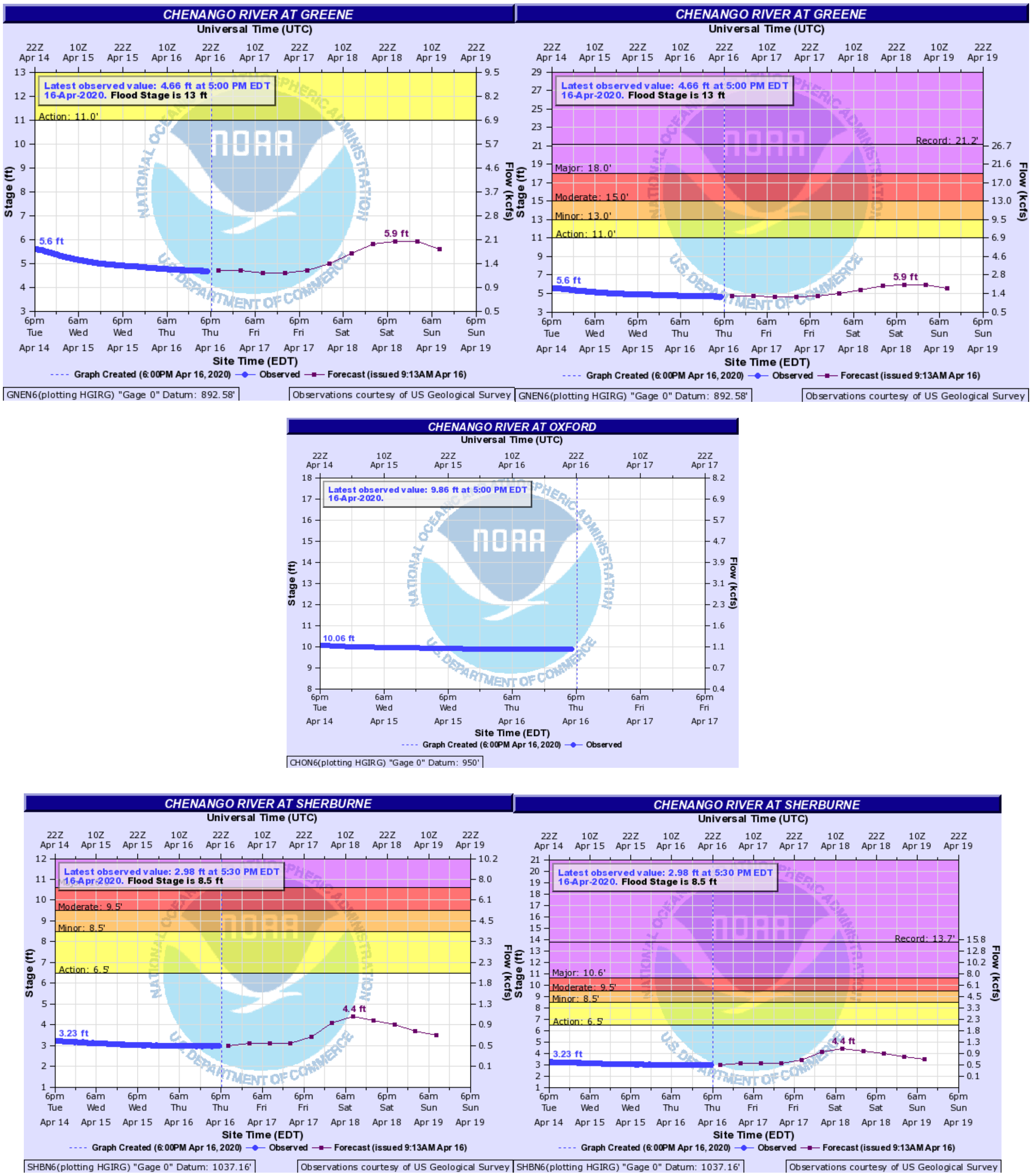
Water Level Data

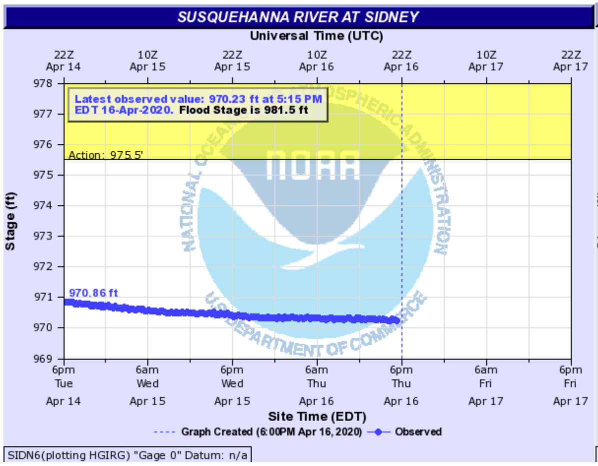
A hydrograph shows how a water level changes over time at a specific location to enable a review of historic water levels which are useful in floodplain management planning. In Chenango County, six of the seven gages provide the probabilistic and deterministic forecast for specific bodies of water. These forecast hydrographs are useful to reference when flooding is expected or to determine the observed water level for the past few days. The hydrographs for the Unadilla, Chenango, and Susquehanna Rivers provide water levels for the action, minor flooding, moderate flooding, and major flooding stages. They also display the flood of record (or the highest recorded water level) for the specific gage. These stages are defined as follows:

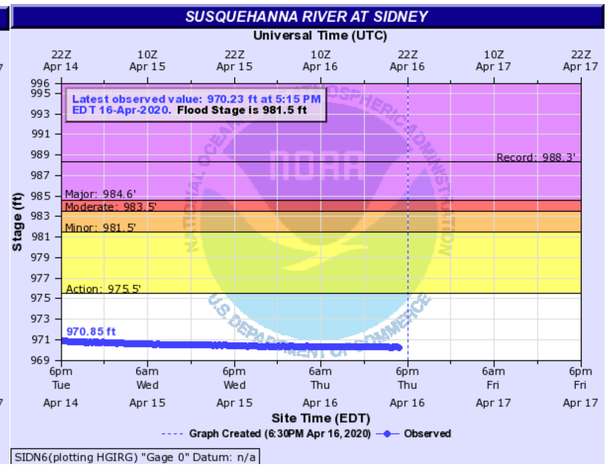
- Action Stage - the stage which; when reached by a rising stream, lake, or reservoir represents the level where the NWS or a partner/user needs to take some type of mitigation action in preparation for possible significant hydrologic activity.
- Minor Flooding - minimal or no property damage, but possibly some public threat.
- Moderate Flooding - some inundation of structures and roads near stream. Some evacuations of people and/or transfer of property to higher elevations.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.
- Record Flooding - flooding which equals or exceeds the highest stage or discharge at a given site during the period of record keeping.
- Stage - level of the water surface in a river measured with reference to some datum.
- Flow - volume of water passing a given point per unit of time.
- kcfs - measurement of water flow equivalent to 1000 cubic feet of water passing a given point for an entire second (NWS 2020) (https://water.weather.gov/ahps2/pdf/hydrograph_terminology.pdf).

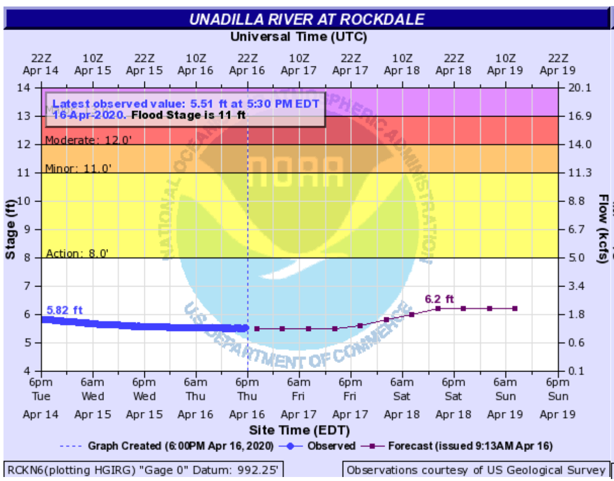
To illustrate the data available, screenshots of the gages are provided in Figure 5.4.4-2. Table 5.4.4-2 provides the action, minor, moderate, and major flood stages for each gage.

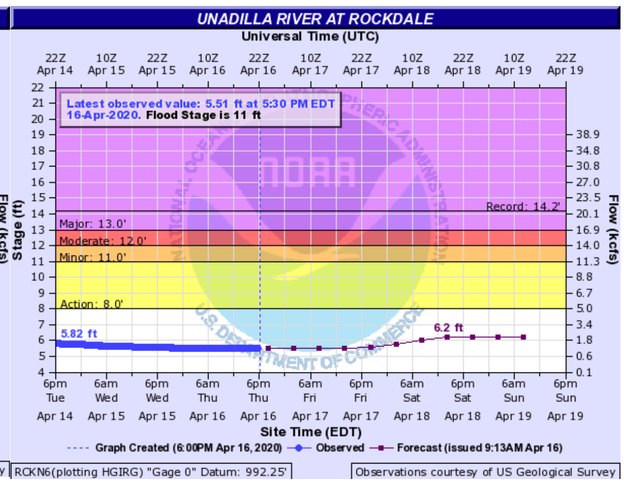
Figure 5.4.4-2. Flood Hydrographs for the Gages in Chenango County, April 16, 2020











Source: NOAA 2020

Ice Jam Flooding

Ice jams can occur along any of Chenango County's rivers and streams. Ice jams and break-up events have occurred along the Chenango River near Sherburne in 1941 and 1996 and in Bainbridge in 1996 (USACE 2020b).

Dam Failure

NYSDEC maintains dam failure data. Location, hazard classification, volume, elevation, and condition information for each dam in Chenango County that has a federal identification number is included in the inventory. Currently, there are 158 dams in Chenango County: 118 low hazard, 9 intermediate hazard, 10 high hazard, 18 negligible or no hazard classification, and 3 with an unknown classification (NYS DEC 2021).

For details on the dams in the County, refer to Section 4 (County Profile) as well as Appendix K.

Levee Failure

Levees protect portions of Norwich from the Canasawacta Creek, Oxford and Greene from the Chenango River, and a section of Bainbridge from Newton Brook (USACE 2020c). Failure of these levees could result in flooding of these jurisdictions.

Previous Occurrences and Losses

Numerous sources provided historical information regarding previous occurrences and losses associated with flood events in Chenango County. According to NOAA-NCEI Storm Events Database, National Performance of Dams Program (NPDP), and Cold Regions Research and Engineering Laboratory (CRREL) databases. Table 5.4.4-3 documents historical flood events (including ice jams) from 2015 to 2020 in Chenango County based on data collected from the NCEI database.

Table 5.4.4-3. Flood Events 2015 – 2020

Hazard Type	Number of Occurrences Between 2015 and 2020	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Flood	1	0	0	$50,000	$0
Flash Flood	15	0	0	$1,127,000	$0
Ice Jam	0	0	0	0	0
TOTAL	**16**	**0**	**0**	**$1,177,000**	**$0**

Source:NOAA-NCEI 2020; USACE Ice Jam Database, 2020
N/A Not Available

FEMA Disaster Declarations

Between 1954 and 2020, FEMA included New York State in 88 flood-related major disaster (DR) or emergency (EM) declarations classified as one or a combination of the following disaster types: severe storms, flooding, hurricane, tropical depression, heavy rains, landslides, ice storm, high tides, nor'easter, tornado, snowstorm, severe winter storm, and inland/coastal flooding. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Chenango County was included in 16 of these flood-related declarations; refer to Table 5.4.4-4.

Table 5.4.4-4. Flood-Related FEMA Declarations for Chenango County, 1954 to April 2020

Disaster Number	Event Date	Declaration Date	Incident Type	Title
DR-338	June 23, 1972	6/23/1972	Flood	Tropical Storm Agnes
DR-1095	January 19 – January 30, 1996	1/24/1996	Flood	Severe Storms and Flooding
DR-1335	May 3 – August 12, 2000	7/21/2000	Severe Storm(s)	Severe Storms and Flooding
DR-1534	May 13 – June 17, 2004	8/3/2004	Severe Storm(s)	Severe Storms and Flooding
DR-1565	September 16 –24, 2004	10/1/2004	Severe Storm(s)	Tropical Depression Ivan
DR-1589	April 2 – 4, 2005	4/19/2005	Severe Storm(s)	Severe Storms and Flooding
DR-1650	June 26 – July 10, 2006	7/1/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1670	November 16 – 17, 2006	12/12/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1857	August 8 – 10, 2009	9/1/2009	Severe Storm(s)	Severe Storms and Flooding
DR-1993	April 26 – May 8, 2011	6/10/2011	Flood	Severe Storms, Flooding, Tornadoes, and Straight-Line Winds
EM-3341	September 7 – 11, 2011	9/8/2011	Severe Storm(s)	Remnants of Tropical Storm Lee
DR-4031	September 7 – 11, 2011	9/13/2011	Severe Storm(s)	Remnants of Tropical Storm Lee

Disaster Number	Event Date	Declaration Date	Incident Type	Title
EM-3351	October 27 – November 8, 2012	10/28/2012	Hurricane	Hurricane Sandy
DR-4129	June 26 – July 10, 2013	7/12/2013	Flood	Severe Storms and Flooding
DR-4397	August 13 – 15, 2018	10/1/2018	Flood	Severe Storms and Flooding
DR-4472	October 31 – November 1, 2019	12/19/2019	Severe Storm(s)	Severe Storms, Straight-Line Winds, and Flooding

Source: FEMA 2020

USDA Declarations

Between 2015 and 2020, Chenango County was included in 5 flood-related USDA Disaster Designations; refer to Table 5.4.4-5 below for more information.

Table 5.4.4-5. USDA Flood Disaster Designations for Chenango County, 2015-2020

Designation Number	Event Date	Declaration Date	Incident Type	Description
S3885	May 1 – July 14, 2015	September 9, 2015	Excessive rain, moisture, humidity; Hail; Wind, High Winds; Tornadoes; Lightning	Excessive Rain, High Winds, Hail, Lightning, and Tornado
S4265	April 1, 2017	December 13, 2017	Excessive rain, moisture, humidity	Excessive Rain
S4479	July 23, 2018	April 10, 2019	Excessive rain, moisture, humidity	Excessive Precipitation
S4622	April 1, 2019	January 29, 2020	Excessive rain, moisture, humidity	Excessive Rain
S4623	April 15, 2019	January 29, 2020	Excessive rain, moisture, humidity; Flood, Flash Flooding	Excessive Rain, Flash Flooding, and Flooding

Previous Events

For this update, flood events were summarized from 2015 to 2020. Known flood events, including FEMA disaster declarations, which have impacted Chenango County during this time are identified in Table 5.4.4-6. Not all sources have been identified or researched due to the quantity of available data. Therefore, Table 5.4.4-6 might not include all events that have occurred in the County. For events prior to 2015, refer to Appendix E (Supplemental Data).

Table 5.4.4-6. Flood Events in Chenango County, 2015 to 2020

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Event Details
August 1, 2016	Flash Flood	N/A	No	Isolated thunderstorms produced torrential rainfall at the rate of three inches in under two hours. Norwich experienced urban flooding, resulting in the closure of 14 roads. Three culverts were washed out. Impacts were also experienced in Guilford, Oxford, and Ambierville. Route 8 near Whitestore was also closed due to a washout (WNBF 2016).
July 17, 2017	Flash Flood	N/A	No	A frontal system caused flash flooding on roads in Chenango County, including Route 12 and the intersection of Route 12 and Route 35 in Oxford.
August 13 – August 15, 2018	Flash Flood	DR-4397	No	Flash flooding resulted from a slow moving storm, washing out several roads in Plymouth and causing a small creek to overflow its banks.

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Event Details
September 18, 2018	Flash Flood	N/A	No	Roads in Oxford flooded resulting from a warm front causing a slow moving, heavy rainfall.
June 19, 2019	Flash Flood	N/A	No	Most roads in Oxford (including County Road 32 and State Highway 220) were flooded and closed after a warm front triggered slow-moving thunderstorms.
October 31 – November 1, 2019	Severe Storm(s)	DR-4472	No	A low pressure system caused locally-heavy rainfall and led to a landslide across Route 23 in Pharsalia, water rescues in Pharsalia, and severe damage on the Route 80 bridge in Smyrna.
December 24 – 25, 2020	Flash Flood	N/A	No	Following a major snow storm that produced nearly 3 feet of snow, heavy rains resulted in sections of Chenango County to experience extreme flash floods due to the combination of nearly 3 inches of rain and snow melt.

Sources: NCEI 2020; Steering Committee Input
FEMA Federal Emergency Management Agency
NCDC National Climatic Data Center
NOAA National Oceanic and Atmospheric Administration
N/A Not Applicable
Note: Many sources were consulted to provide an update of previous occurrences and losses; event details and loss/impact information may vary and has been summarized in the above table.

Climate Change Projections

In the Southern Tier region, it is estimated that precipitation totals will increase between 4 and 10% by the 2050s and 6 to 14% by the 2080s (baseline of 35.0 inches, middle range projection). Table 5.4.4-7 displays the projected seasonal precipitation change for the Southern Tier ClimAID Region (NYSERDA 2014).

Table 5.4.4-7. Projected Seasonal Precipitation Change in Region 3, 2050s (% change)

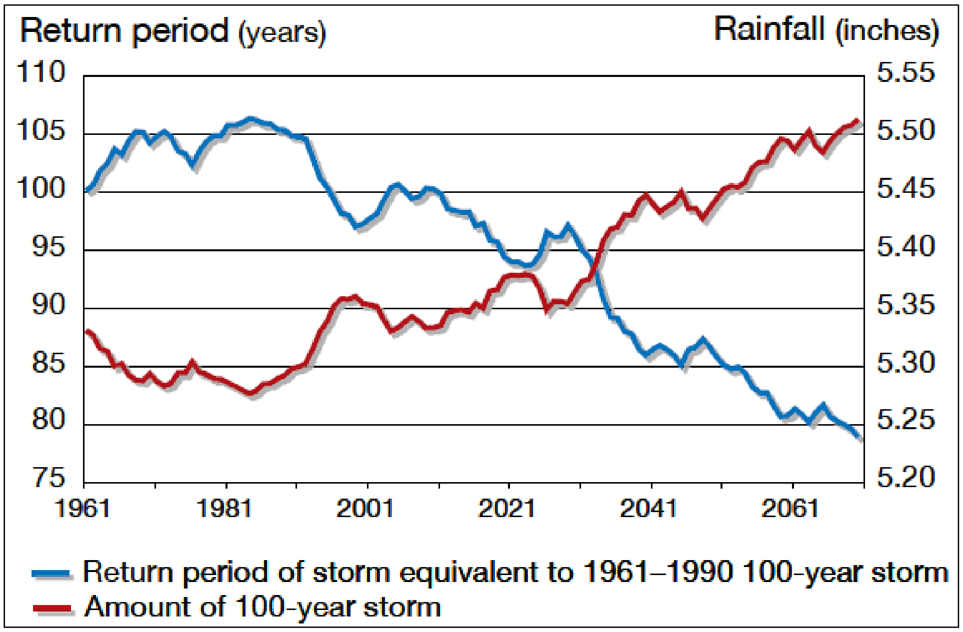
Winter	Spring	Summer	Fall
+5 to +15	0 to +15	-10 to +10	-5 to +10

Source:NYSERDA 2011

Precipitation, which is expected to increase, will likely be in the form of heavier downpours and less in the form of light rains. The increase in heavy downpours has the potential to affect drinking water, heighten the risk of riverine flooding, flood railroads, roadways and transportation hugs, and increase delays and hazards related to extreme weather events (NYSERDA 2011).

Higher air temperatures intensify the water cycle by increasing evaporation and precipitation. This can increase in rain totals during events with longer dry periods in between those events. These changes can have a variety of effects on the State's water resources (NYSERDA 2011). Figure 5.4.4-3 displays the project rainfall and frequency of extreme storms in New York State. The amount of rain fall in a 100-year event is projected to increase, while the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA 2011).

Figure 5.4.4-3. Projected Rainfall and Frequency of Extreme Storms



Source:NYSERDA 2011

Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can significantly affect the hydrograph used for the design of a dam. If the hygrograph changes, the dam conceivably could lose some or all of its designed margin of safety, also known as freeboard. Loss of designed margin of safety increases possibility that floodwaters would overtop the dam or create unintended loads, which could lead to a dam failure.

Probability of Future Occurrences

Chenango County will experience a greater flooding risk in the future owing to the combination of its existing vulnerability and anticipated climate change impacts. The direct and indirect impacts of flooding events occurring annually may induce secondary hazards such as utility failures, infrastructure deterioration or failure, power outages, water quality and supply concerns, and transportation delays, accidents and inconveniences.

> As defined by FEMA, geographic areas within the 1-percent annual chance flood area in Tompkins County are estimated to have a 1-percent chance of flooding in any given year. A structure located within a 1-percent annual chance flood area has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage. Similarly, the 0.2-percent annual chance flood has a 6-percent chance of occurring during a 30-year time period.

Dam failure events are infrequent and usually coincide with events that cause them, 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 and/or frequency of maintenance decreases. Chenango County has not experienced recent dam failures, but the potential for dam failures may increase.

According to the NOAA NCEI, Chenango County has experienced 120 flood events between 1954 and 2020. The table below shows these statistics, as well as the annual average number of events and the percent chance of these individual flood hazards occurring in Chenango County in future years based on the historic record (NOAA NCEI 2020).

Table 5.4.4-8. Probability of Future Occurrence of Flooding Events

Hazard Type	Number of Occurrences Between 1954 and 2020	% chance of occurrence in any given year
Flash Flood	70	100%
Flood	50	74.6%
Ice Jams	1	1.5%
Dam Failure	0	N/A
Levee Failure	0	N/A
TOTAL	**121**	**100%**

Source: NOAA-NCEI 2020; CRREL 2020
Note: Hazard occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act. Due to limitations in data, not all severe storm events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated

Climate change is expected to increase the severity and frequency of heavy rain events in Chenango County. This will likely lead to an increase in flooding events, dam failure events, and levee failure events. In Section 5.3, the identified hazards of concern for Chenango 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 Committee, the probability of occurrence for flood in the County is considered 'frequent' (100% annual probability; a hazard event may occur multiple times per year).

5.4.4.2 Vulnerability Assessment

To assess Chenango County's risk to the flood hazard, a spatial analysis was conducted using the best available spatially-delineated flood hazard areas. The 1-percent annual chance flood event was examined to determine the assets located in the hazard areas and to estimate potential loss using the FEMA HAZUS v4.2 riverine model. These results are summarized below. Refer to Section 5.1 (Methodology) for additional details on the methodology used to assess flood risk.

Impact on Life, Health and Safety

The impact of flooding on life, health and safety is dependent upon several factors including the severity of the event and whether adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. However, exposure is not limited to persons who reside in a defined hazard zone, but includes all individuals who may be affected by the effects of a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event). The degree of that impact will vary and is not strictly measurable.

Based on the spatial analysis, there are an estimated 3,035 people living in the 1-percent annual chance flood event hazard area and 3,986 people living in the 0.2-percent annual chance flood event hazard area (refer to Table 5.4.4-9). These residents may be displaced due to their homes flooding, requiring them to seek temporary shelter with friends and family or in emergency shelters.

The City of Norwich has the greatest percentage of population and the greatest number of residents located in the 1-percent annual chance flood event hazard area; approximately 26.7-percent and 1,017 persons. The City of Norwich and Village of Oxford have the greatest percentage of population located in the 0.2-percent annual chance flood event hazard area; approximately 37.7-percent and 25.9-percent, respectively. Overall, 6.3-percent and 8.2-percent of the Chenango County's residents live in the 1- and 0.2-percent annual chance flood event hazard area, respectively. For this project, the potential population exposed is used as a guide for planning purposes.

Table 5.4.4-9 Estimated Population Exposed to the 1-Percent and 0.2-Percent Annual Chance Flood Event Hazard Areas

Jurisdiction	Total Population	Population in 1-Percent Annual Chance Flood Event		Population in 0.2-Percent Annual Chance Flood Event	
		Number	Percent of Total	Number	Percent of Total
Afton (T)	1,767	154	8.7%	195	11.0%
Afton (V)	986	74	7.5%	84	8.6%
Bainbridge (T)	1,756	127	7.2%	173	9.8%
Bainbridge (V)	1,442	196	13.6%	241	16.7%
Columbus (T)	903	4	0.4%	4	0.4%
Coventry (T)	1,601	11	0.7%	11	0.7%
Earlville (V)	577	4	0.7%	4	0.7%
German (T)	385	0	0.0%	0	0.0%
Greene (T)	3,526	86	2.4%	117	3.3%
Greene (V)	1,704	279	16.4%	343	20.1%
Guilford (T)	2,834	107	3.8%	122	4.3%
Lincklaen (T)	366	4	1.2%	4	1.2%
McDonough (T)	773	8	1.0%	8	1.0%
New Berlin (T)	1,618	35	2.2%	49	3.0%
New Berlin (V)	927	82	8.9%	90	9.7%
North Norwich (T)	1,558	41	2.6%	51	3.3%
Norwich (C)	3,802	1,017	26.7%	1,433	37.7%
Norwich (T)	6,813	58	0.9%	100	1.5%
Otselic (T)	910	37	4.1%	37	4.1%
Oxford (T)	2,325	58	2.5%	63	2.7%
Oxford (V)	1,430	252	17.6%	370	25.9%
Pharsalia (T)	632	3	0.4%	3	0.4%
Pitcher (T)	708	15	2.1%	15	2.1%
Plymouth (T)	1,806	63	3.5%	63	3.5%
Preston (T)	1,089	8	0.7%	8	0.7%
Sherburne (T)	1,896	116	6.1%	129	6.8%
Sherburne (V)	1,414	159	11.2%	228	16.2%
Smithville (T)	1,451	21	1.4%	21	1.4%
Smyrna (T)	1,119	16	1.4%	19	1.7%
Smyrna (V)	230	0	0.0%	0	0.0%
Chenango County (Total)	**48,348**	**3,035**	**6.3%**	**3,986**	**8.2%**

Sources: FEMA DFIRM 2010; American Community Survey 2018 (ACS 2014-2018)
Note: T = Town; V = Village, C= City

Regarding dam failure, impacts depend on several factors including severity of the event and whether or not adequate warning time is provided to residents. The population living in or near the inundation areas are considered exposed to the hazard. However, exposure should not be limited only to those who reside within a defined hazard zone, but everyone who may be affected by a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event); the degree of that impact varies and is not strictly measurable. Dam failures could have a severe impact to life and property in Chenango County. Areas downstream of dams at a lower elevation are the most vulnerable to losses associated with a dam failure. Inundation maps have been prepared for the high hazard dams in Chenango County and presented in Appendix K (Dam Supplementary Data).

As with other hazards, 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 evaluate their risk and 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. Within Chenango County, there are approximately 9,539 people over the age of 65 and 6,826 people below the poverty level (American Community Survey 2018).

The Centers for Disease Control and Prevention (CDC) 2016 Social Vulnerability Index (SVI) ranks U.S. Census tracts on socioeconomic status, household composition and disability, minority status and language, and housing and transportation. Chenango County's overall score is 0.5304, indicating that its communities have a moderate to high social vulnerability (CDC 2016). These scores indicate that some County residents may not have enough resources to respond to flood events.

Using 2010 U.S. Census data, HAZUS v4.2 estimates the potential sheltering needs as a result of a 1-percent annual chance flood event. For the 1-percent flood event, HAZUS v4.2 estimates 4,026 households will be displaced, and 154 people will seek short-term sheltering. These statistics are presented in Table 5.4.4-10 by jurisdiction. The estimated displaced population and number of persons seeking short-term sheltering differs from the number of persons exposed to the 1-percent annual chance flood because the displaced population numbers take into consideration that not all residents will be significantly impacted enough to be displaced or to require short-term sheltering during a flood event.

Table 5.4.4-10 Estimated Population Displaced or Seeking Short-Term Shelter from the 1-Percent Annual Chance Flood Event Hazard Area

Jurisdiction	Population (American Community Survey 5-Year 2014 - 2018)	Replacement Cost Value	
		Displaced Population	Persons Seeking Short-Term Sheltering
Afton (T)	1,767	155	4
Afton (V)	986	154	7
Bainbridge (T)	1,756	164	1
Bainbridge (V)	1,442	194	7
Columbus (T)	903	13	0
Coventry (T)	1,601	14	0
Earlville (V)	577	14	0
German (T)	385	1	0
Greene (T)	3,526	255	3
Greene (V)	1,704	236	4
Guilford (T)	2,834	106	2
Lincklaen (T)	366	17	0
McDonough (T)	773	25	0
New Berlin (T)	1,618	100	0
New Berlin (V)	927	44	0
North Norwich (T)	1,558	101	2
Norwich (C)	3,802	1,253	99
Norwich (T)	6,813	154	2
Otselic (T)	910	74	0
Oxford (T)	2,325	86	0
Oxford (V)	1,430	256	6
Pharsalia (T)	632	2	0
Pitcher (T)	708	49	0
Plymouth (T)	1,806	88	1
Preston (T)	1,089	4	0
Sherburne (T)	1,896	181	2
Sherburne (V)	1,414	244	14
Smithville (T)	1,451	19	0

Jurisdiction	Population (American Community Survey 5-Year 2014 - 2018)	Replacement Cost Value	
		Displaced Population	Persons Seeking Short-Term Sheltering
Smyrna (T)	1,119	16	0
Smyrna (V)	230	8	0
Chenango County (Total)	**48,348**	**4,026**	**154**

Sources: HAZUS v4.2; FEMA 2010; American Community Survey 2018 (ACS 2014-2018)
Note: T = Town; V = Village, C= City
**Population results generated by HAZUS v4.2 are using 2010 Census population statistics and may be underestimated*

Total number of injuries and casualties resulting from typical riverine and tidal flooding are generally limited based on advance weather forecasting, blockades, and warnings. Injuries and deaths generally are not anticipated if proper warning and precautions occur. In contrast, warning time for flash flooding 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.

Cascading impacts of flooding and dam failure inundation may also include exposure to pathogens such as mold. After flood events, excess moisture and standing water contribute to the growth of mold in buildings. Mold may present a health risk to building occupants, especially those with already compromised immune systems such as infants, children, the elderly and pregnant women. The degree of impact will vary and is not strictly measurable. Mold spores can grow in as short a period as 24-48 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 2015).

Molds and mildews are not the only public health risk associated with flooding. Floodwaters can be contaminated by pollutants such as sewage, human and animal feces, pesticides, fertilizers, oil, asbestos, and rusting building materials. Common public health risks associated with flood events also include:

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

Other impacts include the impact the operation and use of the reservoir/pool area, including consequences such as economic, environmental or social impacts of losing the source of drinking water or the recreational use of the pooled water.

Current loss estimation models such as HAZUS v4.2 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.

Impact on General Building Stock

Exposure to the flood hazard includes those buildings located in the flood zone or those that are built downstream in other flood inundation areas such as dam failure inundation areas. Potential damage is the modeled loss that could occur to the exposed inventory measured by the structural and content replacement cost value. For dam failures, vulnerable properties are those located closest to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are where the dam waters would collect. Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues. This includes all roads, railroads and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

There are an estimated 1,928 buildings located in the 1-percent annual chance flood event hazard area with a value of approximately $1.5 billion of building and contents (based on replacement cost value). This represents approximately 6.7-percent of the County's total general building stock inventory replacement cost value (approximately $23 billion). The City of Norwich has the greatest percentage of its buildings located in the 1-percent annual chance flood hazard area; 26.1-percent or 653 buildings of its total building stock. Refer to Table 5.4.4-11 for a summary of 1-percent and 0.2-percent flood inundation area exposure results by jurisdiction. Table 5.4.4-12 and Table 5.4.4-13 break down the 1-percent and 0.2-percent annual chance flood event exposure results for residential structures and commercial structures, respectively.

Furthermore, HAZUS v4.2 estimates approximately $385 million in building and content damage as a result of the 1-percent annual chance flood event (or 1.7-percent of the total building stock replacement cost value). Of the $385 million in potential loss, approximately $179 million losses are estimated to occur to residential structures. Refer to Table 5.4.4-14 for the potential losses from the 1-percent annual chance flood event for all occupancies estimated by jurisdiction. Table 5.4.4-15 and Table 5.4.4-16 summarize HAZUS v4.2 estimated damages for residential and commercial occupancy classes, respectively.

Table 5.4.4-11 Estimated General Building Stock Exposure to the 1-Percent and 0.2-Percent Annual Chance Flood Events

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value	Total (All Occupancies)							
			1-Percent Annual Chance Flood Event				0.2-Percent Annual Chance Flood Event			
			Number of Buildings	Percent Total	Replacement Cost Value	Percent Total	Number of Buildings	Percent Total	Replacement Cost Value	Percent Total
Afton (T)	1,609	$864,699,700	119	7.4%	$36,115,005	4.2%	150	9.3%	$49,701,664	5.7%
Afton (V)	531	$1,019,188,804	38	7.2%	$20,955,341	2.1%	44	8.3%	$22,821,040	2.2%
Bainbridge (T)	1,493	$915,529,770	118	7.9%	$115,049,176	12.6%	160	10.7%	$141,140,585	15.4%
Bainbridge (V)	697	$584,957,184	97	13.9%	$79,389,837	13.6%	119	17.1%	$89,401,285	15.3%
Columbus (T)	748	$862,354,994	5	0.7%	$4,176,818	0.5%	5	0.7%	$4,176,818	0.5%
Coventry (T)	1,255	$703,237,371	8	0.6%	$4,328,203	0.6%	8	0.6%	$4,328,203	0.6%
Earlville (V)	155	$87,153,360	1	0.6%	$525,506	0.6%	1	0.6%	$525,506	0.6%
German (T)	395	$203,106,925	1	0.3%	$1,028,728	0.5%	1	0.3%	$1,028,728	0.5%
Greene (T)	2,711	$1,319,736,091	68	2.5%	$22,776,664	1.7%	95	3.5%	$39,433,051	3.0%
Greene (V)	700	$686,754,321	119	17%	$60,392,164	8.8%	144	20.6%	$83,227,435	12.1%
Guilford (T)	1,963	$1,010,987,220	68	3.5%	$22,702,682	2.2%	77	3.9%	$25,952,697	2.6%
Lincklaen (T)	398	$229,671,722	9	2.3%	$12,120,294	5.3%	9	2.3%	$12,120,294	5.3%
McDonough (T)	807	$339,089,552	10	1.2%	$3,219,651	0.9%	10	1.2%	$3,219,651	0.9%
New Berlin (T)	1,225	$778,713,525	25	2%	$9,426,480	1.2%	34	2.8%	$11,968,060	1.5%
New Berlin (V)	411	$432,605,770	38	9.2%	$15,886,500	3.7%	43	10.5%	$16,937,996	3.9%
North Norwich (T)	1,121	$823,054,726	32	2.9%	$19,174,444	2.3%	41	3.7%	$24,315,645	3.0%
Norwich (C)	2,503	$3,140,959,099	653	26.1%	$396,912,362	12.6%	919	36.7%	$580,974,687	18.5%
Norwich (T)	2,013	$2,080,430,801	42	2.1%	$169,089,308	8.1%	70	3.5%	$208,641,337	10.0%
Otselic (T)	741	$461,373,250	32	4.3%	$39,724,613	8.6%	32	4.3%	$39,724,613	8.6%
Oxford (T)	1,731	$958,330,880	45	2.6%	$23,830,203	2.5%	48	2.8%	$25,493,317	2.7%
Oxford (V)	648	$679,367,779	132	20.4%	$220,600,502	32.5%	191	29.5%	$271,465,414	40.0%
Pharsalia (T)	583	$389,863,952	2	0.3%	$565,766	0.1%	2	0.3%	$565,766	0.1%
Pitcher (T)	609	$315,344,531	11	1.8%	$2,884,347	0.9%	11	1.8%	$2,884,347	0.9%
Plymouth (T)	1,244	$510,829,645	43	3.5%	$24,684,346	4.8%	43	3.5%	$24,684,346	4.8%
Preston (T)	782	$348,948,426	5	0.6%	$852,422	0.2%	5	0.6%	$852,422	0.2%
Sherburne (T)	1,463	$1,113,221,738	95	6.5%	$83,328,426	7.5%	105	7.2%	$89,795,960	8.1%
Sherburne (V)	611	$768,785,678	84	13.7%	$111,758,641	14.5%	116	19%	$175,470,530	22.8%
Smithville (T)	1,032	$690,983,617	19	1.8%	$15,126,536	2.2%	19	1.8%	$15,126,536	2.2%
Smyrna (T)	842	$519,858,907	8	1%	$2,298,338	0.4%	11	1.3%	$3,058,326	0.6%
Smyrna (V)	99	$161,456,951	1	1%	$19,452,136	12.0%	1	1.0%	$19,452,136	12.0%
Chenango County (Total)	**31,120**	**$23,000,596,289**	**1,928**	**6.2%**	**$1,538,375,439**	**6.7%**	**2,514**	**8.1%**	**$1,988,488,395**	**8.6%**

Sources: FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

Table 5.4.4-12 Estimated General Building Stock Exposure to the 1-percent and 0.2- Percent Annual Chance Flood Events – Residential Occupancy Class

Jurisdiction	Total Number of Buildings (Residential Structures Only)	Total Replacement Cost Value (Residential Structures Only)	Residential							
			1-Percent Annual Chance Flood Event				0.2-Percent Annual Chance Flood Event			
			Number of Buildings	Percent Total	Replacement Cost Value	Percent Total	Number of Buildings	Percent Total	Replacement Cost Value	Percent Total
Afton (T)	1,331	$532,628,331	116	8.7%	$34,101,102	6.4%	147	11.0%	$47,687,761	9.0%
Afton (V)	467	$252,492,985	35	7.5%	$18,819,483	7.5%	40	8.6%	$20,163,450	8.0%
Bainbridge (T)	1,160	$455,185,271	84	7.2%	$40,820,548	9.0%	114	9.8%	$56,742,216	12.5%
Bainbridge (V)	611	$263,652,093	83	13.6%	$52,086,574	19.8%	102	16.7%	$59,997,722	22.8%
Columbus (T)	446	$168,681,001	2	0.4%	$903,873	0.5%	2	0.4%	$903,873	0.5%
Coventry (T)	875	$314,112,125	6	0.7%	$2,996,294	1.0%	6	0.7%	$2,996,294	1.0%
Earlville (V)	137	$55,895,731	1	0.7%	$525,506	0.9%	1	0.7%	$525,506	0.9%
German (T)	350	$162,861,915	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Greene (T)	2,498	$947,905,937	61	2.4%	$18,848,201	2.0%	83	3.3%	$29,625,955	3.1%
Greene (V)	587	$292,279,720	96	16.4%	$38,166,741	13.1%	118	20.1%	$47,088,178	16.1%
Guilford (T)	1,719	$638,935,588	65	3.8%	$21,352,916	3.3%	74	4.3%	$24,602,931	3.9%
Lincklaen (T)	332	$143,981,313	4	1.2%	$1,442,726	1.0%	4	1.2%	$1,442,726	1.0%
McDonough (T)	674	$221,651,844	7	1.0%	$2,058,704	0.9%	7	1.0%	$2,058,704	0.9%
New Berlin (T)	1,017	$421,229,852	22	2.2%	$7,370,621	1.7%	31	3.0%	$9,912,201	2.4%
New Berlin (V)	350	$175,364,889	31	8.9%	$9,991,156	5.7%	34	9.7%	$10,175,717	5.8%
North Norwich (T)	949	$354,209,855	25	2.6%	$6,898,859	1.9%	31	3.3%	$10,442,922	2.9%
Norwich (C)	2,258	$1,220,883,174	604	26.7%	$253,362,615	20.8%	851	37.7%	$360,445,191	29.5%
Norwich (T)	1,638	$674,132,460	14	0.9%	$8,356,269	1.2%	24	1.5%	$13,808,571	2.0%
Otselic (T)	587	$222,023,439	24	4.1%	$9,108,012	4.1%	24	4.1%	$9,108,012	4.1%
Oxford (T)	1,432	$550,797,506	36	2.5%	$9,598,473	1.7%	39	2.7%	$11,261,587	2.0%
Oxford (V)	579	$284,337,570	102	17.6%	$72,886,556	25.6%	150	25.9%	$101,140,088	35.6%
Pharsalia (T)	446	$177,916,135	2	0.4%	$565,766	0.3%	2	0.4%	$565,766	0.3%
Pitcher (T)	526	$198,731,400	11	2.1%	$2,884,347	1.5%	11	2.1%	$2,884,347	1.5%
Plymouth (T)	1,140	$401,094,276	40	3.5%	$14,470,454	3.6%	40	3.5%	$14,470,454	3.6%
Preston (T)	705	$268,708,818	5	0.7%	$852,422	0.3%	5	0.7%	$852,422	0.3%
Sherburne (T)	1,194	$428,762,759	73	6.1%	$16,536,856	3.9%	81	6.8%	$19,909,413	4.6%
Sherburne (V)	489	$322,999,342	55	11.2%	$33,260,343	10.3%	79	16.2%	$56,658,156	17.5%
Smithville (T)	844	$307,073,880	12	1.4%	$7,824,195	2.5%	12	1.4%	$7,824,195	2.5%
Smyrna (T)	577	$202,741,399	8	1.4%	$2,298,338	1.1%	10	1.7%	$2,570,742	1.3%
Smyrna (V)	75	$32,182,528	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Chenango County (Total)	**25,993**	**$10,693,453,136**	**1,624**	**6.2%**	**$688,387,949**	**6.4%**	**2,122**	**8.2%**	**$925,865,101**	**8.7%**

Sources: FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

Table 5.4.4-13 Estimated General Building Stock Exposure to the 1-percent and 0.2- Percent Annual Chance Flood Events – Commercial Occupancy Class

Jurisdiction	Total Number of Buildings (Commercial Buildings Only)	Total Replacement Cost Value (Commercial Buildings Only)	Commercial							
			1-Percent Annual Chance Flood Event				0.2-Percent Annual Chance Flood Event			
			Number of Buildings	Percent Total	Replacement Cost Value	Percent Total	Number of Buildings	Percent Total	Replacement Cost Value	Percent Total
Afton (T)	178	$224,686,376	1	0.6%	$516,365	0.2%	1	0.6%	$516,365	0.2%
Afton (V)	46	$626,789,923	3	6.5%	$2,135,857	0.3%	3	6.5%	$2,135,857	0.3%
Bainbridge (T)	278	$382,755,751	31	11.2%	$72,270,317	18.9%	39	14.0%	$80,124,760	20.9%
Bainbridge (V)	70	$227,455,479	14	20.0%	$27,303,263	12.0%	16	22.9%	$29,143,893	12.8%
Columbus (T)	228	$307,604,344	3	1.3%	$3,272,945	1.1%	3	1.3%	$3,272,945	1.1%
Coventry (T)	294	$291,804,567	2	0.7%	$1,331,910	0.5%	2	0.7%	$1,331,910	0.5%
Earlville (V)	15	$24,418,874	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
German (T)	3	$1,570,759	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Greene (T)	87	$134,744,128	5	5.7%	$3,136,487	2.3%	9	10.3%	$8,804,115	6.5%
Greene (V)	77	$193,731,718	17	22.1%	$18,312,270	9.5%	19	24.7%	$20,509,784	10.6%
Guilford (T)	70	$110,600,841	3	4.3%	$1,349,766	1.2%	3	4.3%	$1,349,766	1.2%
Lincklaen (T)	3	$4,739,651	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
McDonough (T)	91	$87,272,473	3	3.3%	$1,160,947	1.3%	3	3.3%	$1,160,947	1.3%
New Berlin (T)	49	$52,373,678	1	2.0%	$915,408	1.7%	1	2.0%	$915,408	1.7%
New Berlin (V)	43	$193,638,738	6	14.0%	$5,118,630	2.6%	8	18.6%	$5,985,565	3.1%
North Norwich (T)	55	$115,449,824	5	9.1%	$10,525,498	9.1%	5	9.1%	$10,525,498	9.1%
Norwich (C)	192	$1,532,435,436	39	20.3%	$105,918,322	6.9%	54	28.1%	$178,710,040	11.7%
Norwich (T)	178	$929,743,052	9	5.1%	$49,967,180	5.4%	12	6.7%	$59,647,276	6.4%
Otselic (T)	36	$54,493,865	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Oxford (T)	21	$27,632,031	2	9.5%	$2,713,529	9.8%	2	9.5%	$2,713,529	9.8%
Oxford (V)	45	$284,832,722	21	46.7%	$122,431,682	43.0%	32	71.1%	$145,043,062	50.9%
Pharsalia (T)	12	$19,289,849	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Pitcher (T)	8	$12,758,503	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Plymouth (T)	18	$19,198,236	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%

Jurisdiction	Total Number of Buildings (Commercial Buildings Only)	Total Replacement Cost Value (Commercial Buildings Only)	Commercial 1-Percent Annual Chance Flood Event Number of Buildings	Percent Total	Replacement Cost Value	Percent Total	Commercial 0.2-Percent Annual Chance Flood Event Number of Buildings	Percent Total	Replacement Cost Value	Percent Total
Preston (T)	3	$2,898,859	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Sherburne (T)	61	$184,539,835	20	32.8%	$59,702,820	32.4%	22	36.1%	$62,797,797	34.0%
Sherburne (V)	93	$227,814,037	22	23.7%	$26,685,148	11.7%	30	32.3%	$66,999,225	29.4%
Smithville (T)	21	$133,179,524	3	14.3%	$5,076,110	3.8%	3	14.3%	$5,076,110	3.8%
Smyrna (T)	181	$188,213,419	0	0.0%	$0	0.0%	1	0.6%	$487,584	0.3%
Smyrna (V)	22	$125,807,922	1	4.5%	$19,452,136	15.5%	1	4.5%	$19,452,136	15.5%
Chenango County (Total)	**2,478**	**$6,722,474,412**	**211**	**8.5%**	**$539,296,592**	**8.0%**	**269**	**10.9%**	**$706,703,572**	**10.5%**

Sources: FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

Table 5.4.4-14 Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event – All Occupancies

Jurisdiction	Total Replacement Cost Value	All Occupancies 1-Percent Annual Chance Flood Event Estimated Loss (Replacement Cost Value)	Percent of Total
Afton (T)	$864,699,700	$16,728,823	1.9%
Afton (V)	$1,019,188,804	$7,283,070	0.7%
Bainbridge (T)	$915,529,770	$39,591,578	4.3%
Bainbridge (V)	$584,957,184	$15,550,178	2.7%
Columbus (T)	$862,354,994	$261,321	0.0%
Coventry (T)	$703,237,371	$639,826	0.1%
Earlville (V)	$87,153,360	$348,585	0.4%
German (T)	$203,106,925	$180,027	0.1%
Greene (T)	$1,319,736,091	$4,611,254	0.3%
Greene (V)	$686,754,321	$18,971,354	2.8%
Guilford (T)	$1,010,987,220	$9,555,786	0.9%
Lincklaen (T)	$229,671,722	$630,536	0.3%
McDonough (T)	$339,089,552	$328,655	0.1%
New Berlin (T)	$778,713,525	$3,960,227	0.5%
New Berlin (V)	$432,605,770	$1,208,909	0.3%
North Norwich (T)	$823,054,726	$2,828,359	0.3%
Norwich (C)	$3,140,959,099	$129,372,486	4.1%
Norwich (T)	$2,080,430,801	$15,517,187	0.7%
Otselic (T)	$461,373,250	$8,759,377	1.9%

Jurisdiction	Total Replacement Cost Value	All Occupancies 1-Percent Annual Chance Flood Event	
		Estimated Loss (Replacement Cost Value)	Percent of Total
Oxford (T)	$958,330,880	$3,782,665	0.4%
Oxford (V)	$679,367,779	$21,954,398	3.2%
Pharsalia (T)	$389,863,952	$134,561	0.0%
Pitcher (T)	$315,344,531	$1,423,402	0.5%
Plymouth (T)	$510,829,645	$10,976,663	2.1%
Preston (T)	$348,948,426	$679,118	0.2%
Sherburne (T)	$1,113,221,738	$24,178,183	2.2%
Sherburne (V)	$768,785,678	$35,399,596	4.6%
Smithville (T)	$690,983,617	$1,164,912	0.2%
Smyrna (T)	$519,858,907	$3,496,830	0.7%
Smyrna (V)	$161,456,951	$5,543,859	3.4%
Chenango County (Total)	**$23,000,596,289**	**$385,061,727**	**1.7%**

Sources: HAZUSv4.2; FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

Table 5.4.4-15 Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event – Residential Occupancy Class

Jurisdiction	Total Replacement Cost Value (Residential Only)	Residential Losses Only 1-Percent Annual Chance Flood Event	
		Estimated Loss (Replacement Cost Value)	Percent of Total
Afton (T)	$532,628,331	$16,099,857	3.0%
Afton (V)	$252,492,985	$6,599,815	2.6%
Bainbridge (T)	$455,185,271	$7,234,091	1.6%
Bainbridge (V)	$263,652,093	$11,186,779	4.2%
Columbus (T)	$168,681,001	$261,321	0.2%
Coventry (T)	$314,112,125	$497,963	0.2%
Earlville (V)	$55,895,731	$348,585	0.6%
German (T)	$162,861,915	$0	0.0%
Greene (T)	$947,905,937	$3,779,620	0.4%
Greene (V)	$292,279,720	$11,322,321	3.9%
Guilford (T)	$638,935,588	$8,995,638	1.4%
Lincklaen (T)	$143,981,313	$181,258	0.1%
McDonough (T)	$221,651,844	$232,573	0.1%
New Berlin (T)	$421,229,852	$3,479,638	0.8%
New Berlin (V)	$175,364,889	$1,045,781	0.6%
North Norwich (T)	$354,209,855	$2,241,633	0.6%

Jurisdiction	Total Replacement Cost Value (Residential Only)	Residential Losses Only 1-Percent Annual Chance Flood Event Estimated Loss (Replacement Cost Value)	Percent of Total
Norwich (C)	$1,220,883,174	$63,847,699	5.2%
Norwich (T)	$674,132,460	$2,837,720	0.4%
Otselic (T)	$222,023,439	$1,027,334	0.5%
Oxford (T)	$550,797,506	$2,602,594	0.5%
Oxford (V)	$284,337,570	$8,881,861	3.1%
Pharsalia (T)	$177,916,135	$134,561	0.1%
Pitcher (T)	$198,731,400	$966,583	0.5%
Plymouth (T)	$401,094,276	$5,357,472	1.3%
Preston (T)	$268,708,818	$679,118	0.3%
Sherburne (T)	$428,762,759	$6,950,595	1.6%
Sherburne (V)	$322,999,342	$10,286,353	3.2%
Smithville (T)	$307,073,880	$441,334	0.1%
Smyrna (T)	$202,741,399	$1,662,173	0.8%
Smyrna (V)	$32,182,528	$0	0.0%
Chenango County (Total)	**$10,693,453,136**	**$179,182,270**	**1.7%**

Sources: HAZUSv4.2; FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

Table 5.4.4-16 Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event – Commercial Occupancy Class

Jurisdiction	Total Replacement Cost Value (Commercial Only)	Commercial Losses Only 1-Percent Annual Chance Flood Event Estimated Loss (Replacement Cost Value)	Percent of Total
Afton (T)	$224,686,376	$0	0.0%
Afton (V)	$626,789,923	$683,255	0.1%
Bainbridge (T)	$382,755,751	$31,092,865	8.1%
Bainbridge (V)	$227,455,479	$4,363,400	1.9%
Columbus (T)	$307,604,344	$0	0.0%
Coventry (T)	$291,804,567	$141,863	<0.1%
Earlville (V)	$24,418,874	$0	0.0%
German (T)	$1,570,759	$0	0.0%
Greene (T)	$134,744,128	$566,828	0.4%

Jurisdiction	Total Replacement Cost Value (Commercial Only)	Commercial Losses Only 1-Percent Annual Chance Flood Event	
		Estimated Loss (Replacement Cost Value)	Percent of Total
Greene (V)	$193,731,718	$4,726,227	2.4%
Guilford (T)	$110,600,841	$560,148	0.5%
Lincklaen (T)	$4,739,651	$0	0.0%
McDonough (T)	$87,272,473	$96,082	0.1%
New Berlin (T)	$52,373,678	$480,589	0.9%
New Berlin (V)	$193,638,738	$163,128	0.1%
North Norwich (T)	$115,449,824	$586,726	0.5%
Norwich (C)	$1,532,435,436	$45,571,593	3.0%
Norwich (T)	$929,743,052	$4,928,986	0.5%
Otselic (T)	$54,493,865	$0	0.0%
Oxford (T)	$27,632,031	$188,864	0.7%
Oxford (V)	$284,832,722	$9,756,452	3.4%
Pharsalia (T)	$19,289,849	$0	0.0%
Pitcher (T)	$12,758,503	$0	0.0%
Plymouth (T)	$19,198,236	$0	0.0%
Preston (T)	$2,898,859	$0	0.0%
Sherburne (T)	$184,539,835	$15,807,248	8.6%
Sherburne (V)	$227,814,037	$6,466,322	2.8%
Smithville (T)	$133,179,524	$704,962	0.5%
Smyrna (T)	$188,213,419	$255,982	0.1%
Smyrna (V)	$125,807,922	$5,543,859	4.4%
Chenango County (Total)	**$6,722,474,412**	**$132,685,377**	**2.0%**

Sources: HAZUSv4.2; FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

NFIP Statistics

FEMA Region 2 provided a list of NFIP policies, past claims, and repetitive loss properties (RL) in Chenango County. According to FEMA, a RL property is a NFIP-insured structure that has had at least two paid flood losses of more than $1,000 in any 10-year period since 1978. A SRL property is a NFIP-insured structure that has had four or more separate claim payments made under a standard flood insurance policy, with the amount of each claim exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or at least two separate claims payments made under a standard flood insurance policy with the cumulative amount of such claim payments exceed the fair market value of the insured building on the day before each loss (FEMA 2018). Table 5.4.4-17 shows that there are more NFIP claims than policies in Chenango County reported. This is likely because multiple repetitive loss properties submitted more than one flood loss claim under their NFIP policy. Note that specific locations of repetitive loss properties were not made available for this Plan. Table 5.4.4-18 and Table 5.4.4-19 summarizes the NFIP RL properties, by occupancy class, in Chenango County.

Table 5.4.4-17 Repetitive Loss Properties and NFIP Data for Chenango County

Municipality	Number of Policies	Number of Claims	Total Paid Claims	Number of Repetitive Loss Properties	Number of Severe Repetitive Loss Properties	Number of Policies in the 1-Percent Annual Chance Flood Event Area
Afton (T)	11	30	$660,958	4	0	4
Afton (V)	11	27	$554,018	5	0	3
Bainbridge (T)	21	39	$686,418	6	1	6
Bainbridge (V)	28	35	$679,420	9	0	8
Columbus (T)	0	1	$0	0	0	0
Coventry (T)	5	5	$34,641	1	0	0
Earlville (V)	0	0	$0	0	0	0
German (T)	1	0	$0	0	0	0
Greene (T)	17	45	$1,165,126	5	1	4
Greene (V)	62	77	$2,515,997	17	2	19
Guilford (T)	9	16	$171,966	1	0	1
Linklaen (T)	0	0	$0	0	0	0
McDonough (T)	3	0	$0	0	0	0
New Berlin (T)	6	5	$43,606	1	0	0
New Berlin (V)	2	4	$31,600	0	0	0
North Norwich (T)	7	3	$40,347	0	0	0
Norwich (C)	193	201	$1,411,677	16	1	15
Norwich (T)	11	23	$1,709,721	1	1	1
Otselic (T)	2	3	$10,535	0	0	0
Oxford (T)	46	53	$594,997	3	0	0
Oxford (V)	7	10	$68,761	7	0	6
Pharsalia (T)	1	0	$0	0	0	0
Pitcher (T)	0	0	$0	0	0	0
Plymouth (T)	7	3	$33,805	0	0	0
Preston (T)	1	1	$75,000	0	0	0
Sherburne (T)	14	18	$183,084	4	0	1
Sherburne (V)	25	11	$332,636	1	0	1
Smithville (T)	2	0	$0	0	0	0
Smyrna (T)	5	3	$55,523	1	0	0
Smyrna (V)	0	0	$0	0	0	0
Chenango County	**497**	**613**	**$11,059,837**	**82**	**6**	**69**

Source: FEMA Region 2, 2020

Note: NFIP = National Flood Insurance Program, V = Village, T = Town; C= City

Table 5.4.4-18 Occupancy Class of Repetitive Loss Structures in Chenango County

Occupancy Class	Total Number of Repetitive Loss Properties	Total Number of Severe Repetitive Loss Properties	Total (Repetitive Loss + Severe Repetitive Loss)
Single Family	64	4	68
Assumed Condo	0	2	2
2-4 Family	9	0	9
Other Residential	2	0	2
Non-Residential	7	0	7
Total	**82**	**6**	**88**

Source: FEMA Region 2, 2020
Note: NFIP = National Flood Insurance Program, V = Village, T = Town; C= City

Table 5.4.4-19 Occupancy Class of Repetitive Loss Structures in Chenango County, by Municipality

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties				
	2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family
Afton (T)	1	0	0	0	3	0	0	0	0	0
Afton (V)	0	0	0	1	4	0	0	0	0	0
Bainbridge (T)	0	0	2	0	4	0	1	0	0	0
Bainbridge (V)	0	0	1	0	8	0	0	0	0	0
Columbus (T)	0	0	0	0	0	0	0	0	0	0
Coventry (T)	0	0	0	0	1	0	0	0	0	0
Earlville (V)	0	0	0	0	0	0	0	0	0	0
German (T)	0	0	0	0	0	0	0	0	0	0
Greene (T)	0	0	0	0	5	0	1	0	0	0
Greene (V)	2	0	1	0	14	0	0	0	0	2
Guilford (T)	0	0	0	0	1	0	0	0	0	0
Linklaen (T)	0	0	0	0	0	0	0	0	0	0
McDonough (T)	0	0	0	0	0	0	0	0	0	0
New Berlin (T)	0	0	0	0	1	0	0	0	0	0
New Berlin (V)	0	0	0	0	0	0	0	0	0	0
North Norwich (T)	0	0	0	0	0	0	0	0	0	0
Norwich (C)	5	0	1	0	10	0	0	0	0	1
Norwich (T)	0	0	1	0	0	0	0	0	0	1
Otselic (T)	0	0	0	0	0	0	0	0	0	0
Oxford (T)	0	0	0	0	3	0	0	0	0	0
Oxford (V)	0	0	1	0	6	0	0	0	0	0
Pharsalia (T)	0	0	0	0	0	0	0	0	0	0
Pitcher (T)	0	0	0	0	0	0	0	0	0	0
Plymouth (T)	0	0	0	0	0	0	0	0	0	0
Preston (T)	0	0	0	0	0	0	0	0	0	0
Sherburne (T)	1	0	0	1	2	0	0	0	0	0
Sherburne (V)	0	0	0	0	1	0	0	0	0	0

Municipality	Repetitive Loss Properties 2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family	Severe Repetitive Loss Properties 2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family
Smithville (T)	0	0	0	0	0	0	0	0	0	0
Smyrna (T)	0	0	0	0	1	0	0	0	0	0
Smyrna (V)	0	0	0	0	0	0	0	0	0	0
Chenango County	**9**	**0**	**7**	**2**	**64**	**0**	**2**	**0**	**0**	**4**

Source: FEMA Region 2, 2020
Note: NFIP = National Flood Insurance Program, V = Village, T = Town; C= City

Impact on Land Uses

An exposure analysis was completed to determine the acres of developed residential land and developed non-residential land use types located in the 1-percent and 0.2-percent flood hazard area. To estimate exposure for developed residential and non-residential land use types to the 1-percent and 0.2-percent flood hazard area, the floodplain boundary was overlaid upon land use data. Refer to Table 5.4.4-20 for a complete summary of this analysis.

