




TIOGA COUNTY HAZARD MITIGATION PLAN UPDATE

VOLUME I

FINAL

DECEMBER 2018

UPDATED FOR NYS DHSES AND FEMA REVIEW—FEBRUARY 2019

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SECTION 1. INTRODUCTION

1.1 BACKGROUND

In response to the requirements of the Disaster Mitigation Act of 2000 (DMA 2000), Tioga County, and the municipalities located therein, have developed this Hazard Mitigation Plan (HMP), which represent a regulatory update to the March 2013 "Tioga County Multi-Jurisdictional Hazard Mitigation Plan". 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 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 will better enable local and State governments to articulate accurate needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects.

1.1.1 DMA 2000 Origins -The Robert T. Stafford Disaster Relief and Emergency Assistance Act

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

Natural hazard mitigation saves $6 on average for every $1 spent on federal mitigation grants (Federal Insurance and Mitigation Administration 2018).

In the early 1990s, a new federal policy regarding disasters began to evolve. Rather than simply 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 simply 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, other costs associated with disasters, such as the time lost from productive activity by business and industries, are minimized.

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). This section 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 can be taken by the community to mitigate those hazards—before disaster strikes. For communities to remain eligible for hazard mitigation assistance from the federal government, they 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 will help prepare citizens and government agencies to better respond when disasters occur. Also, mitigation planning allows Tioga 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. The long-term benefits of mitigation planning include:

- An increased understanding of hazards faced by Tioga County and their inclusive municipalities
- A more sustainable and disaster-resistant community
- Financial savings through partnerships that support planning and mitigation efforts
- Focused use of limited resources on hazards that have the biggest impact on the community
- Reduced long-term impacts and damages to human health and structures and reduced repair costs

1.1.3 Organizations Involved in the Mitigation Planning Effort

Tioga County and the participating jurisdictions intend to implement this HMP with full coordination and participation of County and local departments, organizations and groups, as well as by coordinating with 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 and in the jurisdictional annexes in Section 9. In addition to Tioga County, all of the 15 municipal governments in the County have participated in the 2017-2018 planning process as indicated in Table 1-1 below.

Table 1-1. Participating Tioga County Jurisdictions

Jurisdictions	
Tioga County	
Barton (Town)	Owego (Town)
Berkshire (Town)	Owego (Village)
Candor (Town)	Richford (Town)
Candor (Village)	Spencer (Town)
Newark Valley (Town)	Spencer (Village)
Newark Valley (Village)	Tioga (Town)
Nichols (Town)	Waverly (Village)
Nichols (Village)	

Multiple Agency Support for Hazard Mitigation

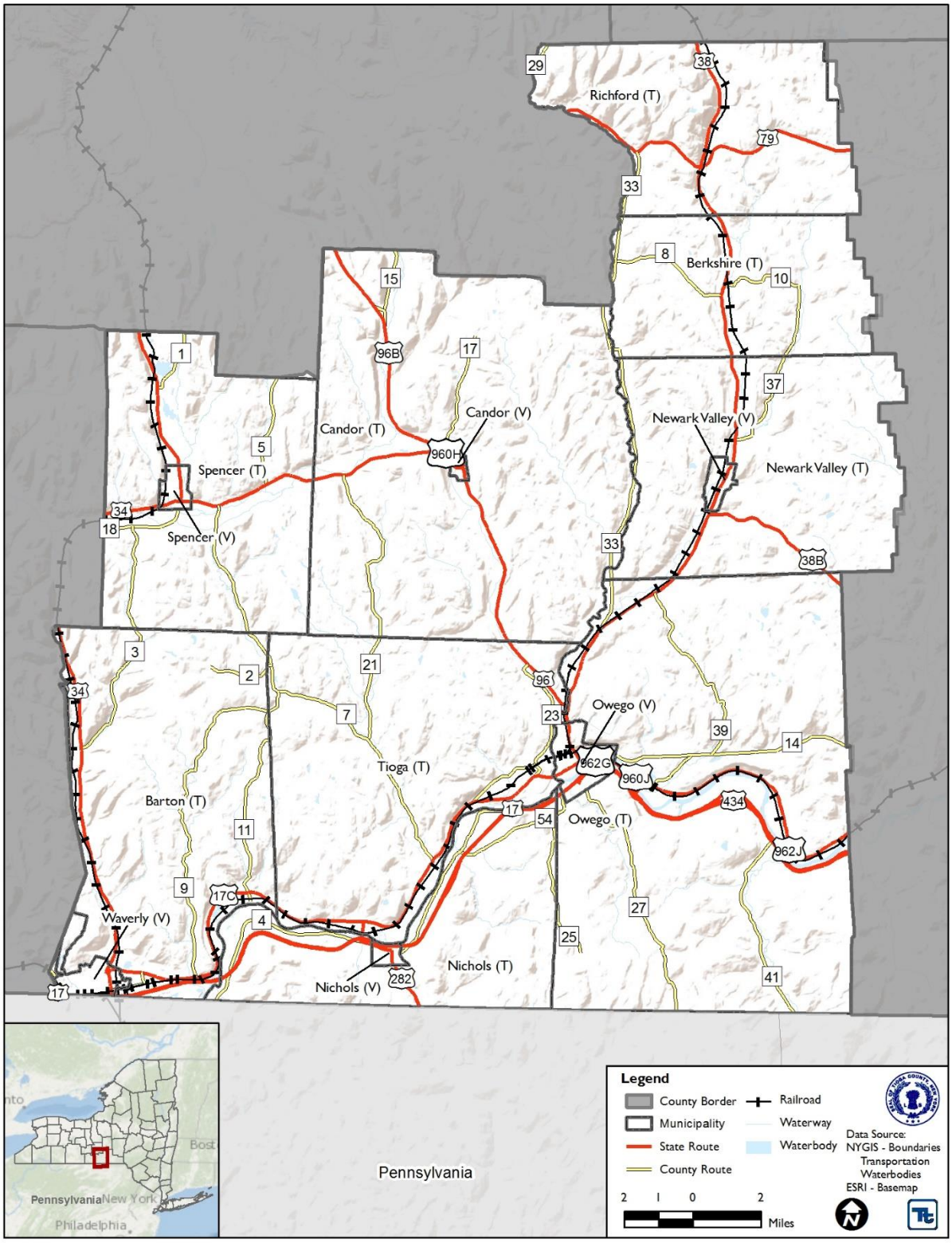
Primary responsibility for the development and implementation of mitigation strategies and policies lies with local governments. However, local governments are not alone; various partners and resources at the regional, state and federal levels are available to assist communities in the development and implementation of mitigation strategies. Within New York State, NYS DHSES is the lead agency providing hazard mitigation planning assistance to local jurisdictions. NYS DHSES 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). Project management and oversight of the planning process was provided by the Tioga County Economic Development & Planning Office and the Tioga County Soil and Water Conservation District, with support from the Steering Committee. 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, while Appendix B 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. 2004. "How-To Guide for Using HAZUS-MH for Risk Assessment." FEMA Document No. 433. February.
- 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 HMP (2014)

Figure 1-1. Tioga County, New York Mitigation Plan Area



Source: NYGIS

Table 1-2 summarizes the requirements outlined in the DMA 2000 Interim Final Rule and where each of these requirements 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

Organization

The Tioga County HMP update has been organized into a two-volume plan to facilitate use of this plan as a resource for each participant. Volume I provides information on the overall planning process, and the natural hazard profiling and vulnerability assessments which served as a basis for the understanding of risk and identification of appropriate mitigation actions. As such, Volume I is intended for use as a resource for on-going mitigation analysis. Volume II consists of an annex dedicated to each participating jurisdiction. Each annex summarizes the jurisdiction's legal, regulatory, and fiscal capabilities; vulnerabilities to natural hazards; status of past mitigation actions; and provides 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 for each jurisdiction to record and maintain their local aspect of the countywide plan.

Hazards of Concern

Tioga County and participating jurisdictions reviewed the natural hazards that caused measurable impacts based on events, losses and information available since the development of the original Tioga County HMP (2013), and the New York State Hazard Mitigation Plan - 2014 Update. Tioga County and participating jurisdictions

evaluated the risk and vulnerability due to each of the hazards of concern on the assets of each participating jurisdiction. Although the resulting hazard risk rankings varied for each jurisdiction, the summary risk rankings corresponded with that of Tioga County and are indicated in each jurisdictional annex. The hazard risk ranks were used to focus and prioritize individual jurisdictional mitigation strategies.

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 within Section 6.

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 hazard mitigation plan integrate and coordinate with, and complement, those mechanisms.

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 have 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 9.

1.1.4 Implementation of Prior and Existing Local Hazard Mitigation Plans

The status of the mitigation projects identified in the 2013 Tioga County HMP are provided in Section 6 (Mitigation Strategy) and Section 9 (Jurisdictional Annexes) of the plan. Numerous projects and programs have been implemented that have reduced hazard vulnerability to assets in the planning area. The County and municipal annexes, and plan maintenance procedures (Section 7), have been developed to encourage specific activities such as review of the HMP during update of codes, ordinances, zoning, and development to ensure that a more thorough integration, with its related benefits, will be completed within the upcoming five-year planning period.

1.1.5 Implementation of the Planning Process

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

- Developed a Steering Committee and countywide planning partnership with municipalities and stakeholders,
- Reviewed the June 2013 "Tioga County Multi-Jurisdictional Hazard Mitigation Plan",
- Identified/reviewed those natural hazards that are of greatest concern to the community (hazards of concern) to be included in the plan,

- Profiled these natural hazards,
- Estimated the inventory at risk and potential losses associated with these hazards,
- Reviewed and updated the hazard mitigation goals and added new objectives,
- Reviewed mitigation strategies identified in the 2013 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, and
- Developed mitigation plan maintenance procedures to be executed after obtaining approval of the plan from NYS DHSES and FEMA.

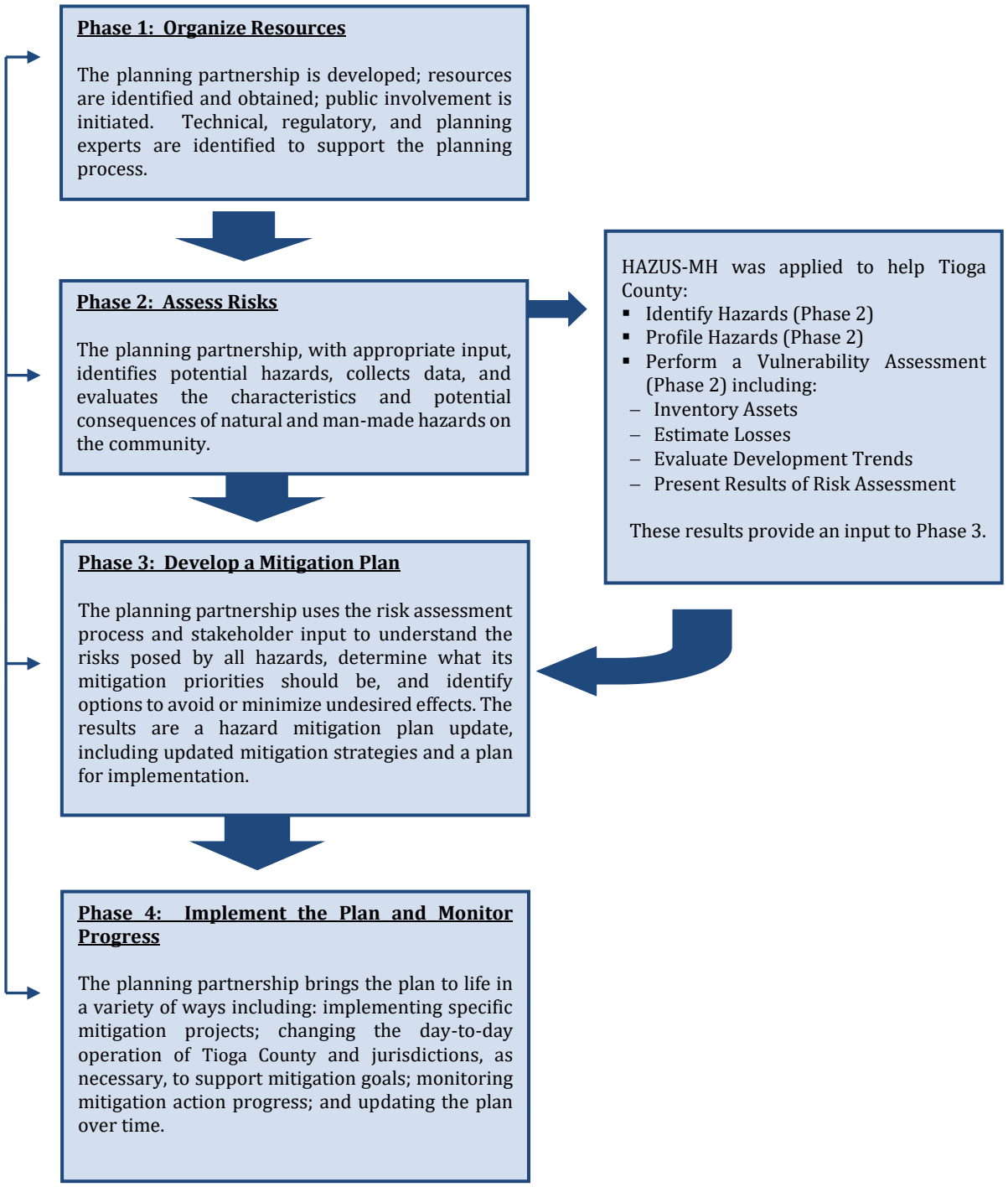
As required by the DMA 2000, Tioga County and participating jurisdictions have informed the public and provided opportunities for public comment and input. In addition, numerous agencies and stakeholders have participated as core or support members, providing input and expertise throughout the planning process.

This HMP update documents the process and outcomes of Tioga County and the jurisdictions' efforts. Additional information on the plan process is included in Section 3, Planning Process. Documentation that the prerequisites for plan approval have been met is included in Section 2, Plan Adoption.

1.1.6 Organization of This Mitigation Plan

This HMP was 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 1-2.

Figure 1-2. Tioga 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 (Tioga 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 Tioga 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 Tioga 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: The 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 each participating jurisdiction and Tioga County containing their hazards of concern, hazard risk ranking, capability assessments, mitigation actions, action prioritization specific only to Tioga 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:

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: This appendix provides 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.

SECTION 2. PLAN ADOPTION

2.1 Overview

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

2.1.1 Plan Adoption by Local Governing Bodies

Adoption by the local governing bodies demonstrates the commitment of Tioga County and each participating jurisdiction to fulfill the mitigation goals and strategies outlined in the plan. Adoption 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 provides conditional approval of this HMP update, known as Approval Pending Adoption (APA).

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 the Tioga County HMP Coordinator. Tioga County will then forward the adoption resolutions to NYS DHSES after which they will be forwarded to FEMA for record. The jurisdictions understand that FEMA will transmit acknowledgement of verification of formal plan adoption and the official approval of the plan to the Tioga County HMP 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; and
- It helps to ensure the continuity of mitigation programs and policies over time because elected officials, staff, and other community decision-makers can refer to the official document when making decisions about the community's future.

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

SECTION 3. PLANNING PROCESS

3.1 INTRODUCTION

This section includes a description of the planning process used to update the June 2013 "Tioga County Multi-Jurisdictional Hazard Mitigation Plan" (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 both met requirements of the DMA 2000, as well as to assure 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. Tioga County invited all jurisdictions to join with them in the planning process. To date, all local municipal governments in the County have participated in the 2018 planning process as indicated in Table 3-1. The previously participating school districts, including Candor Central; Owego Apalachin Central; Tioga Central; Spencer-Van Etten Central school districts are incorporated within the participating municipality in which the district geographically resides.

Table 3-1. Participating Tioga County Jurisdictions

Jurisdictions	
Tioga County	
Barton (Town)	Owego (Town)
Berkshire (Town)	Owego (Village)
Candor (Town)	Richford (Town)
Candor (Village)	Spencer (Town)
Newark Valley (Town)	Spencer (Village)
Newark Valley (Village)	Tioga (Town)
Nichols (Town)	Waverly (Village)
Nichols (Village)	

- 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 Tioga 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 have been 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

Tioga County applied for and was awarded a multi-jurisdictional planning grant under the FEMA Pre-Disaster Mitigation program (PDMC PL- 02 - NY-2016-001), which has supported the development of this update of this multi-jurisdictional HMP.

Project management and grant administration has been the responsibility of the Tioga County Soil and Water Conservation District with support of the Tioga County Department of Economic Development & Planning and Tioga County Emergency Services Department.

Prior to the county receiving the grant award and contracting a planning consultant, the County conducted the following:

- Tioga County Department of Economic Development & Planning has a long-standing partnership with the Tioga County Soil and Water Conservation District (SWCD) to provide ongoing support for maintaining the multi-jurisdictional plan.
- Tioga County has maintained a hazard mitigation team throughout the performance period of the 2013 plan. It convened the steering committee to facilitate the plan update process in July 2017 and met 3 times prior to selection of a mitigation planning consultant to initiate the plan update process, review the hazards of concern and to provide progress on the mitigation actions.
- SWCD contacted all jurisdictions to update the mitigation strategies. This update has supported implementation of projects and formed the basis of the initial mitigation strategy update and the formation of problem statements to focus efforts on identifying high priority mitigation projects to reduce vulnerability to hazards of concern for the planning area.

A contract planning consultant (Tetra Tech, Inc.) was selected to guide the County and participating jurisdictions through the HMP update process. A contract between Tetra Tech Inc. (Tetra Tech) and Tioga County was executed in February 2018. Specifically, Tetra Tech, the "contract consultant", was tasked with:

- Assisting with the organization of a Steering and Planning Committee;
- Assisting with the development and implementation of a public and stakeholder outreach program;
- 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; and

- Authoring of the draft and final plan documents.

In March 2018, the County notified all municipalities within the county of the pending planning process and invited them to formally participate. Jurisdictions were asked to formally notify the County of their intent to participate (via a Letter of Intent to Participate) and to identify planning points of contact 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, Tioga 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:

- 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 is the best available
  - Reviewing and updating the hazard mitigation goals,
  - Identification and screening of appropriate mitigation strategies and activities; and
- 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. Tioga County Hazard Mitigation Steering Committee Members

Affiliation	Name	Title
Tioga County Soil and Water Conservation District	Wendy Walsh	District Manager
Tioga County Economic Development and Planning	Elaine Jardine	Director
Tioga County Emergency Services	Mike Simmons	Director
Tioga County Soil and Water Conservation District	Mike Jura	District Technician
Tioga County Soil and Water Conservation District	Alex Marks	District Technician
Tioga County GIS	Bill Ostrander	GIS Manager
Tioga County DPW/ Solid Waste	Ellen Pratt	Sustainability Manager
Tioga County Public Health	Lisa McCafferty	Public Health Director
Cornell Cooperative Extension	Andy Fagan	Director
Town of Barton	Leon Cary	Supervisor
Town of Owego	Debra Standinger	Planning and Zoning Administrator
Village of Owego	Kevin Millar	Flood Resiliency Coordinator
Village of Spencer	Kenneth Suftin	Mayor
Village of Waverly	Daniel Gelatt	Chief of Police

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 are also part of the overall project Planning Committee, fulfilling these responsibilities on behalf of Tioga 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, etc.);
- 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; and
- Adopt, implement and maintain the plan update.

Table 3-3. Tioga County Hazard Mitigation Planning Partnership Members

Jurisdiction	Primary Point of Contact	Title	Alternate Point of Contact	Title
Barton (T)	Leon Cary	Supervisor	Chris Spaulding	Highway Superintendent
Berkshire (T)	Keith Flesher	Supervisor	Karl Spoonhower	Highway Superintendent
Candor (T)	Bill Strosahl	Supervisor	George Williams	Councilmen
Candor (V)	Eric Halstead	Mayor	Gary Consalvi	
Newark Valley (T)	Stuart Yetter Jr.	Supervisor	Charles Meade	Highway Superintendent
Newark Valley (V)	William Foster	Public Works Supervisor	Jim Tornatore	Mayor
Nichols (T)	Barb Crannell	Deputy Supervisor	Robert Huseby	Code Officer
Nichols (V)	Lesley Pelotte	Mayor	Leon Cary	Code Officer
Owego (T)	Debra Standinger	Planning & Zoning Administrator	Dean Morgan	Deputy Supervisor
Owego (V)	Michael Baratta	Mayor	Jeffrey Soules	Public Works Superintendent
Richford (T)	Charlie Davis	Supervisor	William Stell	Planning Board Chairman
Spencer (T)	Randy Thayer	Supervisor	Allen Fulkerson	Deputy Supervisor
Spencer (V)	Ken Sutfin	Mayor	Gilbert Knapp	Village Board Trustee
Tioga (T)	Lewis Zorn	Supervisor	Robert Strong	Councilmen
Waverly (V)	Pat Ayres	Mayor	Dan Gelatt	Chief of Police
Tioga County	Wendy Walsh	District Manager	Elaine Jardine	County Planning Director

T *Town*
V *Village*

It is noted that 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. It is recognized that the jurisdictions in Tioga 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. It was Tioga County's intent 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 points of contact, evaluated their risk to the hazards of concern, identified their capabilities to effect mitigation in their community, and identified and prioritized an appropriate suite of mitigation initiatives, actions, and projects to mitigate their hazard risk; and eventually, by the adoption of 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.

It is noted that all municipalities in the County actively participate in the National Flood Insurance Program and have a designated NFIP Floodplain Administrator (FPA). All FPAs have been 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" 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. It also identifies which DMA 2000 requirements the activities satisfy. Documentation of meetings (agendas, sign-in sheets, minutes, etc.) may be found 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, Planning 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, soliciting and considering public comment as part of the five-year mitigation plan update.