Table 5.4.4-20 Developed Residential and Non-Residential Land Use Exposed to 1-Percent and 0.2-Percent Annual Chance Flood Event Hazard Areas

Land Use Type	Total Acres for County	1-Percent Annual Chance Event Acres	1-Percent Annual Chance Event Percent of Total	0.2-Percent Annual Chance Event Acres	0.2-Percent Annual Chance Event Percent of Total
Residential Land	5,173	632	12.2%	816	15.8%
Non-Residential Land	565,951	27,820	4.9%	28,684	5.1%
Natural Land	387,797	14,605	3.8%	14,832	3.8%
Total County Land	**571,124**	**28,452**	**5.0%**	**29,500**	**5.2%**

Sources: FEMA 2010, Chenango County GIS 2020; NLCD 2016
Notes: Land use areas do not include areas of water. Non-residential area = Agriculture, Barren, Developed – Open Space, Forest, Wetlands; This analysis does not incorporate areas delineated as water. Residential area = Developed – low intensity, Developed – medium intensity, and Developed – high intensity. Natural Land = Wetlands, Forest

Impact on Critical Facilities

It is important to determine the critical facilities and infrastructure that may be at risk to flooding, and who may be impacted should damage occur. Critical services during and after a flood event may not be available if critical facilities are directly damaged or transportation routes to access these critical facilities are impacted. Roads that are blocked or damaged can isolate residents and can prevent access throughout the planning area to many service providers needing to reach vulnerable populations or to make repairs.

Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues and significant disruption to travel, including all roads, railroads and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines in the inundation zone could also be vulnerable. If phone lines were lost, significant communication issues may occur in the planning area due to limited cell phone reception in many areas. In addition, emergency response would be hindered due to the loss of transportation routes as well as some protective-function facilities located in the inundation zone. Recovery time to restore many critical functions after an event may be lengthy, as wastewater, potable water, and other community facilities are located in the dam inundation zone.

Major roadways that may be impacted by the 1-percent annual chance flood event include Interstate 88-W and 88-E, State Roads NY-12, NY-12B, NY-206, NY-220, NY-23, NY-26, NY-41, NY-51, NY-8, NY-80 and various county roads. Approximately 3.7- percent of all roadways are located within the 1-percent annual chance flood event boundary. Table 5.4.4-21 summarizes the road types and mileage located within the 1-percent annual chance flood event boundary. Overall, over 145 miles of roadway would be impacted by the 1-percent annual chance flood in which the majority of roads are local (129 miles). Bridges washed out or blocked by floods or debris also can cause isolation. Water and sewer systems can be flooded or backed up, causing health problems. Floodwaters can get into drinking water supplies, causing contamination. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers, and streams.

Table 5.4.4-21 Road Miles Located in the 1-Percent Annual Chance Flood Hazard Area

Road Type	Total Miles for County	1-Percent Annual Chance Event Miles	Percent of Total
Local and Private Roads	3,701	129	3.5%
County Roads	6	0.5	8.1%
State Routes	235	15	6.3%
Interstate	29	1	4.5%
Chenango County (Total)	**3,970**	**145**	**3.7%**

Sources: FEMA, 2010; Chenango County GIS, 2020; New York State GIS, 2020

Critical facility exposure to the 1-percent and 0.2-percent annual chance flood hazard event boundary was examined. In addition, HAZUS v4.2 was used to estimate the flood loss potential to critical facilities located in the FEMA mapped floodplains. Table 5.4.4-22 summarizes the number of critical facilities exposed to the 1-percent and 0.2-percent flood inundation areas by jurisdiction. Table 5.4.4-23 and Table 5.4.4-24 summarizes the distribution of critical facilities in the 1-percent and 0.2-percent annual chance flood event boundary. Of the 48 critical facilities located in the 1-percent annual chance flood event boundary, 45 are considered lifelines for the County (Table 5.4.4-22). Refer to Section 4 (County Profile) for more information about the critical facilities and lifelines in Chenango County.

Table 5.4.4-22 Number of Critical and Lifeline Facilities Located in the 1-Percent and 0.2-Percent Annual Chance Flood Hazard Area

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Exposed to the 1-Percent Annual Chance Flood Event				Number of Critical Facilities and Lifeline Facilities Exposed to the 0.2-Percent Annual Chance Flood Event			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines	Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Afton (T)	10	10	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Afton (V)	16	16	4	25.0%	4	25.0%	4	25.0%	4	25.0%
Bainbridge (T)	8	8	4	50.0%	4	50.0%	4	50.0%	4	50.0%
Bainbridge (V)	23	22	5	21.7%	5	22.7%	5	21.7%	5	21.7%
Columbus (T)	7	6	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Coventry (T)	20	20	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Earlville (V)	4	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
German (T)	5	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Greene (T)	14	14	0	0.0%	0	0.0%	2	14.3%	2	14.3%
Greene (V)	25	24	3	12.0%	3	12.5%	4	16.0%	4	16.0%
Guilford (T)	16	16	1	6.3%	1	6.3%	1	6.3%	1	6.3%
Lincklaen (T)	1	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
McDonough (T)	13	13	1	7.7%	1	7.7%	1	7.7%	1	7.7%
New Berlin (T)	15	15	1	6.7%	1	6.7%	2	13.3%	2	13.3%
New Berlin (V)	24	23	2	8.3%	2	8.7%	3	12.5%	3	12.5%
North Norwich (T)	10	10	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Norwich (C)	55	50	7	12.7%	6	12.0%	12	21.8%	11	20.0%
Norwich (T)	39	38	4	10.3%	4	10.5%	5	12.8%	5	12.8%
Otselic (T)	14	13	1	7.1%	0	0.0%	1	7.1%	0	0.0%
Oxford (T)	15	14	1	6.7%	0	0.0%	1	6.7%	0	0.0%
Oxford (V)	25	25	7	28.0%	7	28.0%	14	56.0%	14	56.0%
Pharsalia (T)	5	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pitcher (T)	1	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Plymouth (T)	23	23	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Preston (T)	17	17	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Sherburne (T)	16	16	6	37.5%	6	37.5%	6	37.5%	6	37.5%
Sherburne (V)	23	23	1	4.3%	1	4.3%	7	30.4%	7	30.4%
Smithville (T)	28	28	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Smyrna (T)	102	102	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Smyrna (V)	5	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Chenango County (Total)	**579**	**567**	**48**	**8.3%**	**45**	**7.9%**	**72**	**12.4%**	**69**	**11.9%**

Sources: FEMA 2010, Chenango County GIS 2020
Notes: T= Town; V= Village; City = City

Table 5.4.4-23 Distribution of Critical Facilities in the 1-Percent Annual Chance Flood Event Floodplain by Type and Jurisdiction

Jurisdiction	Facility Types																	
	County Building	Dam	Electrical Substation	Gas Station/Convenience Store	Hazmat	Heating Fuel	Kerosene	Levee	Major Employer	Municipal Hall	Police Station	Potable Water Well	Reservoir	Senior Center	Supermarket	Water Booster Substation	Water Tank	Water Treatment Facility
Afton (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Afton (V)	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	1
Bainbridge (T)	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Bainbridge (V)	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
Columbus (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coventry (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Earlville (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
German (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene (V)	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1
Guilford (T)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Lincklaen (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
McDonough (T)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Berlin (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
New Berlin (V)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
North Norwich (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norwich (C)	1	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	1	1
Norwich (T)	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	0	0
Otselic (T)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Oxford (T)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Oxford (V)	0	0	0	1	0	0	0	1	0	2	1	1	0	0	0	0	0	1
Pharsalia (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pitcher (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plymouth (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Preston (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sherburne (T)	0	0	0	0	0	1	0	0	0	0	0	5	0	0	0	0	0	0
Sherburne (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Smithville (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smyrna (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smyrna (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chenango County (Total)	**1**	**1**	**2**	**3**	**1**	**1**	**1**	**2**	**5**	**2**	**1**	**14**	**1**	**1**	**2**	**1**	**2**	**7**

Sources: FEMA 2010, Chenango County GIS 2020
Notes: T= Town; V= Village; City = City

Table 5.4.4-24 Distribution of Critical Facilities in the 0.2-Percent Annual Chance Flood Event Floodplain by Type and Jurisdiction

Jurisdiction	Facility Types: Convenience Store	County Building	Dam	Electrical Substation	Fire/EMS	Gas Station/Convenience Store	Hazmat	Heating Fuel	Kerosene	Levee	Major Employer	Medical Facility	Municipal Hall	Police Station	Potable Water Well	Public Health Department	Reservoir	Senior Center	Supermarket	Water Booster Substation	Water Tank	Water Treatment Facility
Afton (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Afton (V)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1
Bainbridge (T)	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Bainbridge (V)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Columbus (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coventry (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Earlville (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
German (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene (T)	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene (V)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	1
Guilford (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Lincklaen (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
McDonough (T)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Berlin (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
New Berlin (V)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
North Norwich (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norwich (C)	0	2	0	0	0	0	0	0	0	1	5	0	0	0	0	1	0	1	0	0	1	1
Norwich (T)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	1	1	0	0
Otselic (T)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Oxford (T)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Oxford (V)	1	0	0	0	0	2	0	1	0	1	0	1	2	1	3	0	0	0	0	0	0	2
Pharsalia (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pitcher (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plymouth (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Preston (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sherburne (T)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	0	0	0	0	0	0	0
Sherburne (V)	1	0	0	0	0	0	2	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0
Smithville (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smyrna (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smyrna (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chenango County (Total)	**3**	**2**	**1**	**3**	**1**	**4**	**4**	**3**	**1**	**2**	**7**	**1**	**3**	**2**	**16**	**1**	**1**	**3**	**2**	**1**	**2**	**9**

Sources: FEMA 2010, Chenango County GIS 2020
Notes: T= Town; V= Village; City = City

Impact on the Economy

Flood and dam failure events can significantly impact the local and regional economy. This includes but is not limited to general building stock damages and associated tax loss, impacts to utilities and infrastructure, business interruption, and impacts on tourism. In areas that are directly flooded, renovations of commercial and industrial buildings may be necessary, disrupting associated services. Similar to flooding, losses include, but are not limited to, damages to buildings and infrastructure, agricultural losses, business interruption and impacts on tax base. Flooding as a result of dam failure or levee failure can cause extensive damage to public utilities and disruptions in delivery of services. Loss of power and communications may occur and drinking water and wastewater treatment facilities may be temporarily out of operation. Refer to the 'Impact on Buildings' subsection earlier which discusses direct impacts to buildings in Chenango County.

Debris management may also be a large expense after a flood event. HAZUS v4.2 estimates the amount of structural debris generated during a flood event. The model breaks down debris into three categories: (1) finishes (dry wall, insulation, etc.); (2) structural (wood, brick, etc.); and (3) foundations (concrete slab and block, rebar, etc.). These distinctions are necessary because of the different types of equipment needed to handle debris. Table 5.4.4-25 summarizes the HAZUS v4.2 countywide debris estimates for the 1-percent annual chance flood event. This table only estimates structural debris generated by flooding and does not include non-structural debris or additional potential damage and debris possibly generated by wind that may be associated with a flood event or storm that causes flooding. Overall, HAZUS v4.2 estimates that there will be 70,392 tons of debris generated during the 1-percent annual chance flood event in Chenango County.

Table 5.4.4-25 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)
Afton (T)	3,118	1,013	1,168	938
Afton (V)	1,608	686	544	378
Bainbridge (T)	9,334	1,952	4,022	3,360
Bainbridge (V)	4,988	1,142	2,097	1,749
Columbus (T)	607	164	237	206
Coventry (T)	79	43	17	19
Earlville (V)	109	47	36	27
German (T)	4	3	0	1
Greene (T)	3,090	1,143	1,085	862
Greene (V)	2,631	879	930	822
Guilford (T)	3,484	626	1,591	1,268
Lincklaen (T)	121	112	3	6
McDonough (T)	265	92	89	84
New Berlin (T)	1,747	493	692	561
New Berlin (V)	437	236	109	93
North Norwich (T)	2,371	544	1,013	814
Norwich (C)	17,124	5,666	6,143	5,314
Norwich (T)	4,749	1,018	2,088	1,643
Otselic (T)	313	173	72	69
Oxford (T)	961	402	307	252
Oxford (V)	2,855	1,696	687	472
Pharsalia (T)	13	9	3	2
Pitcher (T)	478	247	131	100
Plymouth (T)	1,148	340	444	364
Preston (T)	26	14	6	6
Sherburne (T)	4,222	898	1,813	1,510
Sherburne (V)	3,734	1,651	1,143	941
Smithville (T)	194	120	34	40
Smyrna (T)	258	78	98	81
Smyrna (V)	324	111	117	96
Chenango County (Total)	**70,392**	**21,597**	**26,717**	**22,078**

Sources: HAZUSv4.2

Notes: T= Town; V= Village, C= City

Impact on the Environment

As Chenango 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 Chenango County's natural and local environment.

Furthermore, the environmental impacts of a dam failure can include significant water-quality and debris-disposal issues. 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 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. In addition, severe erosion is likely; such erosion can negatively impact local ecosystems.

Overall, the acreage of natural land makes up 67.9-percent of the County's total land area (NLCD 2016). Natural land areas from the 2016 land use type dataset includes areas of forested land, and wetlands. Severe flooding will not only influence the habitat of these natural land areas, it can be disruptive to species that reside in these natural habitats. Overall, 3.77-percent and 3.8-percent of the natural land area in the County is exposed to the 1-percent and 0.2-percent annual chance flood event boundary, respectively.

Cascading Impacts on Other Hazards

Flood events can exacerbate the impacts of disease outbreaks and harmful algal blooms. Flooding of lawns and agricultural areas can flow into bays, rivers, and waterbodies and is linked to "overfeeding" harmful algal blooms with nutrients such as phosphorus and nitrogen (NOAA 2020). Flooding could increase the risk of transmitting water-borne and vector diseases by contaminating drinking water facilities (WHO 2020). See Sections 5.4.5 and 5.4.1 for more information on the harmful algal bloom and disease outbreak hazards of concern, respectively.

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. The County considered the following factors to examine potential conditions that may affect hazard vulnerability:

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

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth located in the flood inundation areas could be potentially impacted by flooding. It is recommended that the County and municipal partners implement design strategies that mitigate against the risk of flooding. Refer to the maps in the jurisdictional annexes (Section 9) to view the new development locations throughout the County and their proximity to the 1-percent annual chance flood hazard event boundary.

Projected Changes in Population

According to the U.S. Census Bureau, the population in Chenango County has decreased by approximately 4.2-percent between 2010 and 2018 (US Census Bureau 2020). Estimated population projections provided by the 2017 Cornell Program on Applied Demographics indicates that the County's population will continue to decrease into 2040, decreasing the total population to approximately 41,123 persons (Cornell Program on Applied Demographics 2017). Even though the population will decrease, there are possibilities that people will move to locations that are more susceptible than others to flooding. This includes areas that are directly impacted by flood events and those that are indirectly impacted (i.e., isolated neighborhoods, flood-prone roadways, etc.). Refer to Section 4 (County Profile) for additional discussion on population trends.

Climate Change

As discussed earlier, annual precipitation amounts in the region are projected to increase, primarily in the form of heavy rainfalls, which have the potential to increase the risk to flash flooding and riverine flooding, and flood critical transportation corridors and infrastructure (NYSERDA 2014). Increases in precipitation may alter and expand the floodplain boundaries and runoff patterns, resulting in the exposure of populations, buildings, and 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.

Change of Vulnerability Since the 2015 HMP

Since the 2015 analysis, population statistics have been updated using the 5-Year 2014-2018 American Community Survey Population Estimates. The general building stock was also updated using RS Means 2019 building valuations that estimated replacement cost value for each building in the inventory, updated building footprints and critical facilities were provided and reviewed by Chenango County. The updated building stock inventory and flood data was imported into HAZUS v4.2 to complete a riverine analysis for the 1-percent annual chance flood event.

Overall, this vulnerability assessment uses a more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Chenango County.

5.4.5 Harmful Algal Bloom

This section provides a profile and vulnerability assessment of the harmful algal bloom (HAB) hazard for Chenango County.

5.4.5.1 Hazard Profile

The profile contains a description of the HAB hazard, extent, location, previous occurrences and losses, climate change projections and the probability of future occurrences.

Hazard Description

Cyanobacteria were among the first life on the planet and were responsible for the oxygen-rich atmosphere. However, some cyanobacteria also produce toxins that threaten humans and animals. Because of their color, cyanobacteria are also referred to as blue-green algae, and when they form colonies, are called harmful algal blooms (HAB), though not all are harmful.

Algae are a diverse group of aquatic organisms that have the ability to photosynthesize. They can be found in a wide range of environments, include lakes, ponds, oceans, hot springs, and land (Live Science 2020). Most algae are harmless and are considered an important component of the food web. Certain types of algae can grow rapidly, forming blooms, and covering all or portions of a lake. There are some species of algae that produces toxins which can be harmful to humans and animals. Algae blooms that produce toxins are referred to as harmful algal blooms (HABs) (NYS DEC 2020). More than 40 cyanobacterial species are confirmed or suspected to produce toxins (Graham and Wilcox 2000).

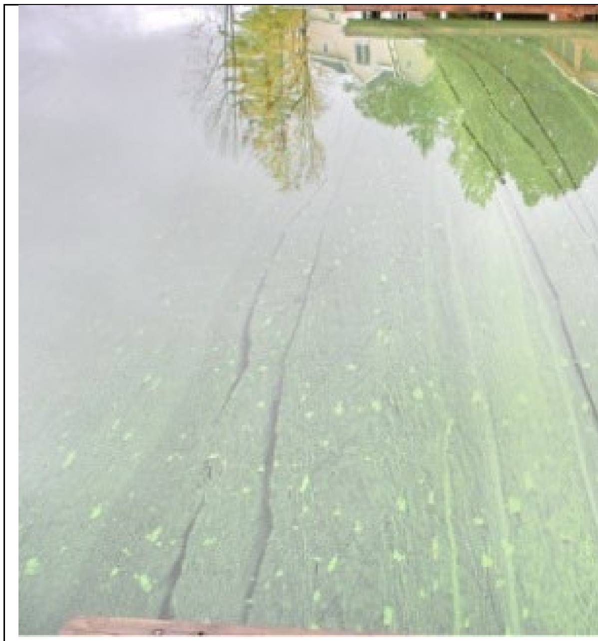
Because of their incredible diversity and shared characteristics with plants, the taxonomy of algae has been much discussed. Originally classified as plants, algae are now found in the kingdom Protista. Algae are further broken down into groups commonly grouped by pigmentation. Most species of green algae are only found in fresh water while most species of red algae and brown algae are only found in salt water. Brown algae are among the most complex forms of algae while blue-green algae are one of the simplest forms of algae. Also referred to as cyanobacteria (a bacteria rather than a true algae), blue-green algae are either single celled or colonial. Blue-green algae are the most common form of algae to result in HABs in Chenango County, impacting the county's lakes, ponds, and reservoirs.

HABs are usually trigged by a combination of water and environmental conditions, including excess nutrients (phosphorus and nitrogen), excessive sunlight, low-water or low-flow conditions, still waters, and warm temperatures. The timeframe of HABs depends on weather conditions and characteristics of the lake. They can last for a few hours (short-lived) to several weeks or longer (long-lived) (NYS DEC 2020).

Identifying Harmful Algal Blooms

The appearance of HABs can vary greatly. According to the NYS DEC, colors can include shades of green, blue-green, yellow, brown, red, or white. The physical appearance of these blooms can include floating dots or clumps and streaks on the water's surface as illustrated in . Some blooms can also resemble spilled paint on the water's surface or change the appearance of water to that of pea soup (NYS DEC 2017b).

Figure 5.4.5-1. Examples of Harmful Algal Bloom Visual Appearance



HABs may look like parallel streaks, usually green, on the water surface.

HABs may look like green dots, clumps, or globs on the water surface.

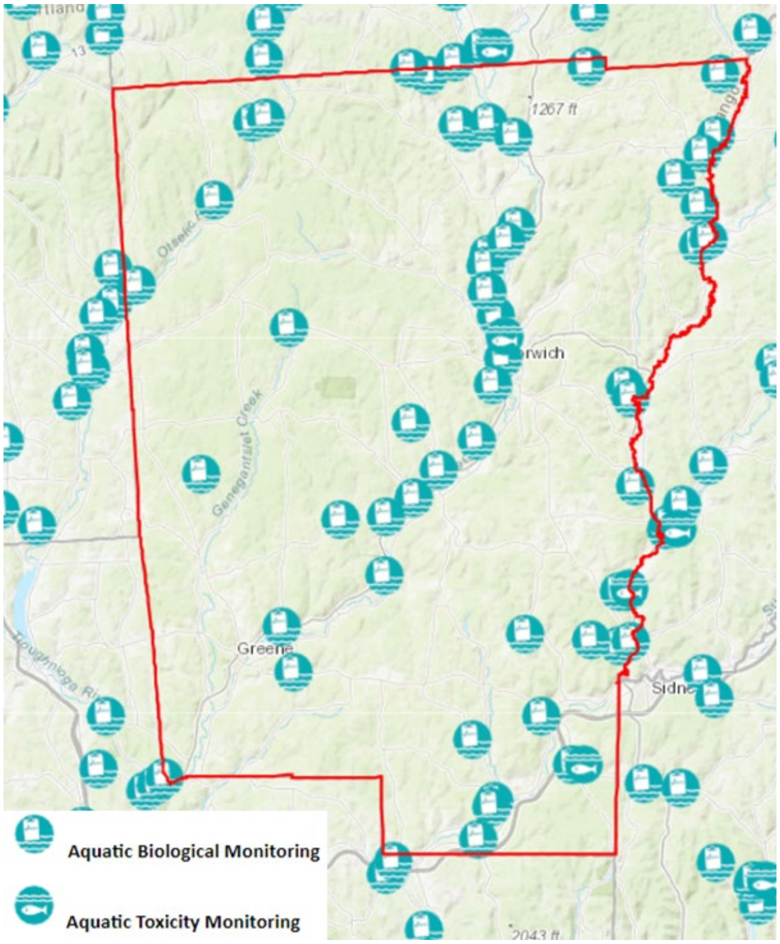
HABs may look like blue, green, or white spilled paint on the water surface.

HABs may make the water look bright green or similar to pea soup.

Source: NYS DEC 2016

The NYS DEC Lake Classification and Inventory Program, Citizen Statewide Lake Assessment Program volunteers and partnered HAB monitoring programs collect and report information about the status of waterbodies in New York that may be impacted by HABs (NYS DEC 2018). Figure 5.4.5-2 shows the location of waterbodies that are monitored in Chenango County or bordering Chenango County.

Figure 5.4.5-2. NYS DEC Lakes Monitoring Program Map



Source: NYS DEC Info Locator, 2020

Location

Chenango County has significant exposure and vulnerability to the HAB hazard, as described below.

- Shorelines of the Chenango County waterbodies with documented HABs are publicly accessible, which can increase the chance of exposure. Many of the county's lakes are popular recreation lakes and have an abundance of lake users, tourism and shoreline development.
- HABs are generally limited to lakes and ponds but any surface water can experience harmful algal blooms as evinced by prior events in Thunder Lake and Plymouth Reservoir.
- The widespread use of septic systems in the County is a major contributing factor to HABs.
- Locations that rely on surface water intake for drinking water are most exposed to the impacts of HABs. However, most of the County relies on groundwater from deep wells.

NYS DEC records indicate 12 waterbodies in Chenango County had documented HABs in recent years (since 2012). In total, these waterbodies have a combined approximately 15.56 miles of shoreline, all of which are part of Chenango County. Table 5.4.5-1 breaks down the total shoreline miles per lake and the shoreline miles per lake in Chenango County. While most HAB contact occurs along shorelines, blooms can take place throughout surface waters. According to the 2010 Census, approximately 3.87 percent of Chenango County is made up of surface water.

Table 5.4.5-1. Shoreline of Major Waterbodies in Chenango County with Documented HABs

Lake	Shoreline Miles (total)	Shoreline Miles (in Chenango County)	Surface Area (Acres)
Bowman Lake	1	1	34
Chenango Lake*	2.1	2.1	133
Echo Lake	0.43	0.43	63.9
Genegantslet Lake	Approx. 2.4	2.4	108.6
Glenn Lake	Approx. 0.8	0.8	-
Guilford Lake	1.5	1.5	70
Lake Petonia	Approx. 0.79	0.79	26
Long Pond	3.5	3.5	114
Norwich Reservoir East*	-	-	-
Plymouth Reservoir	Approx. 1.37	1.37	77
Thunder Lake	Approx. 0.79	0.79	18
Warn Lake	Approx. 0.88	0.88	32
Total	**15.56**	**15.56**	**676.5**

Source: NYS GIS
*Note: * Indicates major drinking water source.*
- Undetermined

Extent

The NYS DEC uses visual observations, photographs, and laboratory sampling results to determine if blooms are comprised of cyanobacteria or other types of algae. Figure 5.4.5-3 is a photograph of a confirmed cyanobacteria bloom at Plymouth Reservoir. NYS DEC staff will set bloom statuses for waterbodies that are being investigated for harmful algal blooms:

- **Suspicious Bloom**: NYS DEC staff have determined that conditions fit the description of a cyanobacteria HAB based on visual observations and/or digital photographs. Laboratory analysis has not been conducted to confirm whether this suspicious bloom is a HAB. It is not known if toxins are present in the water.
- **Confirmed Bloom**: Water sampling results have confirmed the presence of a cyanobacteria HAB, which may produce toxins or other harmful compounds.
- **Confirmed with High Toxins Bloom**: Water sampling results have confirmed that toxins are present in enough quantities to potentially cause health effects if people and animals come in contact with the water through swimming or drinking (NYS DEC 2018).

Suspicious blooms are reported to NYS DEC, local health departments, or the NYS Department of Health (NYSDOH 2017).

Figure 5.4.5-3. Cyanobacteria Bloom in Plymouth Reservoir, Chenango County

Source: NYS DEC, 2020

The extent of a harmful algal bloom is an estimate of the area of the waterbody that is impacted. The NYS DEC has four categories to classify extent within their monitoring program (NYS DEC 2018):

- **Small Localized**: Bloom affects a small area of the waterbody, limited from one to several neighboring properties.
- **Large Localized**: Bloom affects many properties within an entire cove, along a large segment of the shoreline, or in a specific region of the waterbody.
- **Widespread/Lakewide**: Bloom affects the entire waterbody, a large portion of the lake, or most to all of the shoreline.
- **Open Water**: Sample was collected near the center of the lake and may indicate that the bloom is widespread, and conditions may be worse along shorelines or within recreational areas. Special precautions should be taken in situations when a "Confirmed with High Toxins Bloom" is reported with an open water extent because toxins are likely to be even higher in shoreline areas.

Wind currents can play a large role in the concentrations of algae that float at or near the water surface. Consistent winds can accumulate algae at downwind shorelines. Shorelines containing coves or other features that could capture floating algae may be more susceptible to HABs. In instances where freshwater intakes are impacted by these blooms, the extent may also include the area that is serviced by the impacted water utility or the private/residential intake.

Previous Occurrences and Losses

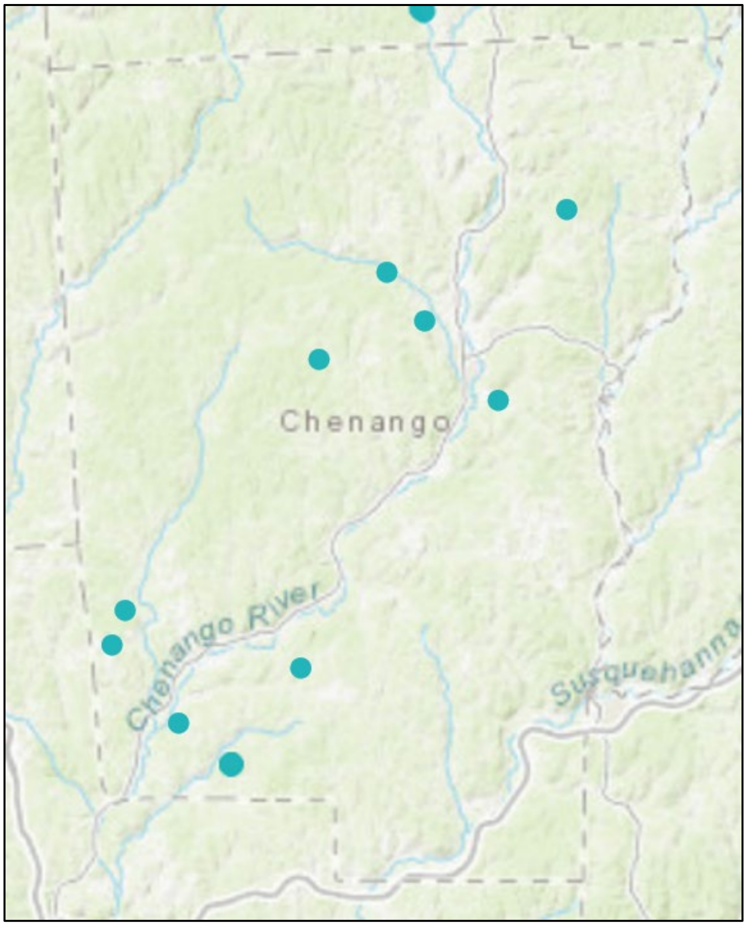
For this HMP update, HAB events were researched from 1972 to September 2020. The NYS DEC began HAB testing and issuing notifications for New York waterbodies in 2012. The 2018 DEC Lake Monitoring Program includes the Lake Classification and Inventory Survey (LCI), the Citizens Statewide Lake Assessment Program (CSLAP) and several individual lake sampling programs. Table 5.4.5-2 lists events identified by the NYS DEC HAB Program between 2012 and 2020. This table includes events specific to Chenango County as well as events listed for neighboring counties but on a shared waterbody, keeping in mind that algal blooms can spread on connected waterways. Figure 5.4.5-4 shows the location of HAB reports throughout the County.

Table 5.4.5-2. Harmful Algal Bloom Events in Chenango County or Lakes Bordering Chenango County, 2012 to 2019

	2012	2013	2014	2015	2016	2017	2018	2019
Bowman Lake					S			
Chenango Lake		C			C			
Echo Lake		C						
Genegantslet Lake		C			S			
Glenn Lake					S			
Guilford Lake					C			
Lake Petonia			HT					
Long Pond					S			
Norwich Reservoir East					S			
Plymouth Reservoir					C	HT	HT	C
Thunder Lake				S		S		C
Warn Lake					C			

Source: NYS DEC 2020
Note:
S (Suspicious Bloom) = DEC staff determined that conditions fit the description of a cyanobacteria HAB based on visual observations and/or digital photographs
C (Confirmed Bloom) = Water sampling results have confirmed the presence of a cyanobacteria HAB which may produce toxins or other harmful compounds
HT (Confirmed with High Toxins Bloom) = Water sampling results confirmed that there were toxins present in quantities to potentially cause health effects if people or animals came in contact with the water

Figure 5.4.5-4. Location of HAB reports, Chenango County, 2012 – 2020



Source: NYS DEC, 2020

Probability of Future Events

HABs appear to be a recent occurrence in Chenango County or have only recently been officially reported and recorded. Even with these blooms becoming increasingly common, season and year-to-year fluctuations make predicting their occurrence difficult (U.S. Environmental Protection Agency [EPA] 2017a). Despite this uncertainty, the impact of HABs on the environment, human health, and local economies cannot be discounted.

Table 5.4.5-3 lists probabilities of occurrences of HAB events. The information used to calculate probabilities of occurrences is based on NYS DEC database records that only date back to 2012. It is possible that HABs were present in waterbodies before 2012 but were not identified or monitored. It is also possible that events have taken place in waterbodies that went unreported.

Table 5.4.5-3. Probability of Occurrence of Harmful Algal Bloom-Related Events

Hazard Type	Number of Occurrences Between 2012 and 2020	Percent Chance of Occurrence in Any Given Year
Harmful Algal Bloom	24	100%

Sources: NYS DEC 2020
Note: Probabilities were calculated from years 2012 to 2020. NYS DEC data only included harmful algal bloom events beginning in 2012.

During the Risk Assessment Planning Partnership meeting, the occurrence of harmful algal blooms was discussed. The Steering Committee also provided documentation of the occurrence of HAB's in the County. In

Section 5.3, the identified hazards of concern for Chenango County were ranked. 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 HAB in Chenango County is considered "frequent" (hazard event has 100% annual probability and may occur multiple times per year).

Climate Change Impacts

Increases in temperature may result in increased frequency of HABs. Most HABs take place during the summer months when water temperatures are warmest. Cyanobacteria in particular prefer warmer water. When lakes are at their warmest, mixing of the water column is less likely. When lakes are stagnant, algae are able to grow thicker and faster. In addition, the lower density of warm water allows algae to float to the surface faster. As algae grow and reproduce, they absorb more sunlight at the surface, further increasing the lake temperature and promoting more blooms (EPA 2017b).

Annual average precipitation is projected to increase by up to five by the 2050s and by up to 10 percent by the 2080s. During the winter months, additional precipitation will most likely occur, in the form of rain, and with the possibility of slightly reduced precipitation projected for the late summer and early fall. Northern parts of New York State are expected to see the greatest increases in precipitation (NYSERDA 2014).

The projected increase in precipitation is expected to occur via heavy downpours and less in the form of light rains. Rising air temperatures intensify the water cycle by increasing evaporation and precipitation, which can cause an increase in rain totals during storm events, with longer dry periods between those events. Alternating periods of drought and heavy rainfall increase the likelihood of nutrient runoff into waterways, which can fuel algal blooms (EPA 2017b).

Warmer temperatures could lead to an increase of the length of the algal growing season and increase the likelihood of algal blooms. In addition to warmer temperatures and heavy precipitation events, carbon dioxide levels are forecast to continue to increase. Higher levels of carbon dioxide in the atmosphere and water can lead to increased algal growth, particularly for cyanobacteria that float at the surface (EPA 2017b).

5.4.5.2 Vulnerability Assessment

To understand risk, a community must evaluate assets that are exposed and vulnerable to the identified hazard. All assets surrounding and relying on the waterways and water in the county are exposed to the HAB hazard. The following text evaluates and estimates the potential impact of the HABs hazard on the county.

Impact on Life, Health, and Safety

Impacts of HABs on life, health, and safety depend on several factors, including the severity of the event and whether or not citizens and tourists have become exposed to waters suspected of containing a HAB. Routes of exposure include consumption, inhalation, and dermal exposure. The population living near or visiting waterbodies is at risk for exposure as well as those that use those waterbodies for recreation, fishing, and water supply. Contact with water containing HABs can cause various health effects including diarrhea, nausea or vomiting; skin, eye, or throat irritation; and allergic reactions or breathing difficulties (NYSDOH 2017).

Cyanobacteria blooms are one of the most common freshwater HABs and have been identified by NYS DEC as being present in Chenango County blooms. Cyanobacteria are known to produce toxins from the following classes and have impacts on human health.

- **Endotoxins:** Endotoxins associated with cyanobacteria have been tied to fever and inflammation in humans that have come in contact with water that contains cyanobacterial blooms.

- **Hepatotoxins:** Hepatotoxins are commonly tied to animal poisonings that are associated with cyanobacterial blooms. Animals may exhibit weakness, heavy breathing, paleness, cold extremities, vomiting, diarrhea, and bleeding in the liver. In humans, hepatotoxins have been indicated to promote tumors and may lead to increases in liver cancer. Some types of hepatotoxins, such as microcystin, can persist in fresh water for up to 2 weeks before being naturally broken down (algae).
- **Neurotoxins:** Neurotoxins act to block transfers between neurons. Extreme cases can result in paralysis.

Populations in Chenango County that rely on surface water intake for drinking water are most exposed to the impacts of HABs. Chenango Lake, Ransford Creek, and the Upper and Lower Reservoirs are the primary source of surface drinking water for the City of Norwich and Town of Norwich (combined population of 10,342) and is accessed using an unfiltered system (City of Norwich 2016). Some recreational lakes, such as Plymouth Reservoir, Echo Lake, Geneganslet Lake, and Guilford Lake, have shoreline housing and campsites with many residents and visitors drawing directly from surface waters without filtration systems in place.

Impact on Critical Facilities

The typical impact of HABs on critical facilities is due to shut down of water intakes from surface waters that are impacted by blooms and their toxins. Water treatment plants can remove variable amounts of microcystin from drinking water, but as much as 20 percent of these toxins may escape the treatment process (Carmichael 1997), sometimes leading to plant closures. The City of Norwich and Village of Afton supplement their public water wells with a filtered surface water supply (Chenango County 2016).

Public Water systems within Chenango County are monitored regularly buy the NYSDOH, Chenango County Environmental Health Staff, and certified municipal employees. The EPA has also established an incident checklist for harmful algal bloom incidents impacting water utilities (EPA 2017c).

Impact on the Economy

Economic impacts from HAB events are difficult to quantify in Chenango County. Nationally, these events have caused significant economic loss. For example, a 1976 red tide event in New Jersey was estimated to have caused losses near $1 billion (in 2000 dollars) and a 1997 outbreak of *Pfiesteria* in Chesapeake Bay is estimated to have resulted in $46 million in lost sales of seafood (PCM HAB Research Plan). The costs of these events were largely estimated to be the result of closed fisheries or impact on consumer choices to purchase seafood.

Economic impacts on Chenango County would largely focus on the water recreation and tourism sector, and public drinking water infrastructure. News of a closure of a body of water or beach can result in tourists avoiding the area. Even after closures are lifted, negative public reaction can persist and continue to impact tourism revenue and property values.

Recreational fishing is popular along the Chenango, Susquehanna, and Unadilla Rivers, as well as on Lakes and Ponds throughout the County, with several species stocked by the NYS DEC to enhance fishing opportunities and restore native species (Chenango County 2016). Other recreational activities in the area include hunting, hiking, boating, bird watching, snowmobiling, canoeing, and camping (Chenango County 2016). Property values, as residences are concentrated around the County's waterbodies could also be impacted.

More traditional economic impacts can be associated with the costs of operating monitoring programs, shutdowns of water supplies and associated backup water source costs, and the costs of advanced drinking water treatment (NYS DEC 2017b).

Impact on the Environment

Harmful algal blooms can release toxins that lead to fish and invertebrate kills. Animals that prey on fish and invertebrates in surface waters, such as birds and mammals, may be affected if they ingest impacted prey. Both harmful and non-harmful algal blooms can have drastic impacts on oxygen levels in surface waters. When algae begin to die off following a bloom, bacteria begin to decompose the organic material. This decomposition consumes dissolved oxygen and releases carbon dioxide. If the bloom and die off is large enough, dissolved oxygen levels in aquatic systems can rapidly crash. Anoxic conditions connected to algal blooms have resulted in large fish and invertebrate kills (Graham and Wilcox 2000).

Cascading Impacts on Other Hazards

Harmful algal blooms can exacerbate the impacts of disease outbreak. Species and persons that are exposed to cyanobacteria may become poisoned, experience gene alterations, or disease (EPA 2020). More information about disease outbreaks can be found in Section 5.4.1 (Disease Outbreak).

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. The county considered the following factors to examine potential conditions that may affect hazard vulnerability:

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

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the county. HABs could impact any areas of growth located near waterbodies that are vulnerable to harmful algal blooms. As increased development is often associated with stormwater and runoff issues, harmful algal blooms may become more likely in areas of increased development. The specific areas of development are indicated in tabular form and/or on the hazard maps included in the jurisdictional annexes in Volume II, Section 9 of this plan.

Projected Changes in Population

According to population projections from the Cornell Program on Applied Demographics, Chenango County will experience a slight population decrease through 2040 (more than 7,500 people in total by 2040). Population change is not expected to have a measurable effect on the overall vulnerability of the county's population over time.

Climate Change

Chenango County will see an increase in both temperature and precipitation amounts as a result of climate change. As discussed above, a warming climate will allow for an extended growing period for algal blooms. Additionally, increases in precipitation will generate more stormwater runoff, which can lead to increased nutrient loads entering waterways from leached nutrients in the soil or fertilizers on agricultural lands. Warmer temperatures and increased nutrient loads will allow for algal blooms to grow and spread more rapidly. These changes will increase the county's overall vulnerability to HABs.

Change of Vulnerability since the 2015 HMP

The 2015 version of this HMP did not identify HABs as a hazard. Chenango County and its municipalities have only recently been impacted by these blooms and it is possible that HAB events had taken place previously but were undetected. It appears likely that these blooms will continue to pose a hazard in the future.

5.4.6 Invasive Species

This section provides a profile and vulnerability assessment for the invasive species hazard.

5.4.6.1 Hazard Profile

This section provides profile information including description, extent, location, previous occurrences and losses, and the probability of future occurrences. For this HMP, the invasive species hazard includes a discussion of invasive plants, invasive animals, and insect borne disease, which are further defined below.

Description

The U.S. Department of Agriculture (USDA) defines *invasive species* as a species that is non-native (or alien) 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 New York State's biodiversity (New York State Department of Environmental Control [NYSDEC] 2014). New York is home to nearly 500 invasive species of plants and animals that are tracked and managed by experts with universities and the Department of Environmental Conservation. According to NYSDEC, invasive species in New York State cause or contribute to:

- 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) is a cooperative partnership of diverse stakeholders from throughout the central region of New York State, including Chenango County. The Finger Lakes PRISM is housed in the Finger Lakes Institute at Hobart and William Smith Colleges and covers 17 central New York counties.

According to the Finger Lakes PRISM, the species with very high or high impact, as well as high difficulty of eradication due to being established or widespread in the area are classified as Tier 4 species. Within Tier 4, local control of species is the best course of action, as eradication is not feasible due to the widespread nature, and a focus on localized management over time to contain, exclude, or suppress the species is recommended. Finger Lakes PRISIM Tier 4 terrestrial species include: 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*), and Multiflora Rose (*Rosa multiflora*). Tier 4 aquatic species in the region include: Alewife (*Alosa pseudoharengus*), Gold Fish (*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*), and Rudd (*Scardinius erythrophthalmus*) (Finger Lakes PRISIM 2020).

Additional priority agricultural invasive plant species of concern in the region include the following: Autumn and Russian olive, Canada thistle, Field bindweed, Japanese knotweed, Johnson grass, Ragweed, Spotted knapweed, Swallow-wort, Velvet leaf, and Wild parsnip for plants; Basil downy mildew (*Peronospora* *belbahrii*), Grape crown gall (*Agrobacterium tumefaciens*), Late blight (*Phytophthora infestans*), Phytophthora blight (*Phytophthora capsici*), and Plum pox virus (*Potyvirus*) for diseases; and BMSB (*Halyomorpha halys*), Garlic bloat nematode (*Ditylenchus dipsaci*), Golden nematode (*Globodera rostochiensis*), Spotted wing drosophila (*Drosophila suzukii),* and Swede Midge (*Contarinia nasturtii*) for insects (Finger Lakes PRISM 2018).

Aquatic invasive species of concern include Hydrilla (*Hydrilla verticillata*), the water chestnut (*Trapa natans*), the macroalgae starry stonewort (*Nitellopsis obtuse*), the bloody red shrimp (*Hemimysis*), the round goby fish (*Neogobius melanostomus*), and the oriental weatherfish (*Misgurnus anguillicaudatus*) (Finger Lakes PRISM 2018).

Terrestrial invasive species of concern include 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),* and Slender falsebrome (*Brachypodium sylvaticum*) (Finger Lakes PRISM 2018).

New York State has been impacted by various past and present infestations of invasive insects, including high populations of invasive mosquitoes 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 and infestations have occurred in Chenango County but were noted regionally and could spread into Chenango County.

Invasive Plants

An invasive plant is able to 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 2017). Invasive plants include invasive aquatic plants. 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.

Giant Hogweed

Source: NYIS (2019)

Giant Hogweed is a large invasive plant species that is classified as a noxious weed. Originally from Europe, Giant Hogweed is a clearly identified giant, towering height of 14 feet or more, large leaves of up to five feet wide, and large white flower heads that are up to two and a half 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 come in contact with the skin through brushing against the bristles on the stem or the breaking of the stem and leaves (NYSDEC 2018).

Common reed or Phragmites

Common reed or Phragmites grows in dense thickets that makes habitats unsuitable for local animals. It outcompetes and replaces native plants, and produces mesoxalic acid, which is a toxin harmful to many plants. Although Common reed has been found in North America for thousands of years, it is spread when soil is disturbed in

Source: NYIS (2019)

upland areas or when introduced into previously unimpacted wetlands. (Syracuse Post Standard 2018).

Invasive Animals and Insects

Emerald Ash Borer

Source: NYIS (2019)

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 3/8- to 5/8- inch 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 2014).

EAB affects black and white ash trees, which are valuable commercially and used for manufacture of flooring, furniture, and shipping pallets, as well as baseball bats. Approximately 114 million board-feet of ash lumber is grown annually in the eastern United States (approximately $25 billion value). Hedgerows composed of ash trees help protect fields from drying and eroding from winds. These hedgerows also provide shelter to plants, animals, and humans (NYIS 2019).

Hemlock Woolly Adelgid

Hemlock woolly adelgid (*Adelges tsugae*) is native to parts of Asia and was first discovered in New York 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 dispersion of the adelgid (NYSDEC 2014).

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, ruffled 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 in drastic changes to the ecosystem (NYIS 2019).

True Armyworm

True Armyworm, also known as the common armyworm, is primarily a pest of plants in the grass family: forage/ pasture/ grasses and lawns, small grains, and corn. Young larvae appear smooth, cylindrical, pale green to brownish, while mature larvae are smooth and marked with two orange, white-bordered strips on each side. Larvae range in size from 1/8 inch to 1 ½ inches long. The insect spends winters in the south and flies up to New York State in the spring (Cornell Cooperative Extension 2019).

Ticks

Ticks are mostly native to Chenango County, with the most common being deer (black-legged), American dog tick, and the Lone Star tick. Several tick species are either invasive or have expanded their original range into

Chenango County. Lone Star tick is not native to New York State but is expanding its range farther north from the south.

Insect Borne Disease

Lyme Disease

Lyme Disease is caused by the Lyme Disease Bacterium, *Borrelia burgdorferi*, which normally lives in mice, squirrels, and other small animals. It is transmitted among these animals and to humans via bite of a certain species of tick, particularly the deer tick. Lyme disease infections can cause symptoms affecting the skin, nervous system, heart, and joints of an individual (New York State Department of Health [NYSDOH] 2015).

Eastern Equine Encephalitis

Eastern Equine Encephalitis (EEE) spread via mosquitoes that have fed on infected bird species. About one third of humans that contract the disease die while most survivors suffer brain damage.

West Nile Virus

West Nile Virus (WNV) is a mosquito-borne virus that can cause encephalitis (inflammation of the brain) or meningitis (inflammation of the lining of the brain and spinal cord). WNV is spread to humans by the bite of an infected mosquito. A mosquito becomes infected by biting a bird that carries the virus (NYSDOH 2015).

Regulations

The New York State Invasive Species Council is a statutory body created in 2008 by Title 17, Section 9 of the Environmental Conservation Law (ECL). Its mission is to coordinate among multiple state entities and partners in addressing 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 the Department of Agriculture and Markets (NYSDAM) and consists of nine members: Commissioners of the NYSDEC, NYSDAM, Transportation, and Education; the Office of Parks, Recreation, and Historic Preservation; the Secretary of State; the Chairperson of the New York State Thruway Authority; the Director of the New York State Canal Corporation; and the Chairperson of the Adirondack Park Agency (NYSDEC 2015).

The NYSDEC, in cooperation with NYSDAM, proposed new invasive species regulations (6 *New York Codes Rules and Regulations* [NYCRR] Part 575). The proposed regulations include 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; and requirement of a permit for education, research, and other approved activities involving prohibited species and release of regulated species into a free-living state. The regulations specify the criteria for imposing these classifications and a means for future classification of species. The proposed regulation establishes grace periods for certain prohibited species to allow businesses to plan management of existing stock (NYSDEC 2015).

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, first described in the 2005 NYS Invasive Species Task Force Report and outlined below. Many of the components are administered as contracts through the NYS Department of Environmental Conservation.

- **New York Invasive Species Council:** Nine state agencies, co-chaired by NYS Department of Environmental Conservation and NYS Department of Agriculture and Markets.
- **New York State Invasive Species Advisory Committee:** Twenty-five representative stakeholders, including environmental, academic, industry groups.
- **Invasive Species Coordination Unit:** Two coordinating staff at the NYS Department of Environmental Conservation housed within the Division of Lands and Forests.
- **Partnerships for Regional Invasive Species Management (PRISMs):** Eight regional public-private partnerships established across New York to coordinate invasive species prevention and management and deliver on-the-ground programming. Chenango 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 alike.
- **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 high quality science-based educational programs and cutting-edge 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 NYS 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.

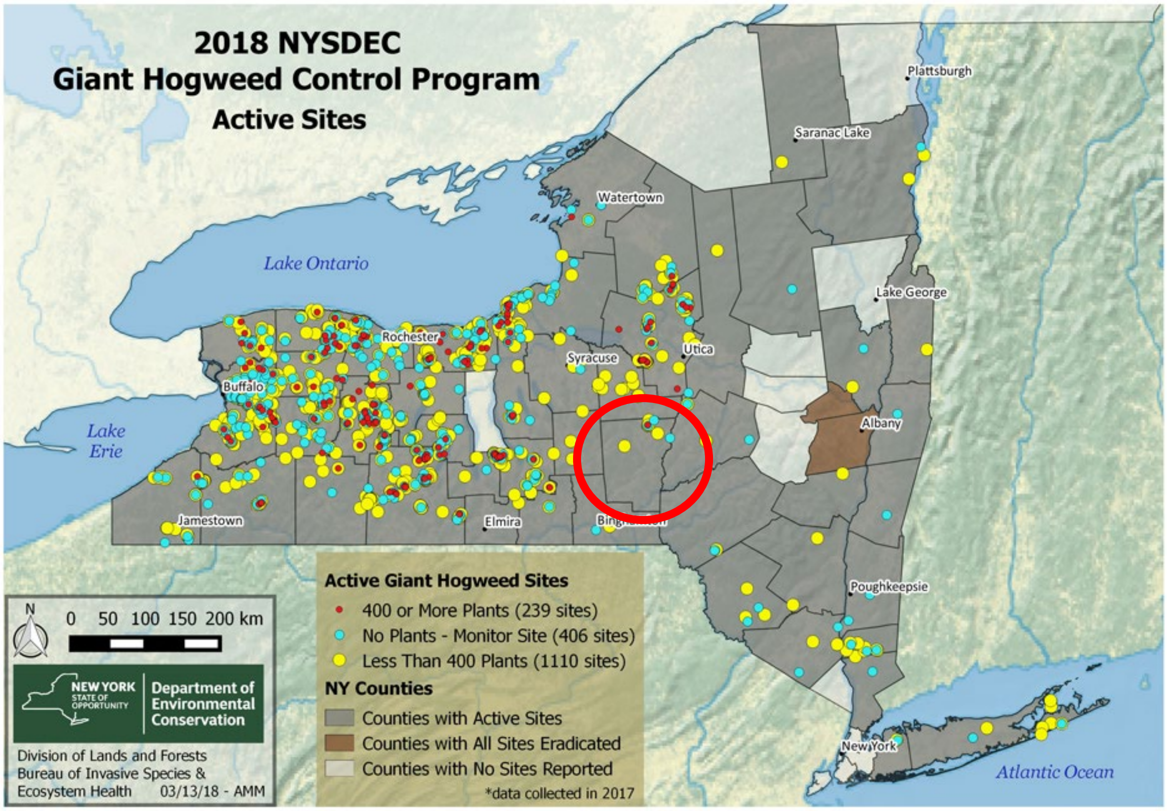
Extent and Location

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. Each threat can impact most areas of New York State, including Chenango County. Levels of threat from invasive species range from nuisance to widespread. The threat typically intensifies when the ecosystem or host species is already stressed, such as during periods of drought. Some invasive species and infestations, such as mosquitoes and ticks, are found countywide. Others are limited to specific locations. Examples of known locations of invasive species within Chenango County are described below.

Giant Hogweed

The NYSDEC runs a Giant Hogweed Control Program. Figure 5.4.6-1 illustrates there are active giant hogweed locations (less than 400 plants) in central Chenango County.

Figure 5.4.6-1. Giant Hogweed Control Program Active Sites for 2018

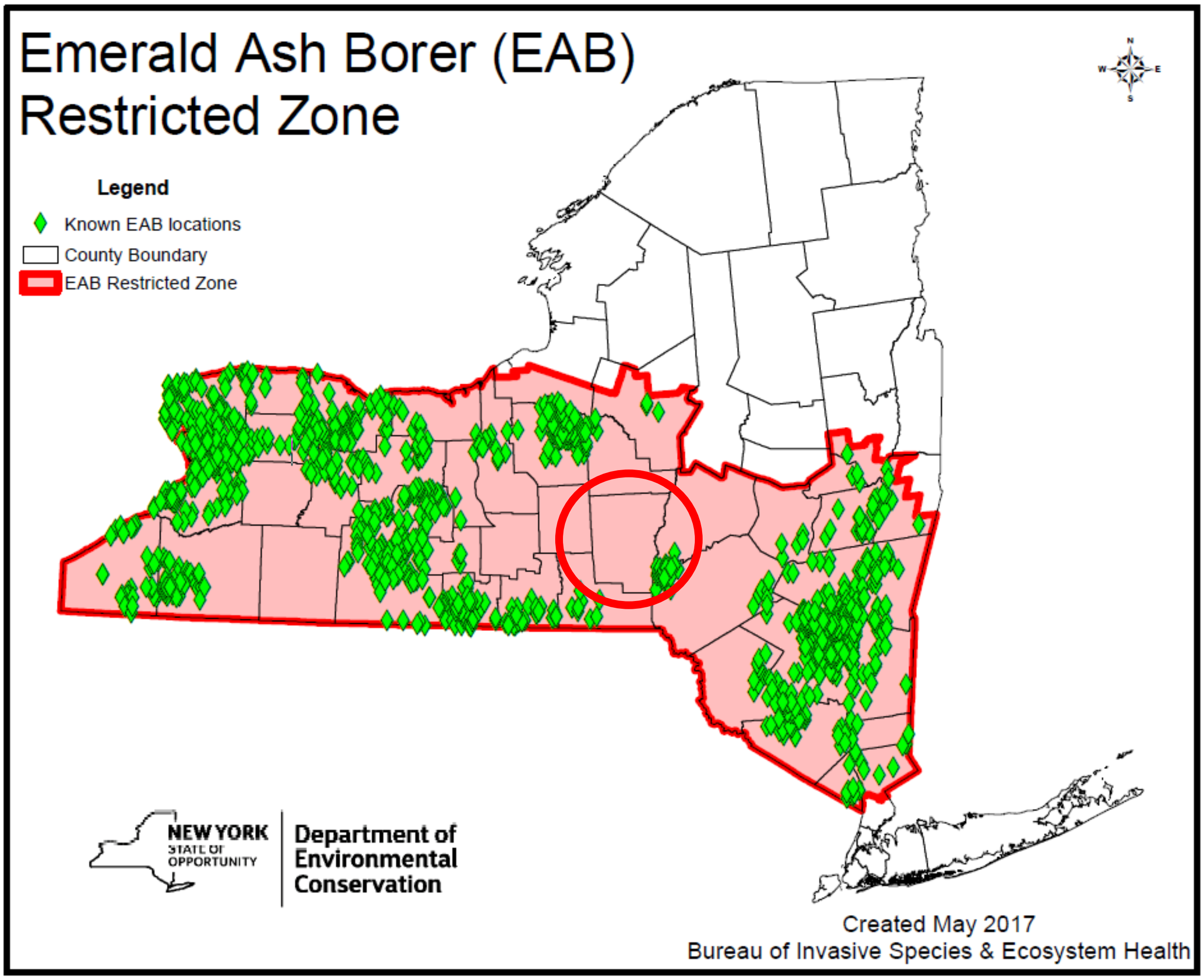


Source: Finger Lakes PRISM 2018
Note: Chenango County is circled in red.

Emerald Ash Borer

EAB feeds on Ash trees. The NYSDEC has found that Ash trees of all species, comprise approximately 10 percent of Chenango County's forests. Figure 5.4.6-2 shows the known locations of EAB documented by NYSDEC. EAB are concentrated near the southeast border of Chenango County and Otsego and Delaware Counties, within the Village of Sidney. Infested ash trees were found in the Pharsalia Woods State Forest in October 2020 (iMapInvasives 2020).

Figure 5.4.6-2. Emerald Ash Borer Locations and the Restricted Zone

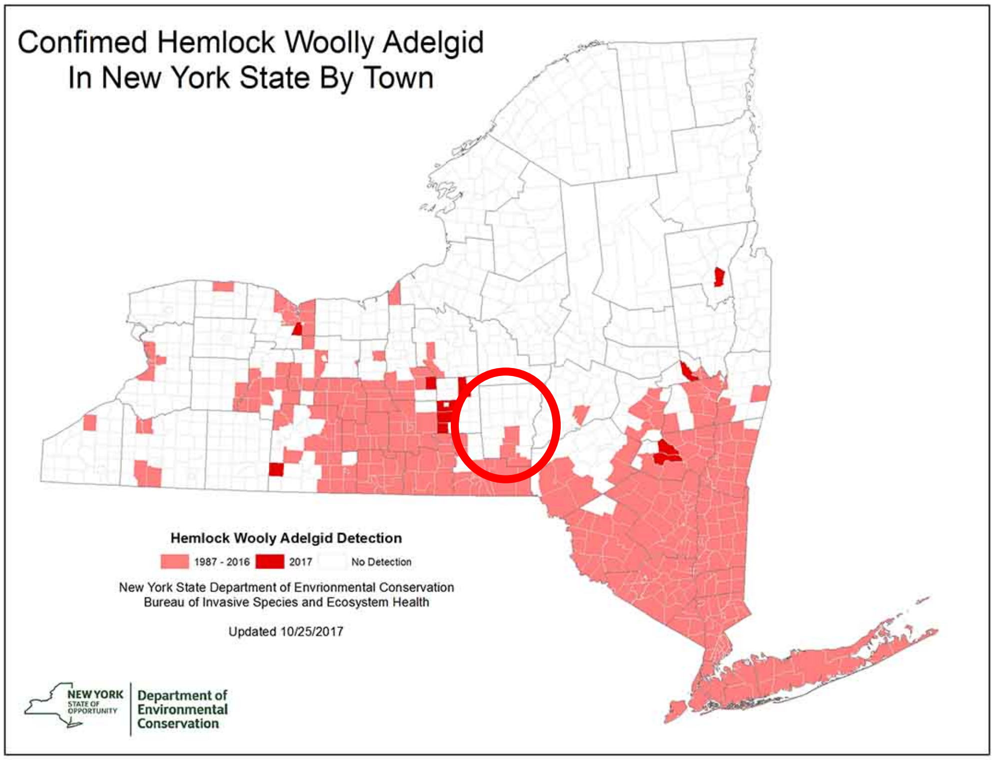


Source: NYSDEC 2017
Note: Chenango County is circled in red.

Hemlock Wooly Adelgid

Hemlock wooly adelgid infects hemlock trees. Figure 5.4.6-3 shows the known locations of hemlock wooly adelgid documented by NYSDEC. Hemlock wooly adelgid is found in numerous locations in the center and southwestern portion of the county (Cornell Cooperative Extension 2018).

Figure 5.4.6-3. Confirmed Hemlock Wooly Adelgid in New York State



Source: NYSDEC 2017
Note:Chenango County is circled in red

Additional extent mapping for a wide range of invasive species in Chenango County can be found at iMapInvasives, New York State's on-line, all-taxa invasive species database and mapping tool. iMapInvasives partners with many organizations to leverage collaboration in the fight against invasive species (PRISMs). According to iMapInvasives (2020), the comprehensive database can be used for the following:

- Documenting and sharing invasive species observation, survey, assessment and treatment data.
- The coordination of early detection and rapid response efforts through email alerts.
- Data analysis and summaries in the web interface and GIS.

Previous Occurrences and Losses

For this HMP Update, known infestation and invasive species events impacting Chenango County between 1999 and 2020 are listed in Table 5.4.6-1. Documentation of invasive species events within Chenango County was not found prior to 1999. Detailed information regarding invasive species and losses resulting from these within the county is scarce. Therefore, Table 5.4.6-1 might not include all events that occurred within the county during the period between 1999 and 2020.

FEMA Disaster Declarations

The Federal Emergency Management Agency (FEMA) has declared that New York State underwent one infestation-related emergency (EM) classified as a virus threat between 1954 and 2015. In 2000, Chenango County was included in EM-3155 related to an outbreak of the West Nile virus (FEMA 2020).

USDA Declarations

Nearby counties have previously been included in a USDA agricultural disaster declaration (S3411) for invasive insects (armyworm); however, Chenango County has not been included in any USDA disasters related to invasive species, and sources did not reveal impacts of armyworm in Chenango County.

Previous Events

The following table includes all infestation and invasive species events and notices that have occurred in Chenango County between 1999 and 2020.

Table 5.4.6-1. Infestation and Invasive Species Events in Chenango County, 1999 to 2020

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Event Details*
1999	Eurasian Milfoil	N/A	N/A	Eurasian Milfoil was first identified in Chenango County.
2000	West Nile virus	EM-3155	Yes	An outbreak of West Nile virus throughout New York State resulted in an emergency declaration.
2012	Purple Loosestrife, European Water Chestnut	N/A	N/A	Purple Loosestrife and European Water Chestnut were first identified in Chenango County.
2012-2016	Lyme Disease	N/A	N/A	Records from the CDC show that lime disease cases in the northeast and Chenango County continued to grow during these years.
2014	Emerald Ash Borer	N/A	N/A	The EAB was first identified in Chenango County.
2015	Wild Parsnip	N/A	N/A	Wild Parsnip was identified at several locations in Chenango County.
2018	Giant Hogweed	N/A	N/A	NYSDEC reported giant hogweed at one site in the county.
2020	Emerald Ash Borer	N/A	N/A	Emerald Ash Borer was found in the Pharsalia Woods State Forest.

Source: EDD Maps 2018; USDA 2018; NYSDOH 2015; CDC 2017
** Many sources were consulted to provide an update of previous occurrences and losses; event details and loss/impact information may vary and has been summarized in the above table*
CDC Centers for Disease Control
EAB Emerald Ash Borer
FEMA Federal Emergency Management Agency
N/A Not applicable
USDA U.S. Department of Agriculture

Climate Change Projections

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 (NISC 2016).

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 (Natural Resources Defense Council [NRDC] 2015). Armyworms die in colder temperatures; however, warmer spring and winter temperatures allow them to continue to reproduce—a factor contributing to the 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 (NRDC 2015). As temperatures increase and rainfall patterns change, these insects can remain active for longer seasons and within wider areas.

As climate change continues to take place, it is anticipated that the occurrence of invasive species is likely to increase in Chenango County, particularly by species acclimated to warmer climates that expand their range to the north as temperatures warm.

Probability of Future Occurrences

Based on historical documentation and given the overall impact of changing climate, New York State is expected to undergo increased incidences of invasive species. Chenango 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, probability of occurrence of invasive species in Chenango County is considered *frequent* (100 percent annual probability; a hazard event may occur multiple times per year). Refer to Section 5.3 (Hazard Ranking) for additional information on the hazard ranking methodology and probability criteria.

5.4.6.2 Vulnerability Assessment

All of Chenango County was identified as vulnerable to the invasive species hazard. Invasive species are of significant concern to Chenango County, mainly due to their effects on public health, natural resources, and agriculture. Estimated losses are difficult to quantify; however, invasive species can impact Chenango County's population and economy.

Impact on Life, Health and Safety

The entire population of Chenango County is vulnerable to insect-borne disease. According to the U.S. Census 2018 ACS 5-Year Population Estimate, Chenango County had a population of 48,348. The elderly population and people with suppressed immune systems are most susceptible to effects of West Nile Virus and EEE. According to the 2018 ACS 5-Year Population Estimate, 19.7 percent of the population in Chenango County is 65 and over. In Chenango County, the following areas have the highest percentage of elderly population: Village of New Berlin (26.6%), Town of Oxford (23.9%), Village of Greene (20%), Village of Afton (19.1%), and Town of McDonough (18.2%). Refer to Figure 4-5 in Section 4 (County Profile) that displays the densities of populations over 65 in Chenango County.

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 waterbodies. This can lead to increased harmful algal blooms and negative impact on drinking water supplies. Soil destabilization can increase the likelihood of mudslides in areas with steep slope.

Impact on General Building Stock and Critical Facilities

No structures are anticipated to be affected directly by invasive species; however, the EAB could cause a catastrophic loss of the ash tree throughout state forests, which could result in stream bank instability, erosion, and increased sedimentation. In addition, a preponderance of dead tree limbs could increase the occurrence of downed trees on roadways and power lines in storms with heavy winds. Dead trees and limbs can increase the risk of wildfire in the county.

Some invasive plants have been shown to destabilize soil due to high densities and shallow root systems, negatively impacting nearby buildings. Other invasive plant species, such as common reed and purple loosestrife, have been known to clog culverts, increasing flood risk.

Impact on the Economy

Impacts of invasive species on the economy and estimated dollar losses are difficult to measure and quantify. Costs associated with activities and programs implemented to conduct surveillance and address invasive species have not been quantified in available documentation. Spreading of disease will impact worker productivity as individuals miss work to recover. Invasive species cause about $50 billion in annual damages across New York State (Casler 2013). Nationally, the annual losses are nearly $220 billion. The National Center for Ecological Analysis and Synthesis estimated in a 2011 report that wood-boring insects will cost nearly $1.7 billion in local government expenditures and approximately $830 million in lost residential property values each year (Casler 2013).

The EAB can infect nursery stock and mature trees, which could reduce the timber value of hardwood exports (CFIA 2014). In 2010, the USDA Northern Research Station conducted computer simulations of EAB spread to estimate the cost of ash tree treatment, removal, and replacement (re-planting of new trees) between 2009 and 2019. The simulations predicted an EAB infestation covering 25 states, and assumed treatment, removal, and replacement of more than 17 million ash trees on developed land within established communities. The total costs were estimated at $10.7 billion. This figure doubled when the model was reset to include developed land outside and inside human communities (USDA 2013).

Impact on the Environment

Direct effects of infestation lead to cascading indirect impacts. As vegetation dies or becomes stressed and weakened by pests such as the emerald ash borer, available fuel and high-intensity wildfires increase. As species compositions change due to infestation outbreaks, whole fire regimes can shift. Physical stresses on trees can also affect how trees respond to other natural hazards such as hurricanes, drought, and ice storms.

Cascading Impacts on Other Hazards

Infestations can pose a variety of health risks to human and animal populations within the County. Increased populations of mosquitoes and ticks have been known to cause disease outbreaks such as West Nile Virus and Lyme Disease in New York State. Refer to Section 5.4.1 (Disease Outbreak) for more information about the impacts of invasive species on disease within the 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. The county considered the following factors to examine potential conditions that can affect hazard vulnerability:

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

Projected Development and Change in Population

As discussed in Sections 4 (County Profile) and 9 (Jurisdictional Annexes), areas targeted for future growth and development were identified across Chenango County. Any areas of growth could be impacted by invasive species because the entire planning area is exposed and vulnerable. Changes in land use have the potential to render some habitats more susceptible to invasive species, such as clearing the land and providing opportunities for invasive species to inhabit the area. Clearing the land also can reduce the habitat for predator species that could manage the spread of invasive species naturally. The specific areas of development are indicated in tabular form and on the hazard maps included in the annexes in Section 9 (Jurisdictional Annexes).

According to population projections from the Cornell Program on Applied Demographics, Chenango County will experience a continual population decrease through 2040 (more than 7,500 people by 2040). This decrease will reduce the overall vulnerability of the county's population over time; however, a closer examination of the demographics (e.g., age) and movement of population within the county could lead to an increase in vulnerability to the elderly and rural versus urban/suburban areas. Refer to Section 4.5.2 (Population Trends) in the County Profile for a discussion on population trends in the county.

Climate Change

Chenango County is projected to see increases in the average annual temperature by 4.4–6.3 ºF by the 2050s and 5.7–9.9 ºF by the 2080s. As the climate warms, the habitat range will increase for insects, including mosquitoes, ticks, and armyworms. As discussed earlier, increases in the rate West Nile Virus infections have been correlated to increasing temperatures and precipitation amounts. In addition, the increased average temperatures allow insects to survive for longer periods throughout the year and extend the time that populations are susceptible to infection of an insect borne disease. As climate changes, Chenango County is likely to experience an increase in invasive species.

Change of Vulnerability Since 2015 HMP

Infestation, including diseases related to pests and non-native species were identified as a hazard of concern in previous versions of this HMP. For the 2021 Update, Invasive species is a separate hazard of concern to the Chenango County HMP; as well as the addition of Disease Outbreak (Section 5.4.1) as a hazard of concern focused on tick and mosquito-borne diseases, as well as communicable diseases. Chenango County's vulnerability to invasive species and cascading disease impacts has not changed and will continue to impact the county in the future.

5.4.7 Natural Gas Development

This section provides a profile and vulnerability assessment for the hazard posed by incidents involving the natural gas infrastructure within Chenango County.

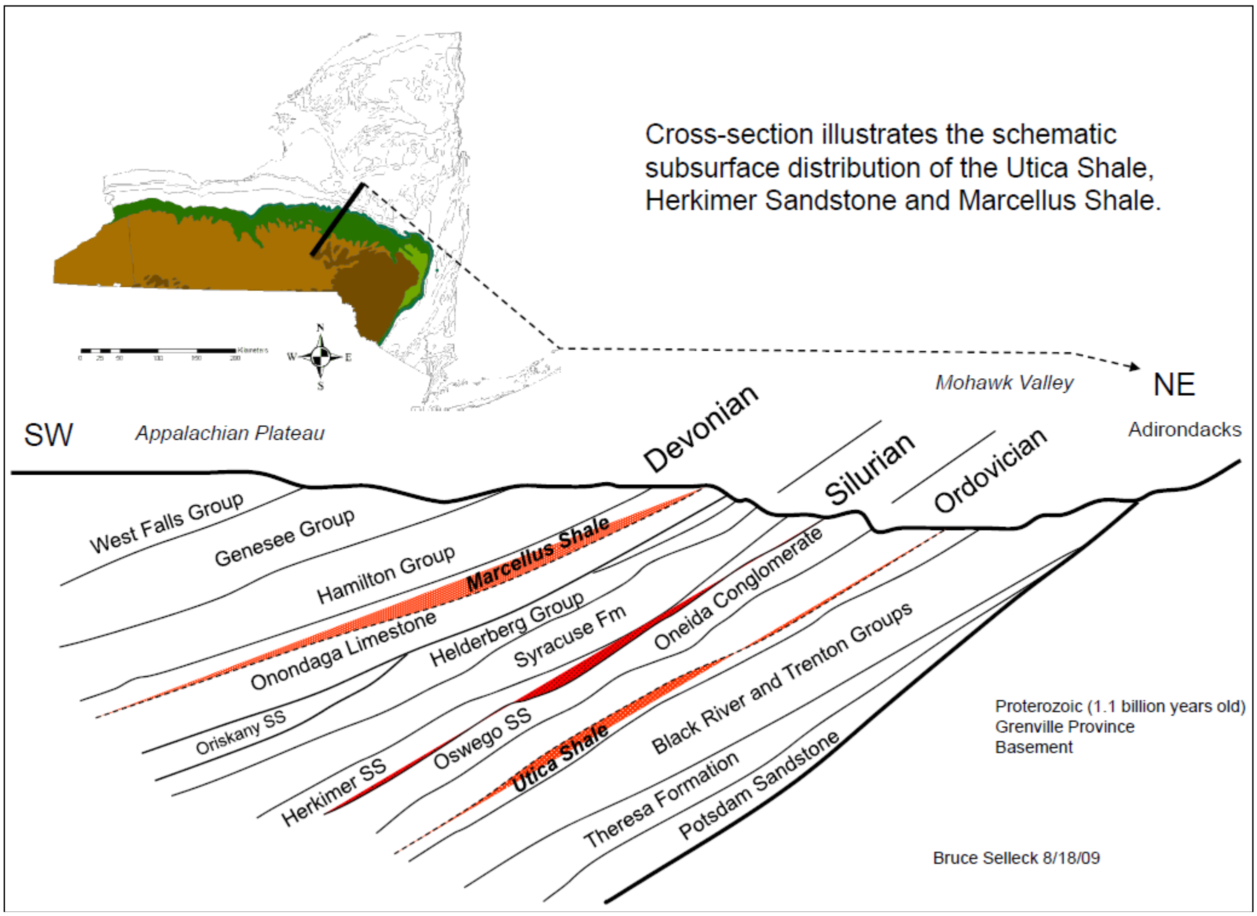
5.4.7.1 Hazard Profile

This section provides a profile and vulnerability assessment for the hazards posed primarily by the ongoing and potential development of the natural gas industry and natural gas infrastructure within Chenango County.

Description

Natural gas is a mixture of hydrocarbon gases- mostly methane with some ethane, propane, and butane (Selleck, 2009). It is created by the breakdown of organic matter at high temperature and pressure under the Earth's surface. Different layers of sedimentary rock in the Earth's crust have varying potential to contain natural gas. Figure 5.4.7-1 shows an exaggerated cross-section of the sedimentary rock layers in New York State around Chenango County (Selleck, 2009).

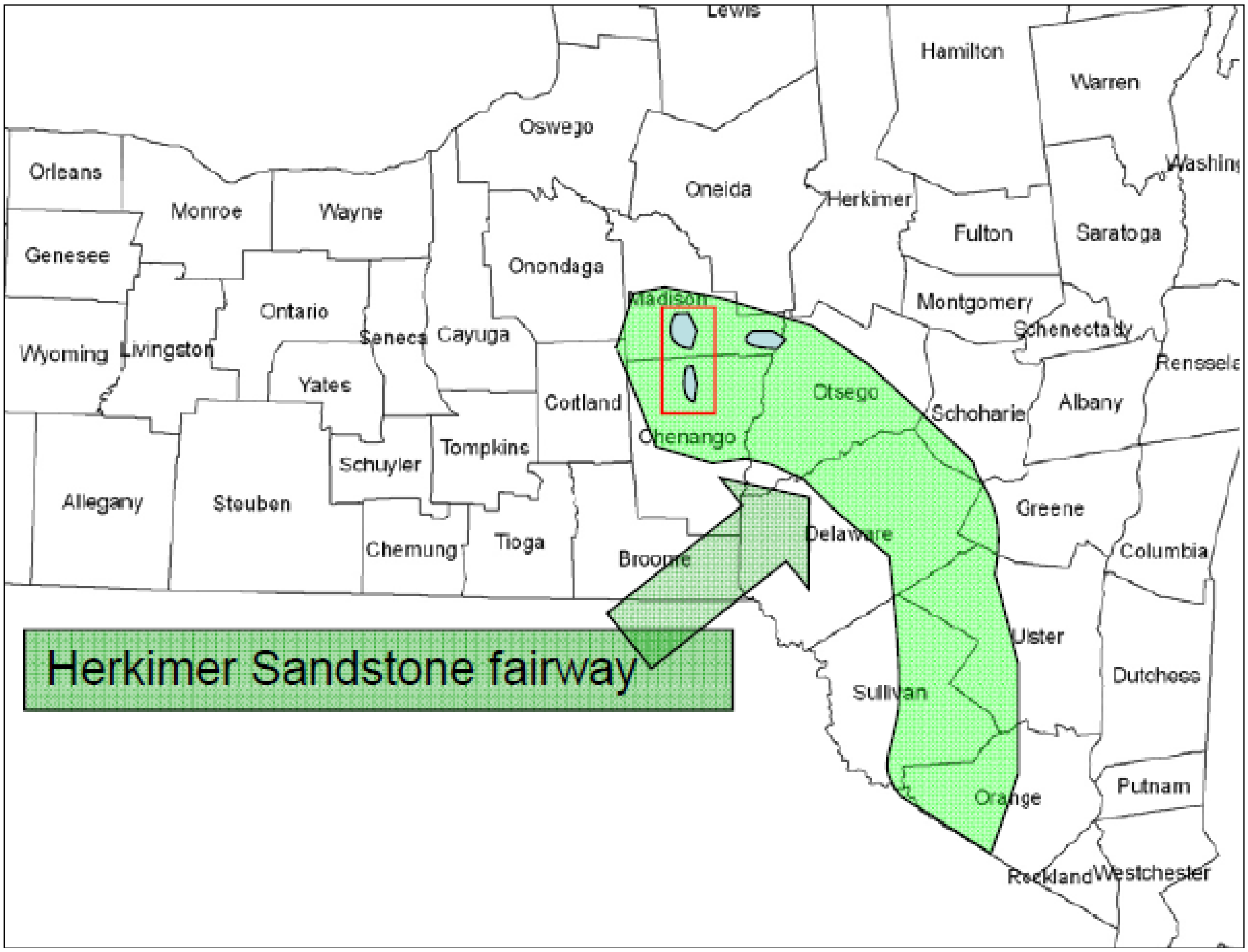
Figure 5.4.7-1. Sedimentary Rock Layers



Source: Selleck, 2009

Three layers of rock are particularly relevant to natural gas drilling in Chenango County. The first is the Herkimer Sandstone, which is the layer from which most of the active natural gas wells in Chenango County draw natural gas, as shown in Figure 5.4.7-2. The indicated "fairway" is the region with a high probability of drawing natural gas from the Herkimer Sandstone. The red box highlights an area of Madison and Chenango Counties in which there are numerous active natural gas wells drawing from the Herkimer Sandstone.

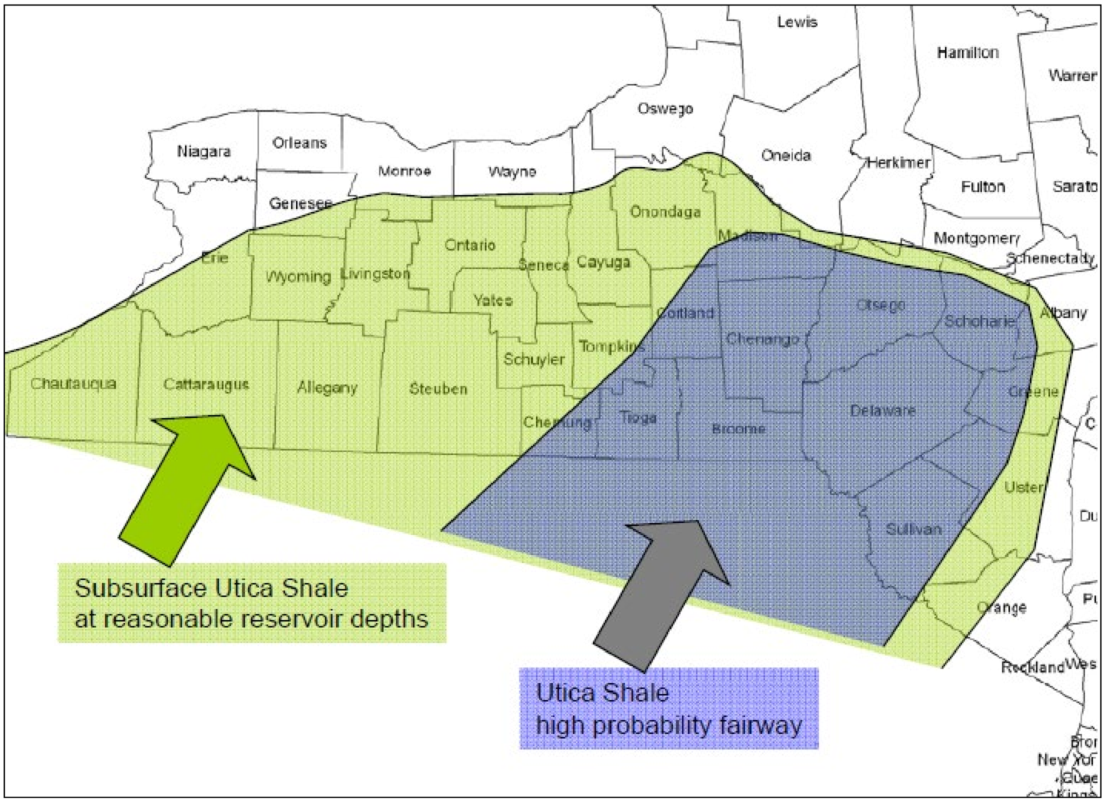
Figure 5.4.7-2. Herkimer Sandstone Fairway



Source: Selleck, 2009

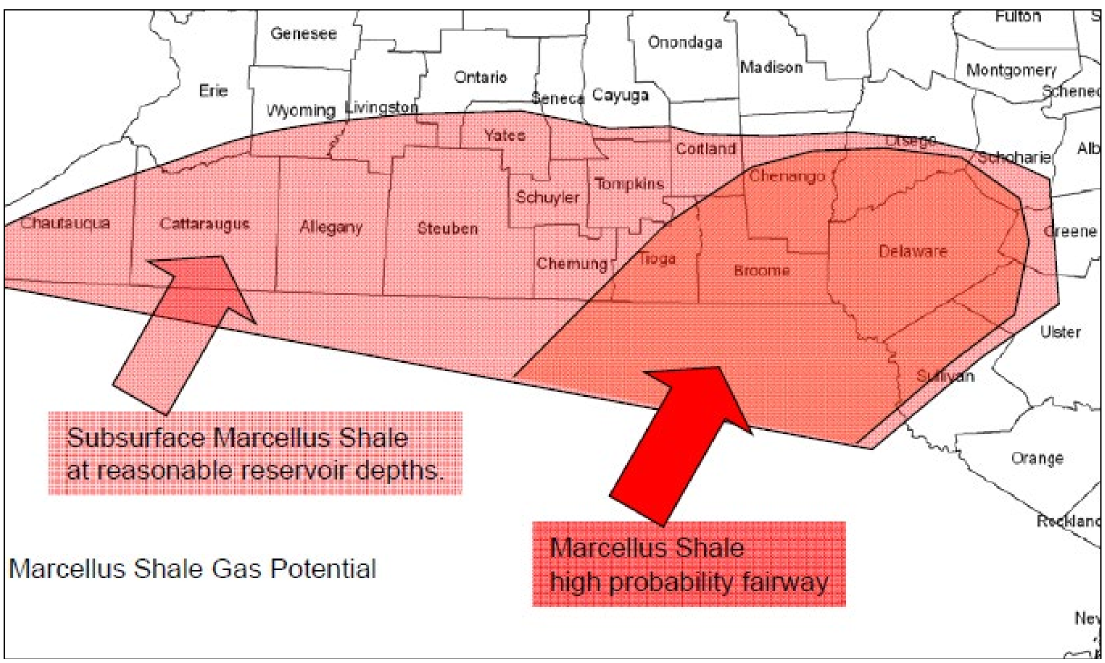
The other two layers, the Marcellus Shale and Utica Shale, have recently been targeted by natural gas drilling companies in West Virginia, Pennsylvania, Ohio, and New York State. However, unlike the Herkimer Sandstone, these two layers require horizontal drilling and high-volume hydraulic fracturing of the rock itself to release sufficient quantities of natural gas to make drilling economical. Figure 5.4.7-3 and Figure 5.4.7-4 show the Utica Shale and Marcellus Shale fairways, respectively. All of Chenango County is within the Utica Shale fairway, making the entire County potentially attractive for natural gas drilling in the Utica Shale. All but the northern parts of Chenango County are within the Marcellus Shale fairway.

Figure 5.4.7-3. Utica Shale Fairway



Source: Selleck, 2009

Figure 5.4.7-4. Marcellus Shale Fairway



Source: Selleck, 2009

Once the gas has been extracted from the ground, it must be distributed to customers. In New York State, over 4.7 million natural gas customers are served by a local gas distribution company (New York State Energy Planning Board, 2009). New York State Electric and Gas (NYSE&G), has natural gas franchise agreements with several municipalities in Chenango County where the infrastructure is available. At this time the primary natural gas customers in Chenango County are residents/businesses in close proximity to the NYSE&G pipeline or the City of Norwich and Village of Oxford. The franchise agreements allows for infrastructure development to provide additional service to potential natural gas customers in Chenango County.

Natural gas is primarily transported by pipelines. Interstate pipelines are regulated by the Federal Energy Regulatory Commission (FERC) and intrastate pipelines are regulated by the New York State Public Service Commission (NYSPSC). The intrastate pipelines are under the jurisdiction of the NYSPCS Gas Safety Division (Chenango County Natural Gas Advisory Committee, 2011). Low-pressure (<125 psi) gathering pipelines are regulated by the Gas Safety Division. Towns do not have regulatory authority over them. The PSC has regulatory authority over intrastate lines at all levels, including, but not limited to, the safety division.

There are a few potential negative impacts of natural gas drilling, which could adversely affect Chenango County. First, natural gas could leak from the well site. This could cause a hazardous situation if the gas were to collect and pool in or near occupied structures, as it could cause direct health effects or ignite. Ignition and explosion of natural gas is the second negative potential impact of natural gas drilling. Third, natural gas and/or flowback fluids could contaminate the environment. Finally, the increased truck traffic directly related to well drilling could result in an increase of transportation accidents. These impacts are described in the sections below.

Extent

Natural gas is flammable and has the potential to cause significant impacts (Lycoming County, 2010). If a large volume of natural gas escapes from a well or pipeline, it has the potential to explode. This explosion, depending on its magnitude, could injure or kill people (potentially overwhelming the local emergency medical services [EMS]), destroy property, cause urban or wildland fires, close roads, force evacuations, cause power or telephone outages (if transmission lines are damaged), etc.

The extent of impacts from natural gas incidents depends on several factors (Lycoming County, 2010):

- Compliance with applicable site design, building, and fire codes
- Maintenance of equipment
- Weather conditions
- Micro-meteorological effects of buildings and terrain
- Warning time for affected populations
- Response time for emergency response units

Site design, and building and fire code compliance are the primary factors which can be controlled by humans. By ensuring that the drill site is properly designed, drilling operations follow established regulations, well(s) are properly designed and constructed. It is also important to ensure that drilling equipment is inspected and maintained regularly, in accordance with equipment specifications and regulations, so that any defects can be addressed before a release.

Should there be an incident that releases natural gas from the well site or pipeline, weather conditions and micro-meteorological effects will affect the spread of any natural gas released in the incident. Natural gas is lighter than air, and will rise when released. Ambient weather conditions and effects of terrain or buildings may keep the gas closer to the ground.

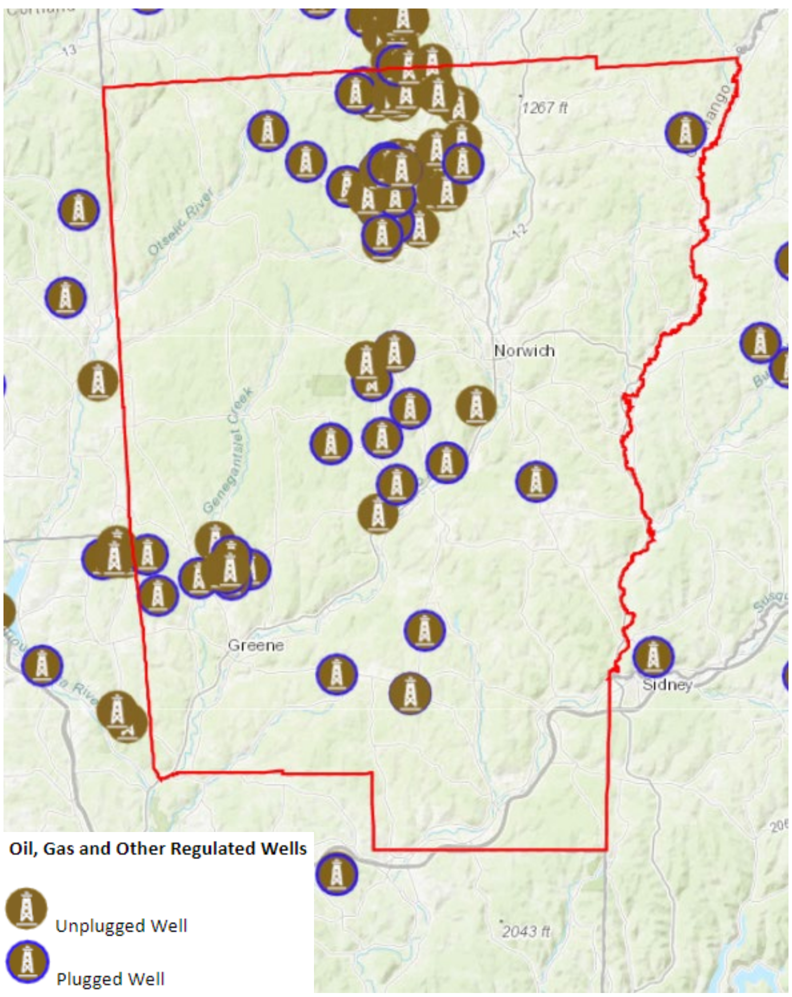
If natural gas escapes due to an incident, and it has the potential to affect people and property, those effects will depend on the warning time available for potentially-affected populations to seek appropriate shelter or evacuate the area. The sooner a qualified emergency response unit, whether from the local community or the infrastructure operator, arrives to address any incidents and releases, the less potential for negative consequences exists.

According to the *2020 Emergency Response Guidebook* published by the U.S. Department of Transportation (US DOT), a large spill of flammable gas, including natural gas from a well site or a point along a pipeline, may result in an initial downwind evacuation of ½ mile (USDOT 2020).

Location

The locations of well sites are tracked by the New York State Department of Environmental Conservation (NYSDEC). Locations of wells in Chenango County are shown in Figure 5.4.7-5. There are currently 42 active natural gas wells in Chenango County. Most gas wells are located in the Town of Smyrna in the northern part of the County.

Figure 5.4.7-5. Natural Gas Wells Completed and Proposed in Chenango County

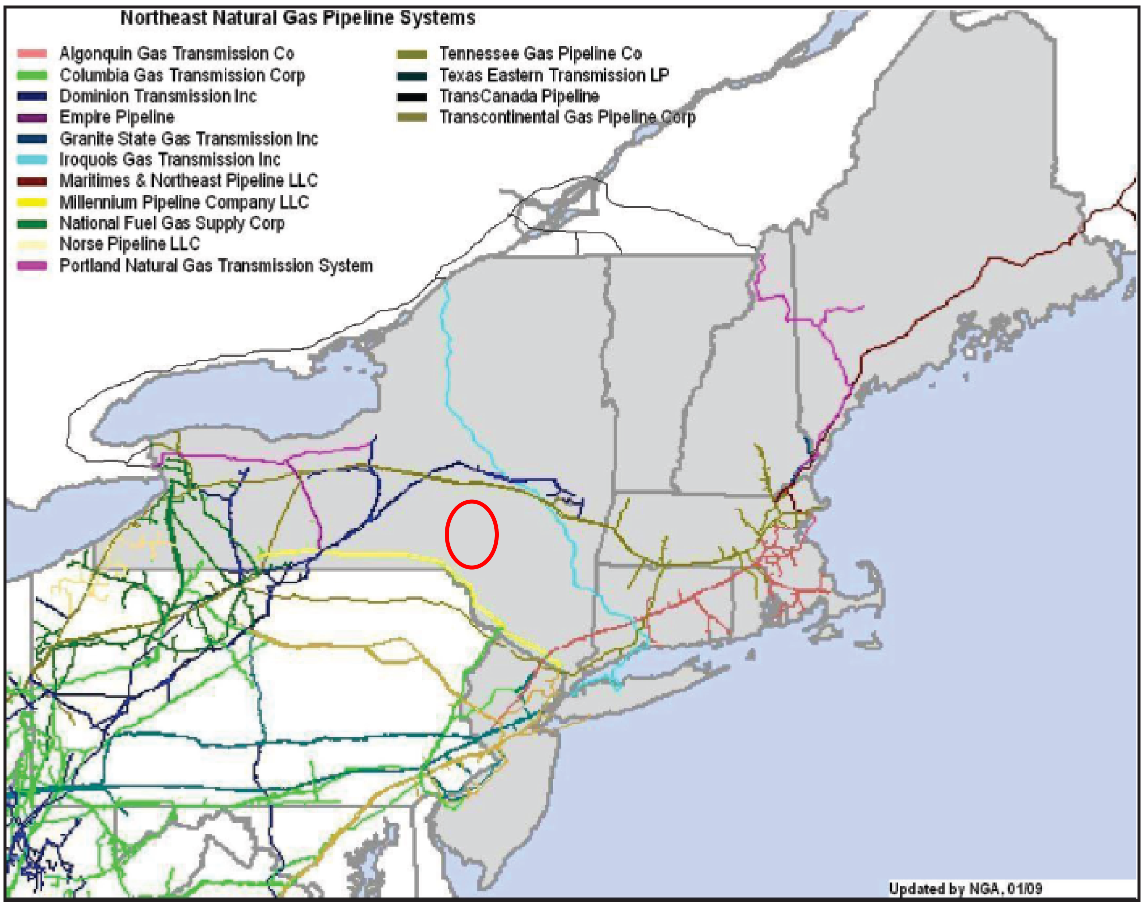


Source: NYSDEC Info Locator, 2020
Note: Chenango County is outlined in red.

There are no major (from a national perspective) pipelines running through Chenango County, as shown in Figure 5.4.7-6. The closest major pipeline is the Millennium Pipeline, running east-west, just south of Chenango County and the Tennessee and Dominion pipelines to the north. The Teppco Pipeline is a pipeline running east-west across Chenango County, through the Towns of McDonough, Preston, Oxford, and Norwich, supplying multiple products but not natural gas.

There is a low-pressure (< 125psi) natural gas gathering pipeline system connecting gas wells in the towns of Smyrna, Plymouth, and Preston. The specific locations of these pipelines have been deemed confidential due to issues related to homeland security. They are on file at the County Bureau of Fire.

Figure 5.4.7-6. Major Pipelines in the Northeast United States



Source: New York State Energy Planning Board, 2009
Note: The location of Chenango County is indicated by the red circle.

A major natural gas pipeline, The Constitution Pipeline, proposed in 2013, was to run from Pennsylvania, through to Albany, NY, passing through the Towns of Afton and Bainbridge in Chenango County. However, due to a New York Statewide ban on hydraulic fracking, the project was disbanded in February 2020 (Constitution Pipeline 2020; NRDC 2020).

Table 5.4.7-1 summarizes natural gas wells identified in the NYSDEC Oil and Gas database (http://www.dec.ny.gov/cfmx/extapps/GasOil/) as of December 2019. This table further identifies existing and proposed natural gas pipelines as identified by the Chenango County Department of Planning and Development, and Commerce Chenango as of 2020.

Table 5.4.7-1. Existing and Proposed Natural Gas Infrastructure

Municipality	Active Natural Gas Wells (as of 12/2019) (1)	Inactive Natural Gas Wells (as of 12/2019) (2)	Natural Gas Distribution System(s) – Existing (3)	Natural Gas Distribution System(s) – Proposed (3)
Afton (T, V)	-	7		Constitution Pipeline
Bainbridge (T, V)	-	1		Constitution Pipeline Leatherstocking Natural Gas Pipeline
Columbus (T)	-	-		
Coventry (T)	-	11		Leatherstocking Natural Gas Pipeline
Earlville (V)	-	-		
German (T)	-	4		
Greene (T, V)	-	-		Leatherstocking Natural Gas Pipeline
Guilford (T)	-	2		
Lincklaen (T)	-	-		
McDonough (T)	-	4		
New Berlin (T, V)	-	-	NYSE&G Pipeline – provides local natural gas service to portion of the Town	
North Norwich (T)	-	-		
Norwich (C, T)	-	-	NYSE&G Pipeline – provides local natural gas service	
Otselic (T)	-	-		
Oxford (T, V)	-	3	NYSE&G Pipeline – provides local natural gas service	
Pharsalia (T)	-	-		
Pitcher (T)	-	-		
Plymouth (T)	4	12	NYSE&G Pipeline – provides local natural gas service to portions of the Town EmKey gathering pipeline system	
Preston (T)	3	4	EmKey gathering pipeline system	
Sherburne (T, V)	-	-		
Smithville (T)	-	13		
Smyrna (T, V)	34	45	EmKey gathering pipeline system	

Sources:
(1) NYSDEC Gas Well Search Website: http://www.dec.ny.gov/cfmx/extapps/GasOil/search/wells/index.cfm . Identifies wells with "Well Status" identified as "Active"
(2) NYSDEC Gas Well Search Website: http://www.dec.ny.gov/cfmx/extapps/GasOil/search/wells/index.cfm . Identifies wells with "Well Status" identified as "Inactive", "Cancelled", "Expired Permit", "Refunded in Fee" or "Voided Permit"
(3) Chenango County Planning Committee, 2007, 2014; Chenango County Department of Planning and Development, 2020; Commerce Chenango, 2020.
Notes:
EmKey = EmKey Resources LLC
NYSE&G = New York State Electric and Gas

Previous Occurrences and Losses

Many sources provided information regarding previous occurrences of incidents at natural gas well sites and transmission pipelines, and possible environmental contamination due to the chemicals used in the drilling process, throughout the shale regions of Pennsylvania and New York. However, there were few records of incidents in Chenango County.

In July 2008, a faulty valve on a well head blew out during pressure testing, causing eye and ear injuries to a worker (DeCordova 2008). The work crew took 30-45 minutes to get the resulting gas leak under control. No property damages were recorded.

On January 5, 2009, a fire erupted at a drilling rig in the Town of Smyrna (DeCordova 2009). Rocks were thrown out of the wellhead. One struck and broke a fluorescent light, causing a spark that ignited the gas coming from the well. The drilling rig was severely damaged, but no injuries were reported.

Probability of Future Events

As natural gas drilling has expanded in New York State, state and local representatives have used Pennsylvania's experience with the natural gas industry to inform their regulations and practices, to try to avoid the problems that Pennsylvania has experienced (NYSDEC 2011). Table 5.4.7-2 shows a sample of these problems, and potential solutions identified in New York's 2011 revised draft Supplemental Generic Environmental Impact Statement (rdSGEIS). These solutions were proposed to minimize the probability of New York State's communities, including Chenango County, experiencing these problems associated with natural gas drilling.

Table 5.4.7-2. Problems and Solutions Related to Natural Gas Drilling

Issue	Problems Identified	SGEIS Solution
Methane Gas Migration	• Improperly cased and cemented wells • Excessive pressures	• Proper well casing design and inspection • Specific requirements for cementing practices, testing, and use of intermediate casing
Fracturing Fluid Releases	• Poor site design • Equipment failure • Stormwater controls failure	• Inspection of well site • Pressure testing of equipment • Stormwater permitting • Secondary containment • Closed loop systems
Uncontrolled Wellborne Release of Flowback Water and Brine	• Inadequate equipment • Lack of certified well control personnel	• Pressure testing of equipment • Use of specialized equipment • Presence of a certified well control specialist
High Total Dissolved Solids (TDS) Discharges	• Lack of regulations for surface water quality	• Permitting and approval process for proposed discharge flowback water or brine to wastewater treatment plants • In-stream limits for TDS • State Pollutant Discharge Elimination System (SPDES) permit, which limits TDS based on stream's capacity to assimilate TDS

Future events related to natural gas exploration could also occur. Lycoming County, Pennsylvania, studied the increase in truck traffic through the county related to natural gas drilling (Lycoming County 2010). Table 5.4.7-3 shows the increase in truck traffic from each well.

Table 5.4.7-3. Truck Loads for One Gas Well

Total Truck Loads for One Gas Well

Type of Vehicle	No. of Axles	Loaded Weight	Empty Weight	One Way Trips	Comments
Drilling Operations					
Rock Hauler	5	84,000	35,000	70	Pad Construction
Rig (install)	5	100,000	n/a	2	Rig Set-up
Rig (removal)	5	100,000	n/a	2	Rig Removal
Bob-Tail	5	50,000	20,000	20	Equipment
Bob-Tail	5	50,000	20,000	20	Equipment
Bob-Tail	5	50,000	20,000	8	Drilling Pipe
Bob-Tail	5	50,000	20,000	6	Cement
Bob-Tail	5	50,000	20,000	9	Drilling Mud
Fracing Operations					
Work-over Rig	5	80,000	n/a	2	Rig Set-up
Work-over Rig	5	80,000	n/a	2	Rig Removal
Tank Truck	5	80,000	35,000	70	Frac Tanks
Water Tanker	3	80,000	35,000	685	Water for Fracing
Water Tanker	3	80,000	35,000	214	Frac Water Removal (25 %)
Bob-Tail	5	80,000	35,000	24	Equipment
Production					
Tank Truck	5	80,000	35,000	353	Empty Dehydration Tanks

1,134 Heavy Truck Loads Plus 353 Trucks / Yr (Maint.) / Well Head

In Section 5.3, the identified hazards of concern for Chenango County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Committee, the probability of occurrence for natural gas incidents at well sites in the County is considered 'Occasional' (between 10 and 100% annual chance of occurrence). Based on Cornell University's analysis of chemical spills related to drilling operations in Pennsylvania, Chenango County can expect one truck accident related to the natural gas industry every four years (Chenango County Natural Gas Advisory Committee 2011).

Climate Change Impacts

It is difficult to assess the impacts that climate change will have on the frequency and severity of natural gas incidents in Chenango County. Unlike drought, winter storms, or flooding, which are natural hazards directly dependent on the climate, natural gas drilling and therefore incidents involving the release of natural gas are man-made issues. However, the extraction of natural gas from wells and transportation in pipelines results in the leakage of methane, which traps heat faster than carbon dioxide, and has the potential to increase the rate at which climate change and global warming occurs (UCS, 2014). Still, any link between climate change and the risks associated with the natural gas industry in the County cannot be made at this time.

5.4.7.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For natural gas incidents, the entirety of Chenango County has been identified as the hazard area. Therefore, all assets in Chenango County, as described in the County Profile section, are vulnerable to these incidents. The following text evaluates and estimates the potential impact of natural gas incidents on the County.

Impact on Life, Health and Safety

The entire population of Chenango County is vulnerable to natural gas development incidents. According to the 2018 5-Year American Community Survey, the County had a population of 48,348. During a natural gas development incident, those populations located near the site of the incident are the most vulnerable and may need to seek appropriate shelter or evacuate the area. According to the *2020 Emergency Response Guidebook* published by the U.S. Department of Transportation (US DOT), a large spill of flammable gas, including natural gas from a well site or a point along a pipeline, may result in an initial downwind evacuation of ½ mile (800 meters) (USDOT, 2020).

Impact on General Building Stock and Critical Facilities

Any facilities located near natural gas wells are vulnerable to natural gas development incidents. Natural gas development incidents can largely impact water quality and water supply; therefore, general building stock and critical facilities related to water supply may be more vulnerable. As previously stated, the hazard area around a natural gas drilling site encompasses an area with a radius of one-half mile, which is the initial downwind evacuation distance for large spills. Although there is currently no active natural gas drilling sites, any buildings or critical facilities in Chenango County located within one-half mile of a former natural gas drilling site is still considered vulnerable.

Impact on Economy

The impact natural gas incidents have on the economy and estimated dollar losses are difficult to measure and quantify.

Impact on the Environment

Natural gas drilling, which is often the cause of related incidents, can have many negative impacts on the environment. This can include contamination of drinking, ground, and surface water, waste disposal issues for toxic substances that flow back during the drilling processes, and leakage during transportation and storage can result in leakage of methane which is known to increase the rate at which heat is trapped within the atmosphere. Crude oil spills can result in harm to human health and the environment, including injuries or fatalities to fish and wildlife populations.

Cascading Impacts on Other Hazards

The greatest risk associated with natural gas pipelines is fires or explosions caused by ignition of the gas, which can cause significant damage to an area like Chenango County, which is abundant in forested areas and populations living within the Wildland-Urban interface (WUI). Spills during transportation, either via pipelines, or by vehicles or trains, can cause spills that contaminate ground and drinking water supplies, affecting crop production in the County as well.

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. The county considered the following factors to examine potential conditions that may affect hazard vulnerability:

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

Projected Development and Change in Population

As discussed in Section 4 (County Profile), areas targeted for future growth and development have been identified across the County. Any areas of growth could be potentially impacted by natural gas incidents because the entire planning area is exposed and vulnerable.

According to population projections from the Cornell Program on Applied Demographics, Chenango County will continue to experience a population decrease through 2040 (a decline of over 7,500 people in total by 2040). This decrease will reduce the overall vulnerability of the county's population over time.

Climate Change

As discussed above, natural gas development incidents are man-made and the impacts of climate change on these events are difficult to quantify. However, as New York State has implemented a ban on natural gas drilling, the effects of the extraction of natural gas from wells which results in the leakage of methane into the atmosphere, which in turn increases the rate at which climate change and global warming occurs, should likely decrease the effects of climate change and its impacts on natural disasters.

Change of Vulnerability Since the 2015 HMP

Natural Gas hazards were identified in the 2015 HMP Update as having the potential to be frequently occurring and of medium risk to the County. Due to the statewide ban on fracking and drilling, the probability of natural gas hazards was lowered to occasional, but due to the number of wells and use of natural gas in businesses and homes, the risk is still 'medium' for the County.

5.4.8 Severe Storms

The following section provides the hazard profile and vulnerability assessment for the severe storm hazard in Chenango County.

5.4.8.1 Hazard Profile

This section presents information regarding the description, extent, location, previous occurrences and losses, climate change projections and probability of future occurrences for the severe storm hazard.

Hazard Description

For this HMP the severe storm hazard includes: thunderstorms, lightning, hail, tornadoes, high winds, and hurricanes/tropical storms, which are defined below.

Thunderstorms

A thunderstorm is a local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder (NWS 2009a). 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. Although thunderstorms generally affect a small area when they occur, they have the potential to become dangerous due to their ability in generating tornadoes, hailstorms, strong winds, flash flooding, and lightning. The NWS considers a thunderstorm *severe* only if it produces damaging wind gusts of 58 mph or higher or large hail one-inch (quarter size) in diameter or larger or tornadoes (NWS 2020).

Thunderstorms can lead to flooding, landslides, strong winds, and lightning. Roads could become impassable from flooding, downed trees or power lines, or a landslide. Downed utility poles can lead to utility losses, such as electricity, phone, and water (from loss of pumping and filtering capabilities).

Lightning

Lightning can damage homes and injure people. In the United States, an average of 300 people are injured, and 80 people are killed by lightning each year. Typical thunderstorms are 15 miles in diameter and last an average of 30 minutes. An estimated 100,000 thunderstorms occur each year in the United States, with approximately 10 percent of them classified as severe. During the warm season, thunderstorms are responsible for most of the rainfall.

Lightning is a bright flash of electrical energy produced by a thunderstorm. The resulting clap of thunder is the result of a shock wave created by the rapid heating and cooling of the air in the lightning channel. All thunderstorms produce lightning and are very dangerous. Lightning ranks as one of the top weather killers in the United States, killing approximately 50 people and injuring hundreds each year. Lightning can occur anywhere there is a thunderstorm. Lightning can be cloud to cloud, cloud to air, and cloud to ground.

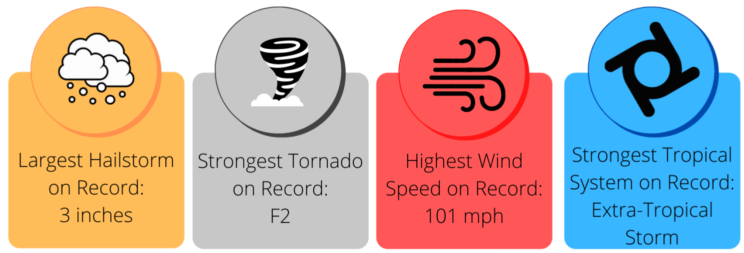
Hailstorms

Hail forms inside a thunderstorm where there are strong updrafts of warm air and downdrafts of cold water. If a water droplet is picked up by the updrafts, it can be carried well above the freezing level. Water droplets freeze when temperatures reach 32 °F or colder. As the frozen droplet begins to fall, it might thaw as it moves into warmer air toward the bottom of the thunderstorm, or the droplet might be picked up again by another updraft and carried back into the cold air to re-freeze. With each trip above and below the freezing level, the frozen droplet adds another layer of ice. The frozen droplet, with many layers of ice, falls to the ground as hail. Most hail is small and typically less than two inches in diameter (NWS 2009).

High Winds

Wind begins with differences in air pressures. It is rough horizontal movement of air caused by uneven heating of the earth's surface. Wind occurs at all scales, from local breezes lasting a few minutes to global winds resulting from solar heating of the earth (Rosenstiel School of Marine & Atmospheric Science 2005). High winds are often associated by other severe weather events such as thunderstorms, tornadoes, hurricanes, and tropical storms.

Figure 5.4.8-1. Recorded Event Records



Tornadoes

A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 250 miles per hour (mph). Damage paths can be greater than 1 mile wide and 50 miles long. Tornadoes typically develop from either a severe thunderstorm or hurricane as cool air rapidly overrides a layer of warm air. Tornadoes typically move at speeds between 30 and 125 mph and can generate combined wind speeds (forward motion and speed of the whirling winds) exceeding 300 mph. The lifespan of a tornado rarely is longer than 30 minutes (FEMA 1997). Tornadoes can occur at any time of the year, with peak seasons at different times for different states (NSSL 2013).

Hurricanes/Tropical Storms

Tropical cyclones are fueled by a different heat mechanism than other cyclonic windstorms, such as Nor'easters and polar lows. The characteristic that separates tropical storms from other cyclonic systems is that at any height in the atmosphere, the center of a tropical storm will be warmer than its surroundings, a phenomenon called *warm core* storm systems (NOAA 2013). Tropical cyclones strengthen when water evaporated from the ocean is released as the saturated air rises, resulting in condensation of water vapor contained in the moist air. Tropical cyclones begin as disturbed areas of weather, often referred to as tropical waves. As the storm organizes, it is designated as a tropical depression.

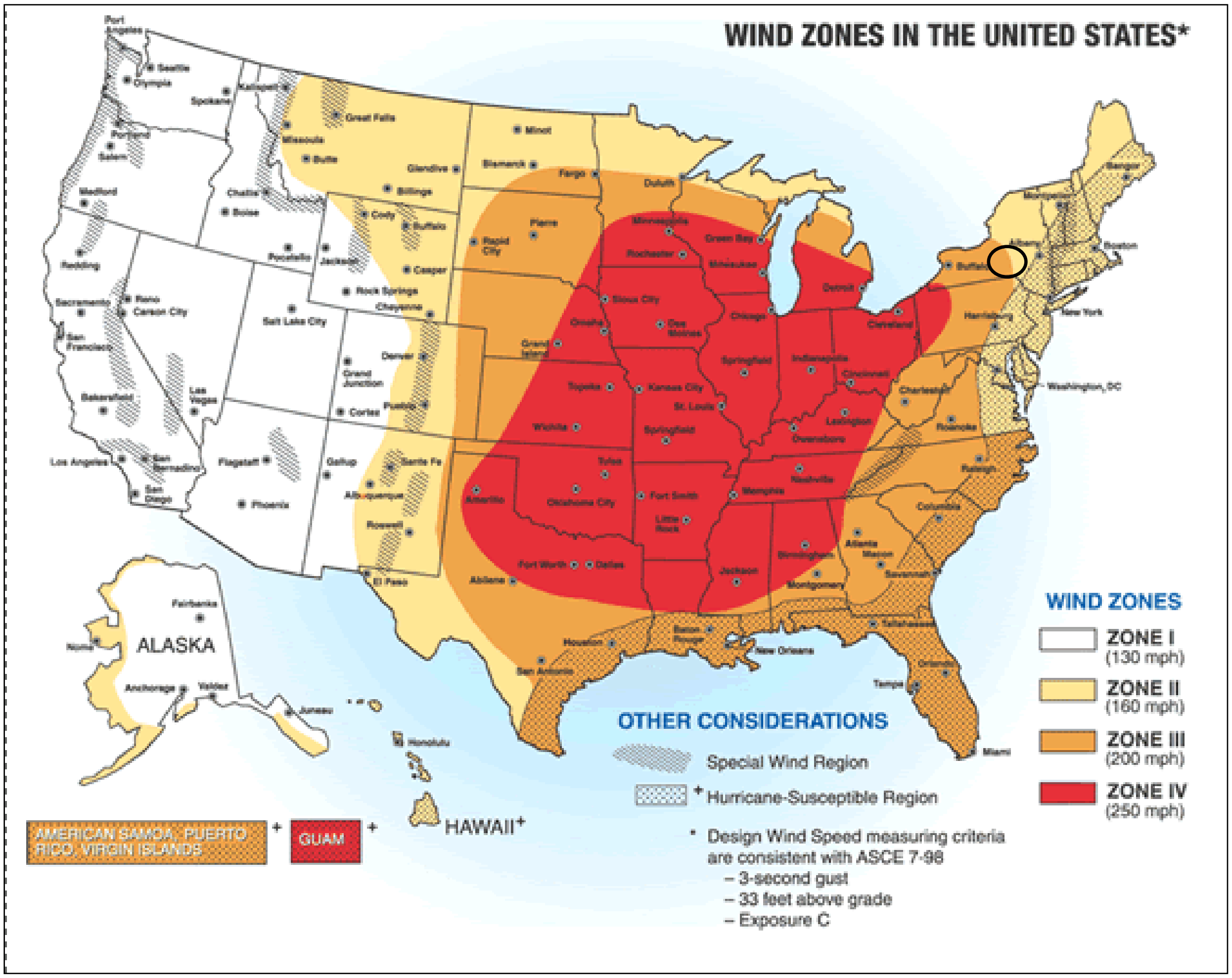
A tropical storm system is characterized by a low-pressure center and numerous thunderstorms that produce strong winds of 39 to 73 mph and heavy rain. A hurricane is a tropical storm that attains hurricane status when its wind speed reaches 74 mph or higher. Tropical systems can develop in the Atlantic between the Lesser Antilles and the African coast or in the warm tropical waters of the Caribbean Sea and Gulf of Mexico. These storms can move up the Atlantic coast of the United States, impacting the eastern seaboard, or move into the United States through the states along the Gulf Coast, bringing wind and rain as far north as New England before moving eastward offshore.

Despite Chenango County being located inland, coastal storms like tropical storms and hurricanes can impact the county (NYS DHSES 2019). Hurricanes and tropical storms can impact Chenango County during the official eastern U.S. hurricane season from June to November. However, late July to early October is the most likely period for hurricanes and tropical storms to impact Chenango County, due to the cooling of the North Atlantic Ocean waters (NYS DHSES 2014).

Location

The totality of Chenango County is exposed to hail, lightning, windstorms, high wind, thunderstorms, tornadoes, hurricanes, and tropical storms. Additionally, all of the county is subject to high winds from severe weather events. According to the FEMA Winds Zones of the United States map, Chenango County is located in both Wind Zones II and III, where wind speeds can reach up to 200 mph. Figure 5.4.8-2 illustrates wind zones across the United States, which indicate the impacts of the strength and frequency of wind activity per region. The information on the figure is based on 40 years of tornado data and 100 years of hurricane data collected by FEMA.

Figure 5.4.8-2 Wind Zones in the United States



Note: The black oval indicates the approximate location of Chenango County.

Extent

The extent (severity or magnitude) of a severe storm is largely dependent upon the most damaging aspects of each type of severe weather. This section describes the extent of thunderstorms, lighting, hail, windstorms, tornadoes, hurricanes, and tropical storms in Chenango County.

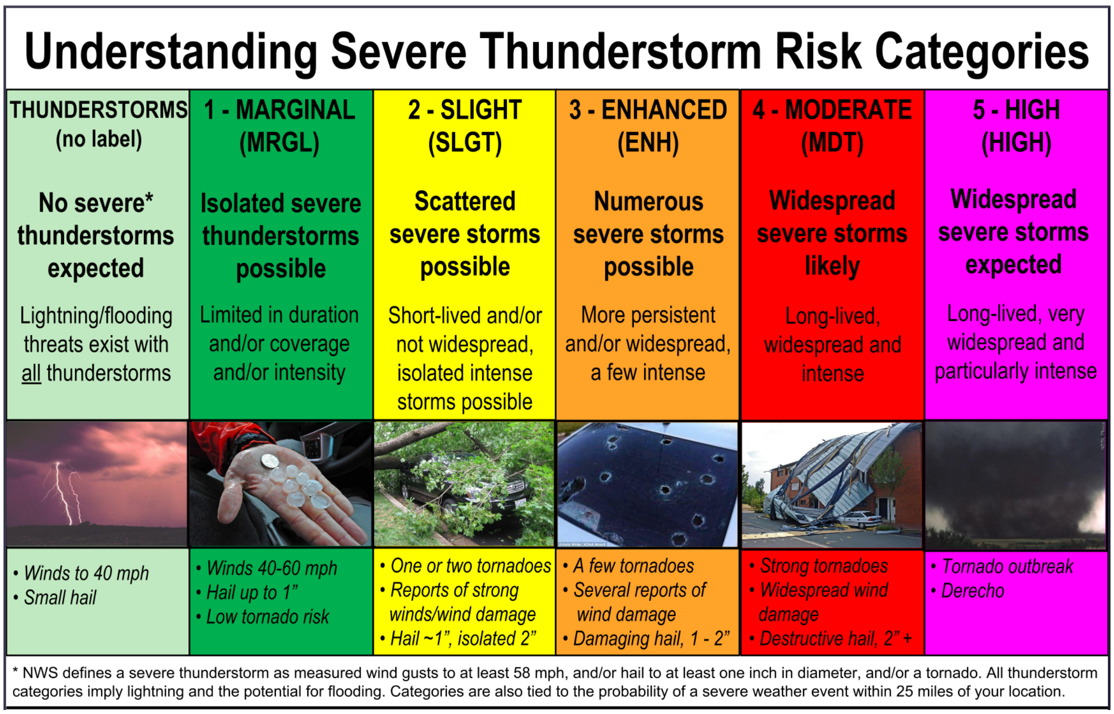
Thunderstorms

Severe thunderstorm watches and warnings are issued by the local NWS office and the Storm Prediction Center (SPC). The NWS and SPC will update the watches and warnings and notify the public when they are no longer in effect. Watches and warnings for tornadoes in New York State are as follows:

- A severe thunderstorm watch is issued by the National Weather Service when there are conditions favorable to severe storm development in the watch area which varies per storm. By definition, a severe thunderstorm is a thunderstorm that produces one inch hail or larger in diameter and/or winds equal or exceed 58 miles an hour. They are usually issued for a duration of 4 to 8 hours. Watches are normally issued in advance of the occurrence of severe weather. (NWS 2020).
- Severe Thunderstorm Warnings are issued when a thunderstorm that can produce hail in excess of one inch and/or winds greater than or equal to 58 mph is indicated by radar. Isolated tornado development can also occur. (NWS 2020).