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

Date	DMA 2000 Requirement	Description of Activity	Participants
April 26, 2015		Opportunities for improvement of 2013 HMP	Paul Hoole – FEMA Wendy Walsh -Tioga County SWCD Elaine Jardine – Tioga County Planning
July 19, 2017	2, 3a	Review and approve changes to current HMP objectives, review and approve hazards of concern	Deb Standinger – Town of Owego, Lesley Pelotte – Village of Nichols, Randy Thayer – Town of Spencer, Lou Zorn – Tioga, Dick Cary – Barton, Bill Ostrander – Tioga County GIS, Dan Cherenowski Deputy Supervisor Newark Valley, Mike Jura, Alex Marks, Wendy Walsh, Miranda Palmer – Tioga SWCD, Elaine Jardine – Tioga EDP, Dan Gelatt – Village of Waverly
September 27, 2017	2	Review of HMP grant status, consultant research, action plan for review status of municipal annexes.	Wendy Walsh, Miranda Palmer, Mike Jura, Alex Marks; Tioga County SWCD, Steve May (Village of Owego), Emily Warfle (Tioga County Public Health), Stu Yetter (Town of Newark Valley), Randy Thayer (Town of Spencer), Christine Lester (Village of Spencer), Jane Bradley (Spencer Van Etten CSD), Dan Gelatt (Village of Waverly), Ron Bieber (Owego Apalachin CSD), Elaine Jardine (Tioga EDP), Lou Zorn (Town of Tioga), Debra Standinger (Town of Owego), Bill Ostrander (Tioga County GIS), Mike Simmons (Tioga County Emergency Management).
October 30, 2017	2	Status of grant award and consultant selection.	Christine Lester (Village of Spencer), Ellen Pratt (Tioga County Recycling), Dan Gelatt (Village of Waverly) Wendy Walsh; Mike Jura; Alex Marks; Miranda Palmer (Tioga SWCD), Andy Fagan (CCE Tioga County), Elaine Jardine (Tioga County ED&P), Deb Standinger (Town of Owego), Mike Simmons (Tioga County Emergency Mgmt. Office), Bob Williams (Tioga County Emergency Mgmt. office)
March 7, 2018	2	Pre-Kick-Off Meeting to determine project schedule and confirm scope of work	Wendy Walsh – Tioga County SWCD Elaine Jardine – Tioga County Planning Mike Jura – Tioga County SWCD Alex – Tioga County SWCD Cynthia Bianco-Tetra Tech
March 19, 2018	2	Steering Committee Kick-Off Meeting	Debra Standinger-Town of Owego Ken Sutfin, Village of Spencer Wendy Walsh - Tioga County SWCD Andy Fagan -CCE Tioga Ellen Pratt – Tioga County DPW/Solid Waste Miranda Palmer – Tioga County SWCD Kevin Clapp – NYS DHSES Christine Lester – Village of Spencer Bill Ostrander -Tioga County GIS Cynthia Bianco – Tetra Tech
March 19, 2018	2	Municipal Kick-Off Meeting	Andy Fagan (TCCCE), Wendy Walsh (TCSWCD), Deb Standinger (T of Owego), Bill Ostrander (TC GIS) , Christine Lester (V of Spencer), Ken Sutfin (V of Spencer), Ellen Pratt (TC DPW/ Solid Waste) , Elaine Jardine (TC EDP), Cynthia Bianco (Tetra Tech), Kevin Clapp (NYSDHSES), Miranda Palmer (TCSWCD), Alex Marks (TCSWCD), Mike

Date	DMA 2000 Requirement	Description of Activity	Participants
			Jura (TCSWCD), Lesley Pelotte (V of Nichols), Bill Foster (V of Newark Valley), Jim Tornatore (V of Newark Valley), Lou Zorn (T of Tioga), Barb Crannell (T of Nichols), Randy Thayer (T of Spencer), Jane Bradley (Spencer VanEtten Boces), Marty Sauerbrey (Tioga County Legislative Chair), Dick Cary (T of Barton), Lisa McCafferty (Tioga County Public Health).
April 26, 2018	2	Steering Committee working group meeting for data collection, update of critical facility inventory, confirmation of mission statement, goals, and objectives, public engagement strategy.	Wendy Walsh, Miranda Palmer, Alex Marks (Tioga County SWCD), Cynthia Bianco (Tetra Tech), Kevin Millar (Flood Resiliency Coordinator Village of Owego), Ellen Pratt (Tioga County Materials Recover Manager), Bill Ostrander (Tioga County GIS Manager), Elaine Jardine (Tioga County EDP), Lisa McCafferty (Tioga County Health Department), Dan Gelatt (Village of Waverly), Leon Cary (Town of Barton), Debra Stadinger (Town of Owego), Andy Fagan (Cornell Cooperative Extension), Emily Warfle (Tioga County Health Department), Michael Simmons (Emergency Services Director).
April 26, 2018	2, 4a	Local support meetings	Jim Douglas – Town of Candor, Charles Davis – Town of Richford, Kevin Millar – Village of Owego
May 1, 2018	2	Coordination call with FEMA and NYSDHSES	Paul Hoole (FEMA), Corrina Cavallo (NYSDHDES), Cynthia Bianco (Tt), Wendy Walsh (Tioga)
June 13, 2018	2, 3a, 3b, 3c, 3d, 3e	Presentation of risk assessment overview, SWOO (Strengths, Weaknesses, Obstacles, and Opportunities) review, development of hazard problem statements by community	Elaine Jardine -Tioga County Planning, Charles Davis – Town of Richford, Alex Marks – Tioga SWCD, Miranda Palmer – Tioga County SWCD, <ole Kira – Tioga County SWCD, Jim Tornatore – Village of Newark Valley, Wendy Walsh – Tioga County SWCD, William Foster – Village of Newark Valley, Ken Sutfin – Village of Spencer, Kevin Millar – Village of Owego, Kevin Milles – Village of Owego, Randy Thayer – Town of Spencer, Lisa McCaffery – Public Health, Chuck Meade – Town of Newark Valley (supervisor), Lesley Pelotte, Village of Nichols, Barb Crannell – Town of Nichols, Michael Simmons – Tioga County OES, Peter DeWind – Tioga County Attorney, Heather Apgar - Tetra Tech, Cynthia Bianco- Tetra Tech
July 11, 2018	2, 4a, 4b, 4c	Mitigation Strategy Workshop	Chuck Meade- Town of Newark Valley, Bill Foster – Village of Newark Valley, Jim Tornatore – Village of Newark Valley, Lesley Pelotte – Village of Nichols, Dick Carey – Town of Barton, Kevin Clapp – NYSDHSES, Leroy Thompson – NYSDHSES, Mike Jura – Tioga County SWCD, Keith Flesher – Town of Berkshire, Charles Davis – Town of Richford, Elaine Jardine of Tioga County Planning, Randy Thayer – Town of Spencer, Daniel Gelatt – Village of Waverley, Ellen Pratt – Tioga County Solid Waste, Ken Sutfin – Village of Spencer, Alex Marks - Tioga County SWCD, Jim Douglas – Town of Candor, William Strogahl –

Date	DMA 2000 Requirement	Description of Activity	Participants
			Town of Candor, Garry Hammond – Tioga County DPW, Paul Hoole – FEMA, Barbara Spaulding – NYSDHSES, Wendy Walsh – Tioga County SWCD, Miranda Palmer – Tioga County SWCD, Kevin Millar – Village of Owego, Dean Morgan – Town of Owego, Lou Zorn – Town of Tioga, Chris Spaulding – Town of Barton, Heather Apgar -Tetra Tech, Cynthia Bianco – Tetra Tech.
July 12, 2018	2, 4a, 4b, 4c	Local Support Meetings	Mertie Pozzi- Village of Newark Valley, Dick Cary – Town of Barton, Leon Carey - Village of Nichols, Village of Waverley – Dan Gelatt, Village of Owego – Kevin Millar; Jeff Soules, Mike Baratta, Town of Newark Valley – Chuck Meade
October 31, 2018	2, 3a-e, 4a-c, 5a-c	Planning Committee Review of Draft Plan	To be advised.
January 31, 2019 (tentative)	2, 3a-e, 4a-c, 5a-c	Submit Draft Plan to NYSDHSES/FEMA for review/approval	To be advised.

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. Information and input provided by these stakeholders has been included throughout this HMP update 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 these stakeholders participated and contributed to the HMP. It should be noted that this summary listing cannot possibly represent the sum total of stakeholders that were aware of and/or 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.

Federal Agencies

FEMA Region II: Provided updated planning guidance; provided summary and detailed NFIP data for planning area; attended meetings; conducted a Mitigation Strategy Workshop in February 2017; provided information on grant applications from County and municipalities; conducted plan review.

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

- National Climatic Data Center (NCDC)
- National Hurricane Center (NHC)
- National Oceanic and Atmospheric Administration (NOAA)
- National Weather Service (NWS)
- Storm Prediction Center (SPC)
- U.S. Army Corps of Engineers (USACE)
- U.S. Census Bureau

State Agencies

New York State Department of Homeland Security and Emergency Services (NYS DHSES: Headquarters and Region II): Administered planning grant and facilitated FEMA review; provided updated planning guidance; provided review of draft and final HMP.

New York State Department of Environmental Conservation (NYSDEC): Provided data and information; supported the identification of mitigation projects

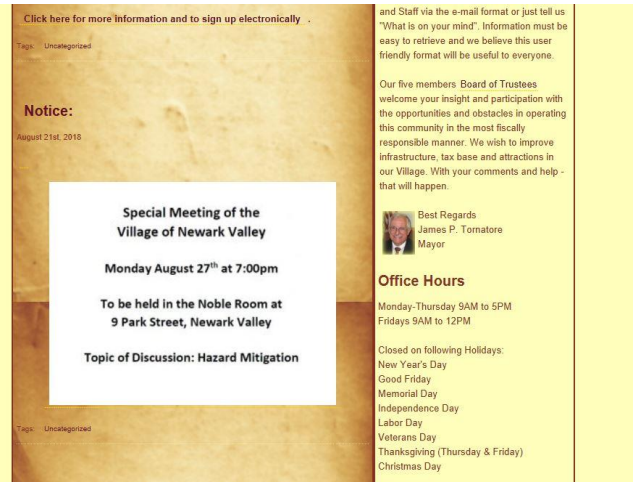
Tioga County Departments

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

Tioga County Soil and Water Conservation District (SWCD): The Tioga County SWCD District Manager has been identified as the ongoing Tioga County Hazard Mitigation Plan Coordinator (see Section 7 – Plan Maintenance) and served in this role throughout the update planning process. In addition, the District provided critical data, assisted with the update of events/losses in the County, update of the previous mitigation strategy, facilitated outreach to stakeholders, contributed to the County's capability assessment and updated mitigation strategy and reviewed draft sections of the HMP. Additionally, SWCD discussed the plan update at the following board meetings: April 18, 2018; May 16, 2018; June 20, 2018; July 18, 2018; August 15, 2018; and September 19, 2018. Copies of meeting minutes were not available at the time of this plan update.

Tioga County SWCD also presented at several municipal meetings. This included:

- On April 10, 2018, SWCD gave a presentation about the planning process to the Town of Spencer Board.
- August 27, 2018 – SWCD gave a presentation to village trustees and flood impacted residents on the HMP update at a special meeting held in the Village of Newark Valley. Informational fliers were also distributed at this meeting informing the public about the planning process. The meeting was advertised on the Village's website.


Click here for more information and to sign up electronically .

Tags: Uncategorized

Notice:

August 21st, 2018

Special Meeting of the
Village of Newark Valley

Monday August 27th at 7:00pm

To be held in the Noble Room at
9 Park Street, Newark Valley

Topic of Discussion: Hazard Mitigation

Tags: Uncategorized

and Staff via the e-mail format or just tell us "What is on your mind". Information must be easy to retrieve and we believe this user friendly format will be useful to everyone.

Our five members Board of Trustees welcome your insight and participation with the opportunities and obstacles in operating this community in the most fiscally responsible manner. We wish to improve infrastructure, tax base and attractions in our Village. With your comments and help - that will happen.