Special Weather Statements for Near Severe Thunderstorms are issued for strong thunderstorms that are below severe levels but still might have some adverse impacts. Usually, they are issued for the threat of wind gusts of 40 to 58 mph or small hail less than one-inch in diameter (NWS 2009b). Figure 5.4.8-3 presents the severe thunderstorm risk categories, as provided by the SPC.

Figure 5.4.8-3 Severe Thunderstorm Risk Categories



Source: NOAA SPC 2017

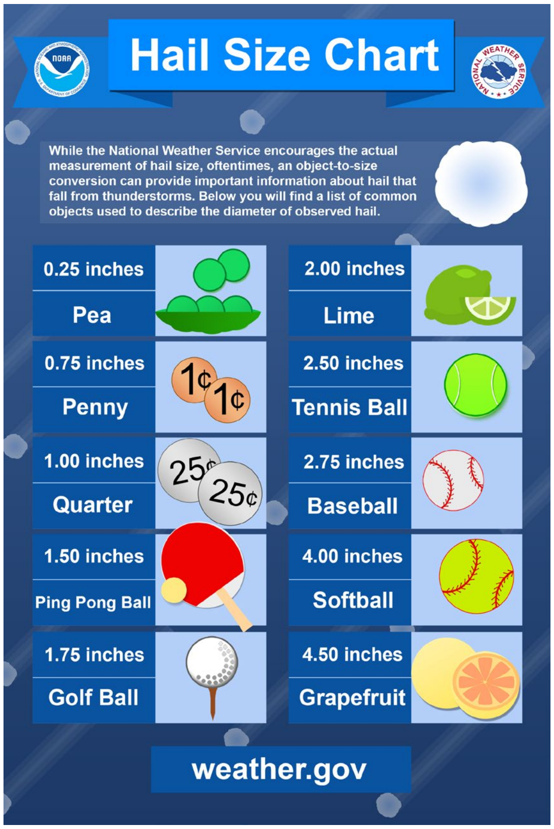
Lightning

Lightning is most often associated with moderate to severe thunderstorms. The severity of lightning refers to 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, 2020).

Hailstorms

The severity of hail is measured by hail size, duration, and geographic extent. Most hail stones from hail storms vary in size. Most hailstorms produce stones that are the size of a marble or smaller and do not present damage to structures (NYS DHSES 2019). The size of hail is estimated by comparing it to a known object. Figure 5.4.8-4 shows the different sizes of hail and the comparison to real-world objects.

Figure 5.4.8-4 Hail Size



The Tornado and Storm Research Organization (TORRO) has determined ratings typical damage and hail sizes using the Hailstorm Intensity Scale (H0 to H10).

Table 5.4.8-1. TORRO Hailstorm Intensity Scale

TORRO Hailstorm Intensity Scale	Intensity Category	Typical Hail Diameter (mm)	Typical Damage Impacts
H0	Hard Hail	5	No damage
H1	Potentially Damaging	5-15	Slight general damage to plants, crops
H2	Significant	10-20	Significant damage to fruit, crops, vegetation
H3	Severe	20-30	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-40	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-50	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-60	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	50-75	Severe roof damage, risk of serious injuries
H8	Destructive	60-90	Severe damage to aircraft bodywork
H9	Super Hailstorms	75-100	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Source: TORRO 2020

High Winds

The following table provides the descriptions of winds and their associated sustained wind speed used by the NWS during wind-producing events. The Beaufort wind scale, developed in 1805, is also used today to classify wind conditions (refer to https://www.spc.noaa.gov/faq/tornado/beaufort.html for details).

Table 5.4.8-2. 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	5-10/ 10-15/ 10-20
Light or light and variable wind	0-5

Source: NWS 2010
mph miles per hour

The NWS issues advisories and warnings for winds. Issuance is normally site-specific. High wind advisories, watches, and warnings are products issued by the NWS when wind speeds can pose a hazard or are life threatening. The criterion for each of these varies from state to state. According to the NWS (2020), wind warnings and advisories for New York State are as follows:

- *High Wind Warnings* are issued when sustained wind speeds of 40 mph or greater lasting for one hour or longer or for winds of 58 mph or greater for any duration or widespread damage are possible.
- *Wind Advisories* are issues when sustained winds of 30 to 39 mph are forecast for one hour or longer, or wind gusts of 46 to 57 mph for any duration.

Tornadoes

The magnitude or severity of a tornado is categorized using the Enhanced Fujita Tornado Intensity Scale (EF Scale). This is the scale now used exclusively for determining tornado ratings by comparing wind speed and actual damage. Figure 5.4.8-5. illustrates the relationship between EF ratings, wind speed, and expected tornado damage.

Figure 5.4.8-5. Explanation of EF-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: Cornell University 2018

Tornado watches and warning are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar. The current average lead time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly, that little, if any, advance warning is possible (NOAA SPC 2018).

Hurricanes/Tropical Storms

The extent of a hurricane or tropical storm is commonly categorized in accordance with the Saffir-Simpson Hurricane Wind Scale, which assigns a designation of tropical storm for storms with sustained wind speeds below 74 mph and a hurricane category rating of 1–5 based on a hurricane's increasing sustained wind speed. This scale estimates potential property damage. 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 2013). Figure 5.4.8-6 presents this scale, which is used to estimate the potential property damage and flooding expected when a hurricane makes landfall.

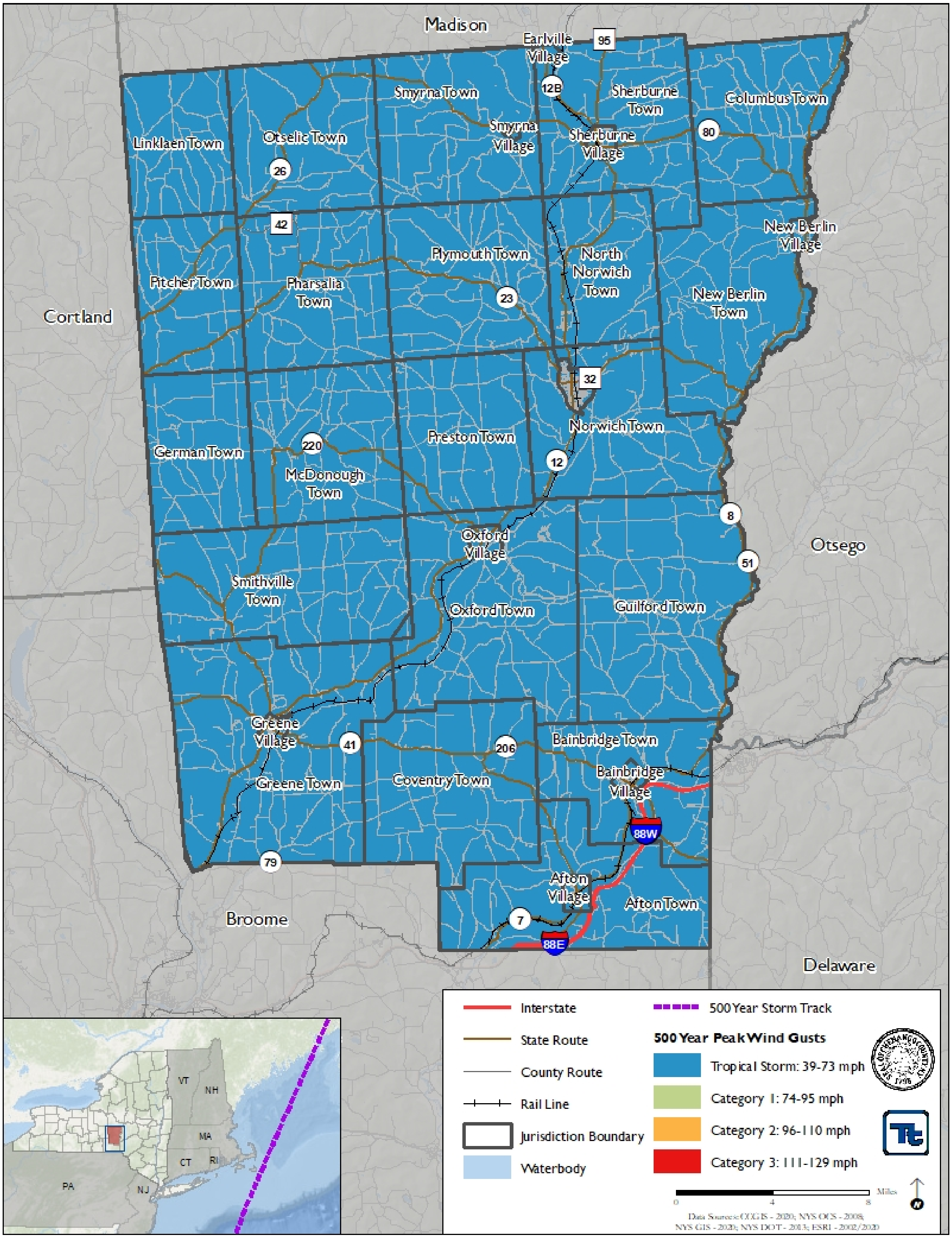
Figure 5.4.8-6. The Saffir-Simpson Hurricane Wind Scale

Source: NOAA, 2020

In evaluating the potential for hazard events of a given magnitude, a mean return period (MRP) is often used. The MRP provides an estimate of the magnitude of an event that might occur within any given year based on past recorded events. The MRP is the average period, in years, between occurrences of a hazard event, equal to the inverse of the annual frequency of exceedance (Dinicola 2009).

Peak wind speed projections were generated using HAZUS-MH v4.2. HAZUS-MH v4.2 estimated the maximum 3-second gust wind speeds for Chenango County to be below 39 mph for the 100-year MRP event and not strong enough to be considered a tropical storm. The maximum 3-second gust wind speeds for Chenango County range from 51 to 64 mph for the 500-year MRP event (tropical storm). The associated impacts and losses from these 100-year and 500-year MRP hurricane event model runs are reported in the Vulnerability Assessment. Figure 5.4.8-7. shows the estimated maximum 3-second gust wind speeds that can be anticipated in the study area associated with the 500-year MRP events.

Figure 5.4.8-7. Wind Speeds for the 500-Year MRP Event



Previous Occurrences and Losses

Many sources have provided historical information regarding previous occurrences and losses associated with severe storm events in Chenango County. According to NOAA-NCEI Storm Events Database, Chenango County has been impacted by 254 severe storm events that caused three fatalities, 10 injuries, $5.2 million in property damage, and $25,000 in crop damage.

Table 5.4.8-3. Severe Storm Events 1950- 2020

Hazard Type*	Number of Occurrences Between 1950 and 2020**	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Funnel Cloud	2	0	0	$0	$0
Hail	46	0	0	$15,000	$15,000
Heavy Rain	2	0	0	$5,000	$0
High Wind	12	0	0	$589,760	$0
Hurricane	0	0	0	$0	$0
Lightning	5	0	1	$10,000	$0
Strong Wind	2	0	0	$11,000	$0
Thunderstorm Wind	172	1	4	$1.722 million	$2,000
Tornado	13	2	5	$2.82 million	$0
Tropical Depression	0	0	0	$0	$0
Tropical Storm	0	0	0	$0	$0
TOTAL	**254**	**3**	**10**	**$5.207 million**	**$25,000**

Source:NOAA-NCEI 2020; NHC 2018
* *Remnants from tropical systems are included in other hazard totals*
***Includes only one occurrence per storm event- excludes multiple listings for the same day*

FEMA Disaster Declarations

Between 1954 and 2020, New York State was included in 65 FEMA declared severe storm-related major disaster declarations (DR) or emergencies (EM) classified as one or a combination of the following hazards: coastal storm, high tides, heavy rain, flooding, hurricane, ice storm, severe storms, thunderstorms, tornadoes, tropical storm, straight-line winds, and landslides. Of those declarations, Chenango County was included in 17 declarations (FEMA 2018). Table 5.4.8-4 lists FEMA DR and EM declarations for Chenango County.

Table 5.4.8-4. Severe Storm-Related FEMA Declarations for Chenango County, 1954 to 2020

Disaster Number	Event Date	Declaration Date	Incident Type	Title
DR-4480	January 20, 2020 -- Ongoing	3/20/2020	Biological	COVID-19 Pandemic
EM-3434	January 20, 2020 -- Ongoing	3/13/2020	Biological	COVID-19
DR-4472	October 31 -- November 1, 2019	12/19/2019	Severe Storm(s)	Severe Storms, Straight-Line Winds, and Flooding
DR-4397	August 13 -- August 15, 2018	10/1/2018	Flood	Severe Storms and Flooding
DR-4322	March 14 -- March 15, 2017	7/12/2017	Snow	Severe Winter Storm and Snowstorms
DR-4129	June 26 -- July 10, 2013	7/12/2013	Flood	Severe Storms and Flooding
EM-3351	October 27 -- November 8, 2012	10/28/2012	Hurricane	Hurricane Sandy
DR-4031	September 7 -- September 11, 2011	9/13/2011	Severe Storm(s)	Remnants of Tropical Storm Lee
EM-3341	September 7 -- September 11, 2011	9/8/2011	Severe Storm(s)	Remnants of Tropical Storm Lee

Disaster Number	Event Date	Declaration Date	Incident Type	Title
DR-1993	April 26 -- May 8, 2011	6/10/2011	Flood	Severe Storms, Flooding, Tornadoes, and Straight-Line Winds
DR-1857	August 8 -- August 10, 2009	9/1/2009	Severe Storm(s)	Severe Storms and Flooding
EM-3299	December 11 -- December 31, 2008	12/18/2008	Severe Storm(s)	Severe Winter Storm
DR-1670	November 16 -- November 17, 2006	12/12/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1650	June 26 -- July 10, 2006	7/1/2006	Severe Storm(s)	Severe Storms and Flooding
EM-3262	August 29 -- October 1, 2005	9/30/2005	Hurricane	Hurricane Katrina Evacuation
DR-1589	April 2 -- April 4, 2005	4/19/2005	Severe Storm(s)	Severe Storms and Flooding
DR-1565	September 16 -- September 24, 2004	10/1/2004	Severe Storm(s)	Tropical Depression Ivan
DR-1534	May 13 -- June 17, 2004	8/3/2004	Severe Storm(s)	Severe Storms and Flooding
EM-3186	August 14 -- August 16, 2003	8/23/2003	Other	Power Outage
DR-1467	April 3 -- April 5, 2003	5/12/2003	Severe Ice Storm	Ice Storm
EM-3184	February 17 -- February 18, 2003	3/27/2003	Snow	Snow
EM-3173	December 25 -- January 4, 2002	2/25/2003	Snow	Snowstorms
DR-1391	11-Sep-01	9/11/2001	Fire	Fires and Explosions
EM-3155	May 22 -- November 1, 2000	10/11/2000	Other	West Nile Virus
DR-1335	May 3 -- August 12, 2000	7/21/2000	Severe Storm(s)	Severe Storms and Flooding
DR-1222	May 31 -- June 2, 1998	6/16/1998	Severe Storm(s)	Severe Storms and Tornadoes
DR-1095	January 19 -- January 30, 1996	1/24/1996	Flood	Severe Storms and Flooding
EM-3107	March 13 – March 17, 1993	3/17/1993	Snow	Severe Blizzard
DR-338	June 23, 1972	6/23/1972	Flood	Tropical Storm Agnes

Source: FEMA 2020

USDA Declarations

Between 2015 and 2020, Chenango County was included in five severe storm-related USDA Disaster Designations; refer to Table 5.4.8-5 below for more information.

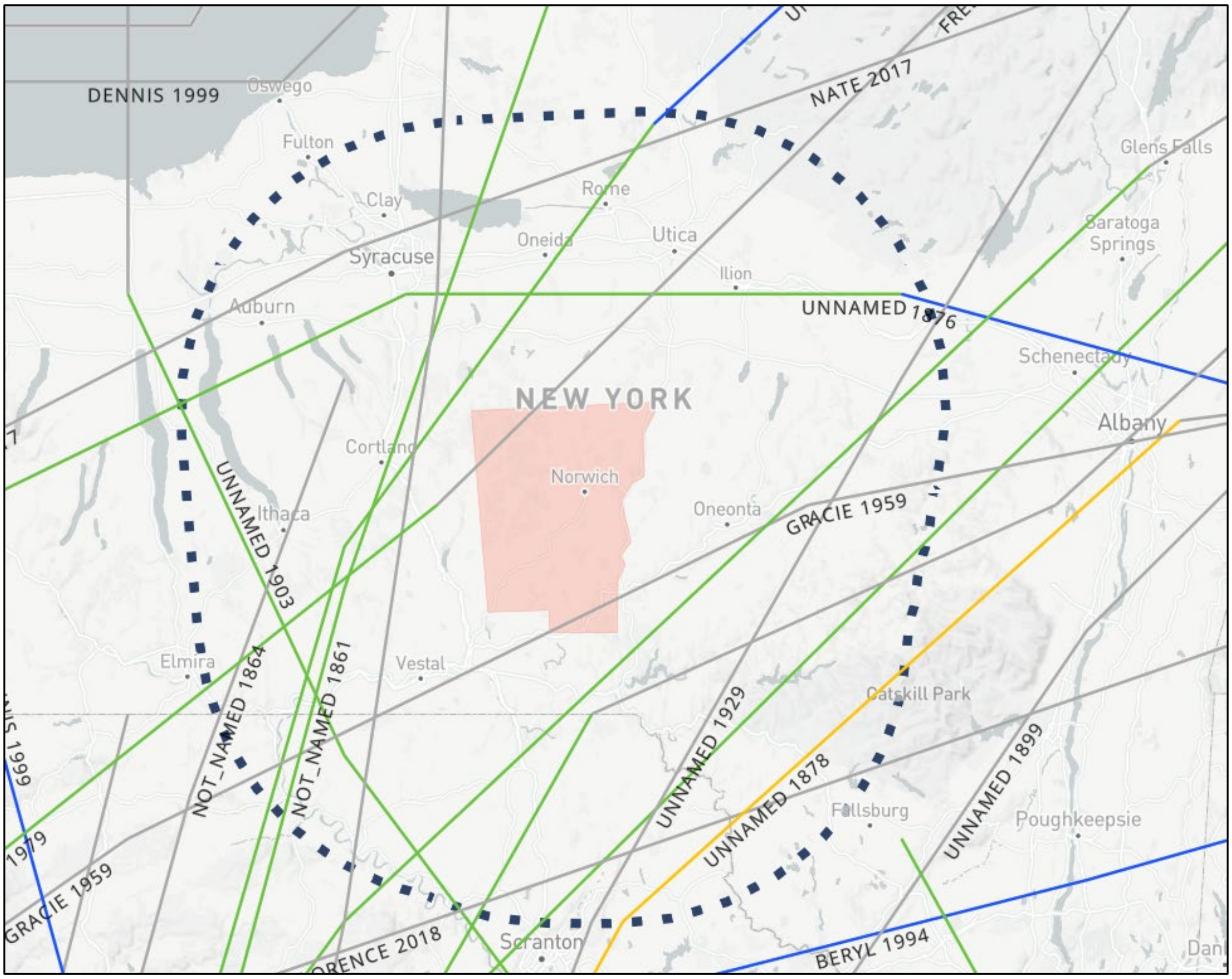
Table 5.4.8-5. USDA Severe Storm Disaster Designations for Chenango County, 2015-2020

Designation Number	Event Date	Declaration Date	Incident Type	Description
S3885	May 1 – July 14, 2015	September 9, 2015	Excessive rain, moisture, humidity; Hail; Wind, High Winds; Tornadoes; Lightning	Excessive Rain, High Winds, Hail, Lightning, and Tornado
S4265	April 1, 2017	December 13, 2017	Excessive rain, moisture, humidity	Excessive Rain
S4479	July 23, 2018	April 10, 2019	Excessive rain, moisture, humidity	Excessive Precipitation
S4622	April 1, 2019	January 29, 2020	Excessive rain, moisture, humidity	Excessive Rain
S4623	April 15, 2019	January 29, 2020	Excessive rain, moisture, humidity; Flood, Flash Flooding	Excessive Rain, Flash Flooding, and Flooding

Previous Events

Figure 5.4.8-8 from the NOAA Historical Hurricane Tracker illustrates the tracks of storms between 1842 and 2020 within 65 miles of Chenango County. Chenango County is rarely impacted by tropical systems but has recently experienced the direct and indirect landward effects associated with hurricanes and tropical storms, including Tropical Storm Lee in 2011 and Superstorm Sandy in 2012.

Figure 5.4.8-8. Historical Hurricane Tracks within 65 miles of Chenango County, 1878 to 2018



Source:NOAA Historical Hurricane Tracks 2020
Note:Category refers to tropical cyclone strength. TS: Tropical Storm, TD: Tropical Depression, ET: Extra-tropical Storm, H1: Category 1 Hurricane, H2: Category 2 Hurricane, H3: Category 3 Hurricane, H4: Category 4 Hurricane.

The NOAA National Centers for Environmental Information (NCEI) Storm Events database records severe storm events. For this HMP update, known severe storm events that have impacted Chenango County between July 2014 and 2020 are identified in Table 5.4.8-6. With severe storm documentation for New York State and Chenango County being extensive, not all sources have been identified or researched. Therefore, Table 5.4.8-6 might not include all events that have occurred in the county. For events prior to 2014, refer to Appendix E (Supplementary Data). For detailed information on damages and impacts to each municipality, refer to Section 9 (Jurisdictional Annexes).

Table 5.4.8-6. Severe Storm Events in Chenango County, July 2014 to 2020

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Event Details*
July 1, 2014	Thunderstorm Wind	N/A	No	Severe thunderstorms blew down trees on Bartlett Road and Route 23 in South Plymouth, North Road in Plymouth, and took down trees and wires in Norwich.
July 3, 2014	Thunderstorm Wind	N/A	No	A cold front interacting with humid, warm air from a tropical system caused large winds up to 50 knots, resulting in downed trees in Earlville and along Route 12B.
July 7, 2014	Thunderstorm Wind	N/A	No	Severe thunderstorms blew down trees and wires in Oxford.
July 8, 2014	Thunderstorm Wind	N/A	No	In East Pharsalia, severe thunderstorms blew down trees on County Route 7 and poles on County Route 10.
July 9, 2014	Thunderstorm Wind	N/A	No	Severe thunderstorms blew town trees in Norwich
Sept. 2, 2014	Thunderstorm Wind; Tornado	N/A	No	Severe thunderstorms affecting Chenango County blew down trees in McDonough, Preston, North Afton, and formed an EF-1 tornado that touched down near the intersection of Saint Johns Road and Hill Top Drive in Bennettsville.
June 12, 2015	Thunderstorm Wind	N/A	No	Severe thunderstorms resulted in blown-down trees and downed lines near Oxford and blown-down trees near Bainbridge/Afton.
July 15, 2016	Thunderstorm Wind	N/A	No	A thunderstorm resulted in downed trees in New Berlin near the intersection of Route 8 and Turnpike Road.
July 19, 2015	Thunderstorm Wind	N/A	No	Bainbridge saw downed trees resulting from a severe thunderstorm.
August 13, 2015	Thunderstorm Wind	N/A	No	A thunderstorm caused downed trees in New Berlin.
April 16, 2017	Thunderstorm Wind	N/A	No	Severe thunderstorms caused 50 knot winds and downed trees and wires on Route 22 near East McDonough and in Norwich.
May 1, 2017	Thunderstorm Wind	N/A	No	Severe thunderstorms resulted in reported 65 knot winds in Oxford, where trees were uprooted trees, which impacted the intersection of Routes 12 and 80 in Sherburne. Preston, New Berlin, Oxford, and Guilford. A microburst caused wind speeds ranging between 90 and 100 mph and uprooted 100 healthy trees near the Norwich Reservoir.
June 30, 2017	Thunderstorm Wind	N/A	No	Trees and wires were downed by a severe thunderstorm that impacted Preston, Pharsalia, and Willet.
August 4, 2017	Thunderstorm Wind	N/A	No	A severe thunderstorm caused damage to trees and power lines in Bainbridge, Smithville Flats, Oxford, and Sherburne.
August 12, 2017	Thunderstorm Wind	N/A	No	Thunderstorms with wind speeds up to 65 knots knocked over trees in McDonough and Norwich.
May 4, 2018	Thunderstorm Wind	N/A	No	Cortland Street in Norwich experienced downed trees and wires, sparking a grass fire.
June 13, 2018	Thunderstorm Wind	N/A	No	County Route 3A in Greene, Tall Pines Campground in East Guilford, and Brisben each experienced impacts from a thunderstorm that produced wind speeds of up to 50 knots.
February 25, 2019	High Wind	N/A	No	Strong winds up to 50 knots caused impacts to the County and region.
July 19, 2019	Thunderstorm Wind	N/A	No	Afton saw impacts from 50 knot winds resulting from a strong thunderstorm. Winds brought down trees and wires on Long Hill Road.

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Event Details*
July 30, 2019	Hail	N/A	No	Severe thunderstorms produced hail up to one inch in size (ranking up to H3 on the TORRO intensity scale) in Lincklaen.
August 8, 2018	Thunderstorm Wind	N/A	No	A thunderstorm impacting Central New York brought downed trees to Oxford,
August 18, 2019	Thunderstorm Wind	N/A	No	Severe thunderstorms moved through Central New York and brought down a tree along Route 235 in Coventry.
October 31, 2019	Thunderstorm Wind	N/A	No	Severe thunderstorms with winds up to 50 knots brought down multiple trees near Smyrna and Plymouth.
August 27, 2020	Thunderstorm Wind	N/A	No	A series of severe thunderstorms impacted Chenango County. Damages included downed trees and wires on Williams Road in Greene, causing $10,000 in property damage.
October 7, 2020	Thunderstorm Wind	N/A	No	A series of storms provided widespread tree and powerline damage in Chenango County. In Earlville, winds downed a tree on a car on Thompson Hill Road. In Otselic, Norwich, and McDonough, downed trees blocked a roadway. Overall, the storms caused approximately $35,000 in property damage.

Source(s):FEMA 2020; NOAA-NCEI 2020

* Many sources were consulted to provide an update of previous occurrences and losses; event details and loss/impact information may vary and has been summarized in the above table

FEMA Federal Emergency Management Agency

HMP Hazard Mitigation Plan

NCDC National Centers for Environmental Information

NOAA National Oceanic and Atmospheric Administration

NWS National Weather Service

NYS New York State

Climate Change Projections

The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. Downpours are likely to increase in intensity and frequency. That change that has the potential to affect drinking water through flood key rail lines, roadways, and transportation hubs, flooding contaminating wells, heighten the risk of riverine flooding; and increase delays and hazards related to extreme weather events (NYSERDA 2011). Less frequent rainfall during the summer months can impact the ability of water supply systems to provide water. Increasing water temperatures in rivers and streams will affect aquatic health and reduce the capacity of streams to assimilate effluent wastewater treatment plants and industrial discharges (NYSERDA 2011). Figure 5.4.8-9 shows the projected seasonal precipitation changes for Southern Tier ClimAID Region (NYSERDA 2014).

Figure 5.4.8-9. Projected Seasonal Precipitation Change in Region 3, 2050s (% change)

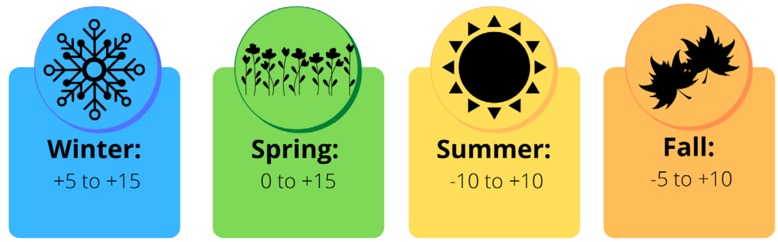
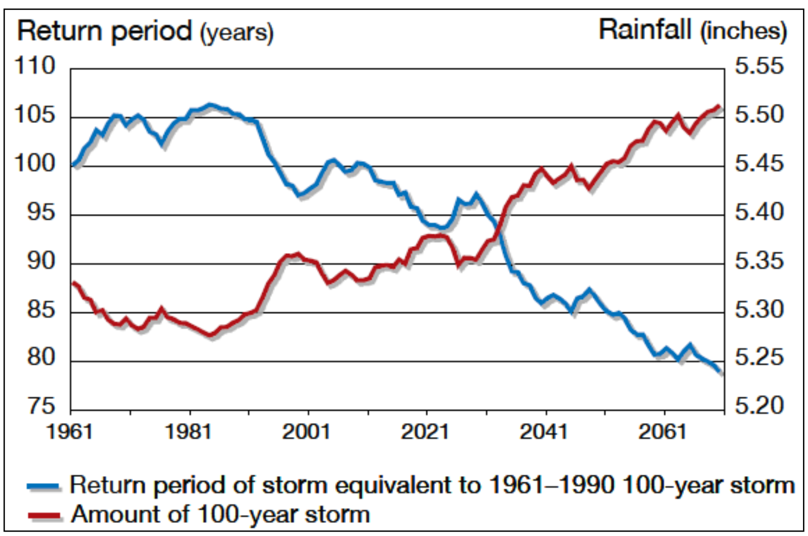


Figure 5.4.8-10 displays the projected rainfall and frequency of extreme storms in New York State. The amount of rainfall in a 100-year event is projected to increase. However, the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA 2011).

Figure 5.4.8-10. Projected Rainfall and Frequency of Extreme Storms



Source:NYSERDA 2011

Probability of Future Occurrences

Table 5.4.8-7 summarizes data regarding the probability of occurrences of severe storm events in Chenango County based on the historic record. Thunderstorm events are the most common in Chenango County, followed by hail events. The information used to calculate the probability of occurrences is based solely on NOAA-NCEI storm events database results.

Table 5.4.8-7. Probability of Future Occurrence of Severe Storm Events

Hazard Type	Number of Occurrences Between 1954 and 2020	% Chance of Occurring in Any Given Year
Funnel Cloud	2	3.0
Hail	46	68.7
Heavy Rain	2	3.0
High Wind	12	18.0
Hurricane	0	N/A
Lightning	5	7.5
Strong Wind	2	3.0
Thunderstorm Wind	172	100.0
Tornado	13	19.4
Tropical Depression	0	N/A
Tropical Storm	0	N/A
TOTAL	**254**	**100.0**

Source: NOAA-NCEI 2020
Note: Hazard occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act. Due to limitations in data, not all severe storm events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.

Chenango County is expected to continue experiencing direct and indirect impacts of severe storms annually. These storms may induce secondary hazards such as flooding and utility failure. In Section 5.3 (Hazard Ranking), the identified hazards of concern for Chenango 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 Committee, the probability of occurrence for severe storms in the county is considered 'frequent' (100% annual chance of occurring; occurring multiple times a year).

5.4.8.2 Vulnerability Assessment

A probabilistic assessment was conducted for the 100-year and 500-year MRP hurricane wind event through a Level 2 analysis in HAZUS-MH v4.2 to analyze the severe storm hazard and provide a range of loss estimates due to wind impacts. Refer to Section 5.1 (Methodology and Tools) for additional details on the methodology used to assess the severe storm risk.

Impact on Life, Health and Safety

The impact of a severe weather event and wind 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. For the purposes of this HMP, all of Chenango County is considered vulnerable to a severe weather event and wind impacts (i.e. 48,438 persons total, American Community Survey 2018). HAZUS-MH v4.2 estimates that no persons will be displaced from their homes or will seek shelter during a 100-year or 500-year MRP hurricane wind event. Secondary impacts caused by extreme wind events include downed trees, damaged buildings, and debris carried by high winds, which can lead to injury or loss of life.

Socially vulnerable populations are most susceptible to severe weather events, based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Vulnerable populations include homeless persons, elderly (over 65 years old), low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. The population over the age of 65 is also more vulnerable and, physically, they may have more difficulty evacuating. They may require extra time or outside assistance during evacuations and are more likely to seek or need medical attention which may not be available due to isolation during a storm event. Within Chenango County, there are approximately 9,539 people over the age of 65 and 6,826 people below the poverty level (American Community Survey 2018).

Additionally, people located outdoors (i.e., recreational activities and farming) are considered most vulnerable to hailstorms, thunderstorms and tornadoes. This is because there is little to no warning and shelter may not be available. Moving to a lower risk location will decrease a person's vulnerability. Refer to Section 4 (County Profile) for population statistics for each participating jurisdiction.

Impact on General Building Stock

Damage to buildings is dependent upon several factors, including wind speed, storm duration, and path of the storm track. Building construction also plays a major role in the extent of damage resulting from a coastal storm. Due to differences in construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings, in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. Furthermore, high-rise buildings are also very vulnerable structures.

To better understand these risks, HAZUS-MH v4.2 was used to estimate the expected wind-related building damages. Table 5.4.8-8 summarizes the definition of the damage categories. HAZUS-MH v4.2 estimates there will be approximately $0 and $2.3 million of replacement cost damages caused by the 100-year and 500-year MRP hurricane wind event, respectively (Table 5.4.8-10). Specific types of wind damages are also summarized in HAZUS-MH v4.2 at the following wind damage categories: no damage/very minor damage, minor damage, moderate damage, severe damage, and total destruction. HAZUS-MH v4.2 estimates that 5 structures would experience minor damage during a 500-year MRP hurricane wind event. HAZUS-MH v4.2 estimates no damages during a 100-year MRP hurricane wind event. Refer to Table 5.4.8-9 for details on damage for all occupancy classes. Furthermore, HAZUS-MH v4.2 estimated damages are summarized by general occupancy classes in Table 5.4.8-10. HAZUS-MH v4.2 estimates that most damages caused by severe wind will occur to residential structures in the County for the 500-year MRP wind events; approximately $2.3 million.

Table 5.4.8-8 Description of Damage Categories

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
No Damage or Very Minor Damage Little or no visible damage from the outside. No broken windows, or failed roof deck. Minimal loss of roof over, with no or very; Limited water penetration.	≤ 2%	No	No	No	No	No
Minor Damage Maximum of one broken window, door or garage door. Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring painting or patching for repair.	> 2% and ≤ 15%	One window, door, or garage door failure	No	<5 impacts	No	No
Moderate Damage Major roof cover damage, moderate window breakage. Minor roof sheathing failure. Some resulting damage to interior of building from water.	> 15% and ≤ 50%	> one and ≤ the larger of 20% & 3	1 to 3 panels	Typically 5 to 10 impacts	No	No

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
Severe Damage Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water.	> 50%	> the larger of 20% & 3 and ≤50%	> 3 and ≤ 25%	Typically 10 to 20 impacts	No	No
Destruction Complete roof failure and/or, failure of wall frame. Loss of more than 50% of roof sheathing.	Typically > 50%	> 50%	> 25%	Typically > 20 impacts	Yes	Yes

Source: HAZUS-MH Hurricane Technical Manual

Table 5.4.8-9 Damage State Categories for Buildings During 100-Year and 500-Year MRP Hurricane Wind Event in Chenango County

Occupancy Class	Total Number of Buildings in Occupancy	Severity of Expected Damage	100-year		500-year	
			Building Count	Percent Buildings in Occupancy Class	Building Count	Percent Buildings in Occupancy Class
Residential Exposure (Single and Multi-Family Dwellings)	25,993	None	25,993	100.0%	25,991	99.9%
		Minor	0	0.0%	2	<0.1%
		Moderate	0	0.0%	0	0.0%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%
Commercial Buildings	2,478	None	2,478	100.0%	2,477	99.9%
		Minor	0	0.0%	1	<0.1%
		Moderate	0	0.0%	0	0.0%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%
Industrial Buildings	130	None	130	100.0%	129	99.9%
		Minor	0	0.0%	1	<0.1%
		Moderate	0	0.0%	0	0.0%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%
Government, Religion, Agricultural, and Education Buildings	2,519	None	2,519	100.0%	2,518	99.9%
		Minor	0	0.0%	1	<0.1%
		Moderate	0	0.0%	0	0.0%
		Severe	0	0.0%	0	0.0%
		Complete Destruction	0	0.0%	0	0.0%

Source: HAZUS v4.2

Table 5.4.8-10 Expected Building Damage for 100-Year and 500-Year MRP Hurricane Wind Events for Chenango County

Jurisdiction	Total Replacement Cost Value (All Occupancies)	Estimated Total Damages		Percent of Total Building and Contents Replacement Cost Value (RCV)		Estimated Residential Damages		Estimated Commercial Damages		Estimated Damages for All Other Occupancies	
		100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Afton (T)	$864,699,700	$0	$164,508	0.0%	<0.1%	$0	$164,508	$0	$0	$0	$0
Afton (V)	$1,019,188,804	$0	$54,291	0.0%	<0.1%	$0	$54,291	$0	$0	$0	$0
Bainbridge (T)	$915,529,770	$0	$119,718	0.0%	<0.1%	$0	$119,718	$0	$0	$0	$0
Bainbridge (V)	$584,957,184	$0	$56,992	0.0%	<0.1%	$0	$56,992	$0	$0	$0	$0
Columbus (T)	$862,354,994	$0	$21,196	0.0%	<0.1%	$0	$21,196	$0	$0	$0	$0
Coventry (T)	$703,237,371	$0	$152,497	0.0%	<0.1%	$0	$151,533	$0	$269	$0	$694
Earlville (V)	$87,153,360	$0	$4,131	0.0%	<0.1%	$0	$4,131	$0	$0	$0	$0
German (T)	$203,106,925	$0	$41,269	0.0%	<0.1%	$0	$41,269	$0	$0	$0	$0
Greene (T)	$1,319,736,091	$0	$507,693	0.0%	<0.1%	$0	$502,430	$0	$1,472	$0	$3,792
Greene (V)	$686,754,321	$0	$123,665	0.0%	<0.1%	$0	$122,698	$0	$270	$0	$696
Guilford (T)	$1,010,987,220	$0	$82,523	0.0%	<0.1%	$0	$82,523	$0	$0	$0	$0
Lincklaen (T)	$229,671,722	$0	$39,225	0.0%	<0.1%	$0	$39,225	$0	$0	$0	$0
McDonough (T)	$339,089,552	$0	$83,289	0.0%	<0.1%	$0	$83,289	$0	$0	$0	$0
New Berlin (T)	$778,713,525	$0	$38,804	0.0%	<0.1%	$0	$38,804	$0	$0	$0	$0
New Berlin (V)	$432,605,770	$0	$13,019	0.0%	<0.1%	$0	$13,019	$0	$0	$0	$0
North Norwich (T)	$823,054,726	$0	$21,417	0.0%	<0.1%	$0	$21,417	$0	$0	$0	$0
Norwich (C)	$3,140,959,099	$0	$84	0.0%	<0.1%	$0	$84	$0	$0	$0	$0
Norwich (T)	$2,080,430,801	$0	$33,693	0.0%	<0.1%	$0	$33,693	$0	$0	$0	$0
Otselic (T)	$461,373,250	$0	$73,029	0.0%	<0.1%	$0	$73,029	$0	$0	$0	$0
Oxford (T)	$958,330,880	$0	$110,775	0.0%	<0.1%	$0	$110,775	$0	$0	$0	$0
Oxford (V)	$679,367,779	$0	$49,436	0.0%	<0.1%	$0	$49,436	$0	$0	$0	$0
Pharsalia (T)	$389,863,952	$0	$57,457	0.0%	<0.1%	$0	$57,457	$0	$0	$0	$0
Pitcher (T)	$315,344,531	$0	$60,019	0.0%	<0.1%	$0	$60,019	$0	$0	$0	$0
Plymouth (T)	$510,829,645	$0	$51,126	0.0%	<0.1%	$0	$51,126	$0	$0	$0	$0
Preston (T)	$348,948,426	$0	$46,541	0.0%	<0.1%	$0	$46,541	$0	$0	$0	$0
Sherburne (T)	$1,113,221,738	$0	$39,548	0.0%	<0.1%	$0	$39,548	$0	$0	$0	$0
Sherburne (V)	$768,785,678	$0	$16,284	0.0%	<0.1%	$0	$16,284	$0	$0	$0	$0
Smithville (T)	$690,983,617	$0	$144,102	0.0%	<0.1%	$0	$144,102	$0	$0	$0	$0
Smyrna (T)	$519,858,907	$0	$48,325	0.0%	<0.1%	$0	$48,325	$0	$0	$0	$0
Smyrna (V)	$161,456,951	$0	$2,638	0.0%	<0.1%	$0	$2,638	$0	$0	$0	$0
Chenango County (Total)	**$23,000,596,289**	**$0**	**$2,257,295**	**0.0%**	**<0.1%**	**$0**	**$2,250,102**	**$0**	**$2,011**	**$0**	**$5,181**

Sources: HAZUSv4.2; Chenango County GIS Services 2020; RS Means 2019
Note: T= Town; V= Village; C= City

Impact on Critical Facilities

Critical facilities are at risk of being impacted by high winds associated with structural damage, or falling tree limbs/flying debris, which can result in the loss of power. Power loss can greatly impact households, business operations, public utilities, and emergency personnel. For example, vulnerable populations in Chenango County are at risk if power loss results in interruption of heating and cooling services, stagnated hospital operations, and potable water supplies. 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 its citizens.

HAZUS-MH v4.2 estimates the probability that critical facilities (i.e., medical facilities, fire/EMS, police, EOC, schools, and user-defined facilities such as shelters and municipal buildings) may sustain minor damage as a result of the 100-year and 500-year MRP hurricane wind event. Additionally, HAZUS-MH v4.2 estimates the loss of use for each facility in number of days. Overall, HAZUS-MH v4.2 estimates that no critical facilities in Chenango County will experience damages or loss of functionality due to a 100-year or 500-year MRP hurricane wind event.

Impact on Economy

Severe storm events can have short- and long-lasting impacts on the economy. When a business is closed during storm recovery, there is lost economic activity in the form of day-to-day business and wages to employees. Overall, economic impacts include the loss of business function (e.g., tourism, recreation), damage to inventory, relocation costs, wage loss and rental loss due to the repair/replacement of buildings.

Impacts to transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting and goods transport) transportation needs. Utility infrastructure (power lines, gas lines, electrical systems) could suffer damage and impacts can result in the loss of power, which can impact business operations and can impact heating or cooling provision to the population.

HAZUS-MH v4.2 estimates the total economic loss associated with the 100-year and the 500-year MRP hurricane wind event (direct building losses and business interruption losses). Direct building losses are the estimated costs to repair or replace the damage caused to the building. This is reported in the "Impact on General Building Stock" section discussed earlier. Business interruption losses are the losses associated with the inability to operate a business because of the wind damage sustained during the storm or the temporary living expenses for those displaced from their home because of the event. HAZUS-MH v4.2 estimates that there are no economic losses for Chenango County caused by the 100-year MRP hurricane wind event. Refer to Table 5.4.8-11 for a summary of HAZUS-MH v4.2 estimated economic losses for Chenango County caused by the 100-year and the 500-year MRP hurricane wind events.

Table 5.4.8-11 Estimated Economic Losses for the 100-Year and 500-Year Mean Return Period Hurricane Wind Events

Mean Return Period (MRP)	Inventory Loss	Relocation Loss	Building and Content Losses	Wages Losses	Rental Losses	Income Losses
100-year MRP	$0	$0	$0	$0	$0	$0
500-year MRP	$0	$0	$2,257,300	$0	$0	$0

Source: HAZUS-MH v4.2

Debris management can be costly and may also impact the local economy. HAZUS-MH estimates the amount of building and tree debris that may be produced as result of the 100- and 500-year MRP wind events. Because the estimated debris production does not include flooding, this is likely a conservative estimate and may be higher if multiple impacts occur. According to the HAZUS-MH Hurricane User Manual, estimates of weight and volume of eligible tree debris consist of downed trees that would likely be collected and disposed at public expense. Refer to the User Manual for additional details regarding these estimates. Table 5.4.8-12 summarizes debris production estimates for the 100- and 500-year MRP wind events.

Table 5.4.8-12 Debris Production for 100- and 500-Year Mean Return Period Hurricane-Related Winds

Jurisdiction	Debris Production During a 100-Year and 500-Year MRP Event							
	Brick and Wood (tons)		Concrete and Steel (tons)		Tree (tons)		Eligible Tree Volume (cubic yards)	
	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Afton (T)	0	0	0	0	0	1,142	0	11,426
Afton (V)	0	0	0	0	0	377	0	3,771
Bainbridge (T)	0	0	0	0	0	405	0	4,048
Bainbridge (V)	0	0	0	0	0	211	0	2,109
Columbus (T)	0	0	0	0	0	0	0	0
Coventry (T)	0	1	0	0	0	721	0	7,211
Earlville (V)	0	0	0	0	0	0	0	0
German (T)	0	0	0	0	0	596	0	5,962
Greene (T)	0	8	0	0	0	2,363	0	23,627
Greene (V)	0	1	0	0	0	624	0	6,243
Guilford (T)	0	0	0	0	0	0	0	0
Lincklaen (T)	0	0	0	0	0	698	0	6,983
McDonough (T)	0	0	0	0	0	1,261	0	12,605
New Berlin (T)	0	0	0	0	0	0	0	0
New Berlin (V)	0	0	0	0	0	0	0	0
North Norwich (T)	0	0	0	0	0	0	0	0
Norwich (C)	0	0	0	0	0	0	0	0
Norwich (T)	0	0	0	0	0	0	0	0
Otselic (T)	0	0	0	0	0	1,300	0	13,001
Oxford (T)	0	0	0	0	0	489	0	4,886
Oxford (V)	0	0	0	0	0	503	0	5,031
Pharsalia (T)	0	0	0	0	0	1,023	0	10,229
Pitcher (T)	0	0	0	0	0	1,069	0	10,685
Plymouth (T)	0	0	0	0	0	805	0	8,053
Preston (T)	0	0	0	0	0	669	0	6,688
Sherburne (T)	0	0	0	0	0	0	0	0
Sherburne (V)	0	0	0	0	0	0	0	0
Smithville (T)	0	0	0	0	0	1,076	0	10,755
Smyrna (T)	0	0	0	0	0	632	0	6,316
Smyrna (V)	0	0	0	0	0	0	0	0
Chenango County (Total)	**0**	**11**	**0**	**0**	**0**	**15,963**	**0**	**159,630**

Source: HAZUS-MH v4.2

Impact on the Environment

The impact of severe weather events on the environment varies, but researchers are finding that the long-term impacts of more severe weather can be destructive to the natural and local environment. National organizations such as USGS and NOAA have been studying and monitoring the impacts of extreme weather phenomena as it impacts long term climate change, streamflow, river levels, reservoir elevations, rainfall, floods, landslides, erosion, etc. (USGS 2020). 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. Researchers also believe that a greater number of diseases will spread across ecosystems because of impacts that severe weather and climate change will have on water supplies (NOAA 2013). 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 Chenango County.

Cascading Impacts on Other Hazards

Severe weather events and severe wind events can escalate the impacts of flooding and severe winter weather. Severe weather may carry extreme rainfall that could exacerbate flooding and could increase the intensity of snow and blizzard events. More information about the flooding and severe winter weather hazards of concern can be found in Section 5.4.4 and Section 5.4.9, respectively.

Future Changes that May Impact Vulnerability

Understanding future changes that effect vulnerability in the County can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. Changes in the natural environment and built environment and how they interact can also provide insight about ways to plan for the future.

Projected Development

Any areas of growth could be potentially impacted by the severe storm hazard because the entire County is exposed and vulnerable to the wind hazard associated with severe storms. However, due to increased standards and codes, new development may be less vulnerable to the severe storm hazard compared to the aging building stock in the County.

Projected Changes in Population

According to the U.S. Census Bureau, the population in Chenango County has decreased by approximately 4.2-percent between 2010 and 2018 (US Census Bureau 2020). Estimated population projections provided by the 2017 Cornell Program on Applied Demographics indicates that the County's population will continue to decrease into 2040, decreasing the total population to approximately 41,123 persons (Cornell Program on Applied Demographics 2017). The population that remains in the county is vulnerable to severe weather and severe wind events. Refer to Section 4 (County Profile) for additional discussion on population trends.

Climate Change

As displayed in Figure 5.4.8-10 the entire State of New York is projected to experience an increase in the frequency and severity of extreme storms and rainfall. The northeast region of the United States has experienced a greater increase in extreme precipitation than any other region in the U.S. between 1958 and 2010, the Northeast experienced more than 70% increase in the amount of precipitation falling in rain events (NCA, 2020). Refer to Section 5.4.4 (Flood) for a discussion related to the impact of climate change due to increases in rainfall. An increase in storms will produce more wind events and may increase tornado activity. Additionally, thunderstorms and increase in temperature can relate to the strength of a storm resulting in tornadoes (NOAA, 2020). With an increased likelihood of strong winds and tornado events, all of the County's assets will experience additional risk for losses as a result of extreme wind events.

Changes in Vulnerability Since the 2015 HMP

Since the 2015 analysis, population statistics have been updated using the 5-Year 2014-2018 American Community Survey Population Estimates. The general building stock was also updated using RS Means 2019 building valuations that estimated replacement cost value for each building in the inventory. The 2015 critical facility inventory dataset was updated and updated parcel data, tax assessments were provided by Chenango County GIS. The updated building stock inventory was imported into HAZUS-MH v4.2 to complete a hurricane wind analysis for the 100-year and 500-year MRP hurricane wind event. Overall, this vulnerability assessment uses a more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Chenango County.

5.4.9 Severe Winter Storm

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

5.4.9.1 Profile

Hazard Description

A winter storm is a weather event in which the main types of precipitation are snow, sleet, or freezing rain. They can be a combination of heavy snow, blowing snow, and dangerous wind chills. According to the National Severe Storms Laboratory (2020), the three basic components needed to make a winter storm include the following:

- Below freezing temperatures (cold air) in the clouds and near the ground to make snow and ice.
- Lift, something to raise the 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 (oliographic lifting).
- Moisture to form clouds and precipitation, such as air blowing across a large lake or the ocean.

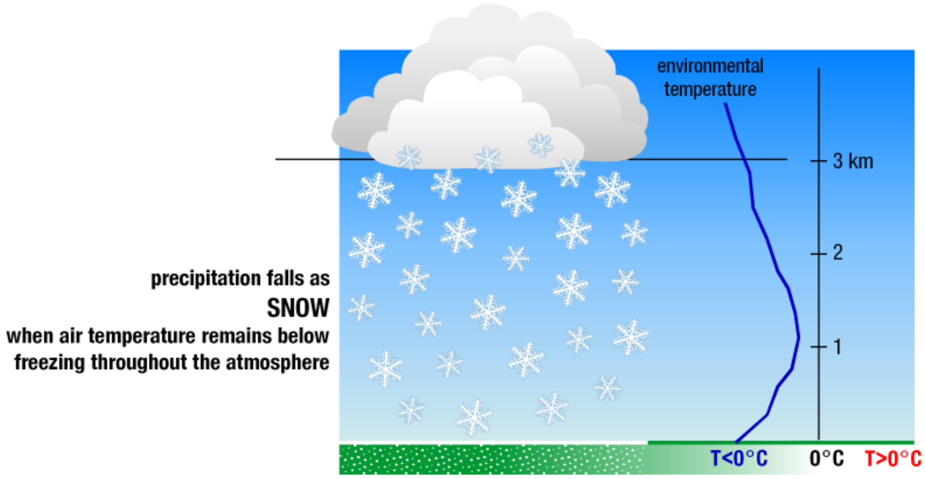
Some winter storms can immobilize an entire region while others might only affect a single community. Winter storms typically are accompanied by low temperatures, high winds, freezing rain or sleet, and heavy snowfall. The aftermath of a winter storm can have an impact on a community or region for days, weeks, or even months; potentially causing cold temperatures, flooding, storm surge, closed and blocked roadways, downed utility lines, and power outages. Chenango County's winter storms include snow storms, blizzards, Nor'Easters, and ice storms. Extreme cold temperatures and wind chills are associated with winter storms.

Figure 5.4.9-1. Snow Accumulation in Downtown Norwich, December 17, 2020

Heavy Snow

According to the National Snow and Ice Data Center (NSIDC), snow is precipitation in the form of ice crystals. It originates in clouds when temperatures are below the freezing point (32 °F) and water vapor in the atmosphere condenses directly into ice without going through the liquid stage. Once an ice crystal has formed, it absorbs and freezes additional water vapor from the surrounding air, growing into snow crystals or a snow pellet, which then falls to the earth. Snow falls in different forms: sleet, snowflakes, or snow pellets. Snowflakes are clusters of ice crystals that form from a cloud. Figure 5.4.9-2 depicts snow creation.

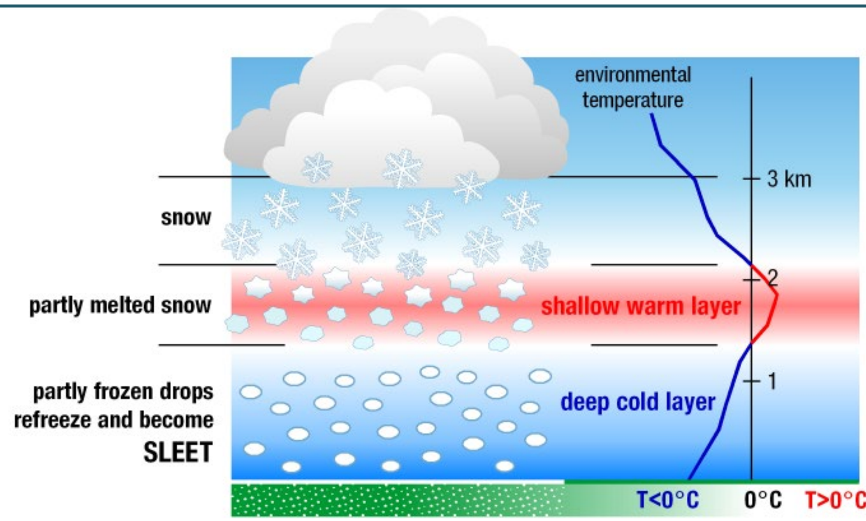
Figure 5.4.9-2. Snow Creation



Source: NOAA-NSSL, 2015

Snow pellets are opaque ice particles in the atmosphere. They form as ice crystals fall through super-cooled cloud droplets, which are below freezing but remain a liquid. The cloud droplets then freeze to the crystals. Sleet is made up of drops of rain that freeze into ice as they fall through colder air layers. They are usually smaller than 0.30 inches in diameter (NSIDC 2015).

Figure 5.4.9-3. Sleet Creation



Source:NOAA-NSSL 2015

Blizzards

A blizzard is a winter snowstorm with sustained or frequent wind gusts of 35 miles per hour (mph) or more, accompanied by falling or blowing snow reducing visibility to or below 0.25 mile, as the predominant conditions over a 3-hour period. Extremely cold temperatures often are associated with blizzard conditions but are not a formal part of the definition. The hazard, created by the combination of snow, wind, and low visibility, significantly increases when temperatures are below 20 °F. A severe blizzard is categorized as having temperatures near or below 10 °F, winds exceeding 45 mph, and visibility reduced by snow to near zero. Storm systems powerful enough to cause blizzards usually form when the jet stream dips far to the south, allowing cold air from the north to clash with warm, moister air from the south. Blizzard conditions often develop on the northwest side of an intense storm system. The difference between the lower pressure in the storm and the higher pressure to the west creates a tight pressure gradient, resulting in strong winds and extreme conditions caused by the blowing snow (The Weather Channel 2019).

Nor'Easters

A Nor'Easter is a cyclonic storm that moves along the east coast of North America. It is called a Nor'Easter because the damaging winds over coastal areas blow from a northeasterly direction. Nor'Easters can occur any time of the year but are most frequent and strongest between September and April typically moving from southwest to northeast along the Atlantic Coast of the United States (NOAA 2013). In order to be called a Nor'Easter, a storm must have the following conditions, as per the Northeast Regional Climate Center (NRCC):

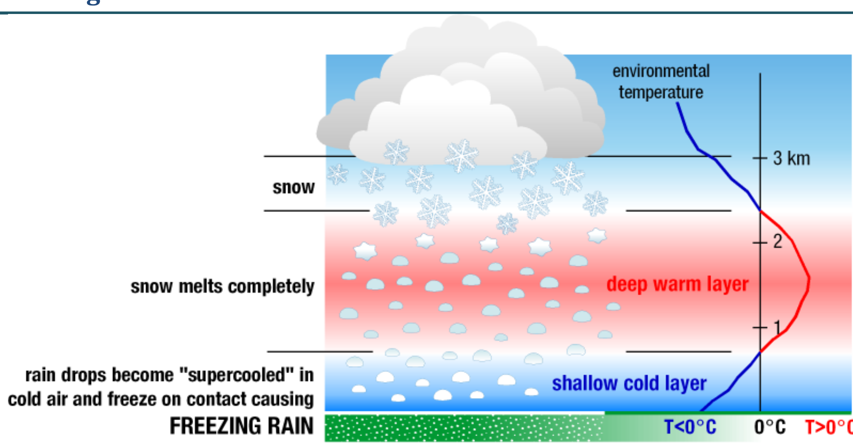
- Must persist for at least a 12-hour period.
- Have a closed circulation.
- Be located within the quadrilateral bounded at 45°N by 65° and 70°W and at 30°N by 85°W and 75°W.
- Show general movement from the south-southwest to the north-northeast.
- Contain wind speeds greater than 23 miles mph.

A Nor'Easter event can cause storm surges, waves, heavy rain, heavy snow, wind, coastal flooding and erosion. Nor'Easters have diameters that can span 1,200 miles, impacting large areas of coastline. The forward speed of a Nor'Easter is usually much slower than a hurricane, so with the slower speed, a Nor'Easter can linger for days and cause tremendous damage to those areas impacted. Approximately 20 to 40 Nor'Easters occur every year, with at least two considered severe (Storm Solution n.d.). The intensity of a Nor'Easter can rival that of a tropical cyclone in that, on occasion, it may flow or stall off the mid-Atlantic coast resulting in prolonged episodes of precipitation, coastal flooding, and high winds.

Ice Storms

An ice storm describes those events when damaging accumulations of ice are expected during freezing rain situations. Significant ice accumulations typically are accumulations of 0.25-inches or greater (NWS 2018). Heavy accumulations of ice can bring down trees, power lines, utility poles, and communication towers. Ice can disrupt communications and power for days. Even small accumulations of ice can be extremely dangerous to motorists and pedestrians (NWS 2018).

Figure 5.4.9-4. Freezing Rain Creation



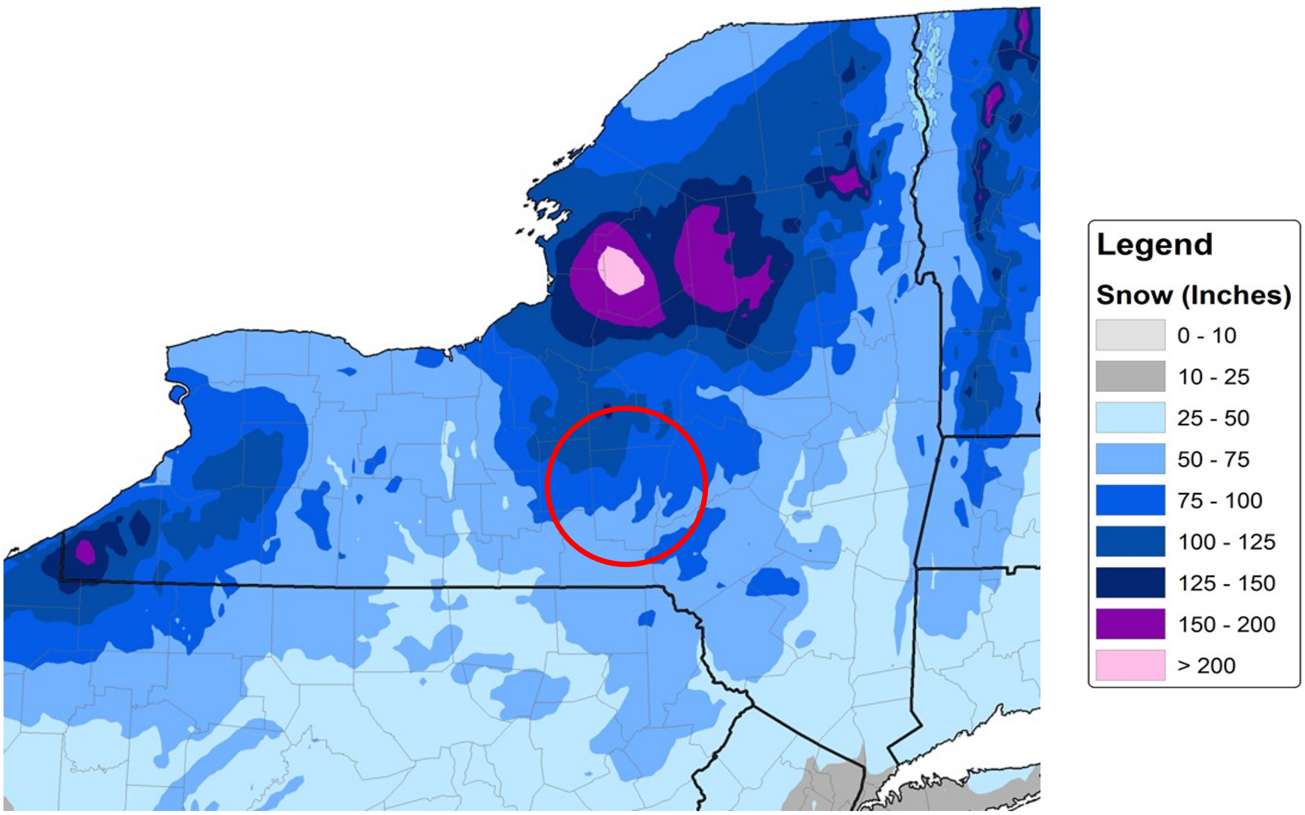
Source: NOAA-NSSL 2015

Location

Snow, Blizzards, and Nor'Easters

Snowfall in New York State is highly variable. The inland regions of the State see an average seasonal amount of 40 inches or more, whereas the coastal regions typically see 25 to 35 inches. More than half of New York State's land area sees more than 70 inches of snow each season (NOAA 2020). According to data from Cornell University, snowfall in Chenango is widely variable, with the southern portion of the County seeing 50 to 75 inches/year and the northwest corner seeing between 100 and 125 inches/year. Nor'Easters typically develop within 100 miles of the East Coast, however their impacts can still be felt in Chenango County, nearly 200 miles inland.

Figure 5.4.9-5. New York Annual Average Snowfall



Source: Cornell University, NYSkiBlog.com
Note: The red circle indicates the location of Chenango County.

Ice Storms

The Midwest and Northeast United States are prime areas for freezing rain and ice storm events. These events can occur anytime between November and April, with most events occurring during December and January. Based on data from 1948 to 2000, in Chenango County there is an average of six to seven days with freezing rain and an average of 15 to 21 hours of freezing rain per year (Midwest Regional Climate Center [MRCC] 2020).

Extent

The severity or magnitude of a severe winter storm depends on several factors, including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day and week (e.g., weekday versus weekend), and time of season.

The extent of a severe winter storm can be classified by meteorological measurements and by evaluating its societal impacts. The National Oceanic and Atmospheric Administration's (NOAA's) National Climatic Data Center (NCDC) is currently producing the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two-thirds of the United States. The RSI ranks snowstorm impacts on a scale from 1 to 5 and is based on the spatial extent of the storm, the amount of snowfall, and the interaction of the extent and snowfall totals with population (based on the 2000 Census). The NCDC has analyzed and assigned RSI values to over 500 storms since 1900 (NOAA 2015). Table 5.4.9-1 presents the five RSI ranking categories. Figure 5.4.9-6 depicts the NOAA National Centers for Environmental Information's Regional Snowfall Index.

Table 5.4.9-1. RSI Ranking Categories

Category	Description	RSI Value
1	Notable	1–3
2	Significant	3–6
3	Major	6–10
4	Crippling	10–18
5	Extreme	18.0+

Source: NOAA 2020
Note: RSI = Regional Snowfall Index

The 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 (NWS 2018).

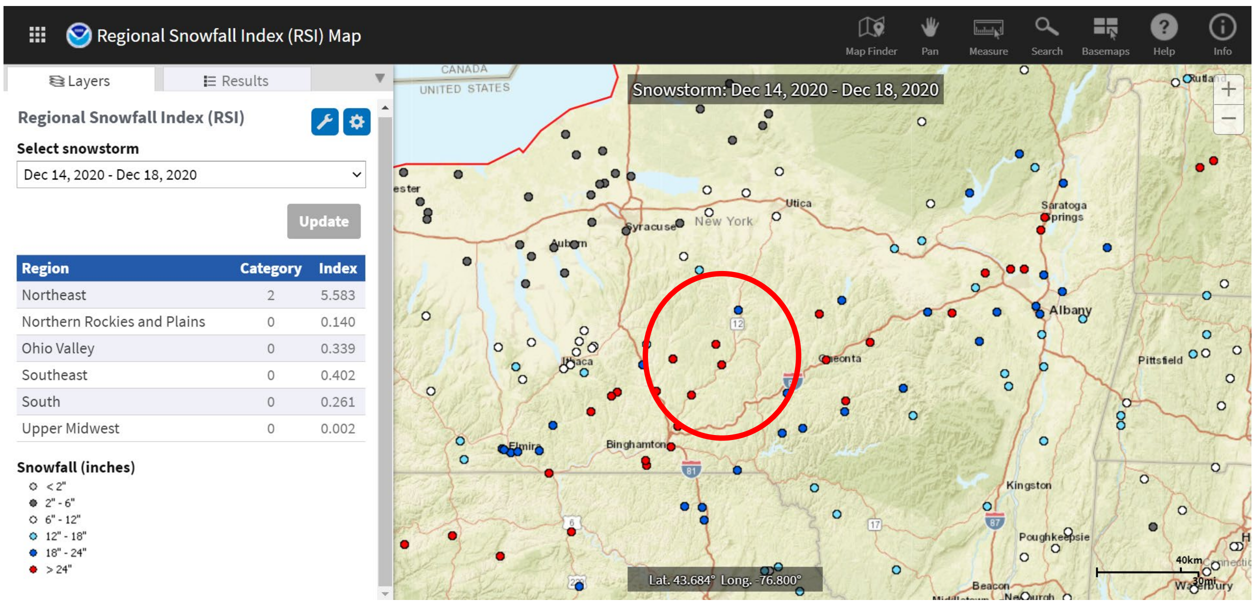
According to the NWS, the magnitude of a severe winter storm can be qualified into five main categories by event type:

- Heavy Snowstorm – Accumulations of 4 inches or more of snow in a 6-hour period, or 6 inches of snow in a 12-hour period.
- Sleet Storm – Significant accumulations of solid pellets that form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces, posing a hazard to pedestrians and motorists.
- Ice Storm – Significant accumulation of rain or drizzle freezing on objects (trees, power lines, roadways) as it strikes them, causing slippery surfaces and damage from sheer weight of ice accumulations.
- Blizzard – Wind velocity of 35 mph or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile prevailing over an extended period.
- Severe Blizzard – Wind velocity of 45 mph, temperatures of 10 °F or lower, a high density of blowing snow with visibility frequently measured in feet prevailing over an extended period.

The NWS uses winter weather watches, warnings, and advisories to ensure that people know what to expect in the coming hours and days.

- A winter storm watch means that severe winter conditions (heavy snow, ice) might affect a certain area, but its occurrence, location, and timing are uncertain.
- A winter storm watch is issued when severe winter conditions (heavy rain or significant ice accumulations) are possible within in the next 24 to 72 hours.
- A winter storm warning is issued when severe winter conditions are expected (heavy snow 7 inches or greater in 12 hours or 9 inches or greater in 24 hours; ice storm with ½ inch or more).
- A winter weather advisory is used when winter conditions (i.e., snow, sleet, freezing rain, ice) are expected to cause significant inconvenience and could be hazardous (e.g., snow or sleet of 4–6 inches, freezing rain and drizzle in any accretion of ice on roads but less than ½ inch).
- A blizzard warning is issued when snow and strong winds will combine to produce a blinding snow, visibility near zero/whiteouts, and deep snow drifts (NWS 2018).

Figure 5.4.9-6 NOAA NCEI Regional Snowfall Index



Note: The red circle indicates the approximate location of Chenango County

Previous Occurrences and Losses

Many sources have provided historical information regarding previous occurrences and losses associated with severe winter storm events in Chenango County. According to the NOAA-NCEI storm events database, Chenango County has experienced 90 winter weather events between 1996 and 2020, including 55 heavy snow events, 10 ice storms, 4 lake effect snowstorms, 20 winter storms, and 2 winter weather events. Table 5.4.9-2 and Table 5.4.9-3 summarize these statistics, as well as the annual average number of events and the percent chance of these individual severe winter storm hazards occurring in Chenango County in future years (NOAA NCEI 2020).

Table 5.4.9-2. Severe Winter Events 1996-April 2020

Hazard Type	Number of Occurrences Between 1950 and 2020	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Blizzard	0	0	0	$0	$0
Heavy Snow	55	0	0	$527,000	$0
Ice Storm	10	0	0	$2,115,000	$0

Hazard Type	Number of Occurrences Between 1950 and 2020	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Lake Effect Snow	4	0	0	$0	$0
Sleet	0	0	0	$0	$0
Winter Storm	20	0	0	$0	$0
Winter Weather	2	0	0	$0	$0
Total	**91**	**0**	**0**	**$2.64 million**	**$0**

Source: NOAA-NCEI 2020
Note: NOAA-NCEI database includes winter-related events starting in 1996. Events that occurred prior to 1996 are not included in the table.

FEMA Disaster Declarations

Between 1954 and April 2020, FEMA included New York State in 28 winter storm-related major disaster (DR) or emergency (EM) declarations classified as one or a combination of the following disaster types: severe winter storm, snowstorm, snow, ice storm, winter storm, blizzard, and flooding. Generally, these disasters cover a wide region of the state; therefore, they may have impacted many counties. Chenango County was included in six of these declarations.

Table 5.4.9-3 FEMA Major Disasters and Emergency Declarations in Chenango County

Disaster Number	Event Date	Declaration Date	Incident Type	Title
EM-3107	March 13 – March 17, 1993	3/17/1993	Snow	Severe Blizzard
EM-3173	December 25 – January 4, 2002	2/25/2003	Snow	Snowstorms
EM-3184	February 17 – February 18, 2003	3/27/2003	Snow	Snow
DR-1467	April 3 – April 5, 2003	5/12/2003	Severe Ice Storm	Ice Storm
EM-3299	December 11 – December 31, 2008	12/18/2008	Severe Storm(s)	Severe Winter Storm
DR-4322	March 14 – March 15, 2017	7/12/2017	Snow	Severe Winter Storm and Snowstorms

Source: FEMA 2020
DR Major Disaster Declaration (FEMA)
EM Emergency Declaration (FEMA)
FEMA Federal Emergency Management Agency

USDA Declarations

Between 2012 and 2020, Chenango County was included in the following winter-related USDA disaster designations:

Table 5.4.9-4. USDA Designations in Chenango County, 2012-2020

Designation Number	Event Date	Declaration Date	Incident Type	Description
S3249	March 1, 2012	June 5, 2012	Frost, Freeze	Frosts and Freezes
S3746	February 1 – April 30, 2014	September 24, 2014	Frost, Freeze	Freeze
S4903	April 1 – June 1, 2020	January 15, 2021	Frost, Freeze	Freeze and Frost

Source: USDA 2020

Previous Events

Table 5.4.9-5 identifies the known severe winter storm events that impacted Chenango County between 2013 and April 2020. For events prior to 2013, please refer to Appendix E (Supplementary Data). For detailed information on damages and impacts to each municipality, refer to Section 9 (Jurisdictional Annexes).

Table 5.4.9-5. Severe Winter Weather Events in Chenango County, 2013 to December 2020

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Event Details*
December 14, 2013	Winter Storm	N/A	N/A	Between eight and eleven inches of snow fell across Chenango County after a low pressure system intensified as it headed towards the northeast, producing high snowfalls across the upper Susquehanna River.
January 1-3, 2014	Winter Storm	N/A	N/A	Up to 13 inches of snow fell in Chenango and nearby counties owing to a stalled frontal boundary.
February 5, 2014	Winter Storm	N/A	N/A	The Southern Tier region of New York received the highest snowfall (up to 15 inches in Bainbridge) owing to an intense snow band that moved through the region.
February 13, 2014	Winter Storm	N/A	N/A	Chenango County saw five to nine inches of snow in a storm that brought eight to eighteen inches of snow to the region.
November 26, 2014	Winter Storm	N/A	N/A	Thirteen inches of snow fell in Coventry and the rest of the County saw between eight and thirteen inches from a storm system causing localized snow to the Susquehanna, western Catskills, and Southern Tier region.
December 9-11, 2014	Winter Storm	N/A	N/A	Chenango County experienced the high end of estimated snowfall totals from a storm that deposited up to two feet of snow in the County.
February 1-2, 2015	Heavy Snow	N/A	N/A	Up to a foot of snow was seen in Chenango County from a widespread evening storm passing through the region.
November 19-22, 2016	Lake-Effect Snow	N/A	N/A	A strong lake-effect snowstorm brought two feet of snow to the higher elevations of the County and much of the Southern Tier region.
February 12, 2017	Heavy Snow	N/A	N/A	Sherburne saw the highest snowfall totals from a winter storm that brought heavy snow to central and north-central New York.
March 14-15, 2017	Heavy Snow	DR-4322	Yes	A record-breaking winter storm traveling northeast along the coast brought major snow to the region, with one and two-day records broken in many locations. Chenango County received between two and three feet of snow.
February 4, 2018	Heavy Snow	N/A	N/A	Chenango County saw between six and nine inches of snow from a snow storm impacting central New York.
February 7, 2018	Heavy Snow	N/A	N/A	Chenango County received between six and nine inches of snow from a snowstorm passing through the region.
March 2, 2018	Heavy Snow	N/A	N/A	Between one and two feet of snow fell in Chenango County during a storm that brought near-blizzard conditions to the region.
November 15-16, 2018	Heavy Snow	N/A	N/A	Up to a foot of snow fell in the County during a winter storm that brought a mix of precipitation.
January 19-20, 2019	Heavy Snow	N/A	N/A	Chenango County received between eight and fifteen inches of snow as well as ice from a winter storm impacting the region.
December 1-2, 2019	Heavy Snow	N/A	N/A	The County received between eight and thirteen inches of snow from a mixed precipitation, two-part storm event that moved through central New York.
December 16-17, 2020	Heavy Snow, Nor'easter	TBD	TBD	A Nor'easter moved slowly up the US eastern coastline on the afternoon of December 16, 2020 through December 17, 2020. The storm system produced very heavy snowfall across parts of central New York and northeast PA. Snowfall levels in Chenango County ranged from 19 inches in Smyrna, to 35 inches in Oxford and Norwich.

Sources: FEMA 2020; NOAA-NCEI 2020

*	*Many sources were consulted to provide an update of previous occurrences and losses; event details and loss/impact information may vary and has been summarized in the above table*
DR	*Major Disaster Declaration (FEMA)*
FEMA	*Federal Emergency Management Agency*
Mph	*Miles per Hour*
NCEI	*National Centers for Environmental Information*
NOAA	*National Oceanic and Atmospheric Administration*
N/A	*Not Applicable*

Climate Change Projections

On average, New York State receives more than 40 inches of snow each year. Snowfall varies regionally based on topography and the proximity to large lakes and the Atlantic Ocean. Maximum snowfall can exceed 175 inches in parts of the Adirondacks and Tug Hill Plateau, as well as in the westernmost parts of the state. The warming influence of the Atlantic Ocean keeps snow in the New York City and Long Island areas below 36 inches each year (NYSERDA 2014).

Climate change is affecting both people and resources in New York State. These impacts are projected to increase. The impacts related to increasing temperatures and sea level rise are already causing complications in the state. *ClimAID: The Integrated Assessment for Effective Climate Change in New York State (ClimAID)* was undertaken 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 (NYSERDA 2011).

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 2–3.4 °F by the 2020s, 4.1–6.8 °F by the 2050s, and 5.3–10.1 °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).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Chenango County is part of Region 3 (Southern Tier) where temperatures are estimated to increase by 4.4–6.3 ºF by the 2050s and 5.7–9.9 ºF by the 2080s (baseline of 47.5 ºF, middle range projection). Precipitation totals are estimated to increase between 4–10 percent by the 2050s and 6–14 percent by the 2080s (baseline of 35.0 inches, middle range projection). Table 5.4.9-6 displays the projected seasonal precipitation change for Southern Tier ClimAID Region (NYSERDA 2014).

Table 5.4.9-6. Projected Seasonal Precipitation Change in Region 3, 2050s (% change)

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

Source:NYSERDA 2011

New York State is already experiencing the effects of climate change during the winter season. 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 New York State are almost 5 degrees warmer than in 1970 (NYSERDA 2011; NYSDEC, n.d.). The state has experienced a decrease in the number of cold winter days (below 32 °F) and can expect to see a decrease in snow cover by as much as 25–50 percent by end of the next century. The lack of snow cover may jeopardize opportunities for skiing, snowmobiling, and other types of winter recreation; and natural ecosystems will be affected by the changing snow cover (Cornell University College of Agriculture and Life Sciences 2011). 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 New York State could support higher snowfall totals during snowstorm events (NYSERDA 2014).

Some climatologists believe that climate change could play a role in the frequency and intensity of Nor'Easters. Two ingredients are needed to produce strong Nor'Easters and intense snowfall: (1) temperatures which are just below freezing and (2) massive moisture coming from the Gulf of Mexico. When temperatures are far below freezing, snow is less likely. As temperatures increase in the winter months, they will be closer to freezing rather than frigidly cold. Climate change is expected to produce more moisture, thus increasing the likelihood that these two ingredients (temperatures just below freezing and intense moisture) will cause more intense snow events.

Probability of Future Occurrences

Table 5.4.9-7 summarizes data regarding the probability of occurrences of severe winter storm events in Chenango County based on the historic record. Heavy snow events are the most common in Chenango County, followed by winter storms. The information used to calculate the probability of occurrences is based solely on NOAA-NCEI storm events database results.

Table 5.4.9-7. Probability of Future Occurrence of Severe Winter Weather Events in Chenango County

Hazard Type	Number of Occurrences Between 1954 and 2020	% Chance of Occurring in Any Given Year
Blizzard	0	N/A
Heavy Snow	55	82.1%
Ice Storm	10	14.9%
Lake Effect Snow	4	5.9%
Sleet	0	N/A
Winter Storm	20	29.8%
Winter Weather	2	3.0%
TOTAL	**91**	100%

Source: *NOAA-NCEI 2020*
Note: *Disaster occurrences include federally declared disasters since the 1950 Federal Disaster Relief Act (Public Law 81-875), and selected winter storm events since 1996. Due to limitations in data, not all winter storm events occurring between 1954 and 1996 are accounted for in the tally of occurrences. As a result, the number of hazard occurrences is underestimated.*

Based on historical data from NYSERDA (2011), it is expected that the following will occur at least once per 100 years:

- Up to four inches of freezing rain in the ice band near central New York State of which between 1–2 inches of accumulated ice will occur over a 24-hour period.
- Up to two feet of accumulated snow in the snow band in northern and western New York State over a 48-hour period.

Based on geography, location, past event history, and climate projections, Chenango County will continue to experience winter storm events. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings; refer to Section 5.3 (Hazard Ranking) for additional information on the hazard ranking methodology and probability criteria. The probability of occurrence for severe winter storms in the county is considered *frequent* (event has a 100 percent annual probability and might occur multiple times in the same year).

5.4.9.2 Vulnerability Assessment

All of Chenango County is exposed to the severe winter storm hazard. The following summarizes the estimated potential impacts of severe winter storm events on the county.

Impact on Life, Health and Safety

For the purposes of this HMP, the entire population of Chenango County (48,348) is exposed to severe winter storm events (U.S. Census 2018 ACS 5-Year Population Estimate). The homeless and elderly are considered most susceptible to this hazard; the homeless due to their lack of shelter and the elderly due to their increased risk of injuries and death from falls and overexertion or hypothermia from attempts to clear snow and ice.

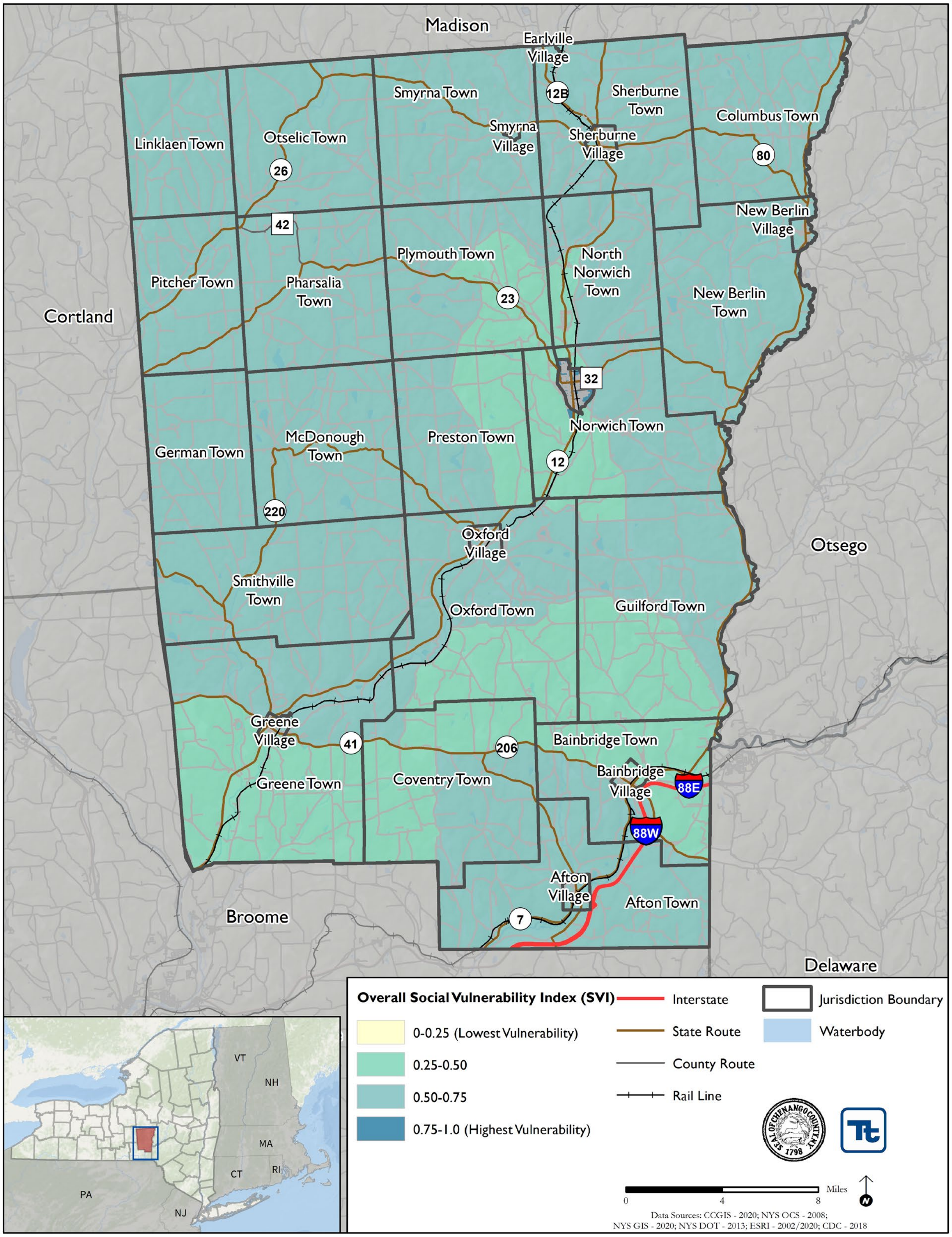
Figure 5.4.9-7. Snow accumulation reached 28 inches at a home in Smithville, December 17, 2020

According to the 2018 ACS 5-Year Population Estimate, 19.7 percent of the population in Chenango County is 65 and over. In addition, severe winter storm events can reduce the ability of these populations to access emergency services. In Chenango County, the following areas have the highest percentage of elderly population: Village of New Berlin (26.6%), Town of Oxford (23.9%), Village of Greene (20%), Village of Afton (19.1%), and Town of McDonough (18.2%). Refer to Figure 4-5 in Section 4 (County Profile) that displays the densities of populations over 65 in Chenango County.

The homeless and residents with low incomes might not have access to housing or their housing could be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). Refer to Figure 4-11 in Section 4 (County Profile) that displays the densities of low-income populations in Chenango County. Additionally, homeless populations might not have access to housing or sheltering during a severe winter storm.

According to the Center for Disease Control and Prevention's (CDC) 2016 Social Vulnerability Index, areas within the City of Norwich are the most vulnerable within the County. The average social vulnerability score for Chenango County is 0.5304, indicating moderate to high level of vulnerability. Vulnerable populations throughout the county may be more susceptible to the impacts from severe winter storms. Figure 5.4.9-8 below displays the CDC 2016 Social Vulnerability Index for Chenango County.

Figure 5.4.9-8 CDC's Social Vulnerability Index 2016



Heavy snow can immobilize a region and paralyze a city. A cascading impact of heavy snowstorms seen in the City of Norwich includes the removal of snow by snow plows blocks the middle lanes in the downtown area, covering left turn lanes. This road blockage results in the potential for increased traffic accidents and decreased safety for both pedestrians and drivers. Additional impacts include stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms can be isolated for days, and unprotected livestock could be lost. In Chenango County, the towns generally are rural compared with the villages and city. The cost of snow removal, repairing damages, and loss of business can have large economic impacts on cities and towns (NSSL 2006).

Impact on General Building Stock

The entire general building stock inventory in Chenango County is exposed and potentially vulnerable to the severe winter storm hazard; however, properties in poor condition or in particularly vulnerable locations may be at risk to the most damage. In general, structural impacts include damage to roofs and building frames rather than building content. Current modeling tools are not available to estimate specific losses for this hazard. As an alternate approach, the percent damage to structures that could result from severe winter storm conditions is considered. This allows planners and emergency managers to select a range of potential economic impact based on an estimate of the percent of damage to the general building stock. Table 5.4.9-8 summarizes the estimated loss to structures because of 1-, 5-, and 10-percent loss. Given professional knowledge and the currently available information, the potential loss for this hazard is considered to be overestimated because of varying factors (building structure type, age, load distribution, building codes in place). Therefore, the table's data should be used as estimates only for planning purposes with the knowledge that the associated losses for severe winter storm events vary greatly.

Table 5.4.9-8 General Building Stock Exposure and Estimated Losses from Severe Winter Storm Events

Municipality	Total Replacement Cost Value (RCV)	1-Percent Exposure/Loss	5-Percent Exposure/Loss	10-Percent Exposure/Loss
Afton (T)	$864,699,700	$8,646,997	$43,234,985	$86,469,970
Afton (V)	$1,019,188,804	$10,191,888	$50,959,440	$101,918,880
Bainbridge (T)	$915,529,770	$9,155,298	$45,776,489	$91,552,977
Bainbridge (V)	$584,957,184	$5,849,572	$29,247,859	$58,495,718
Columbus (T)	$862,354,994	$8,623,550	$43,117,750	$86,235,499
Coventry (T)	$703,237,371	$7,032,374	$35,161,869	$70,323,737
Earlville (V)	$87,153,360	$871,534	$4,357,668	$8,715,336
German (T)	$203,106,925	$2,031,069	$10,155,346	$20,310,692
Greene (T)	$1,319,736,091	$13,197,361	$65,986,805	$131,973,609
Greene (V)	$686,754,321	$6,867,543	$34,337,716	$68,675,432
Guilford (T)	$1,010,987,220	$10,109,872	$50,549,361	$101,098,722
Lincklaen (T)	$229,671,722	$2,296,717	$11,483,586	$22,967,172
McDonough (T)	$339,089,552	$3,390,896	$16,954,478	$33,908,955
New Berlin (T)	$778,713,525	$7,787,135	$38,935,676	$77,871,352
New Berlin (V)	$432,605,770	$4,326,058	$21,630,289	$43,260,577
North Norwich (T)	$823,054,726	$8,230,547	$41,152,736	$82,305,473
Norwich (C)	$3,140,959,099	$31,409,591	$157,047,955	$314,095,910
Norwich (T)	$2,080,430,801	$20,804,308	$104,021,540	$208,043,080

Municipality	Total Replacement Cost Value (RCV)	1-Percent Exposure/Loss	5-Percent Exposure/Loss	10-Percent Exposure/Loss
Otselic (T)	$461,373,250	$4,613,733	$23,068,663	$46,137,325
Oxford (T)	$958,330,880	$9,583,309	$47,916,544	$95,833,088
Oxford (V)	$679,367,779	$6,793,678	$33,968,389	$67,936,778
Pharsalia (T)	$389,863,952	$3,898,640	$19,493,198	$38,986,395
Pitcher (T)	$315,344,531	$3,153,445	$15,767,227	$31,534,453
Plymouth (T)	$510,829,645	$5,108,296	$25,541,482	$51,082,965
Preston (T)	$348,948,426	$3,489,484	$17,447,421	$34,894,843
Sherburne (T)	$1,113,221,738	$11,132,217	$55,661,087	$111,322,174
Sherburne (V)	$768,785,678	$7,687,857	$38,439,284	$76,878,568
Smithville (T)	$690,983,617	$6,909,836	$34,549,181	$69,098,362
Smyrna (T)	$519,858,907	$5,198,589	$25,992,945	$51,985,891
Smyrna (V)	$161,456,951	$1,614,570	$8,072,848	$16,145,695
Chenango County	**$23,000,596,289**	**$230,005,963**	**$1,150,029,814**	**$2,300,059,629**

Sources: Chenango County GIS 2020; RS Means 2019
Notes: T= Town; V= Village; C= City

A specific area that is vulnerable to the severe winter storm hazard is the floodplain. Severe winter storms can cause flooding through blockage of streams or through snow melt. At-risk residential infrastructures are presented in Section 5.4.4 (Flood Hazard Profile). Generally, losses resulting from flooding associated with severe winter storms should be less than that associated with a 1-percent annual chance flood event. In addition, coastal areas are at high risk during winter storm events that involve high winds, as presented in Section 5.4.6 (Severe Storm Profile) for losses resulting from wind.

Impact on Critical Facilities

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 largely constructed of concrete and masonry; therefore, they should only suffer minimal structural damage from severe winter storm events. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles, utility lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice can cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces (NSSL 2006). Because power interruption can occur, backup power is recommended.

Infrastructure at risk for this hazard includes roadways that could be damaged due to salt application and intermittent freezing and warming conditions that can damage roads over time. Severe snowfall requires the clearing roadways and alerting citizens to dangerous conditions; following the winter season, resources for road maintenance and repair are required.

Impact on Economy

The cost of snow and ice removal and repair of roads from the freeze/thaw process can drain local financial resources. Impacts on the economy also include commuter difficulties into or out of the area for work or school. The loss of power and closure of roads prevent commuters within the county. According to the 2020 Chenango County Adopted Budget, County snow removal services including labor, fence materials, ice control, and machinery rentals totals nearly $1.9 million.

Impact on the Environment

Severe winter weather can have a major impact on the environment. Not only does winter weather create changes in natural processes, the residual impacts of a community's methods to maintain its infrastructure through winter weather maintenance may also have an impact on the environment. For example, an excess amount of snowfall and earlier warming periods may affect natural processes such as flow within water resources (USGS 2020). Rain-on-snow events can also exacerbate runoff rates and flash flood events with warming winter weather. Consequentially, these flow rates and excess volumes of water can erode banks, destroying habitats along the riverbanks of the County, and disrupt terrestrial plants and animals.

> Chemically based winter maintenance practices have its own effect on the natural environment. Melting snow and ice that carry de-icing chemicals onto vegetation and into soils can contaminate the local waterways. Elevated salt levels may hinder vegetation from absorbing nutrients, slowing plant growth.

Cascading Impacts on Other Hazards

Severe winter weather events may exacerbate flooding. As discussed, the freezing and thawing of snow and ice associated with winter weather events can create major flooding issues in the County. Maintaining winter weather hazards through snow and ice removal could minimize the potential risk of flooding during a warming period. Refer to Section 5.4.4 (Flood) for more information about the flood hazard of concern. Additionally, heavy snow pile-up on the sides of streets within the County can disrupt traffic patterns and lead to dangerous road conditions and an increase in traffic incidents.

Future Changes that May Impact Vulnerability

Understanding future changes that impact vulnerability in the county can assist in planning for future development and ensure that appropriate mitigation, planning, and preparedness measures are in place. The county considered the following factors to examine potential conditions that can affect hazard vulnerability:

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

Projected Development

As discussed in Sections 4 (County Profile) and 9 (Jurisdictional Annexes), areas targeted for future growth and development have been identified across the county. Any areas of growth could be potentially impacted by the severe winter storm hazard because the entire planning area is exposed and vulnerable. The ability of new development to withstand severe winter storm impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction.

Current New York State land use and building codes incorporate standards that address and mitigate snow accumulation. Some local municipalities in the county implemented the following activities to eliminate loss of life and property and infrastructure damages during winter storm events:

- Remove snow from roadways.
- Remove dead trees and trim trees/brush from roadways to lessen falling limbs and trees.
- Bury electrical and telephone utility lines to minimize downed lines.
- Remove debris/obstructions in waterways and develop routine inspections/maintenance plans to reduce potential flooding.
- Purchase and install backup generators in evacuation facilities and critical facilities to essential services to residents.

Projected Changes in Population

In 2018, the Chenango United Way reported that 33 percent of Chenango County households fall under the ALICE category: Asset Limited, Income Restrained, Employed (Meseck 2019). The homeless, as well as the ALICE population is vulnerable to extreme weather events inclusive of storms and extreme temperatures. According to population projections from the Cornell Program on Applied Demographics, Chenango County will experience a continual population decrease through 2040 (an estimated decline of greater than 7,500 people by 2040). This decrease could reduce the overall vulnerability of the county's population over time; however, a closer examination of the age of the population, changes in their geography, and how climate change could alter the winter weather received (rain versus snow) will be important to continue to assess future changes in vulnerability.

Climate Change

As discussed earlier, it is uncertain how climate change will influence extreme winter storm events. With a potential for more frequent lake-effect snow events over the next two decades, the county's assets will be at risk to the impacts of more frequent severe winter storm events. An increase in the frequency and severity of severe winter storms could result in an increase of snow loads on the county's building stock and infrastructure, putting each building at risk to structural damage. More frequent and severe events also will result in increased resources spent to prepare for and clean-up after an event. However, as winter temperatures continue to rise, climate projections indicate the increase in precipitation is likely to occur during the winter months as rain. Increased rain on snowpack or frozen or saturated soils can lead to increased flooding and related impacts on the county's assets.

Change of Vulnerability Since 2015 HMP

The Chenango County Comprehensive Plan describes changes in the county's population from the 2000 to the 2010 U.S. Census. Overall, Chenango County has experienced a decrease in population; however, there was an increase in the elderly population and low income population, which are vulnerable to severe winter weather hazards. Further, the county has experienced an increase in population moving to more rural areas (Chenango County 2016). Rural areas could be hit hardest during winter storm events because of geographical remoteness and increased additional winter weather preparedness measures. Overall, the entire county remains vulnerable to severe winter storm events.

5.4.10 Wildfire

This section provides a profile and vulnerability assessment of the wildfire hazard for Chenango County.

5.4.10.1 Profile

This section provides information regarding the description, extent, location, previous occurrences and losses, and the probability of future occurrences for the wildfire hazard.

Hazard Description

Wildfire is defined as an uncontrolled fire spreading through natural or unnatural vegetation that can threaten lives and property if not contained. Wildfires are also known as ground fires, grass fires, forest fires, brush fires, wildland urban interface fires, or range fires. Wildfires do not include fires naturally or purposely ignited to manage vegetation for one or more benefits (NYS DHSES 2019). Although destructive fires do not occur annually, the State's fire history shows a cycle of outbreaks that have caused human death, property loss, forest destruction, and air pollution (NYS DHSES 2019).

Extent

Wildfire events can range in size and intensity. A wildfire's intensity depends significantly on meteorological conditions and human activity.

Wildfire Behavior and Fire Ecology

Fire behavior is defined as the manner in which fuel ignites, flame develops, and fire spreads, which depend on interactions among fuel, weather, and topography. Fire behavior is one of the most important aspects of wildfires because almost all actions in response to a fire depend on how it behaves. The extent to which fire manages can understand and predict fire behavior relies on success in pre-suppression planning and actual suppression of wildfires.

Potential for wildfire and its subsequent development (growth) and severity are controlled by the three principal factors of topography, fuel, and weather, described as follows:

Topography – Topography can powerfully influence wildfire behavior. Movement of air over the terrain tends to direct a fire's course. A gulch or canyon can funnel air and act as a chimney, intensifying fire behavior and inducing faster spread. Saddles on ridgetops tend to offer lower resistance to passage of air and draw fires. Solar heating of drier, south-facing slopes produces upslope thermal winds that can complicate behavior. Slope is an important factor. If the percentage of uphill slope doubles, the rate the wildfire spreads will most likely double as well. Terrain can inhibit wildfires: fire travels downslope much more slowly than it does upslope, and ridgetops often mark the end of a wildfire's rapid spread (FEMA 1997).

Fuel – Fuels are classified by weight or volume (fuel loading) and by type. Fuel loading is used to describe the amount of vegetative material available. If this amount doubles, energy released can also double. Each fuel type is given a burn index—an estimate of amount of potential energy that may be released, effort required to ignite a fire in a given fuel and expected flame length. Different fuels have different burn qualities, and some burn more easily than others. Grass fires release relatively little energy but can sustain very high rates of spread (FEMA 1997). According to the U.S. Forest Service (USFS), a forest stand may consist of several layers of live and dead vegetation in the understory (surface fuels), midstory (ladder fuels), and overstory (crown fuels):

- Surface fuels consist of grasses, shrubs, litter, and woody material lying on the ground. Surface fires burn low vegetation, woody debris, and litter. Under the right conditions, surface fires reduce likelihood that future wildfires will grow into crown fires.

- Ladder fuels consist of live and dead small trees and shrubs; live and dead lower branches from larger trees, needles, vines, lichens, mosses; and any other combustible biomass between the top of surface fuels and bottom of overstory tree crowns.
- Crown fuels are suspended above the ground in treetops or other vegetation and consist mostly of live and dead fine material. When historically low-density forests become overcrowded, tree crowns may merge and form a closed canopy. Tree canopies constitute the primary fuel layer in a forest crown fire (USFS 2003).

Fire behavior is strongly influenced by these fuels.

Weather / Air Mass – Weather is the most important factor influencing fire behavior, but it is always changing. Air mass, defined by the National Weather Service (NWS) as a body of air covering a relatively wide area and exhibiting horizontally uniform properties, can affect wildfire through climatic factors that include temperature and relative humidity, local wind speed and direction, cloud cover, precipitation amount and duration, and stability of the atmosphere at the time of the fire (NWS 2009). Extreme weather leads to extreme events, and often a subsidence of severe weather marks the end of a wildfire's growth and the beginning of successful containment. High temperatures and low humidity can produce vigorous fire activity. Fronts and thunderstorms can produce winds that radically and suddenly change in speed and direction, causing similar changes in fire activity. The rate of spread of a fire varies directly with wind velocity. Winds may play a dominant role in directing the course of a fire. The most damaging firestorms are typically marked by high winds (FEMA 1997).

Several tools are available to estimate fire potential, extent, danger, and growth, including: Wildland Fire Assessment System, Fire Potential Index, Fuel Moisture, Keetch-Byram Drought Index, Haines Index, and Buildup Index. In New York State, the Department of Conservation Wildfire Predictive Services created the New York State Fire Danger Rating Area (FDRA). This the tool used by New York State to describe fire danger throughout the state. ,:

The ***Fire Danger Rating Area (FDRA)*** in New York is established using information from the National Fire Danger Rating System (NFDRS) and takes into account current and antecedent weather, fuel types, and both live and dead fuel moisture. This information is provided by local station managers (USFS, n.d.) in each of the ten regions of New York State. Figure 5.4.10-1 shows an example of a FDRA in the State and the fire danger risk within each area on a specific date. Chenango County is part of the Leatherstocking FDRA. As of April 21, 2020, the entire state's fire danger was low. Table 5.4.10-1 lists fire danger ratings and color codes, also used by NYSDEC to update its fire danger rating maps, identified later in this section.

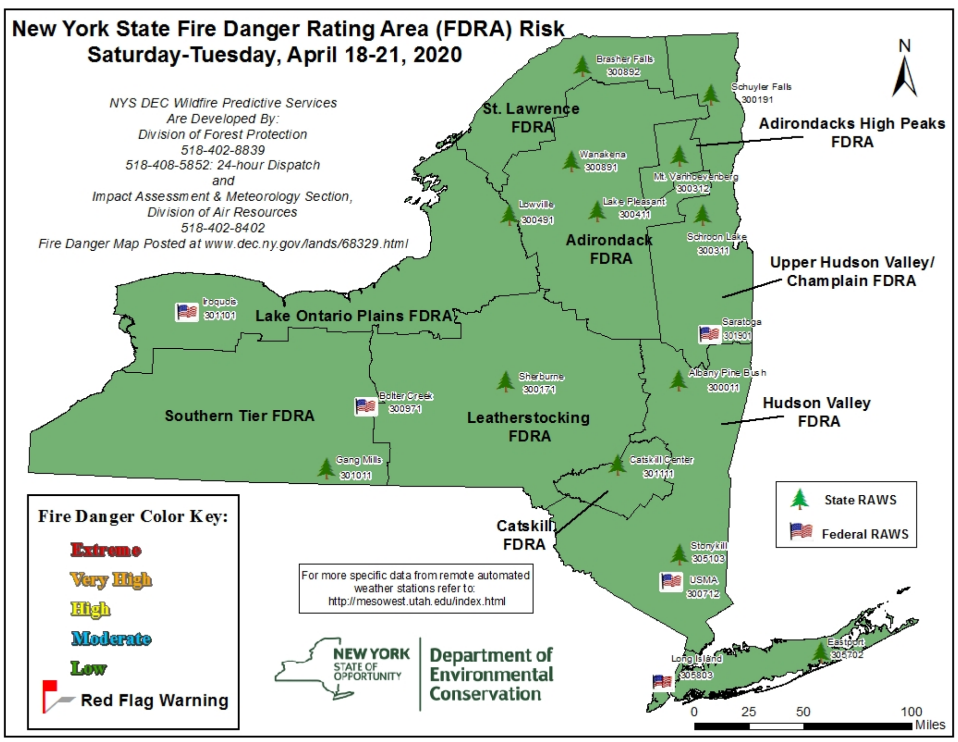
Table 5.4.10-1. Description of Fire Danger Ratings in New York State

Adjective Rating Class and Color Code	Class Description
Red Flag	A short-term, temporary warning, indicating presence of a dangerous combination of temperature, wind, relative humidity, fuel, or drought conditions that can contribute to new fires or rapid spread of existing fires. A Red Flag Warning can be issued at any Fire Danger level.
Extreme (Red)	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious. Development into high- intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only

Adjective Rating Class and Color Code	Class Description
	effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.
Very High (orange)	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
High (yellow)	All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly, and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Moderate (blue)	Fires can start from most accidental causes, but except for lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy.
Low (green)	Fuels do not ignite readily from small firebrands, although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.

Source: NYS DEC 2020

Figure 5.4.10-1. New York State Fire Danger Rating Areas



Source: NYSDEC 2020

Location

Chenango County is a significantly forested County that exhibits characteristics that make it prone to fires (NYSDEC 2020). In New York State, NYSDEC's Division of Forest Protection (Forest Ranger Division) is designated as the State's lead agency for wildfire mitigation. The Division has fought fires and retained records for more than 125 years. Over the past 25 years (1993-2017), Division records indicate that rangers suppressed 5,423 wildfires that burned a total of 52,580 acres (NYSDEC 2018). Currently, more than 1,700 fire departments respond to an average of 5,400 wildfires each year. The Forest Ranger Division (which is separate from the Fire Danger Rating Area) for Chenango County is Region 7. The boundaries of the Fire Danger Rating Areas do not match the Forest Ranger Division boundaries displayed in Figure 5.4.10-2.

Chenango County has a robust network of forests, some of which are in the form of State forest land and others that are in private ownership. Altogether there are over 79,959 acres of State-owned public space (Chenango County Parks & Recreation 2013).

According to tax records analyzed in the Chenango County Comprehensive Plan, forest lands cover 112,777 acres (176 square miles) of land area. This comprises just over 19 percent of the County. The actual proportion of tree cover may be higher due to clusters of trees on other property types. Refer to Table 4-2 in Section 4 (County Profile) for the acreage of land use types in the county.

Table 5.4.10-2 below, adapted from the Chenango County Comprehensive Plan, describes the extent of State Forest in each municipality. The Towns of Pharsalia, German, McDonough, and Lincklaen each have total acreages in excess of 30 percent of land area.

Table 5.4.10-2. Acreage of State Forest by Municipality

Town	Town Acreage	Acreage of State Forest	% of Total Acreage
Afton	29,824	3,881.14	13.01
Bainbridge	23,488	386.01	1.64
Columbus	24,576	1,444.03	5.88
Coventry	31,744	3,396.21	10.7
German	18,368	6,938.12	37.77
Greene	50,368	438.61	0.87
Guilford	39,872	1,751.69	4.39
Lincklaen	17,024	5,241.94	30.79
McDonough	25,280	8,025.38	31.75
New Berlin	29,440	2,783.69	9.46
North Norwich	18,304	1,194.95	6.53
Norwich	27,584	23.63	0.09
Otselic	24,960	7,424.65	29.75
Oxford	39,424	2,765.40	7.01
Pharsalia	25,408	12,879.79	50.69
Pitcher	18,368	3,008.05	16.38
Plymouth	27,392	3,829.46	13.98
Preston	22,592	1,673.90	7.41
Sherburne	28,544	1,449.12	5.08
Smithville	32,512	8,418.89	25.89
Smyrna	27,456	3,991.98	14.54
Chenango County	**582,528**	**80,946.64**	**13.9**

Source: Chenango County Comprehensive Plan, 2016

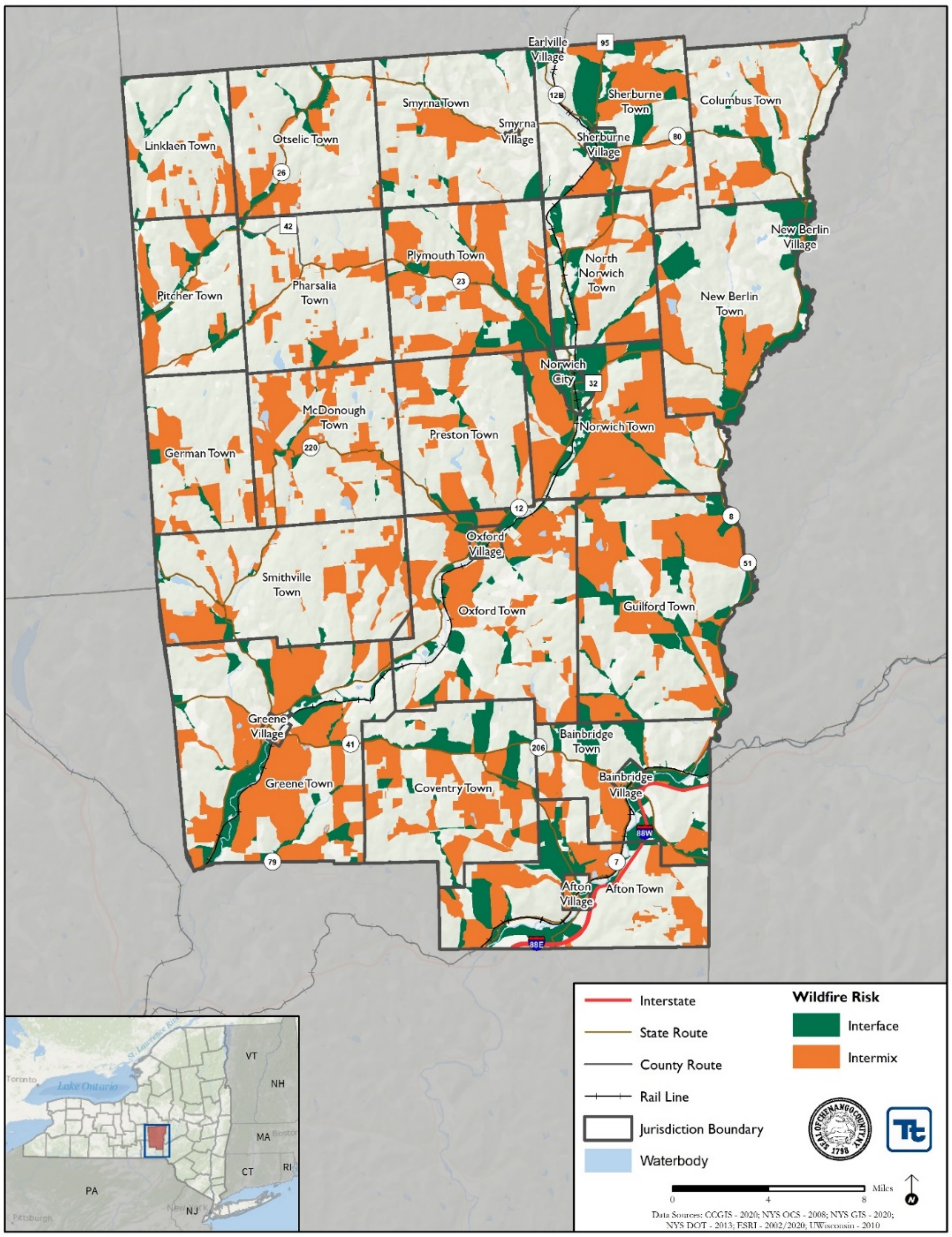
The wildland-urban interface (WUI) is the area where houses and wildland vegetation meet or intermingle, and where wildfire problems are most pronounced (Radeloff et al 2018). A detailed WUI, divided into Interface and Intermix areas, defines the wildfire hazard area for Chenango County. Intermix WUI are areas where housing and vegetation intermingle; interface WUI are areas with housing in the vicinity of contiguous wildland vegetation. This data was obtained through the SILVIS Laboratory, Department of Forest Ecology and Management, University of Wisconsin – Madison. Approximately 10 percent of the county's land area is within the WUI interface and 26.9 percent of the county's land is within the WUI intermix. The table below shows the value and percent of the WUI, changes since 1990, and its relation to the rest of the County.

Table 5.4.10-3. Wildland-Urban Interface Area and Changes Since 1990

	2010 Total (Sq. Mi)	# Change Since 1990 (Sq. Mi)	% of Change	% of County Land Area
Intermix WUI	242.1	75.5	45.30%	26.9%
Interface WUI	92.0	17.0	22.60%	10.2%
WUI Total	**334.1**	**92.5**	**38.20%**	**37.2%**
Non-WUI	**564.5**	**-92.5**	**-14.00%**	**62.8%**

Source: SILVIS Laboratory, Department of Forest Ecology and Management, University of Wisconsin – Madison

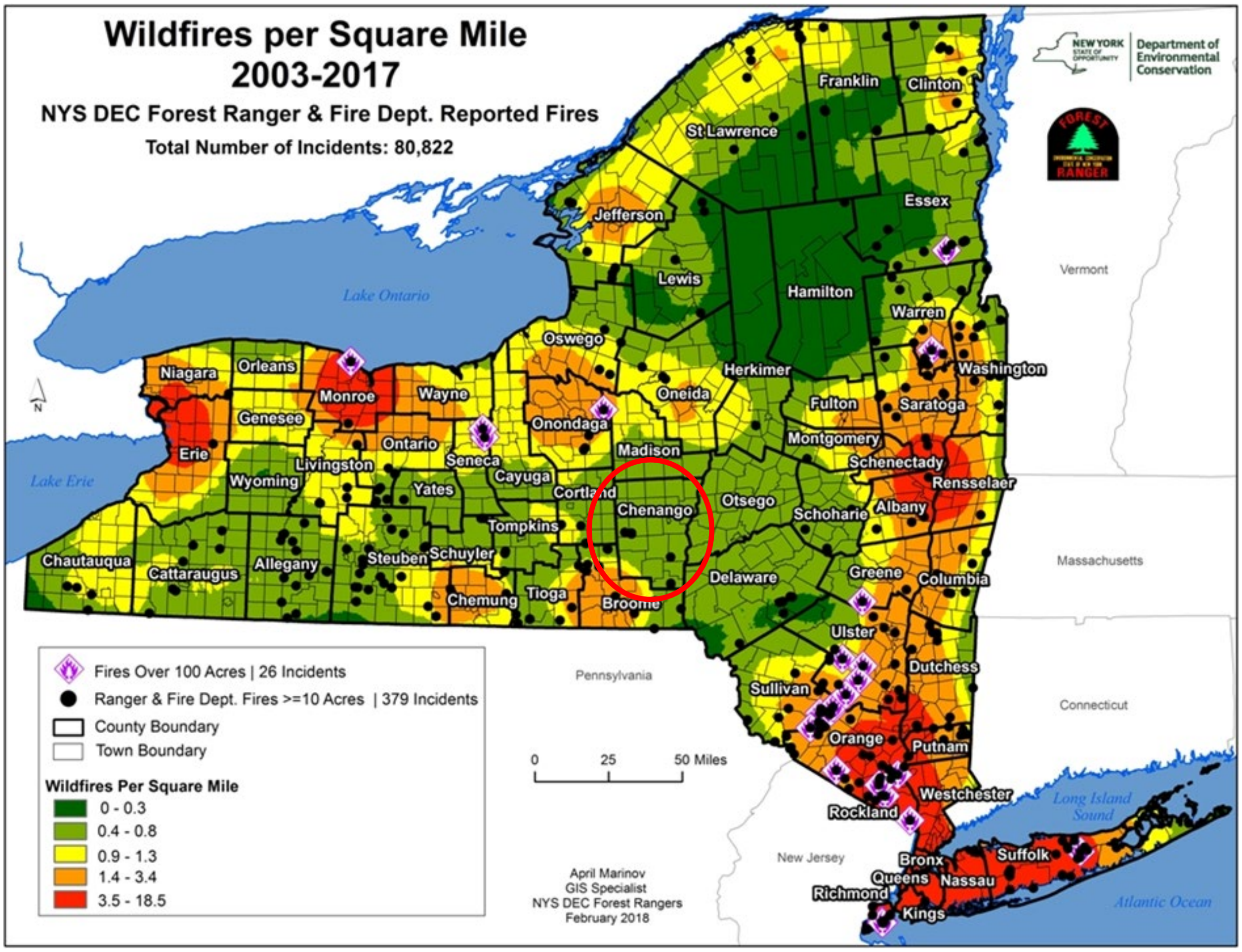
Figure 5.4.10-2. Wildland Urban Interface and Intermix in Chenango County



Previous Occurrences and Losses

Determinations of wildfire occurrences in New York State are based on two data sources: the New York State Forest Ranger force, and the New York State Office of Fire Prevention and Control (NYS OFP&C). Figure 5.4.10-3 illustrates occurrences of wildfires in the State between 2003 and 2017. This figure reveals occurrences of between 0.4 and 0.8 wildfires per square mile from 2003 to 2017 within Chenango County municipalities. The southwest section of the County in the Town of Greene has had a greater extent of occurrences owing to its proximity to Broome County, which faces more recent fire damage. The majority of these fires are small brush fires.

Figure 5.4.10-3. Wildfire Occurrences in New York State, 2003-2017



Source: NYSDEC 2020
Note: The red oval indicates the location of Chenango County.

FEMA Disaster Declarations

Between 1954 and 2020, NYS was not included in any wildfire-related major disaster (DR) or emergency (EM) declarations (FEMA 2020).

USDA Disaster Declarations

Between 2012 and 2020, Chenango County was included in the following USDA Disaster Designations for wildfire:

Table 5.4.10-4. USDA Declarations

Designation Number	Event Date	Declaration Date	Incident Type	Title
S4031	July 12, 2016	September 7, 2016	Fire, Wildfire	Drought – Fast Track

Source:USDA 2020

Previous Events

Between 1950 and 2020, Chenango County has not experienced any major wildfire events (NOAA-NCEI 2021).

Climate Change Projections

Climate change directly and indirectly affects growth and productivity of forests: directly as a result of changes in atmospheric carbon dioxide and climate, and indirectly through complex interactions within forest ecosystems. Climate also affects frequency and severity of many forest disturbances, such as infestations, invasive species, wildfires, and storm events. Extreme heat events and heat waves are also projected to increase, as listed in Table 5.4.10-5. below. As temperatures increase, suitability of a habitat for specific types of trees changes. Prolonged heat waves are likely to generate a greater number of wildfires. Stronger winds from larger storms may lead to more fallen branches for wildfires to consume. Increases in rain and snow events prime forests for fire by supporting growth of more fuel. Drought and warmer temperatures lead to drier forest fuels (NYS DHSES 2019).

Table 5.4.10-5. Extreme Event Projections for Region 3

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)	15	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: NYSERDA 2014

Fire potential depends on climate variability, local topography, and human intervention. Climate change can affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot, dry spells create highest fire risk. With temperatures increasing in NYS, wildfire danger may intensify with warming and drying of vegetation. When climate alters fuel loads and fuel moisture, susceptibility of forest 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.

Probability of Future Occurrences

Nationally, wildfire risk is increasing. Wildfire experts point to four reasons why wildfire risks are increasing:

- The way forests were handled in the past allowed fuel in the form of fallen leaves, branches and plant growth, to accumulate. Now this fuel is lying around the forest with potential to "feed" a wildfire.
- Increasingly hot, dry weather has occurred and will occur within the United States.
- Weather patterns across the country are changing.
- More homes are built within areas of WUI, meaning that homes are built closer to wildland areas where wildfires can occur (NYS DHSES 2014).