Best Regards
James P. Tornatore
Mayor

Office Hours

Monday-Thursday 9AM to 5PM
Fridays 9AM to 12PM

Closed on following Holidays:
New Year's Day
Good Friday
Memorial Day
Independence Day
Labor Day
Veterans Day
Thanksgiving (Thursday & Friday)
Christmas Day

Tioga County Economic Development & Planning Department (EDP): In addition to their role as Steering Committee members, the Department, contributed to the County Profile (Section 4), and updated the following: capability assessment, previous mitigation strategy and updated mitigation strategy. The Department also reviewed draft sections of the HMP prior to public review. Additionally, EDP discussed the plan update at the following EDP legislative committee meetings:

- April 3, 2018 – minutes found in Appendix C (Public and Stakeholder Outreach)
- May 8, 2018 – minutes not available
- June 5, 2018 – minutes not available
- July 3, 2018 – minutes not available
- August 7, 2018 – minutes not available
- September 4, 2018 – minutes not available

Tioga County Solid Waste Department: Tioga County Solid Waste Department provides a convenient and economical method for Tioga County residents to divert recyclables from landfills through our County-Wide Curbside Recycling Program.

The County's Solid Waste Department's Sustainability Manager served on the Steering Committee, attended meetings, reviewed sections, and provided input on the County's mitigation strategy.

Tioga County Information Technology and Communication Services Department – GIS Division – Tioga County's GIS Office provided critical facility inventory data and all other relevant GIS data throughout the planning process.

Tioga County Office of Emergency Services (OES): The Tioga County OES coordinates the County's efforts to prepare for and respond to emergency situations. In an emergency situation, the Office of Emergency Services works with County departments and external agencies to respond to the needs of citizens by helping to protect lives and property, assist those injured or whose normal lives have been disrupted by events, and to provide for the rapid restoration of normal services.

The Tioga County OES coordinated the development of the HMP update reaching out to all municipalities and County departments to solicit involvement in the planning process. The OES Director served on the Steering Committee throughout the plan as well. Tioga County OES provided data, reviewed sections, contributed to the mitigation strategy, and included updates about the HMP on their website.

Tioga County Department of Public Works: The Department of Public Works maintains County-owned roadways, buildings, bridges, and other infrastructure throughout Tioga County. Public Works also houses the Buildings and Grounds Department and the Solid Waste Department. The Solid Waste Department runs the County-Wide Curbside Recycling Program.

A representative from the Department of Public Works served on the Steering Committee, participated in meetings, provided input on the mitigation strategy, and review the County annex on behalf of the department. In addition, the Department of Public Works assisted with the update of the following components of the HMP: capability assessment, previous mitigation strategy, and updated mitigation strategy to support the County's current goals and objectives.

Tioga County Department of Public Health: The Public Health Department is responsible for health promotion; disease prevention and community needs assessment. The Public Health Department supports the citizens of the County through Environmental Health, Dental Health, Disease Control, Nursing Services, Emergency Preparedness and Health Education programs.

The Public Health Director served on the Steering Committee, attended meetings, provided input into the County's mitigation strategy, and reviewed sections of the plan.

Regional and Local Stakeholders

Please see Appendix B (Participation Matrix) for further details regarding regional and local stakeholder agencies. The stakeholders listed below were directly contacted by Tioga County to take a stakeholder survey which included the identification of specific mitigation actions/projects and/or review the draft HMP. Results of the surveys can be found in Appendix D (Public and Stakeholder Outreach).

Local Emergency Planning Committee

All members of the Local Emergency Planning Committee (LEPC) were notified of the HMP update process and were invited via email correspondence and meetings (May 9, 2018 and July 11, 2018) to provide input and were notified of the draft HMP review period. Refer to Appendix D (Public and Stakeholder Outreach) for copies of the meeting minutes.

Academia

All school districts in the County were provided the Academic Stakeholder survey and invited to provide input and were notified of the draft HMP review period. No formal comments were received regarding the draft HMP.

Ambulance/Emergency Medical Services

Tioga County Department of Emergency Services and the Sheriff's Department emailed all ambulance and emergency medical service providers in the County on May 17, 2018 inviting them to take the Emergency Medical Services (EMS) survey and provide input to the planning process. As of the date of this plan update, feedback has not been provided by any EMS stakeholders.

Fire Departments

Tioga County Department of Emergency Services and the Sheriff's Department emailed all fire departments in the county on May 17, 2018 inviting them to take the Firefighter survey and provide input to the planning process. As of the date of this plan update, feedback has not been provided by any firefighter stakeholders.

Hospitals and Healthcare Facilities

The Tioga County Public Health Director sent an email on May 17, 2018 to all hospitals and healthcare facilities located in Tioga County, inviting them to take the stakeholder survey and provide input to the planning process. The following have provided input to the planning process:

- UHS Home Care – completed survey
- Our Lady of Lourdes Memorial Hospital – completed survey
- UHS Wilson Medical Center/UHS Binghamton General Hospital – completed survey
- Elderwood at Waverly – completed survey

Highway and Public Works

The Tioga County Department of Public Works emailed all municipal highway and public work departments in Tioga County on May 17, 2018, inviting them to take the stakeholder survey and provide input to the planning process. As of the date of this plan update, feedback has not been provided by any highway or public works stakeholders.

Law Enforcement

Tioga County Department of Emergency Services and the Sheriff's Department emailed all law enforcement agencies in the County on May 17, 2018 inviting them to take the stakeholder survey and provide input to the planning process. As of the date of this plan update, feedback has not been provided by any law enforcement stakeholders.

Utilities

All utility providers in the County were notified of the Utility Stakeholder survey and invited to provide input on the draft HMP. No formal comments were received on the draft HMP. The following provided input to the planning process.

Business and Commercial Interests

The Tioga County Department of Emergency Services distributed an email on May 17, 2018 to the LEPC regarding the businesses stakeholder survey and inviting them to provide input. Businesses and commercial interests in the county were provided the Business and Commerce Stakeholder survey and invited to provide input. The following provided input to the planning process:

- Lockheed Martin Owego – completed survey
- Leprino Foods – completed survey
- Tioga County Chamber of Commerce – completed survey
- Tioga Opportunities, Inc. – completed survey

Additional Stakeholders

The following stakeholders were identified via email and letter from Tioga County Department of Emergency Services that the draft HMP was available for review and comment. No formal comments were received.

- Tioga County Legislative Chair
- Tioga County Legislative Vice-Chair
- Southern Tier Regional Economic Development Council
- Cornell Cooperative Extension

- Southern Tier 8 Regional Board (formerly Southern Tier East Regional Planning Agency)
- Business Association
- Town Supervisors, Village Mayors
- Village and Town Clerks
- Department of Public Works

Adjacent Counties

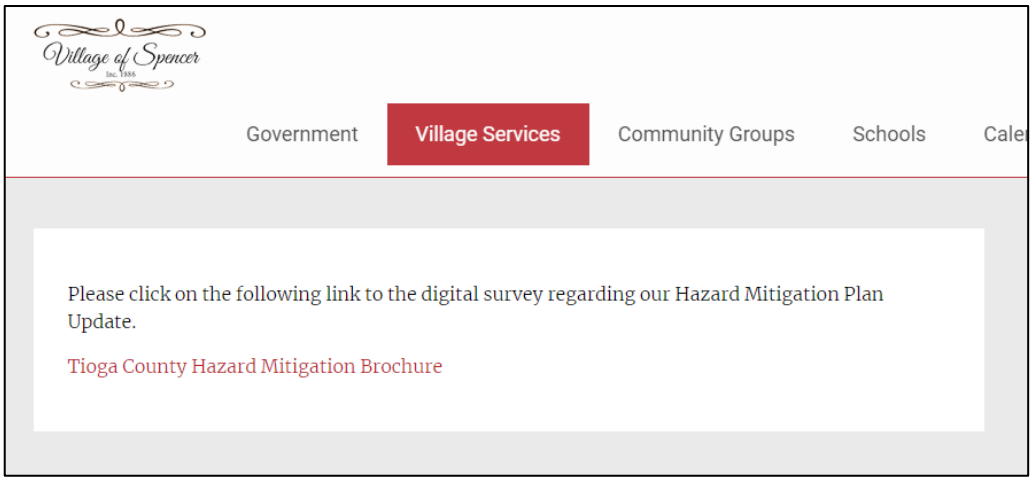
Tioga County has made an effort to keep surrounding counties and municipalities appraised of the project and allowed the opportunity to provide input to this planning process. Specifically, the following adjoining and nearby County representatives were contacted in April and December 2018 to inform them about the availability of the project website, draft plan documents and surveys, and invited to provide input to the planning process. In addition, the County advised the attendees of the Regional Planners Committee of the Southern Tier East Regional Planning Development Board (including representatives of Broome, Cortland, Tompkins, Chenango, Delaware, Schoharie and Otsego counties) in March and May 2018. No formal comments were received from any adjacent counties. Furthermore, the county presented plan information at the Upper Susquehanna Coalition bi-monthly meeting in August 2018. Attendees included Tioga, Madison, Steuben, Onondaga, Chemung, Tompkins, and Cortland Counties.

3.3.1 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.tiogacountyny.com/departments/emergency-services/). The public website contains a project overview, County and local contact information, access to the citizen's survey and various stakeholder surveys, and sections of the HMP for public review and comment (see Figure 3-1). Additionally, Tioga County Department of Emergency Services posted about the planning process on their social media (see Figure 3-3).
- All municipalities with a public website were requested to post a link to the Tioga County HMP website to provide ongoing public outreach.
    - On July 18, 2018, the Village of Spencer incorporated a link to the County's HMP website (refer to Figure 3-1).

Figure 3-1. Village of Spencer's Municipal Website



- On May 12, 2018, the Owego Pennysaver Press printed a press release about the preparation of the County's HMP update. See Figure 3-4.

- An on-line natural hazards preparedness citizen survey was developed to gauge household preparedness that may impact Tioga County and to assess the level of knowledge of tools and techniques to assist in reducing risk and loss of those hazards. The questionnaire asks quantifiable questions about citizen perception of risk, knowledge of mitigation, and support of community programs. The questionnaire also asks several demographic questions to help analyze trends. The questionnaire has been available on the public website since April 30, 2018. A summary of survey results is provided in Appendix D (Public and Stakeholder Outreach) of this plan.

- All participating municipalities have been encouraged to distribute the project brochure and to post the links to the project webpage and citizen and stakeholder surveys. In addition, all participating municipalities have been requested to advertise the availability of the project website via local homepage links, and other available public announcement methods (e.g. Facebook, Twitter, email blasts, etc.).

    - On July 18, 2018, the Village of Waverly Police Department posted about the hazard mitigation plan and provided links to the County's website and citizen survey.

- Starting in November 2018, draft sections of the plan (as available) have been posted on the project website for public review and comment. A notice was posted on the Tioga County Department of Emergency Services Facebook page regarding the draft HMP availability for public review. In addition, in November 2018, the Tioga County Planning and Economic Development Department notified all municipal representatives involved in the planning process, stakeholders and neighboring counties via letter and email requesting review and input on the draft HMP. An online comment form (survey) was provided along with the draft plan sections

to support the receipt and processing of public comment. No public comments were received regarding the draft HMP.

- Once approved by NYS DHSES/FEMA, the final HMP will be available on the County website.