According to the NYS Forest Ranger Division, between 1993 and 2017 more than half of all fire department-response to wildfires occurred between March and May. Beginning in 2010, NYS enacted revised open burning regulations that ban brush burning statewide during this time period. Forest ranger data indicate that this new statewide ban resulted in 46 percent fewer wildfires caused by debris burning in upstate New York from 2010 to 2017 (NYS DEC 2020).

In Chenango County, brush fire events will continue to occur with some regularity. The likelihood of one of those fires attaining significant size and intensity cannot be predicted and is highly dependent on environmental conditions and firefighting response. However, advanced methods of wildfire management and better understanding of fire ecosystems should reduce the number of devastating fires in the future (NYSDEC 2020). Invasive forest insects can increase the likelihood of wildfires occurring; insects that attack and kill trees, such as Emerald Ash Borer, increase the total wildfire fuel available in wooded areas. Climate change is also likely to increase the probability of future wildfires. Prolonged periods of drought caused by climate change can potentially increase the length of the wildfire season and provide a more favorable climate for ignition.

In Section 5.3, the ranking of identified hazards of concern for Chenango County is provided. The probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records and input from the Planning Committee, the probability of occurrence for wildfire in the county is considered 'occasional' (between 10 and 100% chance of occurring annually).

5.4.10.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed and vulnerable in the identified hazard area. A spatial analysis was conducted using the University of Wisconsin 2010 wildland-urban interface/intermix spatial layer. For the purposes of the assessment, an asset (population, structures, critical facilities, and lifelines) is considered exposed and potentially vulnerable to the wildfire hazard if it is located in the wildland-urban interface or wildland-urban intermix hazard areas.

Impact on Life, Health and Safety

Wildfires have the potential to impact human health and life of residents and responders, structures, infrastructure, and natural resources. The most vulnerable populations include 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. Table 5.4.10-6 summarizes the estimated population exposed to the wildfire hazard by jurisdiction.

Based on the analysis, an estimated 37,152 residents, or approximately 76.8-percent of the County's population, are located in the wildland-urban interface/intermix hazard areas. Overall, the Town of Norwich has the greatest number of individuals located in the wildfire hazard areas (i.e., 6,181 persons).

Of the population exposed, the most vulnerable include the economically disadvantaged and the population over age 65. In Chenango County, approximately 9,539 people over the age of 65 and 6,826 people below the poverty level (American Community Survey 2018). Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on net economic impacts on their families. The population over age 65 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. 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. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility.

Table 5.4.10-6. Estimated Population Located in the Wildland-Urban Interface/Intermix Hazard Areas in Chenango County

Jurisdiction	American Community Survey (2014-2018) Population	Estimated Population Exposed				
		Wildland-Urban Interface	Percent of Total	Wildland-Urban Intermix	Percent of Total	Total Wildland- Urban Interface/Intermix (WUI)
Afton (T)	1,767	668	37.8%	652	36.9%	1,320
Afton (V)	986	564	57.2%	418	42.4%	982
Bainbridge (T)	1,756	864	49.2%	527	30.0%	1,391
Bainbridge (V)	1,442	1,194	82.8%	248	17.2%	1,442
Columbus (T)	903	196	21.7%	217	24.0%	413
Coventry (T)	1,601	490	30.6%	693	43.3%	1,184
Earlville (V)	577	573	99.3%	0	0.0%	573
German (T)	385	39	10.0%	185	48.0%	223
Greene (T)	3,526	740	21.0%	1,828	51.8%	2,568
Greene (V)	1,704	75	4.4%	183	10.7%	258
Guilford (T)	2,834	1,126	39.7%	1,068	37.7%	2,194
Lincklaen (T)	366	78	21.4%	95	25.9%	173
McDonough (T)	773	65	8.5%	554	71.7%	619
New Berlin (T)	1,618	557	34.4%	500	30.9%	1,056
New Berlin (V)	927	731	78.9%	180	19.4%	911
North Norwich (T)	1,558	703	45.1%	497	31.9%	1,200
Norwich (C)	3,802	3,800	99.96%	0	0.0%	3,800
Norwich (T)	6,813	2,633	38.6%	3,548	52.1%	6,181
Otselic (T)	910	242	26.6%	361	39.7%	603
Oxford (T)	2,325	395	17.0%	1,137	48.9%	1,531
Oxford (V)	1,430	879	61.5%	541	37.8%	1,420
Pharsalia (T)	632	62	9.9%	361	57.2%	424
Pitcher (T)	708	257	36.3%	198	27.9%	455
Plymouth (T)	1,806	423	23.4%	998	55.3%	1,421
Preston (T)	1,089	114	10.5%	482	44.3%	596
Sherburne (T)	1,896	575	30.3%	745	39.3%	1,320
Sherburne (V)	1,414	1,168	82.6%	246	17.4%	1,414
Smithville (T)	1,451	273	18.8%	683	47.0%	956
Smyrna (T)	1,119	198	17.7%	326	29.1%	524
Smyrna (V)	230	0	0%	0	0.0%	0
Chenango County (Total)	**48,348**	**19,683**	**40.7%**	**17,469**	**36.1%**	**37,152**

Source: American Community Survey 2018 (ACS 2014-2018); University of Wisconsin, 2010
Notes: T = Town, V = Village,

Impact on General Building Stock

The most vulnerable structures to wildfire events are those within the wildland-urban interface/intermix hazard area. Buildings constructed of wood or vinyl siding are generally more likely to be impacted by the fire hazard than buildings constructed of brick or concrete. To estimate the buildings exposed to the wildfire hazard, the wildland-urban interface/intermix hazard areas were overlaid upon the updated building inventory at the structure level. The replacement cost value of the structures with their center in the wildland-urban interface and intermix hazard areas were totaled (refer to Table 5.4.10-7.). Overall, 22,478 buildings with a replacement cost value of $15.8 billion is exposed to the wildfire hazard areas in Chenango County.

Table 5.4.10-7. Building Stock Replacement Cost Value and Building Count within the Wildland-Urban Interface Hazard Area in Chenango County

			Estimated Building Stock Exposed									
Jurisdiction	Number of Buildings	Total Replacement Cost Value (RCV)	Number of Buildings – Wildland-Urban Interface	Percent of Total	Replacement Cost Value (RCV) of Buildings – Wildland-Urban Interface	Percent of Total	Number of Buildings – Wildland-Urban Intermix	Percent of Total	Replacement Cost Value (RCV) of Buildings – Wildland-Urban Intermix	Percent of Total	Total Buildings in Wildland - Urban Interface/Intermix (WUI)	Total Replacement Cost Value (RCV) in Wildland- Urban Interface/Intermix (WUI)
Afton (T)	1,609	$864,699,700	613	38.1%	$315,947,573	36.5%	551	34.2%	$311,883,774	36.1%	1,164	$627,831,346
Afton (V)	531	$1,019,188,804	306	57.6%	$790,093,339	77.5%	216	40.7%	$152,981,515	15.0%	522	$943,074,854
Bainbridge (T)	1,493	$915,529,770	697	46.7%	$417,015,598	45.5%	451	30.2%	$226,784,208	24.8%	1,148	$643,799,806
Bainbridge (V)	697	$584,957,184	588	84.4%	$490,581,424	83.9%	109	15.6%	$94,375,760	16.1%	697	$584,957,184
Columbus (T)	748	$862,354,994	135	18.0%	$159,867,334	18.5%	155	20.7%	$84,222,137	9.8%	290	$244,089,471
Coventry (T)	1,255	$703,237,371	346	27.6%	$178,094,879	25.3%	531	42.3%	$271,888,408	38.7%	877	$449,983,287
Earlville (V)	155	$87,153,360	153	98.7%	$85,604,735	98.2%	0	0%	$0	0%	153	$85,604,735
German (T)	395	$203,106,925	44	11.1%	$19,479,982	9.6%	186	47.1%	$75,596,547	37.2%	230	$95,076,529
Greene (T)	2,711	$1,319,736,091	599	22.1%	$312,079,173	23.6%	1,351	49.8%	$543,204,583	41.2%	1,950	$855,283,756
Greene (V)	700	$686,754,321	28	4.0%	$14,602,199	2.1%	82	11.7%	$81,098,666	11.8%	110	$95,700,865
Guilford (T)	1,963	$1,010,987,220	783	39.9%	$421,398,929	41.7%	717	36.5%	$324,004,333	32.0%	1,500	$745,403,262
Lincklaen (T)	398	$229,671,722	75	18.8%	$34,354,690	15.0%	90	22.6%	$32,105,901	14.0%	165	$66,460,591
McDonough (T)	807	$339,089,552	73	9.0%	$30,980,387	9.1%	551	68.3%	$219,932,560	64.9%	624	$250,912,948
New Berlin (T)	1,225	$778,713,525	428	34.9%	$376,734,490	48.4%	345	28.2%	$151,255,237	19.4%	773	$527,989,727
New Berlin (V)	411	$432,605,770	327	79.6%	$390,072,265	90.2%	77	18.7%	$40,049,620	9.3%	404	$430,121,885
North Norwich (T)	1,121	$823,054,726	509	45.4%	$294,879,495	35.8%	324	28.9%	$166,698,358	20.3%	833	$461,577,853
Norwich (C)	2,503	$3,140,959,099	2,469	98.6%	$2,912,911,744	92.7%	0	0%	$0	0%	2,469	$2,912,911,744
Norwich (T)	2,013	$2,080,430,801	835	41.5%	$927,113,283	44.6%	934	46.4%	$664,712,865	32.0%	1,769	$1,591,826,147
Otselic (T)	741	$461,373,250	202	27.3%	$140,692,043	30.5%	267	36.0%	$148,760,881	32.2%	469	$289,452,924
Oxford (T)	1,731	$958,330,880	310	17.9%	$219,767,698	22.9%	760	43.9%	$316,831,538	33.1%	1,070	$536,599,236
Oxford (V)	648	$679,367,779	404	62.3%	$498,395,802	73.4%	235	36.3%	$170,627,867	25.1%	639	$669,023,668
Pharsalia (T)	583	$389,863,952	57	9.8%	$33,992,193	8.7%	284	48.7%	$146,924,943	37.7%	341	$180,917,135
Pitcher (T)	609	$315,344,531	212	34.8%	$110,157,991	34.9%	162	26.6%	$77,783,980	24.7%	374	$187,941,971
Plymouth (T)	1,244	$510,829,645	303	24.4%	$129,598,409	25.4%	663	53.3%	$256,298,180	50.2%	966	$385,896,589
Preston (T)	782	$348,948,426	84	10.7%	$32,941,678	9.4%	331	42.3%	$130,393,620	37.4%	415	$163,335,297

Jurisdiction	Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Building Stock Exposed									
			Number of Buildings – Wildland-Urban Interface	Percent of Total	Replacement Cost Value (RCV) of Buildings – Wildland-Urban Interface	Percent of Total	Number of Buildings – Wildland-Urban Intermix	Percent of Total	Replacement Cost Value (RCV) of Buildings – Wildland-Urban Intermix	Percent of Total	Total Buildings in Wildland - Urban Interface/Intermix (WUI)	Total Replacement Cost Value (RCV) in Wildland- Urban Interface/Intermix (WUI)
Sherburne (T)	1,463	$1,113,221,738	420	28.7%	$223,665,889	20.1%	513	35.1%	$205,695,116	18.5%	933	$429,361,005
Sherburne (V)	611	$768,785,678	515	84.3%	$698,812,660	90.9%	85	13.9%	$31,488,906	4.1%	600	$730,301,566
Smithville (T)	1,032	$690,983,617	186	18.0%	$199,039,800	28.8%	447	43.3%	$212,230,482	30.7%	633	$411,270,282
Smyrna (T)	842	$519,858,907	147	17.5%	$80,359,187	15.5%	213	25.3%	$84,305,350	16.2%	360	$164,664,537
Smyrna (V)	99	$161,456,951	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%	0	$0
Chenango County (Total)	**31,120**	**$23,000,596,289**	**11,848**	**38.1%**	**$10,539,234,867**	**45.8%**	**10,630**	**34.2%**	**$5,222,135,335**	**22.7%**	**22,478**	**$15,761,370,202**

Source: Chenango County GIS, 2020; University of Wisconsin, 2010
Notes: T = Town, V = Village; C= City

Impact on Critical Facilities

It is recognized that a number of critical facilities are located in the wildfire hazard area and are also vulnerable to the threat of wildfire. Majority of the critical facilities exposed to the wildland-urban interface/intermix hazard areas are government facilities, potable water and wastewater facilities. Table 5.4.10-8 summarizes the number of critical facilities and lifelines within the wildfire hazard areas by jurisdiction. Overall, 314 critical facilities are exposed to the wildland-urban interface/intermix hazard areas. 307 of the critical facilities are considered lifelines for the County. The City of Norwich has the greatest number of critical facilities built in the wildland-urban interface/intermix hazard areas (i.e., 43). The exposed lifelines are categorized into FEMA lifeline groupings and are summarized in Table 5.4.10-8 and Table 5.4.10-9. Additionally, the distribution of critical facilities exposed to the wildfire hazard areas by critical facility type are shown in Table 5.4.10-11.

Table 5.4.10-8. Critical Facilities and Lifelines in the Wildland-Urban Interface Hazard Areas in Chenango County

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Exposed to Wildfire Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Afton (T)	10	10	9	90.0%	9	90.0%
Afton (V)	16	16	16	100.0%	16	100.0%
Bainbridge (T)	8	8	3	37.5%	3	37.5%
Bainbridge (V)	23	22	23	100.0%	22	95.7%
Columbus (T)	7	6	3	42.9%	3	42.9%
Coventry (T)	20	20	13	65.0%	13	65.0%
Earlville (V)	4	4	4	100.0%	4	100.0%
German (T)	5	5	0	0.0%	0	0.0%
Greene (T)	14	14	9	64.3%	9	64.3%
Greene (V)	25	24	5	20.0%	5	20.0%
Guilford (T)	16	16	11	68.8%	11	68.8%
Lincklaen (T)	1	1	1	100.0%	1	100.0%
McDonough (T)	13	13	8	61.5%	8	61.5%
New Berlin (T)	15	15	13	86.7%	13	86.7%
New Berlin (V)	24	23	24	100.0%	23	95.8%
North Norwich (T)	10	10	5	50.0%	5	50.0%
Norwich (C)	55	50	43	78.2%	40	72.7%
Norwich (T)	39	38	20	51.3%	19	48.7%
Otselic (T)	14	13	11	78.6%	10	71.4%
Oxford (T)	15	14	6	40.0%	6	40.0%
Oxford (V)	25	25	24	96.0%	24	96.0%
Pharsalia (T)	5	5	2	40.0%	2	40.0%
Pitcher (T)	1	1	1	100.0%	1	100.0%
Plymouth (T)	23	23	10	43.5%	10	43.5%
Preston (T)	17	17	10	58.8%	10	58.8%
Sherburne (T)	16	16	8	50.0%	8	50.0%
Sherburne (V)	23	23	20	87.0%	20	87.0%
Smithville (T)	28	28	7	25.0%	7	25.0%
Smyrna (T)	102	102	5	4.9%	5	4.9%
Smyrna (V)	5	5	0	0.0%	0	0.0%
Chenango County (Total)	**579**	**567**	**314**	**54.2%**	**307**	**53.0%**

Source: Chenango County GIS 2020; University of Wisconsin, 2010
Notes: T= Town; V=Village; C=City

Table 5.4.10-9. Critical Facilities and Lifelines in the Wildland-Urban Intermix Hazard Areas in Chenango County

Jurisdiction	Facility Types																					
	Convenience Store	Dam	Electrical Substation	Fire Station	Fire/EMS	Gas Station/ Convenience Store	Hazmat	Levee	Major Employer	Medical Facility	Municipal Hall	Natural Gas Well	Police Station	Potable Water Well	Reservoir	School	Senior Center	Shelter	Supermarket	Water Pump House	Water Tank	Water Treatment Facility
Afton (T)	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Afton (V)	0	0	0	0	0	0	0	0	1	1	1	0	1	1	2	1	0	2	0	0	0	1
Bainbridge (T)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Bainbridge (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	0
Columbus (T)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Coventry (T)	0	0	0	0	0	1	0	0	0	0	1	5	1	0	0	0	1	1	0	0	0	0
Earlville (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
German (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene (T)	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0
Greene (V)	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	1
Guilford (T)	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lincklaen (T)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
McDonough (T)	0	2	0	0	1	0	0	0	0	0	1	1	0	0	0	0	2	1	0	0	0	0
New Berlin (T)	0	0	1	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1
New Berlin (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0
North Norwich (T)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0
Norwich (C)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norwich (T)	0	2	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0
Otselic (T)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	1	1	0
Oxford (T)	0	1	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0
Oxford (V)	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	2	0
Pharsalia (T)	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Pitcher (T)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Plymouth (T)	0	0	0	0	1	0	0	0	0	0	1	7	0	0	0	0	0	1	0	0	0	0
Preston (T)	0	0	0	0	1	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0
Sherburne (T)	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Sherburne (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smithville (T)	0	0	0	0	1	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0

Jurisdiction	Convenience Store	Dam	Electrical Substation	Fire Station	Fire/EMS	Gas Station/ Convenience Store	Hazmat	Levee	Major Employer	Medical Facility	Municipal Hall	Natural Gas Well	Police Station	Potable Water Well	Reservoir	School	Senior Center	Shelter	Supermarket	Water Pump House	Water Tank	Water Treatment Facility
	Facility Types																					
Smyrna (T)	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
Smyrna (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chenango County (Total)	**1**	**6**	**5**	**1**	**6**	**2**	**2**	**1**	**7**	**1**	**8**	**37**	**2**	**6**	**3**	**5**	**5**	**10**	**2**	**1**	**8**	**4**

Source: Chenango County GIS 2020; University of Wisconsin, 2010
Notes: T= Town; V=Village; C=City

Table 5.4.10-10. Critical Facilities and Lifelines in the Wildland-Urban Interface Hazard Areas in Chenango County

Jurisdiction	Airport	Bus Station	College	Convenience Store	County Building	Dam	Electrical Substation	EOC	Fire Station	Fire/EMS	Gas Station/ Convenience Store	Hazmat	Heating Fuel	Kerosene	Levee	Major Employer	Medical Center	Medical Facility	Municipal Hall	Natural Gas Well	Police Station	Potable Water Well	Public Health Department	Reservoir	School	Senior Center	Shelter	Supermarket	Water Tank	Water Treatment Facility
	Facility Types																													
Afton (T)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0
Afton (V)	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
Bainbridge (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bainbridge (V)	0	0	0	1	0	0	1	0	0	1	2	1	0	0	1	2	0	0	2	0	1	2	0	0	1	0	1	1	0	2
Columbus (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Coventry (T)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Earlville (V)	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
German (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene (T)	1	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Guilford (T)	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0

Jurisdiction	Facility Types																													
	Airport	Bus Station	College	Convenience Store	County Building	Dam	Electrical Substation	EOC	Fire Station	Fire/EMS	Gas Station/ Convenience Store	Hazmat	Heating Fuel	Kerosene	Levee	Major Employer	Medical Center	Medical Facility	Municipal Hall	Natural Gas Well	Police Station	Potable Water Well	Public Health Department	Reservoir	School	Senior Center	Shelter	Supermarket	Water Tank	Water Treatment Facility
Lincklaen (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
McDonough (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Berlin (T)	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0
New Berlin (V)	0	0	0	1	0	0	1	0	0	1	3	0	0	0	0	2	0	0	2	0	1	3	0	0	0	3	1	1	1	1
North Norwich (T)	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norwich (C)	0	1	1	2	4	0	1	1	0	0	0	0	1	0	1	9	1	1	0	0	1	0	1	0	4	7	3	1	2	1
Norwich (T)	0	0	0	1	0	0	1	0	0	0	4	0	1	0	0	1	0	0	1	0	1	1	0	0	0	0	0	2	1	0
Otselic (T)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	1	2	0	0	0	0	0	0	0	0
Oxford (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Oxford (V)	0	0	0	2	0	0	0	0	0	1	1	0	1	0	0	0	0	1	2	0	1	3	0	0	1	0	2	0	0	2
Pharsalia (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pitcher (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plymouth (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Preston (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Sherburne (T)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0
Sherburne (V)	0	0	0	3	0	0	0	0	0	1	2	4	0	0	0	1	0	2	2	0	1	0	0	0	0	2	0	1	1	0
Smithville (T)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smyrna (T)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smyrna (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chenango County (Total)	**1**	**1**	**1**	**14**	**4**	**1**	**8**	**1**	**1**	**10**	**19**	**5**	**4**	**1**	**2**	**18**	**1**	**4**	**14**	**8**	**7**	**15**	**1**	**1**	**8**	**13**	**9**	**7**	**6**	**6**

Source: Chenango County GIS 2020; University of Wisconsin, 2010

Notes: T= Town; V=Village; C=City

Table 5.4.10-11. Lifelines Exposed to the Wildland-Urban Interface/Intermix Hazard Areas

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines Exposed to the Wildland Urban Interface (WUI) Hazard Area
Communications	2	2
Energy	226	63
Food, Water, Shelter	127	92
Hazardous Material	17	7
Health and Medical	45	36
Safety and Security	147	105
Transportation	3	2
County Total	**567**	**307**

Source: Chenango County GIS 2020; University of Wisconsin, 2010

Impact on Economy

Wildfire events can have major economic impacts on a community from the initial loss of structures and the subsequent loss of revenue from destroyed business and decrease in tourism. Wildfires can cost thousands of taxpayer dollars to suppress and control and can involve hundreds of operating hours on fire apparatus and thousands of volunteer man hours from the volunteer firefighters. There are also many direct and indirect costs to local businesses that excuse volunteers from working to fight these fires.

Impact on the Environment

According to the USGS, post-fire runoff polluted with debris and contaminates can be extremely harmful to ecosystem and aquatic life (USFS 2020). Studies show that urban fires in particular are more harmful to the environment compared to forest fires (USFS 2020). The age and density of infrastructure within Chenango County can exacerbate consequences of fires on the environment because of the increased amount of chemicals and contaminates that would be released from burning infrastructure. These chemicals, such as iron lead, and zinc, may leach into the storm water, contaminate nearby streams, and impair aquatic life.

Cascading Impacts on Other Hazards

Wildfires result in the uncontrolled destruction of forests, brush, field crops, grasslands, real estate, and personal property, and have secondary impacts on other hazards such as flooding, by removing vegetation and destroying watersheds. Additionally, wildfires can be increased with rising temperatures and increased droughts.

Wildfires can also impact the County's susceptibility to dam failures. Wildfires can damage the surface of dams and spillways, especially vegetation on embankment slopes or grass lining in spillway channel. They can also damage dam-associated facilities, power supplies, communication equipment, and access roads. More information about the drought, extreme temperature, and flood hazards of concern can be found in Section 5.4.2, Section 5.4.3 and Section 5.4.4, respectively.

Future Changes That May Impact Vulnerability

Understanding future changes that effect vulnerability in the County can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. Changes in the natural environment and built environment and how they interact can also provide insight about ways to plan for the future.

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth located in the wildland-urban interface/intermix hazard areas could be at risk. Refer to Figure 5.4.10-4 a countywide map of new development and wildfire and additionally, refer the maps in each jurisdictional annex (Section 9 of this HMP) to view the new development project areas and their proximity to the wildland-urban interface/intermix hazard areas.

Projected Changes in Population

According to the U.S. Census Bureau, the population in Chenango County has decreased by approximately 4.2-percent between 2010 and 2018 (US Census Bureau 2020). Estimated population projections provided by the 2017 Cornell Program on Applied Demographics indicates that the County's population will continue to decrease into 2040, decreasing the total population to approximately 41,123 persons (Cornell Program on Applied Demographics 2017). The population that remains in the county is vulnerable to wildfires. Refer to Section 4 (County Profile) for additional discussion on population trends.

Climate Change

As discussed above, most studies project that the State of New York will see an increase in average annual temperatures and precipitation. Changes in temperature can have an effect on how fire interacts with the surrounding natural habitat and built environment. Fire interacts with climate and vegetation (fuel) in predictable ways. Understanding the climate/fire/vegetation interactions is essential for addressing issues associated with climate change that include:

- Effects on regional circulation and other atmospheric patterns that affect fire weather
- Effects of changing fire regimes on the carbon cycle, forest structure, and species composition, and
- Complications from land use change, invasive species and an increasing wildland-urban interface (USFS 2020).

It is projected that higher summer temperatures will likely increase the high fire risk by 10- to 30-percent. Fire occurrence and/or area burned could increase across the U.S. due to the increase of lightning activity, the frequency of surface pressure and associated circulation patterns conductive to surface drying, and fire-weather conditions, in general, which is conductive to severe wildfires. Warmer temperatures will also increase the effects of drought and increase the number of days each year with flammable fuels and extending fire seasons and areas burned (USFS 2020).

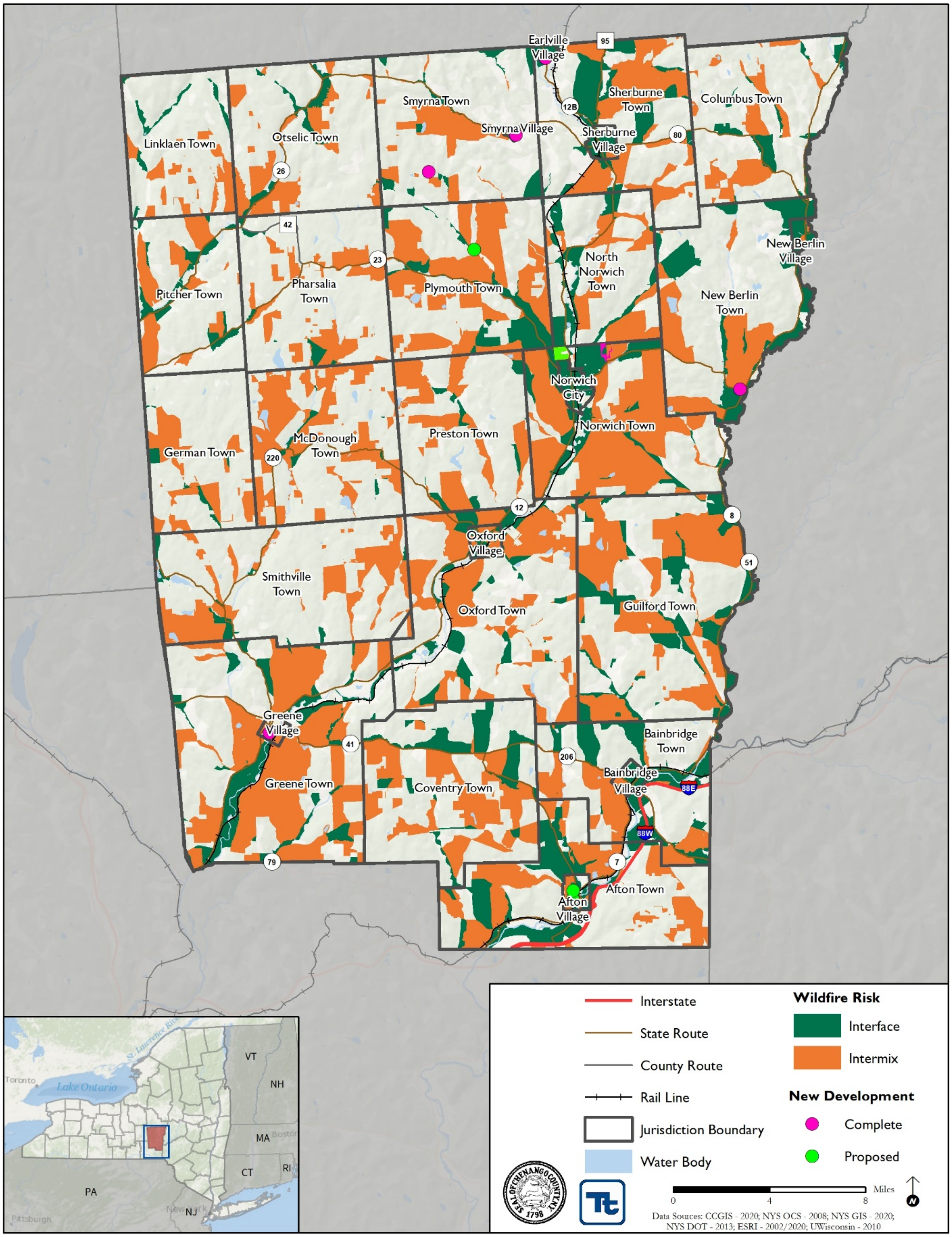
Future changes in fire frequency and severity are difficult to predict. Global and regional climate changes associated with elevated greenhouse gas concentrations could alter large weather patterns, thereby affecting fire-weather conducive to extreme fire behavior (USFS 2020).

Change of Vulnerability Since the 2015 HMP

For this hazard mitigation plan update, the 2010 Wildland-Urban Interface/Intermix data from the University of Wisconsin was referenced to determine areas within Chenango County that are vulnerable to wildfires. Population statistics have also been updated using the 5-Year 2014-2018 American Community Survey Population Estimates. The 2015 general building stock was updated using RS Means 2019 replacement cost values and updated parcel and tax assessment information. Additionally, the critical facility inventory was updated by Chenango County.

Overall, this vulnerability assessment uses a more accurate and updated building inventory which provides more accurate estimated exposure and potential losses for Chenango County.

Figure 5.4.10-4 New Development and Wildfire in Chenango County



SECTION 6. MITIGATION STRATEGIES

This section presents mitigation strategies for Chenango 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, which are presented herein.

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.

This section includes:

1. Background and Past Mitigation Accomplishments
2. General Mitigation Planning Approach
3. Review and Update of Mitigation Goals and Objectives
4. Capability Assessment
5. Mitigation Strategy Development and Update

6.1 BACKGROUND AND PAST MITIGATION ACCOMPLISHMENTS

In accordance with the requirements of the Disaster Mitigation Act of 2000, detailed on Page 1-1 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. Chenango County, through previous and ongoing hazard mitigation activities, has demonstrated that it is proactive in protecting its physical assets and citizens against losses from natural hazards. Examples of previous and ongoing actions and projects include the following:

- The County facilitated the development of the original 2008 "Chenango County All Hazards Mitigation Plan". The current planning process represents the regulatory five-year plan update process, which includes participation of all municipal governments in the County, along with key county and regional stakeholders. In 2018, the County received a $112,500 grant from the FEMA Pre-Disaster Mitigation program to update its Hazard Mitigation Plan.
- All municipalities participating in this Plan participate in the National Flood Insurance Program (NFIP), which requires the adoption of FEMA floodplain mapping and certain minimum construction standards for building within the floodplain. Further, Chenango County Code Enforcement Division of Public Health provides NFIP floodplain administration support for many of the municipalities in Chenango County under Memorandums of Understanding (MOU).
- In 2019, the County undertook a community health and health needs assessment. The assessment addressed the prevalence of obesity and substance abuse in the County as well as a number of health disparities. These disparities are aggravated by lack of transportation, senior citizen isolation and housing issues, lack of access t rehabilitation and specialty care facilities, and an imbalance in the number of health care providers.
- The County and municipalities have implemented mitigation actions to protect critical facilities and infrastructure throughout the planning area. As an example, the Highway Department maintains a multi-year, rotating program of roadway and culvert (drainage) maintenance and improvements to help mitigate stormwater damage to county roads.
- Numerous studies have been conducted by Federal, State, County and local agencies/entities to examine natural hazards affecting Chenango County, and have been reviewed and incorporated into this plan update as appropriate (see Section 3 and References).
- Chenango County was awarded a Clean Energy Communities Grant for $150,000 from NYSERDA to perform energy updates to the County's office building and reduce the carbon footprint. The County

has recently started working on another grant application for Clean Smart Communities and is working towards the Climate Smart Communities program.

- Municipalities in Chenango County have adopted regulatory standards regarding land-use and zoning that exceed minimum requirements and provide the communities with greater capability to manage development without increasing hazard risk and vulnerability. Examples of these standards are presented in the Capability Assessment subsection later in this chapter.
- The County has been incorporating flood risk reduction through stormwater management into its infrastructure and building improvement projects. All projects, especially in areas adjacent to waterways, are oversized to accommodate the potential of future flooding.

6.2 GENERAL MITIGATION PLANNING APPROACH

The overall approach used to update the County and local hazard mitigation strategies are based on FEMA and NYS 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), DATE.
- FEMA *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, January 2013.
- NYS DHSES *New York State Hazard Mitigation Planning Standards*, 2017.
- NYS DHSES *New York State Hazard Mitigation Planning Standards Guide*, 2017.

The mitigation strategy update approach includes the following steps that are further detailed in later subsections:

- 6.3 Review and update mitigation goals and objectives.
- 6.4 Identify mitigation capabilities and evaluate their capacity and effectiveness to mitigate and manage hazard risk.
- 6.5 Prepare an implementation strategy, including:
  - Identify progress on previous county and local mitigation strategies.
  - Develop updated county and local mitigation strategies.
  - Prioritize projects and initiatives in the updated mitigation strategy.

6.3 REVIEW AND UPDATE OF MITIGATION GOALS AND OBJECTIVES

This section documents the County’s efforts to develop hazard mitigation goals and objectives that are established to reduce or avoid long-term vulnerabilities to the identified hazards.

6.3.1 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 were developed based on the risk assessment results, discussions, research, and input from the committee, existing authorities, polices, programs, resources, stakeholders, and the public.

FEMA defines ***Goals*** as general guidelines that explain what should be achieved. Goals are usually broad, long-term, policy statements, and represent a global vision.

FEMA defines ***Objectives*** as strategies or implementation steps to attain mitigation goals. Unlike goals, objectives are specific and measurable, where feasible.

FEMA defines ***Mitigation Actions*** as specific actions that help to achieve the mitigation goals and objectives.

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 broad, long-term, policy-type statements that 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 as a subset for a goal. The objectives also are used to help establish priorities.

During the 2021 plan update process, the Steering Committee reviewed the goals and objectives established in the 2015 HMP in consideration of the hazard events and losses since the 2015 plan, the updated hazard profiles and vulnerability assessment, the goals and objectives established in the New York State 2019 HMP, and county and local risk management plans. The update incorporates direct input for how the County and municipalities need to move forward to best manage their hazard risk. Amendments include additions and edits to goals and objectives to express the planning partnership's interests in integrating this plan with other planning mechanisms/programs and to support mitigation through the protection and preservation of natural systems, including particular reference to certain goals and objectives in the New York State 2019 HMP update, as identified in the table below.

As a result of this review process, the Goals and Objectives for the 2021 update were amended, as presented in Table 6-1.

Table 6-1. Chenango County Hazard Mitigation Plan Goals

Goal Number	Goal Statement
G-1	Protect Life.
G-2	Protect Property.
G-3	Protect Economic Viability and Increase Resiliency of Residents and Businesses.
G-4	Protect the Environment and Promote Mitigation Actions that Emphasize Sustainable Construction and Design Measures.
G-5	Promote Hazard Mitigation Awareness and Education.
G-6	Develop and Implement Mitigation Strategies that use Public Funds in an Efficient and Cost-Effective Way.
G-7	Build Regional, County, and Local Collaborations across Mitigation Strategies to Develop Stronger Emergency Management Capabilities

Table 6-2. Chenango County Hazard Mitigation Plan Objectives

Objective Number	Objective Statement
O-1	Encourage hazard mitigation measures that result in the least adverse effect on the natural environment and that use natural processes. (Geared towards restoration – aimed more at existing construction)
O-2	Strengthen codes so that new construction can withstand the impacts of natural hazards and lessen the impact of that development on the environment's ability to absorb the impact of natural hazards. (Focused on new construction and codes that can affect land use – addresses both protecting the environment and assuring construction is hazard resistant, something also addressed in the next objective)
O-3	Prevent (or discourage) new development in hazardous areas or ensure that if building occurs in high-risk areas that it is done in such a way as to minimize risk
O-4	Integrate the recommendations of this plan into existing County and local plans/programs (incl. comprehensive and emergency operations plans).
O-5	Incorporate hazard considerations into land-use planning and natural resource management.
O-6	Seek partnership opportunities with stakeholders in hazard mitigation that will leverage resources and enhance opportunities to implement mitigation activities within the planning area.
O-7	Seek mitigation actions that will assist in protecting lives and property by making homes, businesses, infrastructure, and critical facilities more resistant to hazards.
O-8	Better characterize flood/stormwater hazard events by conducting additional hazard studies and identify inadequate stormwater facilities and poorly drained areas.
O-9	Develop or improve early warning emergency response systems and evacuation procedures (this is directly life safety)
O-10	Develop and implement additional education and outreach programs to increase public awareness of the risks associated with hazards and to educate the public on specific, individual mitigation, preparedness, and response and recovery activities.
O-11	Ensure continuity of government operations, emergency services, and essential facilities at the local level during and immediately after disaster and hazard events.
O-12	Strengthen inter-jurisdiction and inter-agency communication, coordination, and partnerships in all phases of emergency management.
O-13	Retrofit, purchase, or relocate structures in high hazard areas including those known to be repetitively damaged
O-14	Address long-term vulnerabilities from high hazard dams to • Ensure dam infrastructure is routinely inspected and maintained. • Ensure Emergency Action Plans are developed and updated. • Support the identification and access to funding to repair/replace dams.

Table 6-3. Chenango County Hazard Mitigation Plan Objectives

Obj. #	Objective Statement	Protect Life	Protect Property	Protect Economic Viability and Increase Resiliency	Protect the Environment/ Promote sustainable construction and design	Promote HM Education and Awareness	Develop & Implement Mitigation Strategies Using Public Funds Efficiently	Build Collaborations across Mitigation Strategies to Develop Stronger EM Capabilities
O-1	Encourage hazard mitigation measures that result in the least adverse effect on the natural environment and that use natural processes. (Geared towards restoration – aimed more at existing construction)		X		X		X	
O-2	Strengthen codes so that new construction can withstand the impacts of natural hazards and lessen the impact of that development on the environment's ability to absorb the impact of natural hazards. (Focused on new construction and codes that can affect land use – addresses both protecting the environment and assuring construction is hazard resistant, something also addressed in the next objective)	X	X		X			X
O-3	Prevent (or discourage) new development in hazardous areas or ensure that if building occurs in high-risk areas that it is done in such a way as to minimize risk	X	X	X			X	
O-4	Integrate the recommendations of this plan into existing County and local plans/programs (incl. comprehensive and emergency operations plans).	X		X	X	X		X
O-5	Incorporate hazard considerations into land-use planning and natural resource management.	X		X	X		X	X
O-6	Seek partnership opportunities with stakeholders in hazard mitigation that will leverage resources and enhance opportunities to implement mitigation activities within the planning area.			X			X	X
O-7	Seek mitigation actions that will assist in protecting lives and property by making homes, businesses, infrastructure, and critical facilities more resistant to hazards.	X	X	X		X		
O-8	Better characterize flood/stormwater hazard events by conducting additional hazard studies and identify inadequate stormwater facilities and poorly drained areas.				X	X		
O-9	Develop or improve early warning emergency response systems and evacuation procedures.	X				X		X
O-10	Develop and implement additional education and outreach programs to increase public awareness of the risks associated with hazards and to educate the public on specific, individual mitigation, preparedness, and response and recovery activities.	X	X			X	X	

Obj. #	Objective Statement	Protect Life	Protect Property	Protect Economic Viability and Increase Resiliency	Protect the Environment/ Promote sustainable construction and design	Promote HM Education and Awareness	Develop & Implement Mitigation Strategies Using Public Funds Efficiently	Build Collaborations across Mitigation Strategies to Develop Stronger EM Capabilities
O-11	Ensure continuity of government operations, emergency services, and essential facilities at the local level during and immediately after disaster and hazard events.	X		X				X
O-12	Strengthen inter-jurisdiction and inter-agency communication, coordination, and partnerships in all phases of emergency management.	X		X			X	X
O-13	Retrofit, purchase, or relocate structures in high hazard areas including those known to be repetitively damaged		X					
O-14	Address long-term vulnerabilities from high hazard dams to • Ensure dam infrastructure is routinely inspected and maintained. • Ensure Emergency Action Plans are developed and updated. • Support the identification and access to funding to repair/replace dams.	X	X	X	X	X	X	X

6.4 CAPABILITY ASSESSMENT

According to FEMA's *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 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 on undertaking actions.
- The range of local and state administrative, programmatic, regulatory, financial, and technical resources available to assist in implementing their mitigation actions.
- Actions deemed infeasible, as they are currently outside the scope of capabilities.
- Types of mitigation actions that could be technically, legally (regulatory), administratively, politically, or fiscally challenging or infeasible.
- Opportunities to enhance local capabilities to support long term mitigation and risk reduction.

During the plan update process, all participating jurisdictions were tasked with developing or updating their capability assessment, paying particular attention to evaluating the effectiveness of these capabilities in supporting hazard mitigation, and identifying opportunities to enhance local capabilities.

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 Section 9 (Jurisdictional Annexes). Within each annex, participating jurisdictions identified integration of hazard risk management into their existing planning, regulatory, and operational/administrative framework ("integration capabilities") and intended integration promotion (*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).

A summary of the various federal, state, county, and local planning and regulatory, administrative and technical, and fiscal programs available to promote and support mitigation and risk reduction in Broome County are presented below.

6.4.1 Planning and Regulatory Capabilities - 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 their jurisdictional annexes in Section 9 (Jurisdictional Annexes). The Chenango County Department of Planning and Development provides technical planning guidance and assistance to the County Board of Supervisors and implements projects and programs designed to improve the economy, environment, and physical infrastructure of the County.

Section 239 of New York State General Municipal Law requires the referral of certain local planning actions to the County planning agency or regional planning council. Certain actions include adoption or amendment of a comprehensive plan, adoption or amendments of a zoning ordinance or local law, issuance of special use permits, approval of site plans, use or area variances, or other authorizations under provisions of a zoning ordinance or local law, so long as those actions are within 500 feet of certain parameters including but not limited to State or County roads or highways, municipal boundaries, county or state parks, or the boundary of any farm located in an agricultural district.

The Chenango County Department of Planning and Development coordinates the Section 239 review process by accepting applications from municipal boards, referring to outside agencies for feedback if necessary, creating aerial maps of the location, sending applications to County Planning Board members, providing professional input, and sending corresponding decisions by the County Planning Board back to the referring municipality (Chenango County Department of Planning and Development 2019).

Land Use Planning

The County and municipalities have various land use planning mechanisms that can be leveraged to mitigate flooding and support natural hazard risk reduction. A summary of land use planning mechanisms currently in-place in each municipality is identified in the following table, in addition to within the Planning and Regulatory table in each municipal annex in Section 9.

Table 6-4. Land Use Plans and Regulations in Effect in Chenango County

	Building & Fire		Floodplain Law	County Floodplain Administrator	Junkyard / Junk Storage		Mobile Home	Refuse	Sanitary	Telecommunications	Road Use Agreement or Law	Site Plan Review	Subdivision	Zoning	Local Right to Farm	Comprehensive Plan
	(County)	(Local)														
Towns																
Afton	X		X		X			X	X	X	X	X	X			
Bainbridge	X		X	X	X			X	X	X		X	X			X
Columbus	X		X	X	X			X	X	X	X	X	X	E	X	X
Coventry	X		X	X	X			X	X	X		X	**		X	
German	X		X	X	X		X		X		X		X			
Greene		X	X		X		X	X	X	X		X	X			X
Guilford	X		X	X	X			X	X		X		X		X	X
Lincklaen	X		X	X	X		X		X			X	X			
McDonough	X		X	X	X						X				X	
New Berlin	X	X	X	X	X		X	X	X	X	X	X	X		X	X
North Norwich	X		X	X	X		X	X	X	X		X	X		X	
Norwich	X		X	X	X			X	X		X	X	X			
Otselic	X		X	X	X		X	X	X			X	X			
Oxford	X		X	X	Z		Z			Z	A	Z	X	X		X
Pharsalia	X		X	X	X			X	X		X					
Pitcher	X		X	X	X				X				X			
Plymouth	X		X	X	X	X		X	X	X			X		X	
Preston	X		X	X	X	X		X	X						X	
Sherburne	X		X	X	X	X		X	X		X	X	X		X	X
Smithville	X		X	X	X			X	X	X	X	X	X		X	X
Smyrna	X	X	X	X	X				X				X		X	X
Cities																
Norwich		X	X		X		X	X	X			X	X	X		X
Village																

	Building & Fire (County)	(Local)	Floodplain Law	County Floodplain Administrator	Junkyard / Junk Storage	Mobile Home	Refuse	Sanitary	Telecommunications	Road Use Agreement or Law	Site Plan Review	Subdivision	Zoning	Local Right to Farm	Comprehensive Plan
Afton	X		X		X	X	X	X			X	X	X		
Bainbridge	X		X	X	X	X	X	X	X		X	X	X		X
Earlville		X	X	X	X										X
Greene		X	X		Z	Z	X	X	X		X	X	X		X
New Berlin	X		X	X	X	X	X	X	X		X	X	X		
Oxford	X		X	X	Z	Z	X	X			Z	X	X		X
Sherburne	X		X	X	X	X	X	X							
Smyrna	X		X	X	X	X		X			X			X	X

Source: Chenango County Directory 2021
*** Subdivision regulations addressed in site plan regulations*
Z – Refer to Zoning Ordinances (For copies of these regulations, contact the Town/Village or City Clerk)
A – Refer to agreement
E – Town has laws or regulations regarding wind and solar installation.

6.4.2 Planning and Regulatory Capabilities – State and Federal

National Flood Insurance Program (NFIP)

The U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968 (FEMA's 2002 National Flood Insurance Program (NFIP): Program Description). The NFIP is a federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damages. Please refer to the Flood Hazard Profile in Section 5.4.2 (Flood) for information on recent legislation related to reforms to the NFIP.

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 insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. 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. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance (FEMA 2008).

All 30 municipalities in Chenango County actively participate in the NFIP. As of July 2019, there were 517 NFIP policies in the County. This represents a decrease from April 2015, when there were 709 policies-in-force. There have been 649 claims made, totaling over $11.2 million for damages to structures and contents. There are 215 NFIP Repetitive Loss (RL) properties in the County. Information in Severe Repetitive Loss (SRL) properties was not included in the data set used for this HMP Update. Further details on the County's flood vulnerability can be found in the flood hazard profile in Section 5.4.4 (Flood).

Municipal participation in and compliance with the NFIP is supported at the federal level by FEMA Region II and the Insurance Services Organization, at the state-level by the New York State Department of Environmental

Conservation (NYSDEC) and New York State Office of Emergency Management (NYS DHSES). Additional information on the NFIP program and its implementation throughout the County can be found in the flood hazard profile in Section 5.4.2 (Flood).

The state and municipalities within the NFIP could adopt higher regulatory standards when implementing the provisions of the NFIP. Specifically identified are the following:

Freeboard: By law, NYS requires Base Flood Elevation plus 2 feet (BFE+2) for all construction. When there is a base flood elevation available, the lowest floor including any basement, must be at or above the base flood elevation (plus two feet beginning in 2007). Elevation could be 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 in lieu of elevation. Where a local floodplain administrator has information to estimate a base flood elevation, 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 develop a base flood elevation and build accordingly (NYSDEC 2018). Communities could go beyond this requirement, providing for additional freeboard. In most New York communities, new structures must have the lowest floor three feet or more above the highest adjacent grade.

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 could issue a succession of permits for different repairs or improvement to the same structures. This can greatly increase the overall flood damage potential for structures within a community. The community might wish to deem *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 must meet flood protection requirements.

NFIP Community Rating System (CRS)

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. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: (1) reduce flood losses, (2) facilitate accurate insurance rating, and (3) promote the awareness of flood insurance (FEMA 2012). Municipalities, and the County as a whole, could expect significant cost savings on premiums if enrolled in the CRS programs. As of January 2021, there are no communities in Chenango County actively participating in the CRS program.

Southern Tier 8 Regional Board

The Southern Tier 8 is a regional planning agency that offers leadership support and technical assistance in project development, grant writing, program administration, and data analysis, with considerations for natural resources across the region. The Board operates under joint resolution of the legislative bodies of Chenango, Broome, Cortland, Delaware, Otsego, Schoharie, Tioga, and Tompkins Counties. The Board works with each county's planning departments and economic developers to prioritize federal investments across the region by supporting sustainable community programs and projects to improve local economies for residents and businesses. In 2018, the region developed a Comprehensive Economic Development Strategy Five Year Plan (2018-2022) to encourage community development and private-sector economic growth across the 8 counties.

New York State Floodplain Management

The following two departments have statutory authorities and programs that affect floodplain management at the local jurisdiction level in New York State: the NYSDEC and the Department of State's Division of Code

Enforcement and Administration (DCEA). DCEA is detailed in Section 6.4.4 (Administrative and Technical Capabilities - State and Federal).

The NYSDEC is charged with conserving, improving, and protecting the state's natural resources and environment, and preventing, abating, and controlling water, land, and air pollution. Programs that have bearing on floodplain management are managed by 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 and both structural and nonstructural means.

The Dam Safety Section is responsible for "reviewing repairs and modifications to dams and assuring [sic] that dam owners operate and maintain dams in a safe condition through inspections, technical reviews, enforcement, and emergency planning." The Flood Control Projects Section is responsible for reducing flood risk to life and property through construction, operation, and maintenance of flood control facilities.

The Floodplain Management Section is responsible for reducing flood risk to life and property through management of activities, such as development in flood hazard areas, and for reviewing and developing revised flood maps. The section serves as the NFIP State Coordinating Agency and in this capacity, is the liaison between FEMA and New York communities that elect to participate in the NFIP. The section provides a wide range of technical assistance.

Stormwater Management Planning

When proper controls are not in place, research studies show a clear link between urbanization and increased flooding and pollutant export. The goal of stormwater management is to ensure that the quantity and quality of stormwater runoff from a site that is undergoing construction or development should not be substantially altered from its pre-development conditions (NYSDEC 2015).

The control of stormwater runoff is a national priority. A federal regulation, commonly known as Stormwater Phase II, requires permits for stormwater discharges from Municipal Separate Storm Sewer Systems (MS4s) in urbanized areas and for construction activities disturbing one or more acres. To implement the law, the NYS Department of Environmental Conservation has issued two general permits: one for MS4s in urbanized areas and one for construction activities. The permits are part of the State Pollutant Discharge Elimination System (SPDES). Municipal officials are working hard at the local level to protect water resources through better stormwater management. Throughout Central New York, municipalities are making provisions to allow the use of permeable paving materials on public projects when conditions are appropriate. Developers are being asked to incorporate more green spaces in new developments and to avoid disturbing existing vegetation that naturally slows and infiltrates stormwater runoff. Municipal turf management programs no longer rely on the routine use of pesticides and chemical fertilizers. Roadway maintenance crews routinely remove trash and debris from storm drains and culverts. This reduces stormwater backups, road hazards, and the threat of flooding. These efforts are designed to improve water resources through the control of stormwater runoff.

6.4.3 Administrative and Technical Capabilities - County and Local

Chenango County Department of Planning and Development (CCDPD)

The mission of the CCDPD is to improve the quality of life in Chenango County by providing professional services and programs that promote economic vitality, environmental integrity and strong communities.

The CCDPD coordinates the Section 239 review process by accepting applications from municipal boards, referring to outside agencies for feedback if necessary, creating aerial maps of the location, sending applications to County Planning Board members, providing professional input, and sending corresponding decisions by the County Planning Board back to the referring municipality (Chenango County Department of Planning and Development 2019).

The Department is also responsible for providing training to local planning and zoning board members, who are required to have at least four hours of training each year to serve on their boards. The Department invoices local government trainers from the New York State Department of State to come to the County and provide training.

The Department provides flood information on their website (https://www.co.chenango.ny.us/planning/flood-information/) and maintains copies of county flood maps at their office.

The CCDPD led the update of the 2021 HMP and represented the department on the Steering Committee and identified as the point of contact for the Chenango County annex (Section 9.1).

Chenango County Bureau of Fire & Emergency Management and City of Norwich Emergency Management

The mission of the Chenango County Bureau of Fire and all of its staff is to enhance and improve the overall Fire and EMS operations and safety in Chenango County by providing staff services such as training, fire investigation, supervision of Emergency Medical Services, fire protection programs, technical support (such as Hazardous Materials, Dive, High Angle and Search & Rescue teams), public relations and Communications guidance and support for all Fire and EMS agencies of Chenango County. For the purpose of this HMP, representatives from the County Bureau of Emergency Management and from City of Norwich Emergency Management participated on the Steering Committee and provided data and information about hazard risk and informing the mitigation strategy.

> Chenango County Bureau of Fire and Emergency Management keeps Emergency Action Plans (EAPs) for dams located in the County. Additionally, all NYSDEC Dam Safety inspection reports are sent to the Bureau as well.

The Bureau of Fire's role also serves as the Emergency Management agency for the County. The staff operates the EOC during planned and emergency incidents and fills various functions during the activation, response, recovery and mitigation phase of disasters by coordinating planning efforts, response, resource acquisition and tracking and mitigation planning for all the respective jurisdictions within the County boundaries.

To support public notification during emergency situations (including evacuation and sheltering instructions) County Emergency Management works closely with the City of Norwich, as together have developed a smart phone emergency management application (app), designed as a one-stop resource for emergency preparedness and response. The application allows for push notifications to reach people quickly during an emergency situation, and includes the following features:

- Notify Chenango alerts of road closures, emergency evacuations (both locations where evacuations are being ordered, as well as specified evacuation routes), shelter information and more.
- Live weather conditions direct from the weather station at the joint City/County Emergency Operations Center.
- Local National Weather Service forecasts, including hour-by-hour information.
- Weather camera of downtown Norwich, updated every several minutes.
- River and stream gauge information for all local rivers running through Chenango County, plus the Canasawacta Creek in Norwich and South Plymouth.
- Countywide school closings, as reported to The Evening Sun.

- A link to NYSEG power outages for Chenango County, broken down by town and road.
- Road work updates from the NY-511 system.
- Live NOAA Weather Radio feed from the Norwich transmitter.
- Emergency preparedness information.

The City of Norwich Emergency Management Office, working with the Binghamton Office of the National Weather Service, monitors regional and national weather information for its potential impact on the City. This is particularly true during flooding and severe storm seasons.

Chenango County Soil & Water Conservation District (SWCD)

The Chenango County Soil & Water Conservation District is an agency committed to the conservation of the natural resources of our region. The Soil and Water District works primarily with the farming community to assist producers in installing management practices to ensure soil health and increase the water quality of our region. The Soil & Water District acts as both an administrator of government funds and as a technical service provider for management practices relating to grazing, livestock waste management, riparian buffers, comprehensive nutrient management plans, manure management, field & crop management, wetland construction, and livestock watering systems.

As a County agency, the District provides free technical advice on other water, soil and agricultural issues. The District has often been called to help mitigate storm water issues, drainage issues (both agricultural and non-agricultural) and other land management problems and inquires. For the purpose of this HMP, representatives from the County SWCD participated on the Steering Committee and provided data and information about hazard risk and mitigation initiatives. The SWCD also supported community specific mitigation projects and strategies.

Chenango County Department of Public Works – Highway Department (CCDPW)

The Chenango County Department of Public Works is responsible for 308 centerline miles of roadways and 140 bridges within Chenango County.

The DPW is charged with designing, constructing, and maintaining an extensive infrastructure system for Chenango County. The department also provides oversight on many capital projects big and small. Whenever possible, the DPW is available to assist local city, town and village public works departments. For the purpose of this HMP, representatives from the County DPW participated on the Steering Committee and provided data and information about hazard risk and mitigation initiatives.

Chenango County Health Department

The Chenango County Public Health Department houses the Code Enforcement Division, Environmental Health Division, and supports Emergency Preparedness, in addition to traditional health services. Chenango County Code Enforcement is responsible for code enforcement and NFIP FPA services in the majority of communities. Steve Fox, the County Code Enforcement Officer served on the Steering Committee for this HMP to provide data and information, as well as providing support to the mitigation strategy of the majority of the planning partners. The Director of Environmental Health served on the steering Committee for this HMP, providing data and information throughout the planning process.

6.4.4 Administrative and Technical Capabilities - State and Federal

New York State Division of Homeland Security and Emergency Services (NYS DHSES)

For more than 50 years, NYS DHSES (formerly New York State Office of Emergency Management) and its predecessor agencies have been 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 2019 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. For example, the 2008-2011 State Mitigation Plan allowed the state and its communities to access nearly $57 million in mitigation grants to prepare plans and carry out projects. The 2019 New York State HMP was used as guidance in completing the Chenango County HMP Update. The state HMP can be found here: https://mitigateny.availabs.org/

For the purpose of this HMP, representatives from NY DHSES completed stakeholder surveys, provided technical assistance and data, and attended planning partnership meetings. NYS DHSES also presented about State Requirements for hazard mitigation plans at the January 13, 2021 Mitigation Action Workshop.

New York State Department of Environmental Conservation (NYSDEC) – Division of Water - Bureau of Flood Protection and Dam Safety

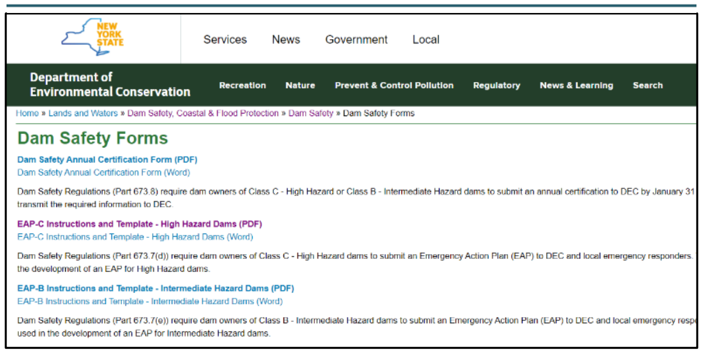
Within the NYSDEC – Division of Water, the Bureau of Flood Protection and Dam Safety (https://www.dec.ny.gov/chemical/290.html#Bureaus) cooperates with federal, state, regional, and local partners to protect lives and property from floods, coastal erosion and dam failures through floodplain management and both structural and non-structural means; and, provides support for information technology needs in the Division. The Bureau consists of there sections as described below.

Dam Safety

NYSDEC has the regulatory power over dams across the State. The functions of the 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.

To provide support and assistance to dam owners and operators, the NYSDEC website contains information that can help. This includes dam safety forms, Emergency Action Plan (EAP) instructions and guidance, documents for dam owners, and a complete inventory of dams for the State. This can all be found on their website: https://www.dec.ny.gov/lands/311.html

Figure 6-1. Dam Safety Forms



Dam Safety has a number of routine interactions and information sharing between New York State and the local governments. This includes:

- The State invites counties to participate in Emergency Action Plan exercises / orientations, during which communities work to identify particularly vulnerable locations that may not have previously been identified on the inundation maps.
- Dam owners are required to implement a dam safety program, which NYSDEC may review and require improvements to the program or program implementation.
- Dam owners also prepare Emergency Action Plans for Class B and Class C dams that are provided to the State Dam Safety Program. The owners also required to submit periodic engineering assessments of dams.
- Dam Safety inspection reports are sent to each municipality in which the dam is located and to the Emergency Manager for the County.

Coastal Erosion and Flooding

The Coastal Erosion branch of this section works to reduce coastal erosion and storm damage to protect lives, natural resources, and properties through structural and non-structural means. The Floodplain Management branch is responsible for reducing flood risk to life and property through proper management of activities including development in flood hazard areas, and review and development of revised flood maps.

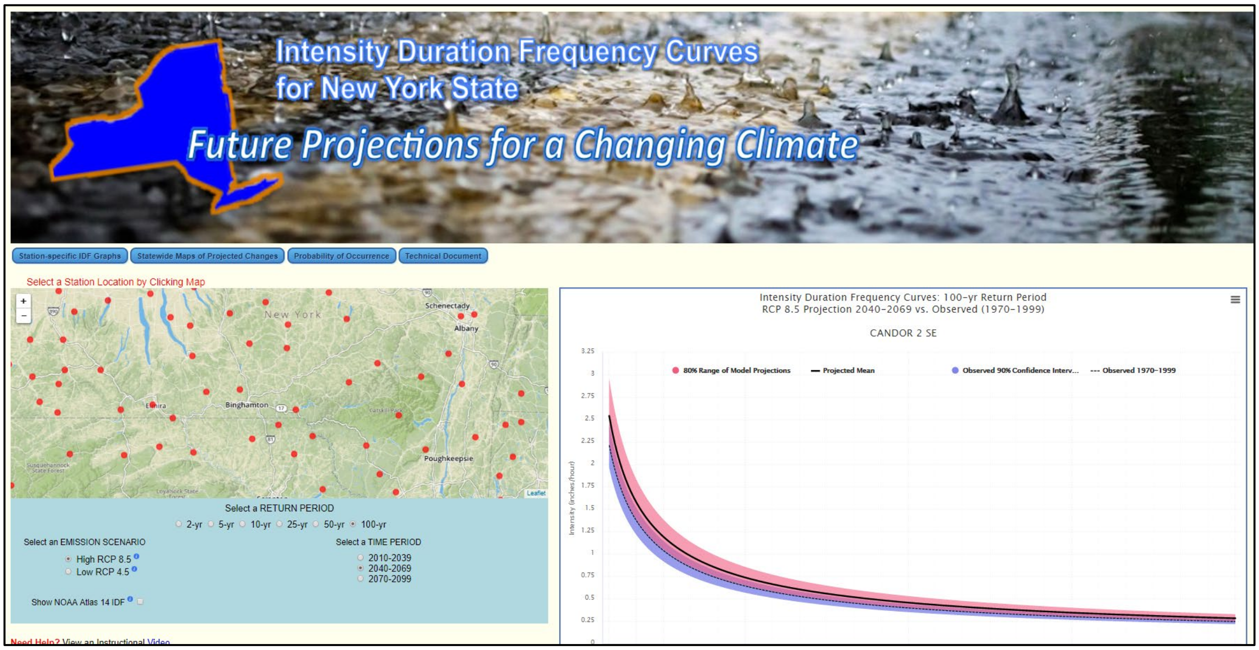
Flood Protection and Floodplain Management

This section is responsible for reducing flood risk to life and property through construction, operation and maintenance of flood control facilities. NYSDEC works with communities throughout the State to find ways to reduce or protect against physical and property damage caused by flooding. The Department works on: structural flood damage reduction projects to prevent flood water from damaging communities; helps communities establish sustainable floodplain management programs to mitigate flooding; and works with communities participating in the NFIP to administer local regulations and building standards for flood damage prevention (NYSDEC Division of Water 2020).

Northeast Regional Climate Center

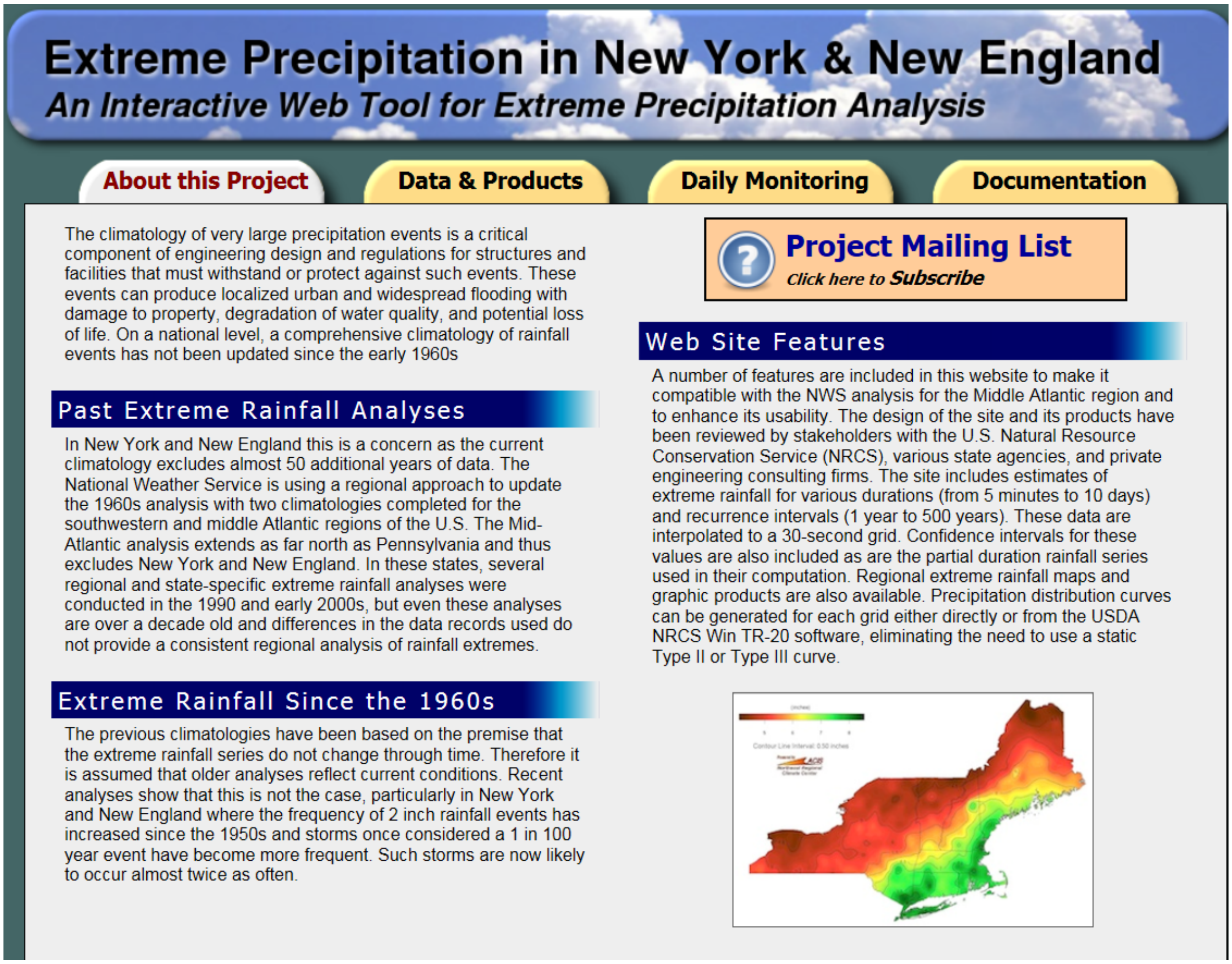
The Northeast Regional Climate Center (NRCC) partnered with the New York State Energy Research and Development Authority (NYSERDA) to compare various methods of downscaling global climate model (GCM) output and create extreme precipitation projections for New York State. These projections will ultimately be incorporated into climate change adaptation planning. In 2009 alone, 175 total flooding events in New York State led to $32.82 million in property damage. The state is also still recovering from the $42 billion toll of Superstorm Sandy. Climate change is resulting in an increase in the frequency of heavy rainfall events. To help New York State communities plan for effects of climate change, new graphics are now available showing the increased likelihood of heavy precipitation events. These graphs, called Intensity Duration Frequency (IDF) curves, show anticipated increases of storm events from 2- to 100-year intervals and are projected into the future as far as 2099. 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. These IDF curves display how precipitation events are being affected by New York State's rapidly changing climate (NRCC 2015). Figure 6-1 displays the screenshot of the website.

Figure 6-2. Screenshot of the IDF Curves for New York State



NRCC also maintains the Extreme Precipitation in New York & New England website, an interactive tool for extreme precipitation analysis. The site includes estimates of extreme rainfall for various durations (5 minutes to 10 days) and recurrence intervals (1 year to 500 years). These data are interpolated to a 30-second grid. Confidence intervals for these values are included as are the partial duration rainfall series used in their computation. Regional extreme rainfall maps and graphic products are available. Precipitation distribution curves can be generated for each grid either directly or from the USDA NRCS Win TR-20 software, eliminating the need to use a static Type II or Type III curve (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. Figure 6-2 shows a screenshot of the website.

Figure 6-3. Screenshot of the Extreme Precipitation in New York & New England website



Department of State's Division of Code Enforcement and Administration (DCEA)

Technical Bulletins for the 2010 Codes of New York State

The DCEA publishes technical bulletins for its building codes. TB-1004 came into effect in October 2017 and addressed Flood Venting in Foundations and Enclosures in Flood Areas. The bulletin clarifies definitions and requirements with regard to Residential and Building Construction (19NYCRR 1220 and 1221). Bulletins also address requirements for critical facilities such as fire stations, requirements for fire extinguishers, and other hazards.

Forms and Publications

The DCEA posts several model reporting forms and related publications on its webpage. The Building Permit Application requests the applicant to indicate whether the site is or is not in a floodplain and advises checking with the jurisdiction's clerk or NYSDEC. The General Residential Code Plan Review form includes a reminder to "add 2' freeboard." Sample Flood Hazard Area Review Forms, including plan review checklists and inspection checklists for Zone A and Zone V, are based on the forms in Reducing Flood Losses through the International Code Series published by International Code Council and FEMA (2008).

6.4.5 Fiscal Capabilities – County and Local

County and Regional Fiscal Capabilities

Commerce Chenango provides funding opportunities for new and existing businesses in Chenango County, including start-up and expansion assistance, demographic and labor market information, low-interest loan programs, workforce development programs, and grant and loan application assistance. Commerce Chenango also provides support to municipalities seeking CDBG funding through the NYS Office of Community Renewal to support public infrastructure projects, small business development, and to create and preserve affordable housing.

The Chenango County Department of Planning & Development administers the Chenango County Revolving Loan Fund to provide economic development loans to create new employment opportunities, increase value of properties, and to provide assistance for projects that will enhance the community. The Department also provides support to municipalities seeking CDBG funding through the NYS Office of Community Renewal to support public infrastructure projects, small business development, and to create and preserve affordable housing.

The Southern Tier 8 Regional Board provides funding opportunities through the Community Revitalization, Rural Initiatives, and Shovel Ready Site Funds. Southern Tier 8 Regional Board also works with non-profits and municipalities through the Appalachian Regional Commission Area Wide Development Program and Federal Economic Development Agency (EDA).

Municipal Fiscal Capabilities

Chenango County municipalities fund mitigation projects though existing local budgets, local appropriations (including referendums and bonding), and a variety of federal and state loan and grant programs. Many municipalities noted throughout the planning process that they are faced with increasing fiscal constraints, including decreasing revenues, budget constraints, and tax caps. In an effort to overcome these fiscal challenges, municipalities continue to leverage the sharing of resources and combining available funding with grants and other sources and note that plans and inter-municipal cooperation are beneficial in obtaining grants.

6.4.6 Fiscal Capabilities – State and Federal

Source: FEMA, 2018

The *NYS Capabilities* section of the 2019 New York State Hazard Mitigation Plan features a section on mitigation-related funding administered by state agencies that eligible jurisdictions can use to find mitigation actions. A list of funding opportunities can be accessed here: https://mitigateny.availabs.org/strategies/funding

As noted on the FEMA hazard mitigation assistance website (https://www.fema.gov/hazard-mitigation-assistance), FEMA administers five programs that provide funding for eligible mitigation planning and projects that reduces disaster losses and protect life and property from future disaster damages. The programs are the Hazard Mitigation Grant Program (HMGP), and the HMGP Post Fire Grant, the Flood Mitigation Assistance (FMA) Program, the Pre-Disaster Mitigation (PDM) Program, and the new Building Resilient Infrastructure & Communities (BRIC) Program.

HMGP assists in implementing long-term hazard mitigation planning and projects following a Presidential major disaster declaration. PDM provides funds for hazard mitigation planning and projects on an annual basis. FMA provides funds for planning and projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis. BRIC supports jurisdictions in hazard mitigation projects, reducing the risks they face from disasters and natural hazards. The BRIC program will replace the existing Pre-Disaster Mitigation (PDM) program. The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency (FEMA 2020).

HMGP funding is generally 15% of the total amount of Federal assistance provided to a State, Territory, or federally-recognized tribe following a major disaster declaration. PDM and FMA funding depends on the amount congress appropriates each year for those programs. BRIC is funded by a 6% ($500 million) set-aside from federal post-disaster grant funding.

Individual homeowners and business owners may not apply directly to FEMA. Eligible local governments may apply on their behalf (FEMA 2020).

Table 6-5 provides an overview of program funding eligibility and cost share.

Table 6-5. FEMA HMA Grant Cost Share Requirements

Programs	Cost Share (Percent of Federal / Non-Federal Share)
HMGP	75 / 25
FMA – insured properties and planning grants	75 / 25
FMA – repetitive loss property(2)	90 / 10
FMA – severe repetitive loss property(2)	100 / 0
BRIC (3)	75 / 25
BRIC – subrecipient is small and impoverished community (3)	90 / 10

Source: FEMA HMA Guidance 2015; Regulations.gov; FEMA 2020

(1) Subapplicants should consult their State Hazard Mitigation Officer (SHMO) for the amount of percentage of HMGP subrecipient management cost funding their State has determined to be passed through subrecipients.

(2) To be eligible for an increased federal cost share, a FEMA-approved state or tribal (standard or enhanced) mitigation plan that addressed repetitive loss properties must be in effect at the time of award, and the property is being submitted for consideration must be a repetitive loss property.

(3) The proposed BRIC program is in the public comment period as of May 2020 and is expected to have an open grant period and be finalized by the Fall of 2020.

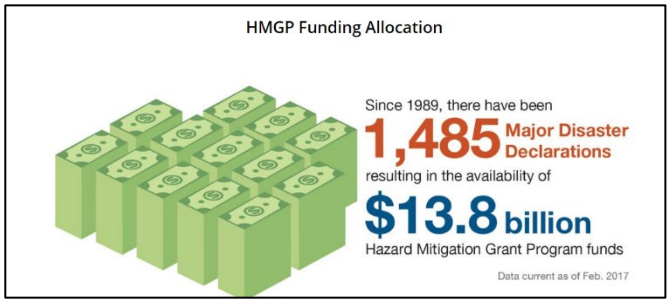
Federal Hazard Mitigation Funding Opportunities

Federal mitigation grant funding is available to all communities with a current HMP (this plan); however most of these grants require a "local share" in the range of 10-25 percent of the total grant amount. Details about grant programs and further descriptions of these opportunities can be found at: https://www.fema.gov/hazard-mitigation-assistance. The FEMA mitigation grant programs are described below.

Hazard Mitigation Grant Program (HMGP)

The HMGP is a post-disaster mitigation program. FEMA makes these grants available to states by after each federal disaster declaration. The HMGP can provide up to 75 percent funding for hazard mitigation measures and can be used to fund cost-effective projects that will protect public or private property or that will reduce the likely damage from future disasters in an area covered by a federal disaster declaration. Examples of projects include acquisition and demolition of structures in hazard prone areas, flood-proofing or elevation to reduce future damage, minor structural improvements, and development of state or local standards. Projects must fit into an overall mitigation strategy for the area identified as part of a local planning effort. All applicants must have a FEMA-approved HMP (this plan).

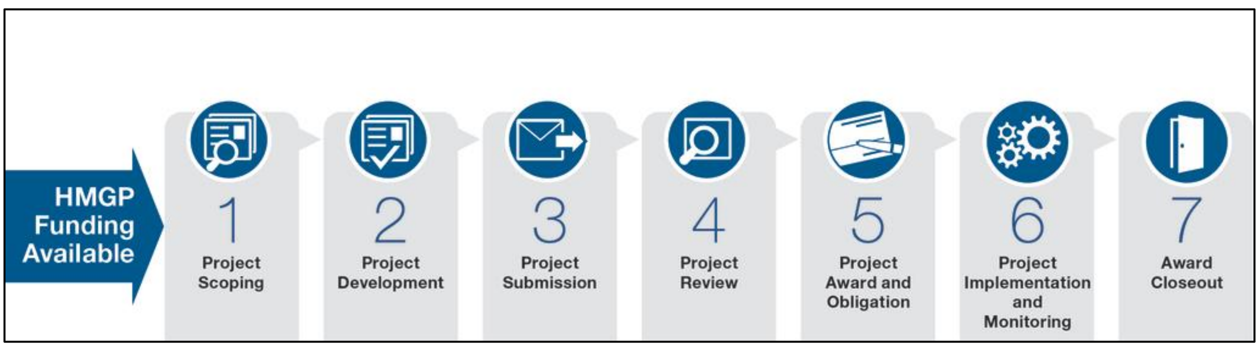
Figure 6-4. FEMA HMGP Funding Allocation



Source: FEMA 2018

Applicants who are eligible for the HMGP are state and local governments, certain nonprofit organizations or institutions that perform essential government services, and Indian tribes and authorized tribal organizations. Individuals or homeowners cannot apply directly for the HMGP; a local government must apply on their behalf. Applications are submitted to NYS DHSES, placed in rank order for available funding, and submitted to FEMA for final approval. Eligible projects not selected for funding are placed in an inactive status and 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.

Figure 6-5. FEMA HMGP Applicant/Subapplicant Process



Source: FEMA 2018

Flood Mitigation Assistance (FMA) Program

The FMA program combines the previous Repetitive Flood Claims and Severe Repetitive Loss Grants into one grant program. The FMA provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. The FMA is funded annually; no federal disaster declaration is required. Only NFIP insured homes and businesses are eligible for mitigation in this program. Funding for FMA is very limited and, as with the HMGP, 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. For the nom-federal share, at most 25 percent of the total eligible costs must be provided by a non-federal source; of this 25 percent, no more than half can be provided as in-kind contributions from third parties. At minimum, a FEMA-approved local flood mitigation plan is required before a project can be approved. The FMA funds are distributed from FEMA to the state. 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 (BRIC) Program

Building Resilient Infrastructure and Communities (BRIC) will support states, local communities, tribes and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. BRIC is a new FEMA pre-disaster hazard mitigation program that replaces the existing Pre-Disaster Mitigation (PDM) program.

The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency.

For additional information regarding the BRIC program, please refer to:
https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities.

Extraordinary Circumstances

For PDM and FMA project subawards, the FEMA Region might apply extraordinary circumstances when justification is provided and with concurrence from FEMA Headquarters (Risk Reduction and Risk Analysis Divisions) prior to granting an exception. If this exception is granted, a local mitigation plan must be approved by FEMA within 12 months of the award of the project subaward to that community.

For HMGP, BRIC, and FMA, 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 (Standard or Enhanced) Mitigation Plan and that the jurisdiction meets at least one of the criteria below. If the jurisdiction does not meet at least one of these criteria, the region must coordinate with FEMA Headquarters (Risk Reduction and Risk Analysis Divisions) for HMGP; however, for BRIC and FMA the region must coordinate and seek concurrence prior to granting an exception. The criteria are as follows:

- 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 lack of available funding, staffing, or other necessary expertise to satisfy the mitigation planning requirement prior to 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 prior to 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 subaward prior to the expiration of the local or tribal mitigation plan.

For HMGP, BRIC, and FMA, 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.

When an 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 subaward. 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 subaward agreements if a planning subaward is also awarded).

Federal and State Disaster and Recovery Assistance Programs

Following a disaster, various types of assistance could be made available by local, state, and federal governments. The types and levels of disaster assistance depend on the severity of the damage and the declarations that result from the disaster event. The following sections detail the general types of assistance that might be provided should the President of the United States declare the event a major disaster.

Individual Assistance (IA)

Individual Assistance (IA) provides help for homeowners, renters, businesses, and some non-profit entities after disasters occur. This program is largely funded by the U.S. Small Business Administration. 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 are restricted by law to small businesses only. IA is detailed on the FEMA website: https://www.fema.gov/individual-disaster-assistance.

Public Assistance (PA)

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.

Small-Business Administration (SBA) Loans

SBA provides low-interest disaster loans to homeowners, renters, business of all sizes, and most private nonprofit organizations. SBA disaster loans can be used to repair or replace the following items damaged or destroyed in a declared disaster: real estate, personal property, machinery and equipment, and inventory and business assets.

Homeowners could apply for up to $200,000 to replace or repair their primary residence. Renters and homeowners could borrow up to $40,000 to replace or repair personal property-such as clothing, furniture, cars, and appliances that were damaged or destroyed in a disaster. Physical disaster loans of up to $2 million are available to qualified businesses or most private nonprofit organizations. Additional information regarding SBA loans is available on the SBA website: https://www.sba.gov/managing-business/running-business/emergency-preparedness/disaster-assistance.

Social Services Block Grant Program (SSBG)

To address the needs of critical health and human service providers and the populations they serve, the State of New York will receive a total of $235.4 million in federal Superstorm Sandy SSBG funding. The state will distribute $200,034,600 through a public and transparent solicitation for proposals and allocate $35.4 million in State Priority Projects, using the SSBG funding. Sandy SSBG resources are dedicated to covering necessary expenses resulting from Superstorm Sandy, including social, health, and mental health services for individuals, and for repair, renovation, and rebuilding of health care facilities, mental hygiene facilities, child care facilities, and other social services facilities. Additional information regarding the SSBG program is available on the website: https://www.acf.hhs.gov/ocs/programs/ssbg.

Department of Homeland Security Grant Program (HSGP)

The 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. The FY 2020 HSGP 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 including the State Homeland Security Program (SHSP), Urban Areas Security Initiative (UASI), and the Operation Stonegarden (OPSG). 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.

Community Development Block Grants (CDBG)

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 the times of “urgent need” (e.g., post disaster) as defined by the CDBG National Objectives, CDBG funding could be used to acquire a property located in a floodplain that was severely damaged by a recent flood, demolish a structure severely damaged by an earthquake, or repair a public facility severely damaged by a hazard event. Additional information regarding CDBG is available on the website: https://www.hudexchange.info/programs/cdbg-entitlement/. In 2018, the Community Development Block Grant Mitigation Program was created to fund resilience projects in qualifying areas struck by disaster in 2015-2017.

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. Through its Public Works Program, USEDA invests in key public infrastructure, such as traditional public works projects, including water and sewer systems 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. 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. Additional information is available on the USEDA website: https://www.eda.gov/.

Federal Highway Administration - Emergency Relief

The Federal Highway Administration Emergency Relief is a grant program that can be used for repair or reconstruction of Federal-aid highways and roads on Federal lands which have suffered serious damage as a result of a disaster. NYS is serving as the liaison between local municipalities and FHWA. The program is appropriated $100 million annually. For information regarding the FHWA Emergency Relief Program, please refer to: https://www.fhwa.dot.gov/programadmin/erelief.cfm

Federal Transit Administration - Emergency Relief

The Federal Transit Authority Emergency Relief is a grant program that funds capital projects to protect, repair, reconstruct, or replace equipment and facilities of public transportation systems. Administered by the Federal Transit Authority at the U.S. Department of Transportation and directly allocated to MTA and Port Authority, this transportation-specific fund was created as an alternative to FEMA PA. Currently, a total of $5.2 Billion has been allocated to NYS-related entities related to Hurricane Sandy. IN the wake of the COVID-19 outbreak in 2020, the program provided emergency-related capital and operating expenses to transit providers. 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.

FEMA National Dam Safety Program

The National Dam Safety Program (NDSP) is administered by FEMA with the primary purpose of providing financial assistance to states to strengthen their dam safety programs. Funds from this program are used for the following types of activities:

- Dam safety training for state personnel
- Increase in the number of dam inspections
- Increase in the submittal and testing of Emergency Action Plans
- More timely review and issuance of permits
- Improved coordination with state emergency preparedness officials
- Identification of dams to be repaired or removed
- Conduct dam safety awareness workshops and creation of dam safety videos and other outreach materials

In 2016, the President signed the Water Infrastructure Improvements for the Nation Act (WIIN Act) which added a new grant program under the NDSP. Section 5006 of the Act, Rehabilitation of High Hazard Potential Dams, provides technical, planning, design, and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams.

Rehabilitation of High Hazard Potential Dams (HHPD) Program

A state or territory with an enacted 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. Nonfederal dams that (i) are in a state or territory with a state or territorial dam safety program; (ii) are classified as having "high hazard potential" by the dam safety agency in the dam's state or territory; (iii) have an emergency action plan approved by the state or territory's dam safety agency; and (iv) the state or territory in which the dam is located determines either of these criteria – the dam fails to meet minimum dam safety standards public. An "eligible high hazard potential dam" does not include: (i) a licensed hydroelectric dam; or (ii) a dam built under the federal authority of the Secretary of Agriculture. For additional information regarding the HHPD program, please refer to: 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. In April 2021, it was announced that $650,000 is available in the State to support eligible dam repairs. Funding is available to local government and non-profit owners of high-hazard dams.

Figure 6-6. NYSDEC HHPD Funding Announcement

Department of Environmental Conservation | Recreation | Nature | Prevent & Control Pollution | Regulatory | News & Learning | Search

Home » Public Involvement and News » Press Releases » DEC Announces $650,000 in Grant Funding Now Available to Support Eligible Dam Repairs

For Release: Thursday, April 1, 2021

DEC Announces $650,000 in Grant Funding Now Available to Support Eligible Dam Repairs

Funding Available to Local Government and Non-Profit Owners of 'High Hazard' Dams for Pre-Construction Activities

New York State Department of Environmental Conservation (DEC) Commissioner Basil Seggos today announced $650,000 in grant funding is now available to assist eligible dam owners with infrastructure repair costs. Funding is provided through the Federal Emergency Management Agency's (FEMA) High Hazard Potential Dam (HHPD) grant program. Of the dozens of states that applied to this federal program, New York was one of two states that received the maximum amount of funding. DEC is now accepting applications for grants to assist with technical, planning, design, and other pre-construction activities associated with the rehabilitation of eligible dams classified as High Hazard dams.

"Ensuring dam safety is a top priority for DEC and we encourage eligible dam owners to take advantage of this important funding," **said Commissioner Seggos.** "The grants announced today will support pre-construction engineering and design activities as part of an overall program to help municipal and non-profit owners of High Hazard dams make necessary repairs and improve public safety."

New York State's High Hazard dam classification refers to the potential for damage upon a dam's failure, not its likelihood of failure. A High Hazard (or Class C) dam is classified where failure may result in widespread or serious damage to homes, main highways, industrial or commercial buildings, railroads, and/or important utilities, including water supply, sewage treatment, fuel, power, cable, or telephone infrastructure, or substantial environmental damage, such that the loss of human life or widespread substantial economic loss is likely. New York State has 425 dams classified as High Hazard.

Local governmental entities and municipalities, including but not limited to counties, cities, towns, and villages, and not-for-profit corporations with dam projects in New York State are eligible to apply. Projects must be in a county with an approved hazard mitigation plan. Projects and applicants must meet additional eligibility criteria as described in the Request for Applications. A total of $650,000 in grants is available, with awards up to $100,000 per project.

The deadline for applications is June 11, 2021. Requests for Applications (RFAs) are available online through the NYS Grants Gateway. The Grants Gateway is a web-based grant management system that streamlines the way grants are administered by the State of New York. All grant applicants, including government agencies and not-for-profit corporations, must be registered in the NYS Grants Gateway to be eligible to apply for any state grant opportunity. Not-For-Profit applicants are required to "prequalify" in the Grants Gateway system. For more information about Grants Gateway, please visit the Grants Management website or contact the Grants Gateway Team at: grantsgateway@its.ny.gov.

DEC's High Hazard Dam Rehabilitation program is funded through FEMA's HHPD grant program. A future round of grants will make funding available for eligible dam construction projects.

Source: NYSDEC 2021

State Hazard Mitigation Funding Opportunities

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/.

New York State Department of Transportation (NYSDOT)

Damaged Roads and Signals

High winds, storm tidal surge and flooding caused significant damage to NYSDOT facilities, roads and local transportation infrastructure in the Hudson Valley, Long Island and New York City. Repair and replacement will be necessary for these facilities and infrastructure. In some cases, municipalities will be direct applicants; therefore, not all FEMA-eligible costs are included for damaged infrastructure.

Scour Critical/Floodprone Bridge Program

The Scour Critical/Flood Prone Bridge Program is an initiative developed to harden New York State's at-risk bridges to withstand extreme weather events. In the past three years, the state has suffered 9 presidentially declared disasters due to extreme weather, many involving severe flooding (NYSDOT 2014).

For this initiative, 105 scour critical/flood prone bridges throughout New York State were identified as most at-risk from repeated flooding and are located in the Capital District, Long Island, Mid-Hudson, Mohawk Valley, North Country, Finger Lakes, Central/Western and Southern Tier regions. The locations encompass 78 communities within 30 counties across the State (NYSDOT 2014). Additional information of the list of bridges is available on the website: https://www.dot.ny.gov/main/business-center/cbow/repository/CBOW_list_2014.pdf.

All the bridges included in this program were built to the codes and standards of their time and remain safe and open for everyday traffic; however, due to a variety of natural severe weather events and the increasing frequency of major storms and floods, they are vulnerable to scour and flooding caused by the intensity and velocity of water from extreme natural events. Bridge scour erodes and carries away foundation materials, such as sand and rocks from around and beneath bridge abutments, piers, foundations, and embankments (NYSDOT 2014).

This program encompasses a variety of bridge improvement work, including upgrading concrete bridge abutments and/or piers by adding steel or concrete pile foundations, increasing the size of waterway openings to meet 100-year flood projections, and reducing or eliminating the number of bridge piers in the water to prevent debris and ice jams that can flood surrounding areas. Completion of the program will ensure continual access to critical facilities and essential personnel during emergency events. Adverse impacts to travel throughout the state will be greatly reduced during severe weather events, as well (NYSDOT 2014).

This program aims to increase the state's resiliency and mitigate the risks of loss and damage associated with future disasters. The total cost of the program, including all 105 bridges across the state, is $518 million. It will be paid for with a mix of funding from FEMA and the U.S. Department of Housing and Urban Development. No state funding will be required (NYSDOT 2014).

Emergency Watershed Protection Program

The purpose of the Emergency Watershed Protection Program (EWP) was established by Congress to respond to emergencies created by natural disasters. The EWP Program is designed to help people and conserve natural resources by relieving imminent hazards to life and property caused by floods, fires, drought, windstorms, and other natural occurrences. The U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) administers the EWP Program, EWP-Recovery, and EWP–Floodplain Easement. 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 Program is a recovery effort program 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 work is not limited to any one set of measures. It is designed for 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 (FPE)

Privately-owned lands or lands owned by local and state governments might be eligible for participation in EWP-FPE. 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 are eligible, provided the lands would contribute to the restoration of the flood storage and flow, provide for control of erosion, or that would improve the practical management of the floodplain easement.
- Lands that would be inundated or adversely impacted as a result of a dam breach.

EWP-FPE easements are restored to the extent practicable to the natural environment and can include both structural and nonstructural practices to restore the flood storage and flow, erosion control, 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.

New York State Department of Environmental Conservation Climate Smart Communities (CSC) Program

The CSC program is jointly sponsored by the following six New York State agencies: DEC; Energy Research and Development Authority; Public Service Commission; Department of State; NYSDOT; and the Department of Health. The program encourages municipalities to minimize the risks of climate change and reduce long-term costs through actions which reduce greenhouse gas emissions and adapt to a changing climate. The program offers free technical support on energy and climate and guidance tailored to New York State communities. As of April 2020, more than 303 communities, representing 8.7 million New Yorkers in every region of the state, have committed to acting on climate through New York State's Climate Smart Communities program.

Benefits of participating in the program include saving taxpayer dollars, improving operations and infrastructure, increasing energy independence and security, demonstrating leadership, and positioning for economic growth. Registered Climate Smart Communities receive notification of state and federal assistance that they can leverage to help adopt low-carbon technologies and of programs and support for efficiency improvements and energy conservation. Further, those communities receive an advantage in accessing some state assistance programs, can call on the help of other local governments that already have adopted climate smart practices and policies, and receive statewide recognition for their climate-smart accomplishments. Key elements of the Climate Smart Communities program are described below.

Additional information regarding the CSC program is available on the website: http://www.dec.ny.gov/energy/50845.html.

Climate Smart Communities Pledge

Any city, town, village or county in New York can join the program by adopting the Climate Smart Communities Pledge. To become a registered Climate Smart Community, the municipality's governing body must adopt a resolution that includes all ten elements of the pledge and inform DEC of the passage of the resolution. The required ten elements of the pledge are as follows:

- Pledge to be a Climate Smart Community.
- Set goals, inventory emissions, plan for climate action.

- Decrease community energy use.
- Increase community use of renewable energy.
- Realize benefits of recycling and other climate-smart solid waste management practices.
- Reduce greenhouse gas emissions through use of climate-smart land-use tools.
- Enhance community resilience and prepare for the effects of climate change.
- Support development of a green innovation economy.
- Inform and inspire the public.
- Commit to an evolving process of climate action.

At the time of this plan update, no communities in Chenango County have adopted the Climate Smart Communities Pledge.

Climate Smart Communities Certification (CSC) Program

The CSC program enables high-performing registered communities to achieve recognition for their leadership. Designed around the existing ten pledge elements, the certification program recognizes communities achieving any on 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. At the time of this plan update, no communities in the County have achieved certification.

Climate Smart Communities Grant Program

In April 2016, DEC announced an expansion of the Environmental Protection Fund to support communities ready to reduce greenhouse gas emissions and prepare for the effects of climate change. Climate Smart Community Implementation grants support mitigation and adaptation projects and range from $100,000 to $2 million. Competitive grants ranging from $25,000 to $100,000 will provide support for local governments to become certified Climate Smart Communities. All counties, cities, towns, and villages of the State of New York are eligible to receive funding. The CSC grant program will provide 50/50 matching grants for eligible projects in the following categories.

Funding is available for **implementation projects** that advance a variety of 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 area.
- Reduction of flood risk.
- Clean transportation.
- Reduction or recycling of food waste.

Funding is available for **certification projects** that advance several specific actions aligned with Climate Smart Communities Certification requirements, including the following:

- Right-sizing of 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.

In scoring grant applications, increasing points are awarded to communities who have already taken the CSC pledge and to those that have achieved certification status. All grant recipients must take the Climate Smart Communities Pledge within the term of their grant contract. For climate mitigation projects, grant recipients must provide a report of estimates of emissions reduction. Certification actions must adhere to the requirements and standards described in the Climate Smart Communities Certification Manual that is available on the website: http://www.dec.ny.gov/energy/96511.html. For implementation projects involving property (construction, improvements, restoration, rehabilitation), grant recipients that do not have ownership of the property must obtain a climate change mitigation easement.

The Climate Smart Communities Toolkit was developed to educate New York communities on recommended practices that will help to reduce greenhouse gas emissions and adapt to the effects of climate change, specifically in the areas of land-use, transportation policy, green buildings, infrastructure investment, green infrastructure, housing policy, adaptation, and resilience. The Climate Smart Communities Guide to Local Action contains overviews of possible community actions, how-to's and case studies to help communities implement the CSC pledge. The Climate Smart Communities Land Use Toolkit allows New York communities to find recommended practices that will help to reduce greenhouse gas emissions in the areas of land use, transportation policy, green building, infrastructure investment, green infrastructure, and housing policy.

New York State Department of Environmental Conservation (NYSDEC)

Water Quality Improvement Project (WQIP) Program

The WQIP program is a competitive, reimbursement grant program that funds projects that directly address documented water quality impairments. The competitive, statewide grant 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; and up to 40 percent for general wastewater infrastructure improvement projects. Additional information regarding this program are available on the website: https://www.dec.ny.gov/pubs/4774.html. Eligible activities for the WQIP Program include the following:

- Wastewater treatment improvement.
- Non-agricultural nonpoint source abatement and control.
- Land acquisition for source water protection.
- Salt storage.
- Aquatic habitat restoration.
- MS4s.

New York State DEC/ Environmental Facilities Corporation (EFC) Wastewater Infrastructure Engineering Planning Grant (EPG)

The DEC, in conjunction with the New York State EFC, offers grants to municipalities to help pay for the initial planning of eligible Clean Water State Revolving Fund (CWSRF) water quality projects.

The Wastewater Infrastructure EPG assists municipalities with the engineering and planning costs of CWSRF-eligible water quality projects. Eligible municipalities have a median household income (MHI) of $65,000 or less in the Regional Economic Development Council (REDC) regions of Capital District, Southern Tier, North Country, Mohawk Valley, Central NY, Finger Lakes, or Western NY OR an MHI 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 for the production of an engineering report.

The goal of the EPG 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, WQIP 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. 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 (SPDES) 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 (TMDL) Implementation Plan.

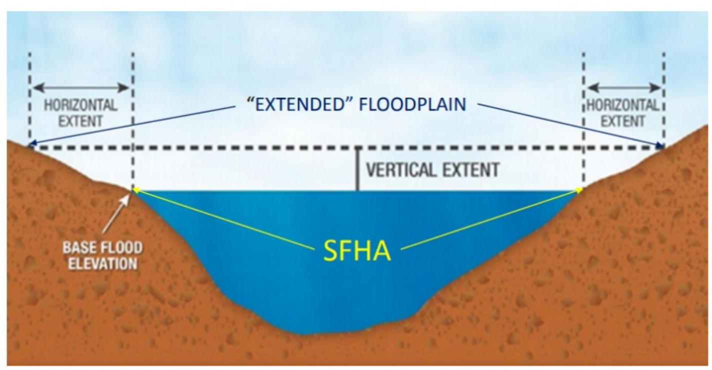
New York State Department of Transportation

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 website: https://www.dot.ny.gov/BRIDGENY.

Community Risk and Resiliency Act (CRRA)

On September 22, 2014, Governor Andrew Cuomo signed bill A06558/S06617-B, the CRRA. The purpose of the bill is to ensure that certain state monies, facility-siting regulations, and permits include consideration of the effects of climate risk and extreme-weather events. According to NYSDEC (2018), CRRA's five major provisions include the following:



- Official Sea-level Rise Projections—CRRA requires the DEC to adopt science-based sea-level rise projections into regulation.
- Consideration of Sea-Level Rise, Storm Surge and Flooding—CRRA requires applicants for permits or funding in a number of specified programs to demonstrate that future physical climate risk due to sea-level rise, storm surge, and flooding have been considered and that DEC considered incorporating these factors into certain facility-siting regulations.
- Smart Growth Public Infrastructure Policy Act Criteria—CRRA adds mitigation of risk due to sea-level rise, storm surge, and flooding to the list of smart-growth criteria to be considered by state public-infrastructure agencies.

- Guidance on Natural Resiliency Measures—CRRA requires DEC, in consultation with the Department of State, to develop guidance on the use of natural resources and natural processes to enhance community resiliency.
- Model Local Laws Concerning Climate Risk—CRRA requires the Department of State, in cooperation with DEC, to develop model local laws that include consideration of future risk due to sea-level rise, storm surge, and flooding. These model local laws must be based on available data predicting the likelihood of extreme-weather events, including hazard-risk analysis.

CRRA requires NYSDEC, in consultation with the Department of State, to prepare guidance on implementation of the statute. To meet its obligation to develop guidance for the implementation of CRRA, DEC is proposing a new document, State Flood Risk Management Guidance (SFRMG). The SFRMG is intended to inform state agencies as they develop program-specific guidance to require that applicants demonstrate consideration of sea-level rise, storm surge, and flooding, as permitted by program-authorizing statutes and operating regulations. The SFRMG incorporates possible future conditions, including the greater risks of coastal flooding presented by sea-level rise and enhanced storm surge and of inland flooding expected to result from increasingly frequent extreme-precipitation events (NYSDEC 2018). Additional details on the CRRA are provided on the website: https://www.dec.ny.gov/energy/102559.html.

6.4.7 Potential Mitigation Funding Sources

While it is important to recognize the mitigation strategies for each jurisdiction to help achieve the mitigation goals and objectives of the (HMP, it is also important to provide sources for funding to implement these strategies. The table below provides a list of programs, descriptions, and links for those seeking funding sources. Please note that this table is not intended to be a comprehensive list, but rather a starting point to help identify potential sources of funding for the identified mitigation strategies. For additional resources, refer to the FEMA 2020 *New York Mitigation Resource Guide* (https://www.fema.gov/sites/default/files/2020-09/fema_region-03_mitigation-funding-resource-guide_new-york-09-24-2020.pdf).

Table 6-6. Mitigation Funding Sources

Program	Description	Lead Agency	Website
Federal			
Hazard Mitigation Assistance (HMA)	Grants to provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages – includes FMA, HMGP, PDM	FEMA	https://www.fema.gov/hazard-mitigation-assistance
Flood Mitigation Assistance (FMA)	Program Grants to States and communities for pre-disaster mitigation planning and projects to help reduce or eliminate the long-term risk of flood damage to structures insurable under the National Flood Insurance Program	FEMA	https://www.fema.gov/flood-mitigation-assistance-grant-program
Hazard Mitigation Grant Program (HMGP)	Grants to States and communities for planning and projects providing long-term hazard mitigation measures following a major disaster declaration	FEMA	https://www.fema.gov/hazard-mitigation-grant-program
Building Resilient Infrastructure and Communities (BRIC)	Replacement program for PDM that will invest in local mitigation projects and promote capacity-building	FEMA	https://www.fema.gov/bric
Public Assistance: Hazard Mitigation Funding Under Section 406	Hazard mitigation discretionary funding available under Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act following a Presidentially declared disaster	FEMA	https://www.fema.gov/news-release/2017/05/03/4309/fema-hazard-mitigation-grants-404-and-406
Assistance to Firefighters Grant Program	The primary goal of the Assistance to Firefighters Grants (AFG) 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.	FEMA	https://www.fema.gov/welcome-assistance-firefighters-grant-program
Disaster Housing Program	Emergency assistance for housing, including minor repair of home to establish livable conditions, mortgage and rental assistance	HUD	https://www.hud.gov/program_offices/public_indian_housing/publications/dhap
HOME Investment Partnerships Program	Grants to local and state government and consortia for permanent and transitional housing, (including financial support for property acquisition and rehabilitation for low income persons)	HUD	https://www.hud.gov/program_offices/comm_planning/affordablehousing/programs/home/
HUD Disaster Recovery Assistance	Grants to fund gaps in available recovery assistance after disasters (including mitigation)	HUD	https://www.hud.gov/info/disasterresources
Section 108 Loan Guarantee	Enables states and local governments participating in the Community Development Block Grant (CDBG) program to obtain federally guaranteed loans for disaster-distressed areas	HUD	https://www.hudexchange.info/programs/section-108/
Smart Growth Implementation Assistance (SGIA) program	The SGIA program focuses on complex or cutting-edge issues, such as stormwater management, code revision, transit-oriented development, affordable housing, infill development, corridor planning, green building, and climate change. Applicants can submit proposals under 4 categories: community resilience to disasters, job creation, the role of manufactured homes in sustainable neighborhood design or medical and social service facilities siting.	EPA	https://www.epa.gov/smartgrowth

Program	Description	Lead Agency	Website
Partners for Fish and Wildlife	Financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats	U.S. Fish and Wildlife Service	https://www.fws.gov/partners/
FHWA Emergency Relief Program	Fund for the repair or reconstruction of Federal-aid highways that have suffered serious damage as a result of (1) natural disasters or (2) catastrophic failures from an external cause	U.S. Department of Transportation (DOT)	https://www.fhwa.dot.gov/programadmin/erelief.cfm
Better Utilizing Investments to Leverage Development (BUILD)	Investing in critical road, rail, transit and port projects across the nation	U.S. DOT	https://www.transportation.gov/BUILDgrants/about
Community Facilities Direct Loan & 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.	USDA	https://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program
Emergency Loan Program	USDA's Farm Service Agency (FSA) provides emergency loans to help producers recover from production and physical losses due to drought, flooding, other natural disasters or quarantine	USDA	https://www.fsa.usda.gov/programs-and-services/farm-loan-programs/emergency-farm-loans/index
Emergency Watershed Protection (EWP) program	Provide assistance to relieve imminent hazards to life and property caused by floods, fires, drought, windstorms, and other natural occurrences	NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/
Financial Assistance	Financial assistance to help plan and implement conservation practices that address natural resource concerns or opportunities to help save energy, improve soil, water, plant, air, animal and related resources on agricultural lands and non-industrial private forest land	NRCS	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/
Emergency Management Performance Grants (EMPG) Program	Assist local, tribal, territorial, and state governments in enhancing and sustaining all-hazards emergency management capabilities	U.S. DHS	https://www.fema.gov/emergency-management-performance-grant-program
Land & Water Conservation Fund	Matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities (as well as funding for shared federal land acquisition and conservation strategies)	National Park Service	https://www.nps.gov/subjects/lwcf/index.htm
State			
Local Government Records Management Improvement Fund (LGRMIF) Disaster Recovery Grants	Grants for disaster recovery projects related to damage caused by a sudden, unexpected event involving fire, water, man-made or natural phenomena where a timely response is necessary to prevent the irretrievable loss of vital or archival records, or to ensure reasonable, timely access to vital records	New York State Archives / New York State Education Department	http://www.archives.nysed.gov/grants/grants_lgrmif.shtml
The New York State Emergency Services Revolving Loan	Repair of firefighting apparatus, ambulances, or rescue vehicles; Renovation, rehabilitation, or repair of facilities that house firefighting equipment, ambulances, rescue vehicles, and related equipment	NYS DHSES	http://www.dhses.ny.gov/ofpc/services/loan/

Program	Description	Lead Agency	Website
Environmental Protection Fund (EPF)	Matching grants for the acquisition, planning, development, and improvement of parks, historic properties	New York State Parks, Recreation & Historic Preservation (NYSOPRHP)	https://www.dec.ny.gov/about/92815.html
Recreational Trails (RTP)	Program Matching grants for the acquisition, development, rehabilitation and maintenance of trails and trail-related projects	NYSOPRHP	https://parks.ny.gov/grants/recreational-trails/default.aspx
Environmental Protection & Improvement Grants	Competitive grants for environmental protection and improvement; available for municipalities, community organizations, not-for-profit organizations and others	New York State Department of Environmental Conservation	https://www.dec.ny.gov/about/92815.html
Volunteer Fire Assistance Grants	The grant is a 50/50 matching funds program. Its purpose is to make 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, hose, portable radios and dry hydrants.	NYSDEC	https://www.dec.ny.gov/regulations/2364.html
Clean Water Act Section 604(b) 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. 604(b) 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.	NYSDEC	https://www.dec.ny.gov/lands/53122.html
Water Quality Improvement Project (WQIP) Program	The Water Quality Improvement Project (WQIP) program is a competitive, reimbursement grant program that funds projects that directly address documented water quality impairments. Applications are typically available each spring through the Consolidated Funding Application.	NYSDEC	https://www.dec.ny.gov/pubs/4774.html
New York State DEC/EFC Wastewater Infrastructure Engineering Planning Grant (EPG)	The New York State Department of Environmental Conservation (DEC), in conjunction with the New York State Environmental Facilities Corporation (EFC), will offer grants to municipalities to help pay for the initial planning of eligible Clean Water State Revolving Fund (CWSRF) water quality projects. The ultimate goal of the EPG 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.	NYSDEC	https://www.dec.ny.gov/pubs/81196.html
Climate Smart Communities Grant Program	The CSC Grant program was established in 2016 to provide 50/50 matching grants to cities, towns, villages, and counties (or boroughs of New York City) of the State of New York for eligible climate adaptation and mitigation projects.	NYSDEC	https://www.dec.ny.gov/energy/109181.html
BRIDGE NY	The State is making funding available for local governments to rehabilitate and replace bridges and culverts statewide.	NYS DOT	https://www.dot.ny.gov/BRIDGENY

6.5 MITIGATION STRATEGY DEVELOPMENT AND UPDATE

6.5.1 Update of Municipal Mitigation Strategies

To evaluate progress on local mitigation actions, each jurisdiction was provided with a Mitigation Action Plan Review Worksheet, pre-populated with those actions identified for their jurisdiction in the prior (2015) plan. For each action, municipalities were asked to indicate the status of each action (*No Progress/Unknown*, *In Progress/Not Yet Complete*, *Ongoing*, *Completed*, *Discontinued*) and provide review comments on each. Municipalities were requested to quantify the extent of progress and provide reasons for the level of progress or why actions were discontinued. Each jurisdictional annex in Section 9 (Jurisdictional Annexes) provides a table identifying the jurisdiction's prior mitigation strategy, the status of those actions and initiatives, and their disposition within their updated strategy.

Local mitigation actions identified as *Complete*, and those actions identified as *Discontinued*, were removed from the updated strategies. Those local actions that municipalities identified as *No Progress/Unknown*, *In Progress/Not Yet Complete, or* certain actions/initiatives identified as *Ongoing* were carried forward in their local updated mitigation strategies. Actions considered ongoing capabilities were marked as *Discontinued* and included in the plan as ongoing capabilities. Municipalities were asked to provide further details on these projects to help better define the projects, identify benefits and costs, and improve implementation.

At the Kick-Off and during subsequent local-level planning meetings, all participating municipalities were further surveyed to identify mitigation activities completed, ongoing, and potential/proposed. As new additional potential mitigation actions, projects, or initiatives became evident during the plan update process, including as part of the risk assessment update and as identified through the public and stakeholder outreach process detailed in Section 3 (Planning Process), communities were made aware of these either through direct communication (local meetings, email, phone) or via their draft municipal annexes.

To help support the selection of an appropriate, risk-based mitigation strategy, each annex provided a summary of hazard vulnerabilities identified during the plan update process, either directly by municipal representatives or through review of available county and local plans and reports, and through the hazard profiling and vulnerability assessment process.

Beginning in June 2020, members of the Steering Committee and contract consultants worked directly with each jurisdiction (phone, email, local support meetings) to assist with the development and update of their annex and include mitigation strategies, focusing on identifying well-defined, implementable projects with a careful consideration of benefits (risk reduction, losses avoided), costs, and possible funding sources (including mitigation grant programs).

Concerted efforts were made to assure that municipalities develop updated mitigation strategies that included activities and initiatives covering the range of mitigation action types described in recent FEMA planning guidance (FEMA *Local Mitigation Planning Handbook* March 2013), specifically:

- <u>Local Plans and Regulations</u>—These actions include government authorities, policies, or codes that influence the way land and buildings are being developed and built.
- <u>Structure and Infrastructure Project</u>—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. This type of action involves projects to construct manmade structures to reduce the impact of hazards.

- Natural Systems Protection—These are actions that minimize damage and losses and preserve or restore the functions of natural systems.

- Education and Awareness Programs—These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions could include participation in national programs, such as the National Flood Insurance Program and Community Rating System, StormReady (NOAA), and Firewise (NFPA) Communities.

A mitigation strategy workshop was conducted on January 13, 2021, for all participating jurisdictions to support the development of focused problem statements based on the impacts of natural hazards in the County and their communities. NYS DHSES presented at the meeting about the NYS HMP requirements and the importance of creating strong mitigation projects that connect to the mitigation strategy and will increase resiliency within the County. Prior to the mitigation workshop, members of the planning partnership completed Mitigation Action Development and Brainstorming Worksheets to guide the development and identification of "problem areas" and areas where mitigation actions may be needed in their communities. These problem statements are intended to provide a detailed description of the problem area, including impacts to the jurisdiction, past damages, and loss of service. An effort was made to include the street address of the property/project location, adjacent streets, water bodies, and well-known structures, as well as a brief description of existing conditions (topography, terrain, hydrology) of the site. These problem statements form a bridge between the hazard risk assessment, which quantifies impacts to each community, with the development of actionable mitigation strategies.

A strong effort has been made to better focus local mitigation strategies to clearly defined, readily implementable projects and initiatives that meet the definition or characteristics of mitigation. Broadly defined mitigation objectives were eliminated from the updated strategy unless accompanied by discrete actions, projects, or initiatives.

Certain continuous or ongoing strategies that represent programs that are fully integrated into the normal operational and administrative framework of the community have been identified within the Capabilities section of each annex and removed from the updated mitigation strategy.

At least two mitigation projects per jurisdiction have been documented with an Action Worksheet, as per the New York State Hazard Mitigation Planning Standards Guide.

As discussed within the hazard profiles in Section 5.4, the long-term effects of climate change are anticipated to exacerbate the impacts of weather-related hazards including flood, severe storm, severe winter storm, and wildfire. By way of addressing these climate change-sensitive hazards within their local mitigation strategies and integration actions, communities are working to evaluate and recognize these long-term implications and potential impacts, and to incorporate in planning and capital improvement updates.

Municipalities included mitigation actions to address vulnerable critical facilities and lifelines. These actions were proposed in consideration of protection against 0.2% annual chance (500-year) events, or worst-case scenarios. It is recognized, however, that in the case of projects being funded through federal mitigation programs, the level of protection can be influenced by cost-effectiveness, as determined through a formal benefit-cost analysis. In the case of "self-funded" projects, municipal discretion must be recognized. Further, the County and municipalities have limited authority over privately-owned critical facility owners regarding mitigation at any level of protection.

6.5.2 Update of County Mitigation Strategy

The update of the County-level mitigation strategies included a review of progress on the actions/initiatives identified in the 2015 HMP using a process similar to that used to review municipal mitigation strategy progress. The County, through their various department representatives, was provided with a Mitigation Action Plan Review Worksheet identifying all county-level actions and initiatives from the 2015 plan. The County reviewed each action and provided progress. For each action, relevant county representatives were asked to indicate the status of each action (*No Progress/Unknown*, *In Progress/Not Yet Complete*, *Ongoing*, *Completed*, or *Discontinued*), and provide review comments on each.

Projects/initiatives identified as "*Complete*", as well as those actions identified as *Discontinued*, have been removed from this plan update. Those actions the County has identified as *No Progress/Unknown*, *In Progress/Not Yet Complete,* or *Ongoing* have been carried forward in the County's updated mitigation strategy. Actions considered ongoing capabilities were marked as *Discontinued* and included in the plan as ongoing capabilities.

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, including:
    - Chenango County Department of Planning and Development
    - Chenango County Department of Public Works
    - Chenango County Bureau of Fire & Emergency Management
    - Chenango County Information Technology
    - Chenango County Public Health – Division of Code Enforcement
    - Chenango County Public Health – Environmental Health Division
    - Chenango County Soil & Water Conservation District
    - Commerce Chenango
- Input received through the public and stakeholder outreach process.

As discussed within the hazard profiles in Section 5.4 (Risk Assessment), the long-term effects of climate change are anticipated to exacerbate the impacts of weather-related hazards including drought, flood, severe storm, and severe winter storm. The County has included mitigation actions and initiatives, including continuing and long-term planning and emergency management support, to address these long-term implications and potential impacts.

Various county departments and agencies included mitigation actions to address vulnerable critical facilities. These actions were proposed in consideration of protection against 0.2% annual chance (500-year) events, or worst-case scenarios.

It is recognized, however, that in the case of projects being funded through federal mitigation programs, the level of protection can be influenced by cost-effectiveness, as determined through a formal benefit-cost analysis. In the case of "self-funded" projects, local government authority can affect the ability to implement. Further, the County has limited authority over privately-owned critical facility owners regarding mitigation at any level of protection.

6.5.3 Mitigation Strategy Evaluation and Prioritization

Section 201.c.3.iii of 44 CFR requires an action plan describing how the actions identified will be prioritized.

The County and participating municipalities utilized a modified STAPLEE (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) mitigation action evaluation methodology based on a set of evaluation criteria suited to the purposes of hazard mitigation strategy evaluation. This method provides a systematic approach that considers the opportunities and constraints of implementing a specific mitigation action.

The Steering Committee applied an action evaluation and prioritization methodology, which includes an expanded set of 14 criteria to include the consideration of cost-effectiveness, availability of funding, anticipated timeline, and if the action addresses multiple hazards.

The 14 evaluation/prioritization criteria used in the 2021 update process are the following:

1. Life Safety—How effective will the action be at protecting lives and preventing injuries?
2. Property Protection—How significant will the action be at eliminating or reducing damage to structures and infrastructure?
3. Cost-Effectiveness—Are the costs to implement the project or initiative commensurate with the benefits achieved?
4. Technical—Is the mitigation action technically feasible? Is it a long-term solution? Eliminate actions that, from a technical standpoint, will not meet the goals.
5. Political—Is there overall public support for the mitigation action? Is there the political will to support it?
6. Legal—Does the municipality have the authority to implement the action?
7. Fiscal—Can the project be funded under existing program budgets (i.e., is this initiative currently budgeted for)? Would it require a new budget authorization or funding from another source such as grants?
8. Environmental–What are the potential environmental impacts of the action? Will it comply with environmental regulations?
9. Social—Will the proposed action adversely affect one segment of the population? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?
10. Administrative—Does the jurisdiction have the personnel and administrative capabilities to implement the action and maintain it? Will outside help be necessary?
11. Multi-hazard—Does the action reduce the risk to multiple hazards?
12. Timeline—Can the action be completed in less than 5 years (within our planning horizon)?
13. Local Champion—Is there a strong advocate for the action or project among the jurisdiction’s staff, governing body, or committees that will support the action’s implementation?
14. Other Local Objectives—Does the action advance other local objectives, such as capital improvements, economic development, environmental quality, or open space preservation? Does it support the policies of other plans and programs?

Participating jurisdictions were asked to use these criteria to assist them in evaluating and prioritizing mitigation actions identified in the 2021 update. Specifically, for each mitigation action, the jurisdictions were asked to assign a numeric rank (-1, 0, or 1) for each of the 14 evaluation criteria, defined as follows:

- 1 = Highly effective or feasible
- 0 = Neutral
- -1 = Ineffective or not feasible

Further, jurisdictions were asked to provide a summary of the rationale behind the numeric rankings assigned, as applicable. The numerical results were totaled and then used by each jurisdiction to help prioritize the action or strategy as *Low*, *Medium*, or *High*. Actions that had a numerical value between 1 and 5 were categorized as *low*; actions with numerical values between 6 and 9 were categorized as *medium*; and actions with numerical values between 10 and 14 were categorized as *high*. While this provided a consistent, systematic methodology to support the evaluation and prioritization of mitigation actions, jurisdictions might have additional considerations that could influence their overall prioritization of mitigation actions.

It is noted that jurisdictions might be carrying forward mitigation actions and initiatives from prior mitigation strategies that were prioritized using a different, but not inherently contrary, approach. Mitigation actions in the prior (2015) Chenango County HMP were "qualitatively evaluated against the mitigation goals and objectives and other evaluation criteria. They were then prioritized into three categories: high, medium, and low." At their discretion, jurisdictions carrying forward prior initiatives were encouraged to re-evaluate their priority, particularly if conditions that would affect the prioritization criteria had changed.

For the plan update there has been an effort to develop more clearly defined and action-oriented mitigation strategies. These local strategies include projects and initiatives 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 municipality was asked to develop problem statements. With active support from NYS DHSES planning staff, municipalities were able to develop action-oriented and achievable mitigation strategies.