Figure 3-2. Tioga County HMP Webpage

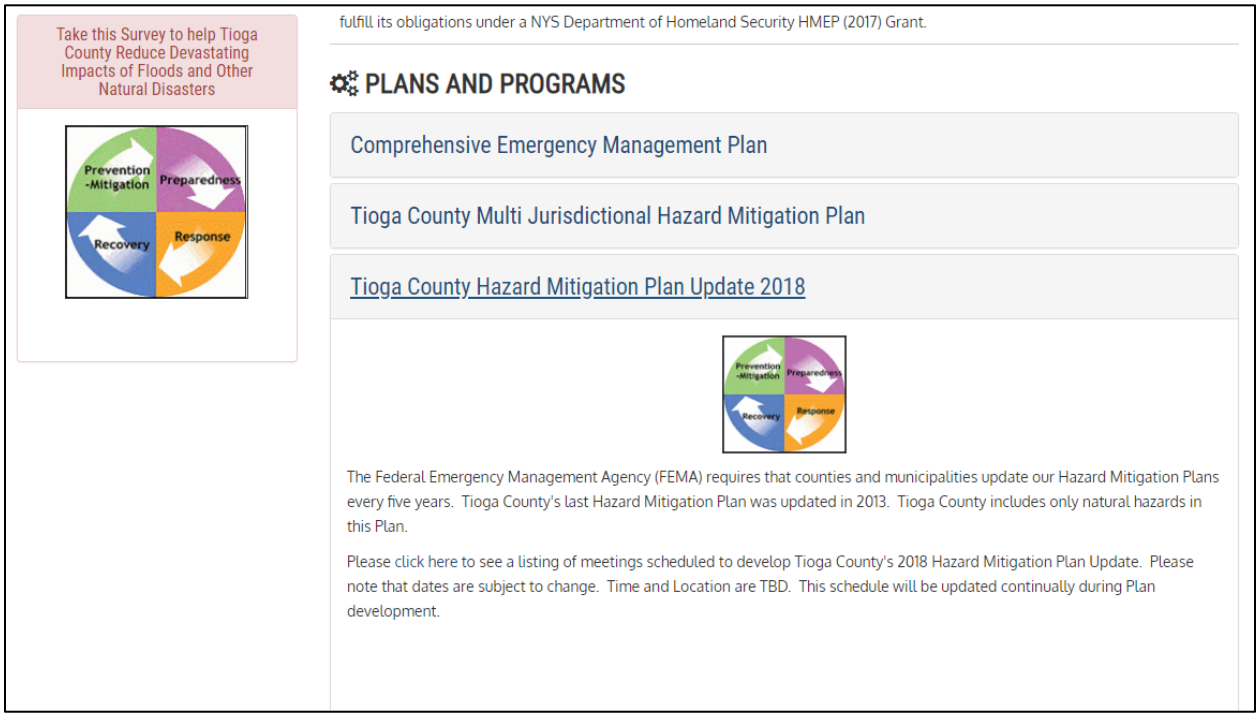
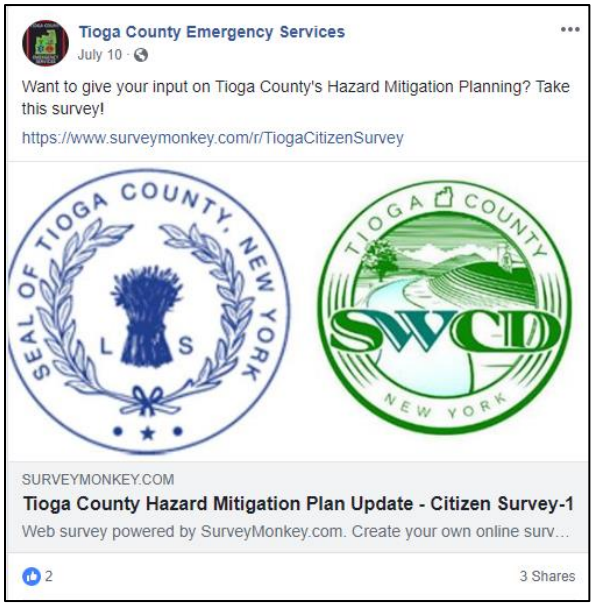


Figure 3-3. Tioga County Facebook Post



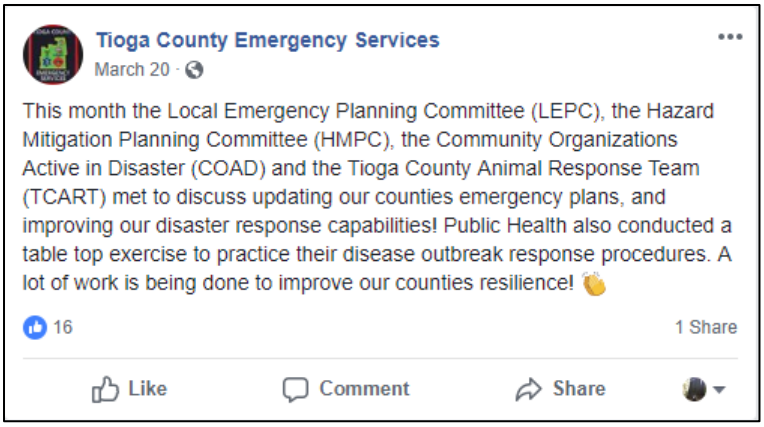


Figure 3-4. May 12, 2018 Press Release

Figure 3-5. Press Releases

TEAM TIOGA
we work for you

ECONOMIC DEVELOPMENT & PLANNING | INDUSTRIAL DEVELOPMENT AGENCY | LOCAL DEVELOPMENT CORPORATION

PRESS RELEASE

Release Date: 4/30/2018
Contact: Elaine D. Jardine
County Planning Director
Office: Tioga County Department of Economic Development and Planning

Address: 56 Main Street
Owego NY 13827
Phone: (607) 687-8257
E-mail: jardinee@co.tioga.ny.us

Tioga County Is Preparing For Future Flooding and Other Natural Hazards by Updating It's All-Hazards Mitigation Plan from 2013

The Tioga County Departments of Emergency Services and Economic Development & Planning, along with the Tioga County Soil and Water Conservation District have begun the process of updating the 2013 Hazard Mitigation Plan for the County and its 15 municipalities.

This plan will identify key actions to be taken to reduce or eliminate the long-term risk to human life and property from natural disasters such as floods, severe storms, and winter storms. FEMA defines hazard mitigation as a "sustained action taken to reduce or eliminate long-term risk and their property from hazards."

With the aid of the hired consultant, Tetratech, the county's Hazard Mitigation Planning Committee will conduct risk assessment tasks. First the Committee will identify hazards that may impact the county and its municipalities and then profile the relevant hazards and their potential consequences. Secondly, assets that are subject to losses or damage, including physical structures, critical facilities, functions and populations will be identified. Finally, potential losses that could result from each type of hazard will be estimated.

Source: Tioga County Department of Emergency Services 2018

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

The Tioga 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 is 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, is 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. Further, the source of technical data and information used may be found within the References Section.

At the beginning of the planning process, 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 (see Capability Assessment section of each jurisdictional annex in Section 9) and providing relevant planning and regulatory documents as applicable. Relevant documents, including plans, reports, and ordinances were reviewed to identify:

- Existing municipal capabilities;
- Needs and opportunities to develop or enhance capabilities, which may be identified within the County or local mitigation strategies;
- Mitigation-related goals or objectives considered in the review and update of the overall Goals [and Objectives] (see Section 6);
- Proposed, in-progress, or potential mitigation projects, actions and initiatives to be incorporated into the updated County and local mitigation strategies.

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

- Comprehensive/Master Plans
- Building Codes
- Zoning and Subdivision Ordinances
- NFIP Flood Damage Prevention Ordinances
- Site Plan Requirements
- Local Waterfront Revitalization Plans
- Stormwater Management Plans
- Emergency Management and Response Plans
- Land Use and Open Space Plans
- Capital Plans
- New York State Standard Multi-Hazard Mitigation Plan, 2014

A partial listing of the plans, reports and technical documents reviewed in the preparation of this plan is included in Table 3-5.

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
Berkshire Comprehensive Plan	2000	Town of Berkshire
Town of Berkshire Comprehensive Plan – DRAFT	2017	Town of Berkshire
Town of Candor Comprehensive Plan	1999	Town of Candor
Town of Candor Comprehensive Plan	2016	Town of Candor
Town/Village Spencer Joint Comprehensive Plan	2015	T/V of Spencer
Emergency Operations Plan for the Town of Owego	2016	Town of Owego
Tioga County and Town of Owego Stormwater Management Program Plan, 2015-2020	May 12, 2015	Town of Owego

Existing plan, program or technical documents	Date	Jurisdictional Applicability
Comprehensive Plan Update Village of Owego	2013	Village of Owego
Town of Richford Comprehensive Plan Update 2015	December 8, 2015	Town of Richford
Waverly Glen Park Master Plan	July 25, 2017	Village of Waverly
Tioga County Comprehensive Emergency Management Plan	2013	Countywide
Tioga County SWCD 2017 Annual Report	2017	Countywide
Tioga County Flood Insurance Study	April 17, 2012	Countywide
Tioga County 2020 Strategic Plan – Establishing Priorities for Government Operations	July 12, 2016	Countywide
NYRCR Tioga – NY Rising Community Reconstruction Plan	March 2014	Town and Village of Nichols, Town and Village of Owego, and Town of Tioga
Tioga County Agricultural and Farmland Protection Plan Update	April 12, 2015	Countywide
Infrastructure Master Plan for Tioga County	2004	Countywide
The Tioga County Community Health Improvement Plan 2014-2017	2014	Countywide

Notes:
*** = *this document may or may not include all jurisdictions*
T = *Town*
V = *Village*

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 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 Chapter 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 Chapter 9, the County and each participating jurisdiction have identified how they have 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

Tioga County and participating jurisdictions are committed to the continued involvement of the public in the hazard mitigation process. This HMP update will be posted on-line at https://www.tiogacountyny.com/departments/emergency-services/ 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 public plan website.

A notice regarding annual updates of the plan and the location of plan copies will be publicized annually after the Planning Committee's annual evaluation and posted on the public website at https://www.tiogacountyny.com/departments/emergency-services/.

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 5-year plan update as appropriate; however, members of the Planning Committee will assist the HMP Coordinator. Additional meetings may also 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.

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.

Ms. Wendy Walsh has been identified as the ongoing Tioga County HMP Coordinator (see Section 7), and is responsible for receiving, tracking, and filing public comments regarding this plan. Contact information is:

Wendy Walsh, District Manager
Tioga County Soil and Water
183 Corporate Drive
Owego, New York 13821
607-687- 3553
Email: walshw@co.tioga.ny.us

SECTION 4 COUNTY PROFILE

Tioga County profile information is presented in the plan and analyzed to develop an understanding of a study area, including the economic, structural, and population assets at risk and the particular concerns that may be present related to hazards analyzed later in this plan (e.g., low lying areas prone to flooding or a high percentage of vulnerable persons in an area). This profile provides general information for Tioga County (physical setting, population and demographics, general building stock, and land use and population trends) and critical facilities located within the County.

4.1 GENERAL INFORMATION

Tioga County is one of the 62 counties in New York State. It consists of nine towns and six villages, with a majority of the County's population located in the towns of Barton, Nichols, and Owego. Tioga County is bordered to the north by Tompkins and Cortland County, to the south by Pennsylvania, to the east by Broome County and to the west by Chemung County.

Tioga County was once home to the Cayuga and Onondaga tribes of the Iroquois confederacy. Tioga County was originally formed from the division of Montgomery County in 1791. In 1798, Tioga County was reduced in size to create Chemung County (which included part of the present Schuyler County and by the combination of a portion with a portion of Herkimer County to create Chenango County). In 1806, Tioga County was split again to allow for the creation of Broome County.

4.2 MAJOR PAST HAZARD EVENTS

Presidential disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses and public entities. Some of the programs are matched by state programs. Review of presidential disaster declarations helps establish the probability of reoccurrence for each hazard and identify targets for risk reduction. Table 4-1 shows FEMA disaster declarations that included Tioga County through 2018 (records date back to 1954).