As such, many of the initiatives in the updated mitigation strategy were ranked as *High* or *Medium* priority, as reflective of the community's clear intent to implement, available resources not-withstanding. In general, initiatives that would have had *low* priority rankings were appropriately screened out during the local action evaluation process.

6.5.4 Benefit/Cost Review

Section 201.6.c.3iii of 44 CFR requires the prioritization of the action plan to emphasize the extent to which benefits are maximized according to a cost/benefit review of the proposed projects and their associated costs. Stated otherwise, cost-effectiveness is one of the criteria that must be applied during the evaluation and prioritization of all actions comprising the overall mitigation strategy.

The benefit/cost review applied in for the evaluation and prioritization of projects and initiatives in this plan update process was qualitative; that is, it does not include the level of detail required by FEMA for project grant eligibility under the Hazard Mitigation Assistance (HMA) grant programs. For all actions identified in the local strategies, jurisdictions have identified both the costs and benefits associated with project, action or initiative.

Costs are the total cost for the action or project, and could include administrative costs, construction costs (including engineering, design and permitting), and maintenance costs.

Benefits are the savings from losses avoided attributed to the implementation of the project, and could include life-safety, structure and infrastructure damages, loss of service or function, and economic and environmental damage and losses.

When available, jurisdictions were asked to identify the actual or estimated dollar value for project costs and associated benefits. Having defined costs and benefits allows a direct comparison of benefits versus costs and a quantitative evaluation of project cost-effectiveness. Often, however, numerical costs and/or benefits have not been identified or might be impossible to quantitatively assess.

For the purposes of this planning process, jurisdictions were tasked with evaluating project cost-effectiveness with both costs and benefits assigned to *High*, *Medium,* and *Low* ratings. Where quantitative estimates of costs and benefits were available, ratings/ranges were defined as:

Low = < \$10,000 *Medium* = \$10,000 to \$100,000 *High* = > \$100,000

Table 6-7 provides the qualitative cost and benefit ratings definitions when quantitative estimates of costs and benefits were not available.

Table 6-7. Qualitative Cost and Benefit Ratings

Costs	
High	Existing funding levels are not adequate to cover the costs of the proposed project, and implementation would require an increase in revenue through an alternative source (e.g., bonds, grants, and fee increases).
Medium	The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
Low	The project could be funded under the existing budget. The project is part of or can be part of an existing, ongoing program.
Benefits	
High	Project will have an immediate impact on the reduction of risk exposure to life and property.
Medium	Project will have a long-term impact on the reduction of risk exposure to life and property or will provide an immediate reduction in the risk exposure to property.
Low	Long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low) are considered cost-effective.

For some of the Chenango County initiatives identified, the planning partnership might seek financial assistance under FEMA's HMA programs. These programs require detailed benefit/cost analysis as part of the application process. These analyses will be performed when funding applications are prepared, using the FEMA benefit/cost analysis model process. The planning partnership is committed to implementing mitigation strategies with benefits that exceed costs. For projects not seeking financial assistance from grant programs that require this sort of analysis, the planning partnership reserves the right to define "benefits" according to parameters that meet its needs and the goals and objectives of this plan.

SECTION 7. PLAN MAINTENANCE PROCEDURES

This section details the formal process that will ensure that the HMP remains an active and relevant document and that the Planning Partnership maintains their 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 become available, resulting in a plan that will remain current and relevant.

The plan maintenance matrix shown in Table 7-1 provides a synopsis of responsibilities for plan monitoring, evaluation, and update, which are discussed in further detail in the sections below.

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 Annual Progress Report.	January or upon major update to Comprehensive Plan or major disaster	Jurisdictional points of contact 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	In order for integration of mitigation principles action to become an organic part of the ongoing county and municipal activities, the county will incorporate the distribution of the safe growth worksheet (see 7.1.2 below) for annual review and update by all participating jurisdictions.	January 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
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 15 of each year	Steering Committee; Plan Maintenance element	Jurisdictional points of contacts identified in Section 9 (Jurisdictional Annexes)

Task	Approach	Timeline	Lead Responsibility	Support Responsibility
Update	Reconvene the planning partners, at a minimum, every 5 years to guide a comprehensive update to review and revise the plan.	Every 5 years or upon major update to Comprehensive Plan or major disaster	Chenango County HMP Coordinator	Jurisdictional points of contacts identified in Section 9 (Jurisdictional Annexes)

7.1 MONITORING, EVALUATING AND UPDATING THE PLAN

The procedures for monitoring, evaluating, and updating the plan are provided below.

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 Committee and be the prime 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 Committee 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 Committee 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 Chenango County HMP Coordinator is designated as:

Shane H. Butler
Chenango County Department of Planning and Development
5 Court Street, Norwich, NY 13815
(607) 337-1640
ShaneB@co.chenango.ny.us

7.1.1 Monitoring

The Planning Committee 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, Chenango County and local Planning Committee 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 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 implementation of actions, the information that Planning Committee 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,
- Public and stakeholder input.

Plan monitoring for years 2 through 4 of the plan performance periods will be similarly addressed via the BATool^{SM} or manually.

7.1.2 Integration Process of the HMP into Municipal Planning Mechanisms

Hazard mitigation is sustained action taken to reduce or eliminate the long-term risk to human life and property from natural hazards. Integrating hazard mitigation into a community's existing plans, policies, codes, and programs leads to development patterns that do no increase risk from known hazards or leads to redevelopment that reduces risk from known hazards. The Chenango 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 (Section 2 – 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:

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 Chenango 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 (2013), 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. By completing the checklist, it 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 Check List

Planning Mechanisms	Do you Do This? Yes	No	Notes: How is it being done or how will this be utilized in the future?
Operating, Municipal and Capital Improvement Program Budgets			
• When constructing upcoming budgets, hazard mitigation actions will be funded as budget allows. Construction projects will be evaluated to see if they meet the hazard mitigation goals.			
• Annually, during 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 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			

Planning Mechanisms	Do you Do This? Yes	No	Notes: How is it being done or how will this be utilized in the future?
zoning changes that allow greater intensity or density of use?			
• Do the ordinances prohibit development within, of 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 in order to conserve environmental resources?			
• Do the regulations allow density transfers where hazard areas exist?			
Comprehensive Plan			
• Are the goals and policies of the plan related to those of the County HMP?			
• Does the future land use map clearly identify natural hazard areas?			
• Do the land use policies discourage development or redevelopment with 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 development or redevelopment with 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?			

Planning Mechanisms	Do you Do This? Yes	No	Notes: How is it being done or how will this be utilized in the future?
• Is transportation policy used to guide growth to safe locations?			
• Are transportation systems designed to function under disaster conditions (e.g. evacuation)?			
Environmental Management			
• Are environmental systems that protect development from hazards identified and mapped?			
• Do environmental policies maintain and restore protective ecosystems?			
• Do environmental policies provide incentives to development that is 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 group will take into account information regarding identified hazard areas when assisting new businesses in finding a location.			
Public Education and Outreach			
• Does the municipality have any public outreach mechanisms / programs in place to inform citizens on natural hazards, risk, and ways to protect themselves during such events?			

7.1.3 Evaluating

The evaluation of the mitigation plan is an assessment of whether the planning process and actions have been effective, if the HMP goals are being achieved, and whether changes are needed. The HMP will be evaluated on an annual basis to determine the effectiveness of the programs, and to reflect changes that could affect mitigation priorities or available funding.

The status of the HMP will be discussed and documented at an annual plan review meeting of the Planning Committee, 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 Chenango County HMP Coordinator will advise Planning Committee members of the meeting date, agenda and expectations of the members.

The Chenango 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:

- 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 presents.
- 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 Committee will review the mitigation goals, objectives, and activities using performance-based indicators, including:

- New agencies/departments
- Project completion
- Under/over spending
- Achievement of the goals and objectives
- Resource allocation
- Timeframes
- Budgets
- Lead/support agency commitment
- Resources
- Feasibility

Finally, the Planning Committee will evaluate how other programs and policies have conflicted 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
- Transportation

The Planning Committee 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 Committee should refer to any process and plan review deliverables developed by the county or participating jurisdictions as a part of the plan review processes established for prior or existing local HMPs within the county.

The Chenango 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 Committee members, information presented at the annual Planning Committee 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 Committee will be able to assess which projects are completed, which are no longer feasible, and what projects should require additional funding.

The Annual HMP Progress Report shall be posted on the Chenango County Department of Planning and Development website to keep the public apprised of the plan's implementation (https://www.co.chenango.ny.us/planning/). 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 Committee will strive to complete the review process and prepare an Annual HMP Progress Report by January 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 the Section 5.4 (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.

7.1.4 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 Chenango County HMP Planning Committee to update this plan on a five-year cycle from the date of initial plan adoption.

To facilitate the update process, the Chenango County HMP Coordinator, with support of the Planning Committee, shall use the second annual Planning Committee meeting to develop and commence the implementation of a detailed plan update program. The Chenango 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 assure that the update is completed according to regulatory requirements.

At this meeting, the Planning Committee shall determine what resources will be needed to complete the update. The Chenango 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.

7.1.5 Grant Monitoring and Coordination

Chenango County recognizes the importance of having an annual coordination period that helps each planning partner become aware of upcoming mitigation grant opportunities identifies multi-jurisdiction projects to pursue. Grant monitoring will be the responsibility of each municipal partner as part of their annual progress reporting.". The Chenango County HMP Coordinator will keep the planning partners apprised of Hazard Mitigation Assistance grant openings and assist in developing letters of intent for grant opportunities when practicable.

Chenango 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, Chenango County intends to provide the following:

- Notification to planning partners about impending grant opportunities.
- A current list of eligible, jurisdiction-specific projects for funding pursuit consideration.
- Notification about mitigation priorities for the fiscal year to assist the planning partners in the selection of appropriate projects.

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.

7.2 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.

The “Capability Assessment” section of Section 6 (Mitigation Strategy) 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”).

It is the intention of Planning Committee representatives to incorporate mitigation planning as an integral component of daily government operations. Planning Committee 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 (Section 2 – 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 Committee anticipates that:

1) Hazard mitigation planning will be formally recognized as an integral part of overall 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.

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
- Emergency Action Plans (EAPs) for Class B and Class C dams
- Dam inundation maps
- 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 Committee 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.

7.3 CONTINUED PUBLIC INVOLVEMENT

Chenango 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 on-line (https://www.chenangocountynyhmp.com/ and https://www.co.chenango.ny.us/planning/). In addition, public outreach and dissemination of the HMP will include:

- Links to the plan on municipal websites of each jurisdiction with capability.
- Continued utilization of existing social media outlets (Facebook, Twitter) 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.
- Development of annual articles or workshops on flood hazards to educate the public and keep them aware of the dangers of flooding.

Planning Committee representatives and the Chenango 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 this website, posting new information and maintaining an active link to collect public comments.

The public can also provide input at the annual review meeting for the HMP and during the next five-year plan update. The Chenango 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 meeting would be to provide the public an opportunity to express concerns, opinions, and ideas about the mitigation plan.

The Planning Committee representatives shall be responsible to assure that:

- 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 Chenango 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 Chenango County HMP Coordinator shall be responsible to assure that:

- Public and stakeholder comment and input on the plan, and hazard mitigation in general, are recorded and addressed, as appropriate.
- The Chenango 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.

%	Percent
ACOE	Army Corps of Engineers
ACS	American Community Survey
ADA	Americans with Disabilities Act
AICP	American Institute of Certified Planners
ACE	Annual Chance Exceedance
ANSS	Advanced National Seismic System
APA	Approval Pending Adoption
ARC	American Red Cross
ASCE	American Society of Civil Engineers
BC	Broome County
BCA	Benefit Cost Analysis
BCC	Broome Community College
BC IDA	Broome County Industrial Development Agency
BC GIS	Broome County GIS
BCDSS	Broome County Department of Social Services
BCEGS	Building Code Effectiveness Grading Schedule
BCOES	Broome County Office of Emergency Services
BCPD	Broome County Planning Department
BCPED	Broome County Department of Planning and Economic Development
BFE	Base Flood Elevation
BHA	Binghamton Housing Authority
BU	Binghamton University
BMSB	Brown Marmorated Stink Bug
BMTS	Binghamton Metropolitan Transportation Study
BOA	Brownfield Opportunity Area
BOCES	Board of Cooperative Educational Services of New York State
BUI	Buildup Index
CBS	Chemical Bulk Storage
CAV	Community Assisted Visit
CDBG	Community Development Block Grant
CDBG-DR	Community Development Block Grant Disaster Recovery
CDC	Centers for Disease Control
CDMS	Comprehensive Data Management System

CEMP	Comprehensive Emergency Management Program
CEO	Chief Executive Officer
CFR	Code of Federal Regulations
CIP	Capital Improvement Plan
COOP/COG	Continuity of Operations/Continuity of Government
COAD	Community Organizations Active in Disaster
CPC	Climate Prediction Center
C-PUD	Commercial Planned Unit Development
CRREL	Cold Regions Research and Engineering Laboratory
CRS	Community Rating System
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CSC	Climate Smart Communities (NYSDEC)
CSD	Central School District
DEM	Digital Elevation Model
DFIRM	Digital Flood Insurance Rate Map
DMA 2000	Disaster Mitigation Act of 2000
DPW	Department of Public Works
DCPW	Deputy Commissioner of Public Works
DR	Major Disaster Declaration (FEMA)
EAB	Emerald Ash Borer
EDD	Early Detection and Distribution
EF	Enhanced Fujita Scale
EM	Emergency Declaration (FEMA)
EMS	Emergency Medical Services
EOC	Emergency Operation Center
EOP	Emergency Operation Plan
EPA	Environmental Protection Agency
ESF	Emergency Support Function
ESRI	Environmental Systems Research Institute
EWP	Emergency Watershed Protection Program
FD	Fire Department
FDRA	Fire Danger Rating Areas
FEMA	Federal Emergency Management Agency

FIRM	Flood Insurance Rate Map
FIA	Flood Insurance Administration
FIS	Flood Insurance Study
FM	Fuel Moisture
FMA	Flood Mitigation Assistance
FPA	Floodplain Administrator
FPI	Fire Potential index
FY	Fiscal Year
GIS	Geographic Information System
GML	General Municipal Law
GOSR	Governor's Office for Storm Recovery
GSN	Global Seismographic Network
GP	General Permit
HAZMAT	Hazardous Materials
HAZUS	Hazards U.S.
HAZUS-MH	Hazards U.S. Multi-Hazard
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HUC	Hydrologic Unit
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating, Ventilation, and Air Conditioning
IA	Individual Assistance
ICS	National Incident Command System
ISO	Insurance Service Office
IT	Information Technology
JC	Johnson City
JSTP	Joint Sewage Treatment Plant
KBDI	Keetch-Bryam Drought Index
LCSN	Lamon-Doherty Cooperative Seismographic Network
LAMP	Levee Analysis and Mapping Process
LSAC	Levee Safety Action Classification
LEPC	Local Emergency Planning Committee
LWRP	Local Waterfront Revitalization Program
MOSF	Major Oil Storage Facilities

MGD	Million Gallons per Day
Mi	Mile
MMI	Modified Mercalli Intensity Scale
Mph	Miles per Hour
MRCC	Midwest Regional Climate Center
MRP	Mean Return Period
N/A	Not Applicable
NA	Not Available
NASA	National Aeronautics and Space Administration
NAC-AAA	National Avalanche Center – American Avalanche Association
NCDC	National Climate Data Center
NCEI	National Centers for Environmental Information
NEHRP	National Earthquake Hazards Reduction Program
NESIS	Northeast Snowfall Impact Scale
NFDRS	National Fire Danger Rating System
NFIP	National Flood Insurance Program
NHC	National Hurricane Center
NID	National Inventory of Dams
NIMS	National Incident Management System
NLD	National Levee Database
NOAA	National Oceanic and Atmospheric Administration
NPDP	National Performance of Dams Program
NPL	National Priorities List (EPA)
NRCC	Northeast Regional Climate Center
NRCS	Natural Resources Conservation Service
NSIDC	National Snow and Ice Data Center
NSSL	National Severe Storms Library
NWS	National Weather Service
NY	New York
NYIS	New York Invasive Species Network
NYCRR	New York Codes, Rule, and Regulations
NYRCR	New York Rising Community Reconstruction
NYS	New York State
NYS DHSES	New York State Division of Homeland Security and Emergency Services

NYS GIS	New York State Geographic Information System
NYS OFP&C	New York State Office of Fire Prevention and Control
NYSDAM	New York State Department of Agriculture and Markets
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
NYSDPC	New York State Disaster Preparedness Commission
NYSEG	New York State Electric and Gas
NYSERDA	New York State Energy Research and Development Authority
NYSHMP	New York State Hazard Mitigation Plan
NYSFSMA	New York State Floodplain and Stormwater Managers
NYSOEM	New York State Office of Emergency Management
OES	Office of Emergency Services
OFA	Office for Aging
PA	Pennsylvania
PBS	Petroleum Bulk Storage
PD	Police Department
PDM	Pre-Disaster Mitigation Program
PFIS	Preliminary Flood Insurance Study
PE	Professional Engineer
PGA	Peak Ground Acceleration
POC	Point of Contact
POE	Point of Entry
Pop.	Population
PRISM	The Finger Lakes Partnership for Regional Invasive Species Management
PW	Public Works
RC	Red Cross
RCV	Replacement Cost Value
RL	Repetitive Loss
ROW	Right of Way
RSI	Regional Snowfall Index
RTE	Route
SBA	Small Business Administration
SEQRA	State Environmental Quality Review Act

SDI	State Drought Index (NYSDEC)
SF	Square Feet
SFHA	Special Flood Hazard Area
SILVIS	Spatial Analysis for Conservation and Sustainability
SPC	Storm Prediction Center
SPDES	State Pollutant Discharge Elimination System
SUNY	State University of New York
Sq. Mi.	Square mile
SRL	Severe Repetitive Loss
SWCD	Soil and Water Conservation District
SWOO	Strengths, Weaknesses, Obstacles and Opportunities
SWPPP	Stormwater Pollution Prevention Plan
TBD	To Be Determined
TD	Tropical Depression
TS	Tropical Storm
UCAR	University Corporation for Atmospheric Research
UHS	United Health Services
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
VA	Vulnerability Assessment
WWTP	Waste Water Treatment Plant
WCT	Wind Chill Index
WFAS	Wildland Fire Assessment System
WUI	Wildland/Urban Interface
WW	Wastewater
ZBA	Zoning Board of Appeals

REFERENCES

Section 1: Introduction

Chenango County Department of Planning & Development. 2015. "Chenango County Hazard Mitigation Update." December. Online Address: https://www.chenangocountynyhmp.com/draft-plans/

Federal Emergency Management Agency (FEMA). 2015. "Plan Integration: Linking Local Planning Efforts." Online Address: https://www.fema.gov/media-library-data/1440522008134-ddb097cc285bf741986b48fdcef31c6e/R3_Plan_Integration_0812_508.pdf

Section 2: Plan Adoption

Federal Emergency Management Agency (FEMA). 2003. How to Series: Bringing the Plan to Life (FEMA 386-4).

Section 3: Planning Process

Chenango County Department of Planning & Development. 2015. "Chenango County Hazard Mitigation Update." December. Online Address: https://www.chenangocountynyhmp.com/draft-plans/

Federal Emergency Management Agency (FEMA). 2000. *Disaster Mitigation Act of 2000*. October 30.

Federal Emergency Management Agency (FEMA). 2004. "Multi-Hazard Mitigation Planning Guidance Under The Disaster Mitigation Act of 2000."

New York State Departments of Homeland Security and Emergency Services (NYSDHSES). 2017. "New York State Hazard Mitigation Planning Standards." Accessed 2020. Online Address: http://qa.dhses.ny.gov/recovery/mitigation/documents/2017-NYS-Mitigation-Planning-Standards.pdf

New York State Departments of Homeland Security and Emergency Services (NYSDHSES). 2019. New York State 2019 Hazard Mitigation Plan. Online Address: https://mitigateny.availabs.org/

Section 4: County Profile

Chenango County. 2016. "Guiding Chenango: A County Comprehensive Plan." Online Address: https://www.co.chenango.ny.us/planning/planning-board/documents/Comprehensive%20Plan%20January%202016.pdf

Cornell University. 2018. County Projections Explorer. Online Address: https://pad.human.cornell.edu/counties/projections.cfm

Paleontological Research Institution. 2020. "The Inland Basin: Topography." Online Address: https://earthathome.org/hoe/ne/inland-basin/topography/

Susquehanna River Basin Commission (SRBC). 2006. Online Address: https://www.srbc.net/

U.S. Census Bureau. 2010. Quick Facts. Online Address: https://www.census.gov/quickfacts/fact/table/chenangocountynewyork,US/PST045219

U.S. Census Bureau. 2018. Poverty Thresholds. Accessed 2020. Online Address: https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html

U.S. Department of Agriculture (USDA) National Agricultural Statistics Service. 2017. Census of Agriculture County Profile. Accessed 2020. Online Address: https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/New_York/cp36017.pdf

Section 5.4.1: Disease Outbreak

Barry-Eaton District Health Department. 2013. “Pandemic Influenza.” Online Address: http://www.barryeatonhealth.org/Influenza/PandemicInfluenza.aspx

Centers for Disease Control and Prevention (CDC). N.d. “Diseases Carried by Vectors.” Online Address: https://www.cdc.gov/climateandhealth/effects/vectors.htm

Centers for Disease Control and Prevention (CDC). 2010. “Pandemic (H1N1) 2009 – update 100.” May 14. On-Line Address: http://www.who.int/csr/don/2010_05_14/en/index.html

Centers for Disease Control and Prevention, 2018. “Selected Tickborne Diseases Reported to CDC, U.S., 2018.” Accessed September 2020. https://www.cdc.gov/ticks/tickbornediseases/overview.html

Centers for Disease Control and Prevention (CDC). 2019a. “Lyme Disease; Recent Surveillance Data”. Accessed April 2020. Online Address: https://www.cdc.gov/lyme/datasurveillance/tables-recent.html

Centers for Disease Control and Prevention (CDC). 2019b. “West Nile Virus; Cumulative Maps & Data for 1999-2018”. Accessed April 2020. Online Address: https://www.cdc.gov/westnile/statsmaps/cumMapsData.html

Centers for Disease Control and Prevention (CDC). 2020. “Coronavirus (COVID-19)”. Online Address: https://www.cdc.gov/coronavirus/2019-ncov/index.html

Chenango County Department of Health. 2018. “Flu is Surging”. February 16. Accessed January 2021, Online Address: https://www.co.chenango.ny.us/public-health/press-release/2018%20Flu%20Surge%20Press%20Release.pdf

FEMA. 2020. “Data Visualization: Disaster Declarations for States and Counties”. Online Address: https://www.fema.gov/data-visualization-disaster-declarations-states-and-counties

Harmon, Katherine. 2010. *Climate Change will Impact Infectious Diseases Woldwide, but questions remain as to how.* March 3. Online Address: https://blogs.scientificamerican.com/observations/climate-change-will-impact-infectious-diseases-worldwide-but-questions-remain-as-to-how/

Health Data NY. 2020. “Community Health: Lyme Disease Incidence Rate per 100,000 by County.” Online Address: https://health.data.ny.gov/Health/Community-Health-Lyme-Disease-Incidence-Rate-per-1/6sxr-cqij

New Jersey Office of Emergency Management (NJOEM). 2019. “2019 New Jersey State Hazard Mitigation Plan Update.” Online Address: http://ready.nj.gov/mitigation/2019-mitigation-plan.shtml

NYC Emergency Management. 2019. “2019 New York City Hazard Mitigation Plan”. Accessed April 2020. Online Address: https://nychazardmitigation.com/

New York Department of Environmental Conservation. 2020b. “Pesticide Laws and Regulations”. Accessed 2020. Online Address: https://www.dec.ny.gov/chemical/112881.html#:~:text=Pesticide%20Laws%20and%20Regulations,in%20 the%20Environmental%20Conservation%20Law.&text=Businesses%20must%20be%20registered%20with,services%20in%20New%20York%20State.

New York State Department of Health. 2006. “Pandemic Influenza Plan.” Online Address: https://www.questar.org/wp-content/uploads/2017/08/Pandemic_influenza_plan.pdf

New York State Department of Health. 2010. “Community Preparedness - Effective Emergency Response and Recovery”. Accessed November 2020. Online Address: https://www.health.ny.gov/prevention/prevention_agenda/community_preparedness/

New York State Department of Health. 2017a. “Arboviral (Arthropod-borne Viral) Diseases”. Accessed 2020. Online Address: https://www.health.ny.gov/diseases/communicable/arboviral/fact_sheet.htm

New York State Department of Health. 2017b. “Lyme Disease (Tick-borne borreliosis, Lyme arthritis) Fact Sheet”. Accessed April 2020. Accessed 2020. Online Address: https://www.health.ny.gov/diseases/communicable/lyme/fact_sheet.htm

New York State Department of Health. 2017c. “West Nile Virus (WNV)”. Accessed 2020. Online Address: https://www.health.ny.gov/diseases/west_nile_virus/fact_sheet.htm

NYS Department of Health. 2019a. “Lyme Disease and Other Diseases Carried by Ticks”. Accessed 2020. Online Address: https://www.health.ny.gov/diseases/communicable/lyme/

New York State Department of Health. 2019b. “Mosquitoes and Disease”. Accessed 2020. Online Address: https://www.health.ny.gov/diseases/west_nile_virus/

New York State Department of Health. 2019c. “Communicable Disease Annual Reports and Related Information”. Accessed 2020. Online Address: https://www.health.ny.gov/statistics/diseases/communicable

New York State Department of Health. 2020. COVID-19 Tracker. Accessed 2020. Online Address: https://covid19tracker.health.ny.gov/views/NYS-COVID19-Tracker/NYSDOHCOVID-19Tracker-TableView?%3Aembed=yes&%3Atoolbar=no&%3Atabs=n

Patch.com. 2020. “Coronavirus Forces 100K NY Small Businesses to Close Permanently.” May 22. Accessed August 2020. Online Address: https://patch.com/new-york/new-york-city/coronavirus-forces-100k-ny-small-businesses-close-permanently

Placer Mosquito and Vector Control District. 2019. “Invasive Species.” Accessed 2020. Online Address: http://www.placermosquito.org/unlisted-news/invasivespecies/

Steere, Allen C., Jenifer Coburn, and Lisa Glickstein. 2004. "The Emergence of Lyme Disease." The Journal of Clinical Investigation. Accessed 2014. Online Address: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=385417

Washington Post. 2017. “Another deadly consequence of climate change: The spread of dangerous diseases.” June 07. Online Address: https://www.washingtonpost.com/opinions/another-deadly-consequenceof-climate-change-the-spread-of-dangerous-diseases/2017/05/30/fd3b8504-34b1-11e7-b4ee434b6d506b37_story.html?noredirect=on&utm_term=.8c6c7319fea3

WHO. 2009. “The WHO Pandemic Phases”. Accessed 2020. Online Address: https://www.ncbi.nlm.nih.gov/books/NBK143061/

WHO. 2020. "Coronavirus". Accessed 2020. Online Address: https://www.who.int/health-topics/coronavirus#tab=tab_1

Section 5.4.2: Drought

Centers for Disease Control and Prevention (CDC). 2012. "Drought and Health." July 30. Accessed 2020. Online Address: http://www.cdc.gov/nceh/drought/

Chenango County. 2016. "Guiding Chenango: A County Comprehensive Plan." Online Address: https://www.co.chenango.ny.us/planning/planning-board/documents/Comprehensive%20Plan%20January%202016.pdf

Cornell University. 2017. "Survey details impact of 2016 drought on New York farming." April 6. Accessed 2020. Online Address: https://news.cornell.edu/stories/2017/04/survey-details-impact-2016-drought-new-york-farming

National Drought Mitigation Center (NDMC). 2002. Drought Severity Classification. Accessed 2020. Online Address: http://www.unc.edu/~rowlett/units/scales/drought.html.

National Drought Mitigation Center (NDMC). 2013. Palmer Drought Category. Accessed 2020. Online Address: https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx

National Oceanic and Atmospheric Administration (NOAA). 2000. "All Dried Up." Accessed 2020. Online Address: http://coastwatch.noaa.gov/cwn/images/Drought_Module.pdf

New York State Department of Environmental Conservation (NYS DEC). No date. "Drought." Accessed April 2020. Online Address: http://www.dec.ny.gov/lands/5011.html

New York State Department of Environmental Conservation (NYS DEC). No date. "New York State Drought Management Regions and Map of Conditions." Accessed April 2020. Online Address: https://www.dec.ny.gov/lands/5014.html

New York State Division of Homeland Security and Emergency Services (NYS DHSES). 2014. "Drought Hazard Profile". Online Address: http://www.dhses.ny.gov/recovery/mitigation/documents/2014-shmp/Section-3-6-Drought.pdf

New York State Departments of Homeland Security and Emergency Services (NYSDHSES). 2019. New York State 2019 Hazard Mitigation Plan. Online Address: https://mitigateny.availabs.org/

New York State Energy Research and Development Authority (NYSERDA). 2011. "Responding to Climate Change in New York State." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

New York State Energy Research & Development (NYSERDA). 2014. "Responding to Climate Change in New York State: Updating the 2011 ClimAID Climate Risk Information Supplement to NYSERDA Report 11-18 (Responding to Climate Change in New York State)." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

United States Census Bureau. 2018. "American Community Survey: 2014-2018." Online Address: https://data.census.gov/cedsci/

United States Department of Agriculture (USDA). 2017. *Census of Agriculture*. Online Address: https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/New_York/

U.S. Geological Survey (USGS). 2019. "Drought and Overpumping and Groundwater Decline." Online Address: https://water.usgs.gov/edu/droughtandgw.html

Section 5.4.3: Extreme Temperature

Center for Disease Control and Prevention (CDC). 2016. "Extreme Heat." Accessed 2020. Online Address: https://www.cdc.gov/disasters/extremeheat/index.html

Centers for Disease Control and Prevention (CDC). 2020. "Temperature Extremes". Online Address: https://www.cdc.gov/climateandhealth/effects/temperature_extremes.htm

Climate Prediction Center (CPC). 2005. Climate Divisions with Counties. Online Address: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/CLIM_DIVS/new_york.gif

Federal Emergency Management Agency (FEMA). 2019. "Put a Freeze on Winter Fires." Online Address: https://www.usfa.fema.gov/downloads/pdf/publications/winter_infographic.pdf

Federal Emergency Management Agency (FEMA). 2020. "Disaster Information." Online Address: https://www.fema.gov/disasters

Molekule. 2020. "What Relative Humidity means for indoor air quality. August 21. Accessed 2020. Online Address: https://molekule.science/what-relative-humidity-means-for-indoor-air-quality/

National Climatic Data Center (NCDC). 2006. "Climate of New York." Online Address: https://www.ncdc.noaa.gov/climatenormals/clim60/states/Clim_NY_01.pdf

National Oceanic and Atmospheric Administration (NOAA). 2008. "Winter Storms the Deceptive Killers." Accessed 2020. Online Address: https://www.weather.gov/media/safety/Winter_Storms2008.pdf

National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information (NCEI). 2020. "Storm Events Database." Online Address: https://www.ncdc.noaa.gov/stormevents/

National Weather Service (NWS). 2013. "Heat: A Major Killer." National Oceanic & Atmospheric Administration. Online Address: http://www.nws.noaa.gov/os/heat/index.shtml

National Weather Service (NWS). 2018. "National Weather Service Glossary." Accessed 2020. Online Address: http://w1.weather.gov/glossary/

National Weather Service (NWS). 2020. "Heat." Online Address: https://www.weather.gov/bgm/heat

National Weather Service (NWS). 2020. "Wind Chill Safety." Online Address: https://www.weather.gov/bou/windchill

New York State Departments of Homeland Security and Emergency Services (NYSDHSES). 2019. New York State 2019 Hazard Mitigation Plan. Online Address: https://mitigateny.availabs.org/

New York State Energy Research and Development Authority (NYSERDA). 2011. "Responding to Climate Change in New York State." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

New York State Energy Research and Development Authority. 2014. "Climate Change in New York State Updating the 2011 ClimAID Climate Risk Information Supplement to NYSERDA Report 11-18 (Responding to Climate Change in New York State)." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

U.S. Environmental Protection Agency (EPA). 2019. "Heat Island Effect". Online Address: https://www.epa.gov/heat-islands

The Weather Channel. Weather Glossary. 2019. Accessed 2020. Online Address: http://www.weather.com/glossary/h.html.

Weatherquestions.com. 2019. "What is the Urban Heat Island?" Accessed 2020. Online Address: https://weatherstreet.com/weatherquestions/What_is_the_urban_heat_island.htm#:~:text=%22Urban%20Heat%20Island%22%20(UHI,F%20or%20more.&text=As%20the%20day%20progresses%2C%20a,to%20higher%20in%20the%20atmosphere.

Section 5.4.4: Flood

Centers for Disease Control and Prevention (CDC). 2015. "Homeowner's and Renter's Guide to Mold Cleanup After Disasters." Accessed 2020. Online Address: https://www.epa.gov/sites/production/files/2017-08/documents/mold._homeowners_and_renters_guide_to_cleanup_after_disasters.pdf

Centers for Disease Control and Prevention (CDC). 2016. Social Vulnerability Index. Accessed 2020. Online Address: https://svi.cdc.gov/map.html

Cornell University Program on Applied Demographics. 2017. Online access: https://pad.human.cornell.edu/counties/projections.cfm

Federal Emergency Management Agency (FEMA). 1997. "FEMA's Multi-Hazard Identification and Risk Assessment (MHIRA)." January 1. Online Address: http://www.fema.gov/library/viewRecord.do?id=2214

Federal Emergency Management Agency (FEMA). 2003. "FEMA Flood Insurance Study Tutorial." Accessed 2018. Online Address: https://www.fema.gov/media-library-data/20130726-1550-20490-1795/ot_fis.pdf

Federal Emergency Management Agency (FEMA). 2007. Floodplain Management Principles and Current Practices. Accessed 2020. Online Address: https://training.fema.gov/hiedu/aemrc/courses/coursetreat/fm.aspx

Federal Emergency Management Agency (FEMA). 2009. "NFIP Floodplain Management Guidebook." Accessed 2020. One-Line Address: https://www.fema.gov/media-library-data/20130726-1647-20490-1041/nfipguidebook_5edition_web.pdf

Federal Emergency Management Agency (FEMA). 2010. Flood Insurance Study for Chenango County.

Federal Emergency Management Agency (FEMA). 2020. "Data Visualization: Disaster Declarations for States and Counties". Online Address: https://www.fema.gov/data-visualization-disaster-declarations-states-and-counties

Federal Emergency Management Agency (FEMA). 2020. "Flood Zones." Online Address: https://www.fema.gov/glossary/flood-zones

Federal Emergency Management Agency (FEMA). 2020. "Disaster Information." Online Address: https://www.fema.gov/disasters

Harris, T. 2008. "How Floods Work." Online Address: http://science.howstuffworks.com/flood.htm

National Oceanic and Atmospheric Administration (NOAA). 2013. "Ice Jams." March 13. Online Address: http://www.floodsafety.noaa.gov/ice_jam.shtml

National Oceanic and Atmospheric Administration (NOAA). 2020. "River Observations." Online Address: https://water.weather.gov/ahps/

National Oceanic and Atmospheric Administration (NOAA). 2020. "What is a harmful algal bloom?" Online Address: https://www.noaa.gov/what-is-harmful-algal-bloom

National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information (NCEI). 2020. "Storm Events Database." Online Address: https://www.ncdc.noaa.gov/stormevents/

National Weather Service (NWS). 2009. "Flash Flood." Online Address: http://w1.weather.gov/glossary/index.php?word=flash+flood

National Weather Service (NWS). 2011. "Flood Safety." Online Address: http://www.erh.noaa.gov/car/WCM/Awareness_Campaigns_files/flood_part_1.htm

New York State Department of Environmental Conservation (NYSDEC). 2009. "Part 673 Dam Safety Regulations." Accessed 2020. Online Address: https://govt.westlaw.com/nycrr/Browse/Home/NewYork/NewYorkCodesRulesandRegulations?guid=I06198200b5a111dda0a4e17826ebc834&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)

New York State Department of Environmental Conservation (NYSDEC). 2020. "Watersheds." Online Address: https://www.dec.ny.gov/lands/26561.html

New York State Energy Research and Development Authority (NYSERDA). 2011. "Responding to Climate Change in New York State." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

New York State Energy Research and Development Authority. 2014. "Climate Change in New York State Updating the 2011 ClimAID Climate Risk Information Supplement to NYSERDA Report 11-18 (Responding to Climate Change in New York State)." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

New York State Departments of Homeland Security and Emergency Services (NYSDHSES). 2019. New York State 2019 Hazard Mitigation Plan. Online Address: https://mitigateny.availabs.org/

The Daily Star. 2011. "Flood Recovery Under Way in Area." September 10. Online Address: https://www.thedailystar.com/news/local_news/flood-recovery-under-way-in-area/article_8c64b960-f184-5a09-8fdd-104194e83638.html

The Evening Sun. 2011. "Flooding Photos." April 28. Online Address: https://www.facebook.com/NorwichEMO/posts/major-flooding-along-the-canasawacta-creek-courtesy-of-the-evening-sun/194309880613943/

The Illinois Association for Floodplain and Stormwater Management. 2006. "Section 1 Natural Aspects of Flooding: Part 1 Flooding and Floodplain Management." Online Address: http://www.illinoisfloods.org/documents/home_study_course/1%20Natural%20Aspects%20of%20Flooding.pdf.

U.S. Army Corps of Engineers (USACE). 2002. "Ice Engineering." October 30. Accessed June 2020. Online Address: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1612.pdf

U.S. Army Corps of Engineers (USACE). 2020a. Upper Susquehanna River Basin Comprehensive Flood Damage Reduction Feasibility Study. January 2020. Online Address: https://www.nab.usace.army.mil/Portals/63/USRB_Completion_Report_May_2020.pdf

U.S. Army Corps of Engineers (USACE). 2020b. "Ice Jam Database." Online Address: https://icejam.sec.usace.army.mil/ords/f?p=101:7

U.S. Army Corps of Engineers (USACE). 2020c. "National Levee Database." Online Address: https://levees.sec.usace.army.mil/#/

United States Geological Survey (USGS). 2020. "USGS Current Water Data for the Nation." Online Address: https://waterdata.usgs.gov/nwis/rt

World Health Organization (WHO). 2020. "Flooding and communicable diseases fact sheet." Online Address: https://www.who.int/hac/techguidance/ems/flood_cds/en/#:~:text=Floods%20can%20potentially%20increase%20the,fever%2C%20and%20West%20Nile%20Fever

WNBF News Radio 1290. 2016. "Storm Damage & Flooding in Norwich." August 2. Online Address: https://wnbf.com/storm-damage-flooding-in-norwich/

Section 5.4.5: Harmful Algal Blooms

Carmichael, W.W. 1997. "The Cyanotoxins". Advances in Botanical Research 27:211-255.

City of Norwich. 2016. "Department of Public Works Annual Water Supply Statement." Accessed 2020. Online Address: https://www.norwichnewyork.net/pdfs/2015-city-of-norwichannual-water-supply-statement.pdf

Chenango County. 2016. "Guiding Chenango: A County Comprehensive Plan." Online Address: https://www.co.chenango.ny.us/planning/planning-board/documents/Comprehensive%20Plan%20January%202016.pdf

Graham, L.E. and Lee W. Wilcox. 2000. "Algae." Prentice Hall. Upper Saddle River, NJ.

Environmental Protection Agency (EPA). 2017a. "Incident Action Checklist-Harmful Algal Blooms". Accessed 2020. Online Address: https://www.epa.gov/sites/production/files/2017-11/documents/171030-incidentactionchecklist-hab-form_508c.pdf

Environmental Protection Agency (EPA). 2017b. "Climate Change and Harmful Algal Blooms". Accessed 2020. https://www.epa.gov/nutrientpollution/climate-change-and-harmful-algal-blooms

Environmental Protection Agency (EPA). 2017c. "Incident Action Checklist – Harmful Algal Blooms." October. Accessed 2020. Online Address: https://www.epa.gov/sites/production/files/2017-11/documents/171030-incidentactionchecklist-hab-form_508c.pdf

New York State Department of Health (NYSDOH). 2017a. "More Details: Blue-green Algae and Health". Accessed 2018. Online Address: https://www.health.ny.gov/environmental/water/drinking/bluegreenalgae/blue-green_algae_advice.htm

New York State Department of Environmental Conservation (NYSDEC). 2016. "Harmful Algal Blooms (HABs) Photo Gallery". April 29. Accessed 2020. http://www.dec.ny.gov/chemical/81962.html

New York State Department of Environmental Conservation (NYSDEC). 2017a. "DEC HABs Program Archive Summary 2012-2017". Accessed 2020. Online Address: http://www.dec.ny.gov/docs/water_pdf/habsextentsummary.pdf

New York State Department of Environmental Conservation (NYSDEC). 2017b. "Harmful Algal Blooms (HABs) Brochure". Accessed 2020. http://www.dec.ny.gov/docs/water_pdf/habsbrochure.pdf

New York State Department of Environmental Conservation (NYSDEC). 2018. "Harmful Algal Blooms (HABs) Notifications Page". Accessed 2020. http://www.dec.ny.gov/chemical/83310.html

New York State Department of Environmental Conservation (NYSDEC). 2020. "Harmful Algal Blooms by County 2012-2019." Online Address: https://www.dec.ny.gov/docs/water_pdf/habsextentsummary.pdf

New York State Energy Research and Development Authority. 2014. "Climate Change in New York State Updating the 2011 ClimAID Climate Risk Information Supplement to NYSERDA Report 11-18 (Responding to Climate Change in New York State)." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

Section 5.4.6: Invasive Species

Casler, Andrew. 2013. "Non-native species threaten region." October 19. Online Address: https://www.ithacajournal.com/story/news/local/2016/06/24/archive-non-native-species-threaten-region/86336284/

Canadian Food Inspection Agency (CFIA). 2015. "Regulated Areas for Emerald Ash Borer (EAB)." March 2. Online Address: http://www.inspection.gc.ca/plants/plant-protection/directives/risk-management/emerald-ash-borer/eng/1368741925939/1368741926892#item6.0.

Cornell Cooperative Extension (CCE) Chenango County. 2019. "Invasive Pests." July 26. Online Address: http://ccechenango.org/natural-resources/invasive-pests

Finger Lakes Partnership for Regional Invasive Species Management (PRISIM). 2018. Invasive Species Profiles. Online Address: http://fingerlakesinvasives.org/invasive_species/

Finger Lakes Partnership for Regional Invasive Species Management (PRISIM). 2020. Priority Invasive Species Tiered List. Online Address: http://fingerlakesinvasives.org/wp-content/uploads/2020/02/Combined_TieredSpp_Categories_RegProList.pdf

iMapInvasives. 2020. "Presence Record." Online Address: https://imapinvasives.natureserve.org/imap/services/page/Presence/1072437.html

National Invasive Species Council (NISC). 2016. "National Invasive Species Council Management Plan 2016-2018". Online Address: https://www.doi.gov/invasivespecies/management-plan

Natural Resources Defense Council (NRDC). 2015. "Infectious Diseases: Dengue Fever, West Nile Virus, and Lyme Disease". Online Address: http://www.nrdc.org/health/climate/disease.asp

New York State Department of Environmental Conservation (NYSDEC). 2014. "Emerald Ash Borer". Online Address: http://www.dec.ny.gov/animals/7253.html

New York State Department of Environmental Conservation (NYSDEC). 2017. "Emerald Ash Borer (EAB) Restricted Zone". Online Address: http://www.dec.ny.gov/animals/7253.html

New York State Department of Environmental Conservation (NYSDEC). 2018. "Nuisance & Invasive Species". Online Address: http://www.dec.ny.gov/animals/265.html

New York State Department of Health (NYSDOH). 2015. "Mosquitoes and Disease." Accessed 2020. Online Address: https://www.health.ny.gov/diseases/west_nile_virus/

New York Invasive Species (NYIS). 2019. "New York Invasive Species Information Clearinghouse." Online Address: http://nyis.info/?action=prism&prism_id=6

Syracuse Post Standard. 2018. "Noxious and Dangerous." July 19.

U.S. Department of Agriculture (USDA) Forest Service. 2013. "Emerald Ash Borer". January 8. Online Address: http://www.nrs.fs.fed.us/disturbance/invasive_species/eab/effects_impacts/cost_of_infestation/

U.S. Department of Agriculture (USDA). 2016. "What is an Invasive Species?". Accessed 2020. Online Address: https://www.invasivespeciesinfo.gov/whatis.shtml

U.S. Department of Agriculture (USDA). 2017. "Aquatic Species" Online Address: https://www.invasivespeciesinfo.gov/aquatics/main.shtml#aqpl

Section 5.4.7 Natural Gas

Chenango County Natural Gas Advisory Committee. 2011. Minutes from the February 22, 2011 Meeting. Online Address: http://www.co.chenango.ny.us/planning/natural-gas/documents/Minutes2011.pdf

Chenango County Natural Gas Advisory Committee. 2011. Minutes from the January 25, 2011 Meeting. Online Address: http://www.co.chenango.ny.us/planning/natural-gas/documents/Minutes2011.pdf

Constitution Pipeline. 2020. Media Statement. February 24. Online Address: https://constitutionpipeline.com/

DeCordova, Melissa. 2008. "County leaders surprised by gas well head 'explosion' in Preston". The Evening Sun. August 13. Online Address: http://www.evesun.com/news/stories/2008-08-13/4939/

DeCordova, Melissa. 2009. "Smyrna Gas Rig Catches Fire". The Evening Sun. January 5. Online Address: http://chenangogreens.org/home/index.php?option=com_content&task=view&id=275&Itemid=60

Lycoming County. 2010. "Lycoming County 2010 Hazard Mitigation Plan". Online Address: http://www.lyco.org/Portals/1/PlanningCommunityDevelopment/Documents/haz_mit_plan/lycoming_co_hmp_26may2011_smaller.pdf

Natural Resources Defense Council (NRDC). 2020. "New York State Codifies Fracking Ban in Budget." April 3. Online Address: https://www.nrdc.org/experts/marisa-guerrero/new-york-state-codifies-fracking-ban-budget

New York State Department of Environmental Conservation (NYSDEC). 2011. "Fact Sheet: What We Learned from Pennsylvania". Online Address: http://www.dec.ny.gov/docs/administration_pdf/pafactsheet072011.pdf

New York State Department of Environmental Conservation (NYSDEC). 2020. *DECinfo Locator.* Online Address: https://gisservices.dec.ny.gov/gis/dil/

New York State Energy Planning Board. 2009. "Natural Gas Assessment – New York State Energy Plan 2009". Online Address: http://www.nysenergyplan.com/Prior-State-Energy-Plans/2009stateenergyplan.aspx>.

Selleck, Bruce. 2009. Colgate University Department of Geology. "Natural Gas in Chenango County". Online Address:http://www.colgate.edu/portaldata/imagegallerywww/31407766-9246-4202-a3d4-ffd01f214df8/ImageGallery/natural-gas-chenango

Union of Concerned Scientists (UCS). 2014. "Environmental Impacts of Natural Gas. June 19. Online Address: https://www.ucsusa.org/resources/environmental-impacts-natural-gas

U.S. Department of Transportation (US DOT). 2020. *2020 Emergency Response Guidebook.* Online Address: https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2020-08/ERG2020-WEB.pdf

Section 5.4.8: Severe Storm

Encyclopedia Britannica. 2011. "Windstorm." Online Address: https://www.britannica.com/science/windstorm

Federal Emergency Management Agency (FEMA). Multi-Hazard Identification and Risk Assessment (MHIRA). January 1997. Accessed 2013. http://www.fema.gov/library/viewRecord.do?id=2214

National Oceanic and Atmospheric Administration (NOAA). 2013. "Tropical Cyclone Introduction." Online Address: https://www.weather.gov/jetstream/tc

National Oceanic and Atmospheric Administration (NOAA), Storm Prediction Center (SPC). 2017. "What is Severe Weather?" Online Address: https://www.spc.noaa.gov/misc/about.html

National Severe Storms Laboratory (NSSL). 2013. "Severe Thunderstorm Climatology." National Oceanic & Atmospheric Administration. March 29. Online Address: http://www.nssl.noaa.gov/projects/hazard/index.html

National Weather Service (NWS). 2009a. "Thunderstorm." Online Address: http://w1.weather.gov/glossary/index.php?word=thunderstorm

National Weather Service (NWS). 2009b. "Hail Awareness." Online Address: http://www.weather.gov/cae/hail.html

National Weather Service (NWS). 2020. "Severe Weather Definitions." Online Address: https://www.weather.gov/bgm/severedefinitions

New York City Emergency Management. 2020. "Thunderstorms and Lightning." Online Address: https://www1.nyc.gov/site/em/ready/thunderstorms.page

New York State Division of Homeland Security and Emergency Services (NYS DHSES). 2014. 2014 New York State Standard Multi-Hazard Mitigation Plan. Online Address: http://www.dhses.ny.gov/oem/mitigation/plan.cfm

New York State Departments of Homeland Security and Emergency Services (NYSDHSES). 2019. New York State 2019 Hazard Mitigation Plan. Online Address: https://mitigateny.availabs.org/

New York State Energy Research and Development Authority. 2011. "Responding to Climate Change in New York State." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

New York State Energy Research and Development Authority. 2014. "Climate Change in New York State Updating the 2011 ClimAID Climate Risk Information Supplement to NYSERDA Report 11-18 (Responding to Climate Change in New York State)." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

Rosenstiel School of Marine & Atmospheric Science. 2005. "Katabatic Winds." University of Miami. December 1. Online Address: http://www.rsmas.miami.edu/personal/milicak/katabatic/node3.html

The Tornado and Storm Research Organization (TORRO). 2020. "Hail Scale." Online Address: http://www.torro.org.uk/hscale.php

Section 5.4.9: Severe Winter Storm

Chenango County. 2016. "Guiding Chenango: A County Comprehensive Plan." Online Address: https://www.co.chenango.ny.us/planning/planning-board/documents/Comprehensive%20Plan%20January%202016.pdf

Federal Emergency Management Agency (FEMA). 2020. "Data Visualization: Disaster Declarations for States and Counties". Online Address: https://www.fema.gov/data-visualization-disaster-declarations-states-and-counties

Meseck, Zachary. 2019. "Nearly One in Four Homes in Chenango County Are Vacant." June 28. Online Access: https://www.evesun.com/news/stories/2019-06-28/31530/Nearly-one-in-four-homes-in-Chenango-County-are-vacant

Midwest Regional Climate Center (MRCC). 2020. "Ice Storms." Online Address: https://mrcc.illinois.edu/living_wx/icestorms/index.html

National Oceanic and Atmospheric Administration (NOAA). 2020. "Regional Snowfall Index (RSI)." Online Address: http://www.ncdc.noaa.gov/snow-and-ice/rsi/

National Oceanic and Atmospheric Administration (NOAA). 2020. "Regional Snowfall Index (RSI) Map." Online Address: https://gis.ncdc.noaa.gov/maps/ncei/rsi

National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information (NCEI). 2020. "Storm Events Database." Online Address: https://www.ncdc.noaa.gov/stormevents/

National Severe Storm Laboratory (NSSL). 2020. "Severe Weather: Winter Weather". Online Address: https://www.nssl.noaa.gov/research/winter/

National Snow and Ice Data Center (NSIDC). 2015. "Severe Weather 101." On-Line Address: https://www.nssl.noaa.gov/education/svrwx101/winter/types/

National Snow and Ice Data Center (NSIDC). 2020. "Cryosphere Glossary". Accessed 2020. Online Address: https://nsidc.org/cryosphere/glossary/

National Weather Service (NWS). 2018. "What Ice Storm Accumulations Mean and How to Stay Safe." February 19. Accessed 2020. Online Address: https://weather.com/news/news/ice-storm-damage-impacts-20121123

New York State Energy Research and Development Authority. 2011. "Responding to Climate Change in New York State." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

New York State Energy Research and Development Authority. 2014. "Climate Change in New York State Updating the 2011 ClimAID Climate Risk Information Supplement to NYSERDA Report 11-18 (Responding to Climate Change in New York State)." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

Northeast Regional Climate Center. 2020. "Northeast Regional Climate Center." Online Address: http://www.nrcc.cornell.edu/

National Severe Storms Laboratory (NSSL). 2006. "Severe Weather Primer: Questions and Answers About Winter Weather: Damages and Impacts." Online Address: https://www.nssl.noaa.gov/education/svrwx101/winter/

NYSkiBlog.com. 2020. "New York State Annual Snowfall Data." Online Address: https://nyskiblog.com/directory/weather-data/new-york/state-average-snowfall-map/

United States Census Bureau. 2018. "American Community Survey: 2014-2018." Online Address: https://data.census.gov/cedsci/

The Weather Channel. 2019. "Ground Blizzards: Why Blizzard Warnings are Issued with Little to No Falling Snow." January 23. Online Address: https://weather.com/storms/winter/news/2019-01-23-ground-blizzard-warning-no-falling-snow

Section 5.4.10: Wildfire

Burgan, R. et al. U.S. Forest Service (USFS). Wildland Fire Assessment System (WFAS). Fuel Models and Fire Potential from Satellite and Surface Observations. Last Modified 2000. Accessed 2012 Online Address: http://www.wfas.net/index.php/live-fuel-moisture-experimental-products-42/35-fpi-paper

Federal Emergency Management Agency (FEMA). 1997. Multi-Hazard Identification and Risk Assessment (MHIRA). Accessed 2013. Online Address: http://www.fema.gov/media-library/assets/documents/7251

Federal Emergency Management Agency (FEMA). 2020. "Data Visualization: Disaster Declarations for States and Counties". Online Address: https://www.fema.gov/data-visualization-disaster-declarations-states-and-counties

National Weather Service (NWS). 2009. "National Weather Service Glossary." June 25. Online Address: http://w1.weather.gov/glossary/

New York State Department of Environmental Conservation (NYSDEC). 2018. "Wildland Fires & Acres Burned in New York State." Accessed 2020. Online Address: https://www.dec.ny.gov/lands/42438.html

New York State Department of Environmental Conservation (NYSDEC). 2020. "Wildfire in New York State." Accessed 2020. Online Address: https://www.dec.ny.gov/lands/4975.html

New York State Department of Environmental Conservation (NYSDEC). 2020b. "Map of Wildland Fire Protection Areas." Online Address: https://www.dec.ny.gov/lands/68331.html

New York State Department of Environmental Conservation (NYSDEC). 2020c. "Fire Danger Map." Online Address: http://www.dec.ny.gov/lands/68329.html

New York State Division of Homeland Security and Emergency Services (NYS DHSES). 2011. "2011 New York State Standard Multi-Hazard Mitigation Plan."

New York State Department of Homeland Security and Emergency Services. 2014. New York State 2014 Hazard Mitigation Plan.

New York State Department of Homeland Security and Emergency Services. 2019. New York State 2019 Hazard Mitigation Plan. Online Address: https://mitigateny.availabs.org/hazards/wildfire

New York State Energy Research and Development Authority. 2011. "Responding to Climate Change in New York State." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

New York State Energy Research and Development Authority. 2014. "Climate Change in New York State Updating the 2011 ClimAID Climate Risk Information Supplement to NYSERDA Report 11-18 (Responding to Climate Change in New York State)." Online Address: https://www.nyserda.ny.gov/About/Publications/Research%20and%20Development%20Technical%20Reports/Environmental%20Research%20and%20Development%20Technical%20Reports/Response%20to%20Climate%20Change%20in%20New%20York

North Carolina Forest Service. Fire Environment Working Group. What is the Buildup Index?. 4 April 2007. Accessed 2020. http://ncforestservice.gov/fire_control/pdf/technotes/FDTN03.pdf

Northern Virginia Regional Commission (NVRC). Northern Virginia Regional Hazard Mitigation Plan. March 2006. Accessed 2012 < http://www.novaregion.org/index.aspx?NID=661>.

Stewart, S. et al. U.S. Forest Service (USFA). The Wildland-Urban Interface in the United States. 2006. Accessed 2012. Online Address: http://www.nrs.fs.fed.us/pubs/gtr/gtr_nrs1/stewart_1_197.pdf

U.S. Department of Agriculture (USDA). 2012. Effects of Climatic Variability and Change on Forest Ecosystems: A Comprehensive Science Synthesis for the U.S. Forest Sector. December. Accessed 2014. Online Address: http://www.usda.gov/oce/climate_change/effects_2012/FS_Climate1114%20opt.pdf

U.S. Department of Agriculture (USDA). 2020. "Wildland Fire". Online Address: https://www.fs.usda.gov/ccrc/topics/wildland-fire

U.S. Fire Administration (USFA). "State Fire Death Rates and Relative Risk". May 9, 2013. Accessed 2013. Online Address: http://www.usfa.fema.gov/statistics/estimates/states.shtm

U.S. Forest Services. 2016. Online Address: http://www.fs.fed.us/

U.S. Forest Service (USFS). Wildland Fire Assessment System (WFAS). Fire Danger Rating. Date Unknown. Accessed 2013. Online Address: http://www.wfas.net/index.php/fire-danger-rating-fire-potential--danger-32

U.S. Geological Survey (USGS). Fact Sheet 2006-3066: USGS Fire Science: Fire Danger Monitoring and Forecasting. March 2005. Accessed 2012. Online Address: http://pubs.usgs.gov/fs/2005/3066/FS-2005-3066.pdf

USGS. 2020. "Water Quality After Wildfire". Online Address: https://www.usgs.gov/mission-areas/water-resources/science/water-quality-after-wildfire?qt-science_center_objects=0#qt-science_center_objects

University of Wisconsin. 2020. SILVIS Lab. Online Address: http://silvis.forest.wisc.edu/data/wui-change/

Section 6: Mitigation Strategy

Federal Emergency Management Agency (FEMA). 2008. "2008 Supplement to the 2006 Evaluation of the National Flood Insurance Program's Building Standards." Accessed 2020. Online Address: https://www.fema.gov/sites/default/files/2020-07/fema_nfip_2008_freeboard_report_0.pdf

Federal Emergency Management Agency (FEMA). 2013. "Local Mitigation Planning Handbook." March. Accessed 2020. Online Address: https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-planning-handbook_03-2013.pdf

Federal Emergency Management Agency (FEMA). 2020. "Fiscal Year 2020 Notices of Funding Opportunities for Hazard Mitigation Assistance Grants." Online Address: https://www.fema.gov/grants/mitigation/fy2020-nofo

Federal Emergency Management Agency (FEMA). 2020. "Notice of Funding Opportunity for Hazard Mitigation Assistance Grants." Online Address: https://www.fema.gov/sites/default/files/2020-09/fema_bric_fy-2020_nofo_fact-sheet.pdf

Federal Emergency Management Agency (FEMA). 2021. "Flood Insurance Rules and Legislation." January 4. Accessed 2021. Online Address: https://www.fema.gov/flood-insurance/rules-legislation

New York State Department of Environmental Conservation (NYSDEC). 2018. "Floodplain Construction Requirements in New York State." Online Address: https://www.dec.ny.gov/lands/40576.html

New York State Departments of Homeland Security and Emergency Services (NYSDHSES). 2019. New York State 2019 Hazard Mitigation Plan. Online Address: https://mitigateny.availabs.org/

Northeast Regional Climate Center. 2015, 2018. "Northeast Regional Climate Center." Online Address: http://www.nrcc.cornell.edu/