Table 4-1. History of Tioga County Hazard Events

Disaster Number	Declaration Date	Incident Type	Title
DR-4397	8/14/2018	Flood	Severe Storms and Flooding
DR-4322	7/12/2017	Snow	Severe Winter Storm and Snowstorm
EM-3351	10/28/2012	Hurricane	Hurricane Sandy
DR-4031	9/13/2011	Severe Storm(s)	Remnants of Tropical Storm Lee
EM-3341	9/8/2011	Severe Storm(s)	Remnants of Tropical Storm Lee
DR-1993	6/10/2011	Flood	Severe Storms, Flooding, Tornadoes, And Straight-Line Winds
DR-1670	12/12/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1650	7/1/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1589	4/19/2005	Severe Storm(s)	Severe Storms and Flooding
DR-1565	10/1/2004	Severe Storm(s)	Tropical Depression Ivan
DR-1534	8/3/2004	Severe Storm(s)	Severe Storms and Flooding

Disaster Number	Declaration Date	Incident Type	Title
DR-1335	7/21/2000	Severe Storm(s)	Severe Storms and Flooding
DR-1233	7/7/1998	Severe Storm(s)	Severe Storms and Flooding
DR-1095	1/24/1996	Flood	Severe Storms and Flooding
DR-515	7/21/1976	Flood	Severe Storms & Flooding
DR-487	10/2/1975	Flood	Storms, Rains, Landslides & Flooding
DR-338	6/23/1972	Flood	Tropical Storm Agnes

Source: FEMA 2018

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

Tioga County is located in south central New York State, on the Pennsylvania border. The County is bordered to the north by Tompkins and Cortland County, to the south by Pennsylvania, to the east by Broome County and to the west by Chemung County. Tioga County is made up of 15 municipalities (towns and villages) and encompasses an area of approximately 524 square miles (Tioga County HMP, 2007). Figure 4-1 illustrates the County and its municipalities.

4.3.2 Topography and Geology

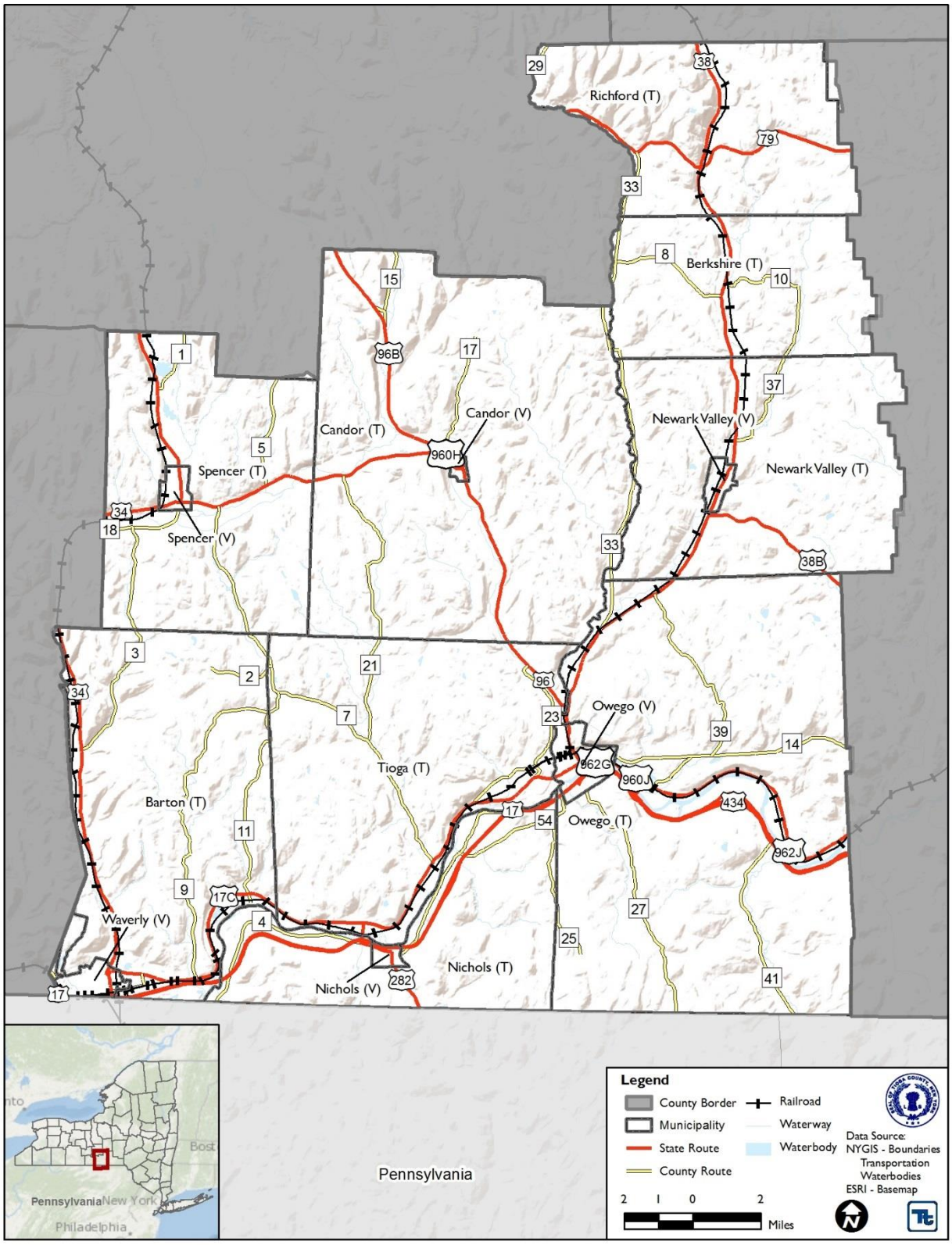
Topography

Tioga County occupies a heavily eroded portion of the Appalachian Plateau characterized by rounded hillsides and flat, relatively narrow (under a mile wide) valleys, many of which are of glacial origin. The Pocono Mountains lie to the south, and the Catskill Mountains lie to the east. The County is situated between about 750 and just under 1,900 feet above sea level, and this elevation contributes to the cooler average temperatures. The lowest elevation in the county is located at the point where the Susquehanna River leaves the county east of Waverly near the southwest edge of the County. The highest elevation is located on a ridge top northeast of the hamlet of Richford near the Tioga-Cortland County boundary in the northeastern part of the County (Southern Tier East Regional Planning Development Board, 2007).

Geology

The geology of Tioga County is largely comprised of sedimentary rock with small areas of soft to medium clays or sands surrounding creeks and rivers (NYS DHSES 2014). The Upper Walton Formation (shale, sandstone, conglomerate) comprises over 50% of the County. The Gardeau Formation (Shale, siltstone, Roricks Glen Shale) covers 31% of the County. The remainder of the County is covered by formations largely comprised of shale, siltstones, and sandstones (USGS no date). Less than 50% of Tioga County is underlain by soils with abundant clays of slight to moderate swelling potential. The County has expansive salt deposits (NYS DHSES 2018).

Figure 4-1. Tioga County, New York

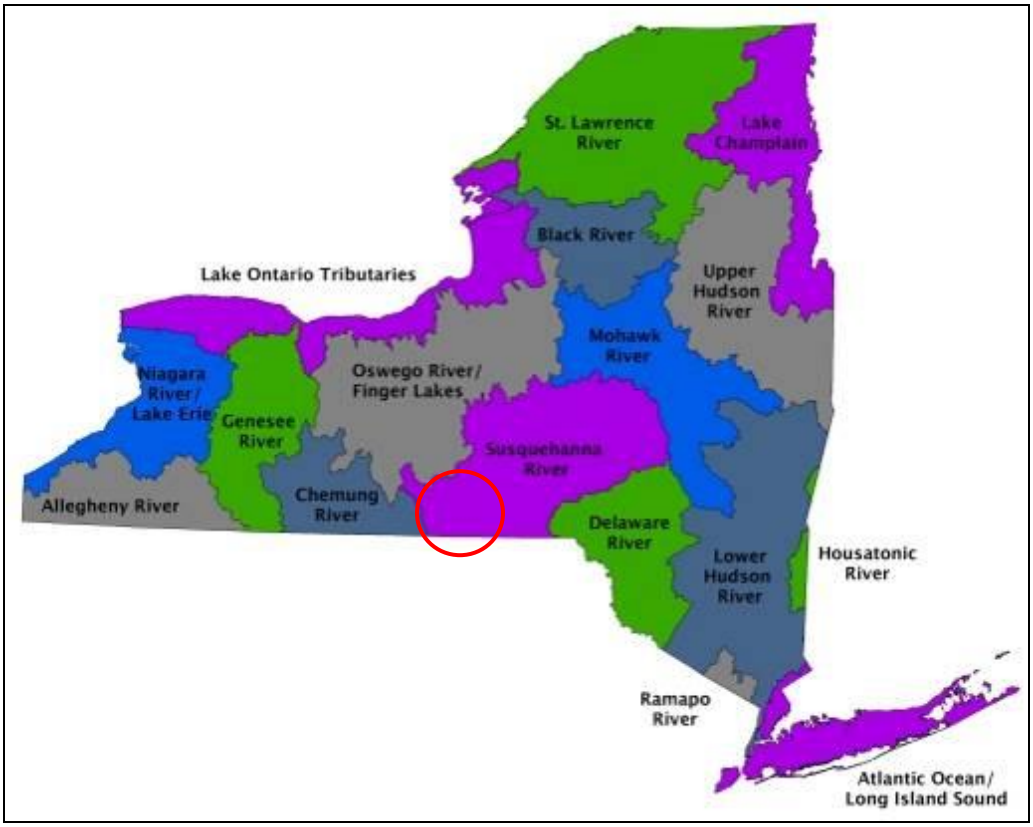


Source: ESRI, 2009; Tioga County, 2012

4.3.3 Hydrography and Hydrology

Numerous ponds, lakes, creeks and rivers make up the waterscape of Tioga County, which lie within one major drainage basin (Susquehanna River Basin) and four sub-basins (Chenango, Chemung, and Owego-Wappasening). The major bodies of water and waterways within the County include the East and West Branch of the Owego Creek, Catatonk Creek, Cayuta Creek and the Susquehanna River. Figure 4-2 depicts the 17 drainage basins found in New York State and the location of Tioga County within the state.

Figure 4-2. Drainage Basins of New York State



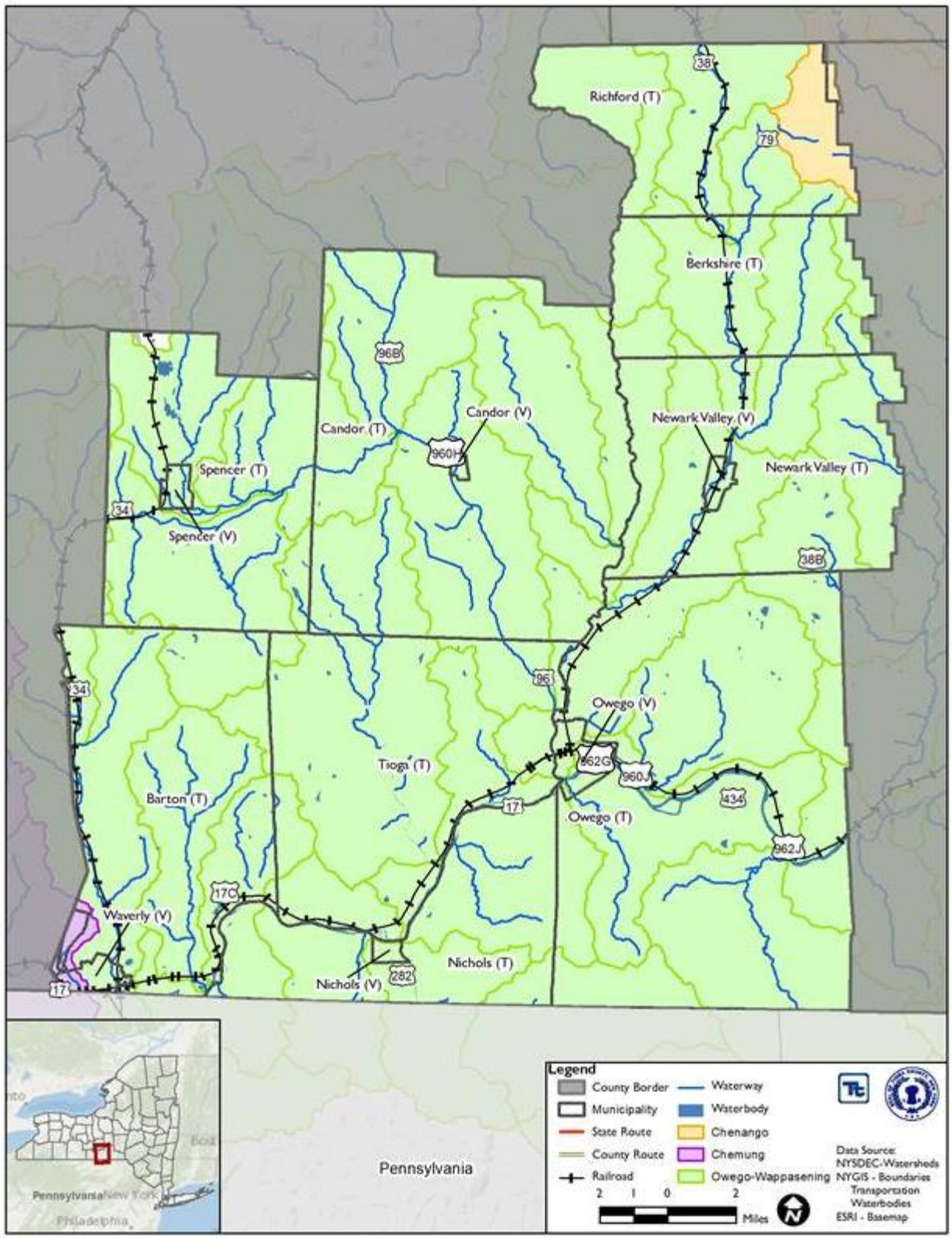
Source: NYSDEC, Date Unknown

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

The Susquehanna River Basin is the second largest east of the Mississippi River. The 444 miles of this Basin drains 27,500 square miles covering large portions of New York State, Pennsylvania and Maryland, before emptying into the Chesapeake Bay. The Basin has 4,520 square miles of land area within New York State and over 8,185 miles of freshwater rivers and streams. The major tributaries to the Susquehanna River in New York State include the Chenango River, the Tioughnioga River, the Unadilla River and the Owego Creek. There are 130 significant freshwater lakes, ponds and reservoirs that make up the Basin and include Otsego Lake, Canadarago Lake and Whitney Point Lake/Reservoir (NYSDEC, Date Unknown). The Susquehanna Watersheds (HUC 10 and HUC 12) and major riverine reaches in Tioga County are provided in Appendix E (County Profile and Risk Assessment Supplementary Data).

The majority of the County is located in the Owego-Wappasening watershed as shown in Figure 4-3. A map of the watersheds that intersect the County is provided in Appendix E (County Profile and Risk Assessment Supplementary Data).

Figure 4-3. Surface Water Features in Tioga County



Source: NYSDEC Watersheds

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 that move northeastward along the Atlantic coast or the western side of the Appalachian Mountains. Storms that form 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).

Tioga County generally experiences seasonable weather patterns characteristic of the northeastern U.S. Summer temperatures typically range from about 70 degrees Fahrenheit (°F) to 82°F. Winter high temperatures are usually in the middle to upper 30s (°F), with minimum temperatures of 14°F expected (The Weather Channel, 2012).

Land Use and Land Cover

Tioga County is typical of many counties in New York State in that it has experienced only moderate growth over the past three decades. Much of the area within the villages was largely built out before World War II. Additional development occurred in the 1950s and 1960s, using up much of the remaining land within the County's municipalities. Because they were founded in an era when water power was critical to industrial development or transportation, the core of most villages in the county are located within floodplain areas. The bulk of residential development in Tioga County since 1970 has been and continues to be small-scale, low density rural residential development comprised of one- to five house lots in scattered locations. The majority of recent growth and development within the region since 1970 has occurred in areas with few identified natural or technological hazards (Tioga County HMP, 2007).

Figure 4-4. Land Use (2011) in Tioga County

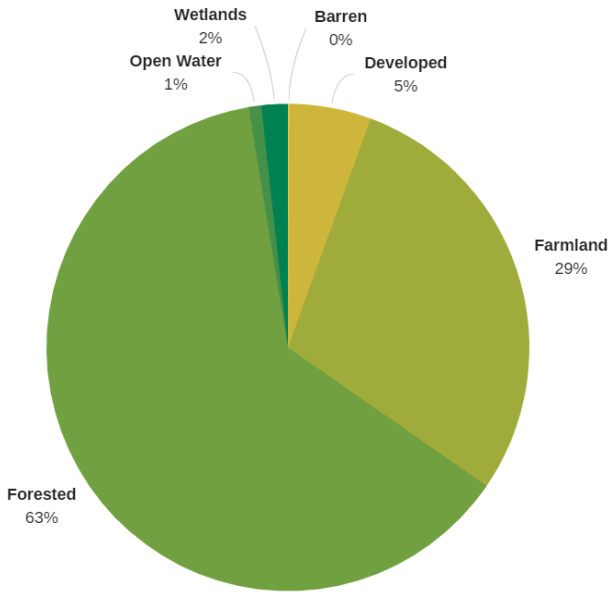
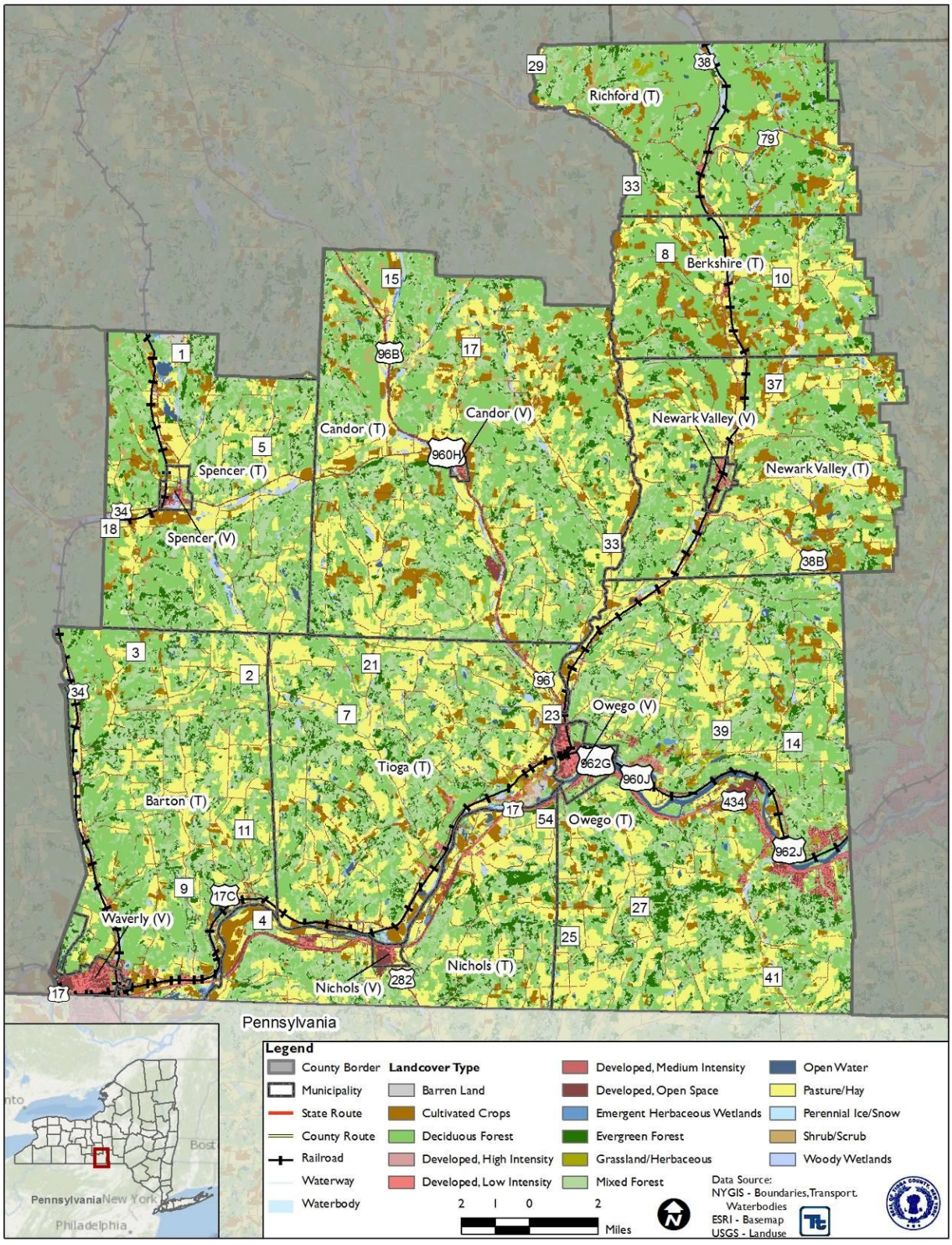


Figure 4-4 shows the land use categories and their total square miles and percentages and indicates that the primary land cover is forest with agriculture being the dominant land use covering 29% of the County, with developed land approximately including six percent of the total land use. Figure 4-5 shows the distribution of land use throughout Tioga County.

Figure 4-5. Land Use in Tioga County



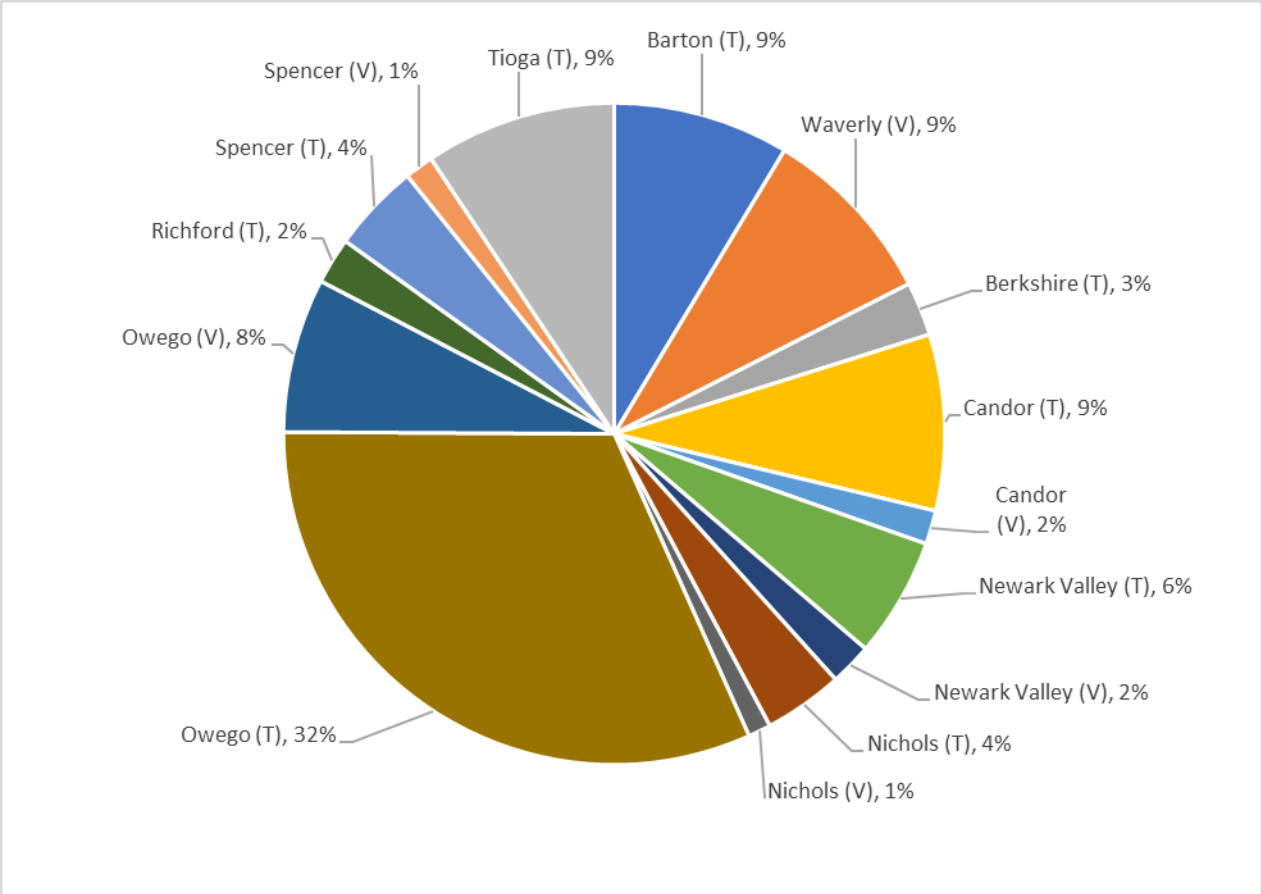
Source: USGS, 2011

4.4 POPULATION AND DEMOGRAPHICS

According to the 2010 U.S. Census, Tioga County had a population of 51,125 people. The U.S. Census data in HAZUS-MH is based on the 2000 data in which there were 51,784 people in the County. Figure 4-6 and Figure 4-7 present the population statistics for Tioga County based on the 2010 U.S. Census data. For the purposes of this plan, data available in HAZUS-MH are used (representing 2010 data); this data is considered appropriate given the less than 3% decrease in population between 2010 and 2016.

Tioga County experienced an increase in population between 1950 and 1990 with the largest increase in population in the 1960's and 1970's. Since that time, population growth has steadily slowed and, starting in 2000, has decreased. The 2012-2016 American Community Survey estimates the 2016 population to be 49,649, a 2.8% decrease in population from the 2010 U.S. Census. The median age of persons living in Tioga County is 43.9 years of age, according to the U.S. Census Bureau 2012-2016 American Community Survey 5-year estimates. 96.9% of Tioga residents are white, 1.7% are Hispanic or Latino, and 0.7% of residents are black or African American. Of the population over 25 years old, 90.2% graduated from high school or higher, while 25.0% have a bachelor's degree or higher. The median household income for Tioga County is $58,115, while the average household income is $72,985.

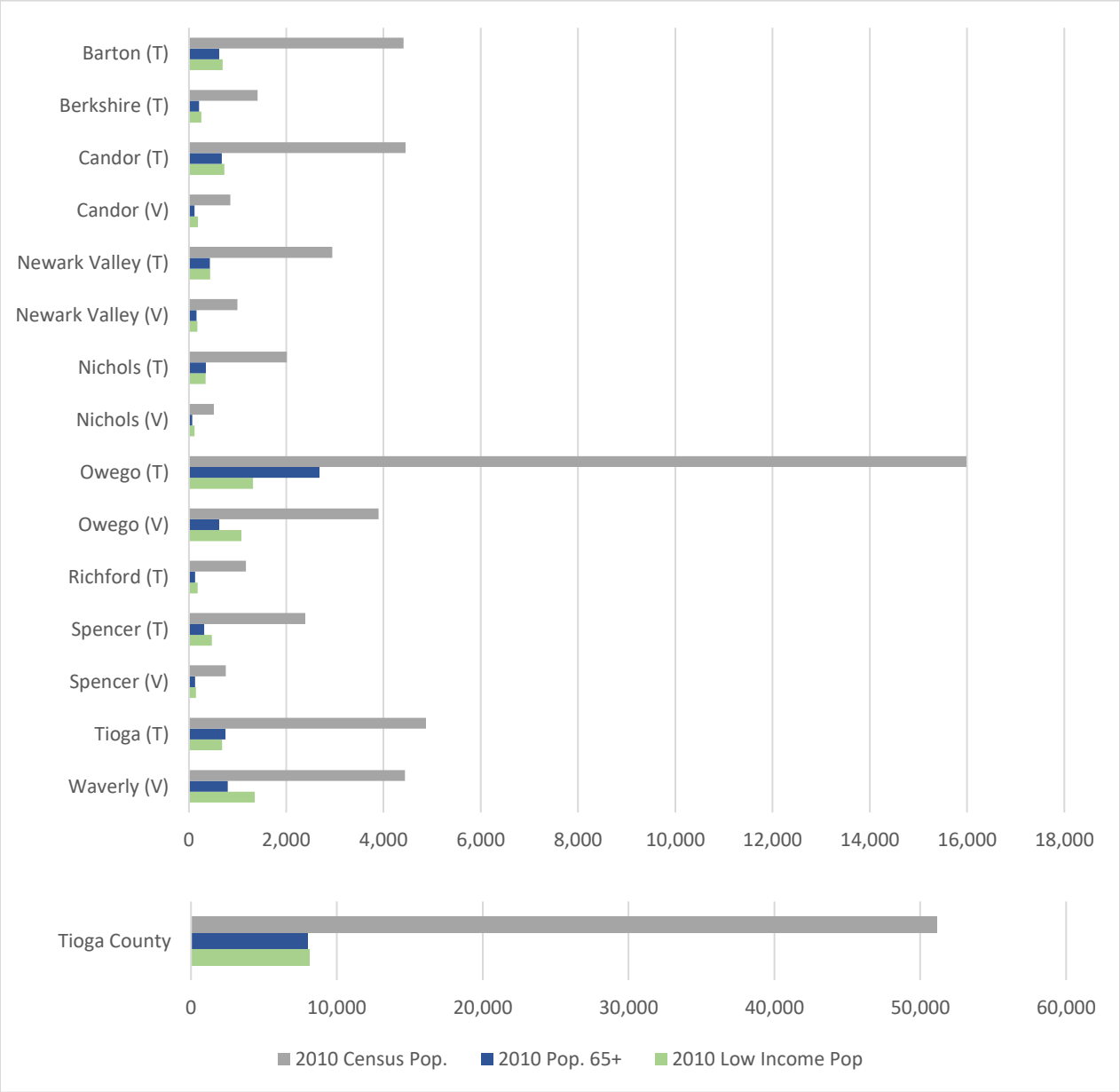
Figure 4-6. Tioga County Municipal Populations as Percent of County Population



Source: *U.S. Census 2010*

Note: *The percentage was calculated for each municipality.*

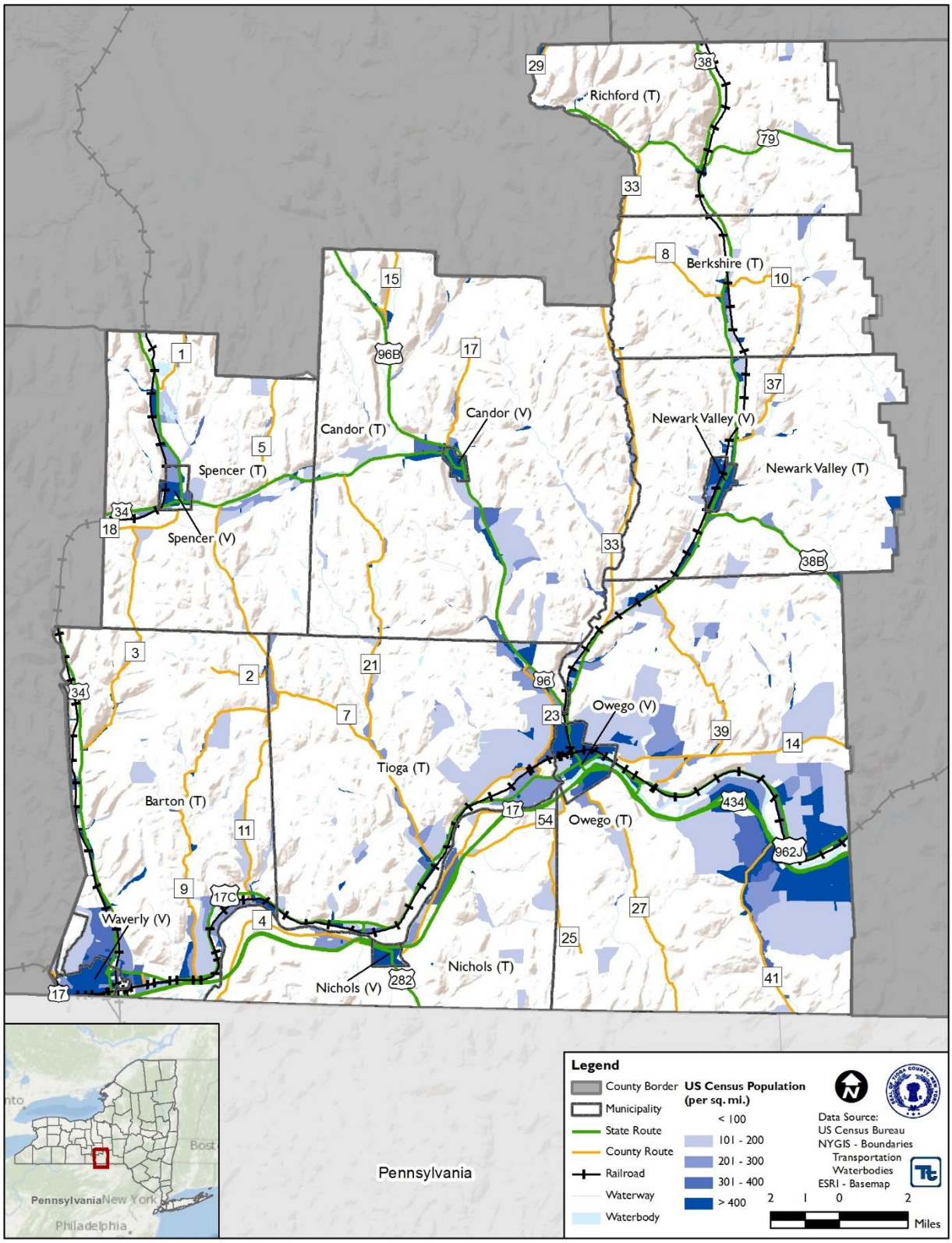
Figure 4-7. Tioga County Municipal Population Statistics



Source: U.S. Census 2010

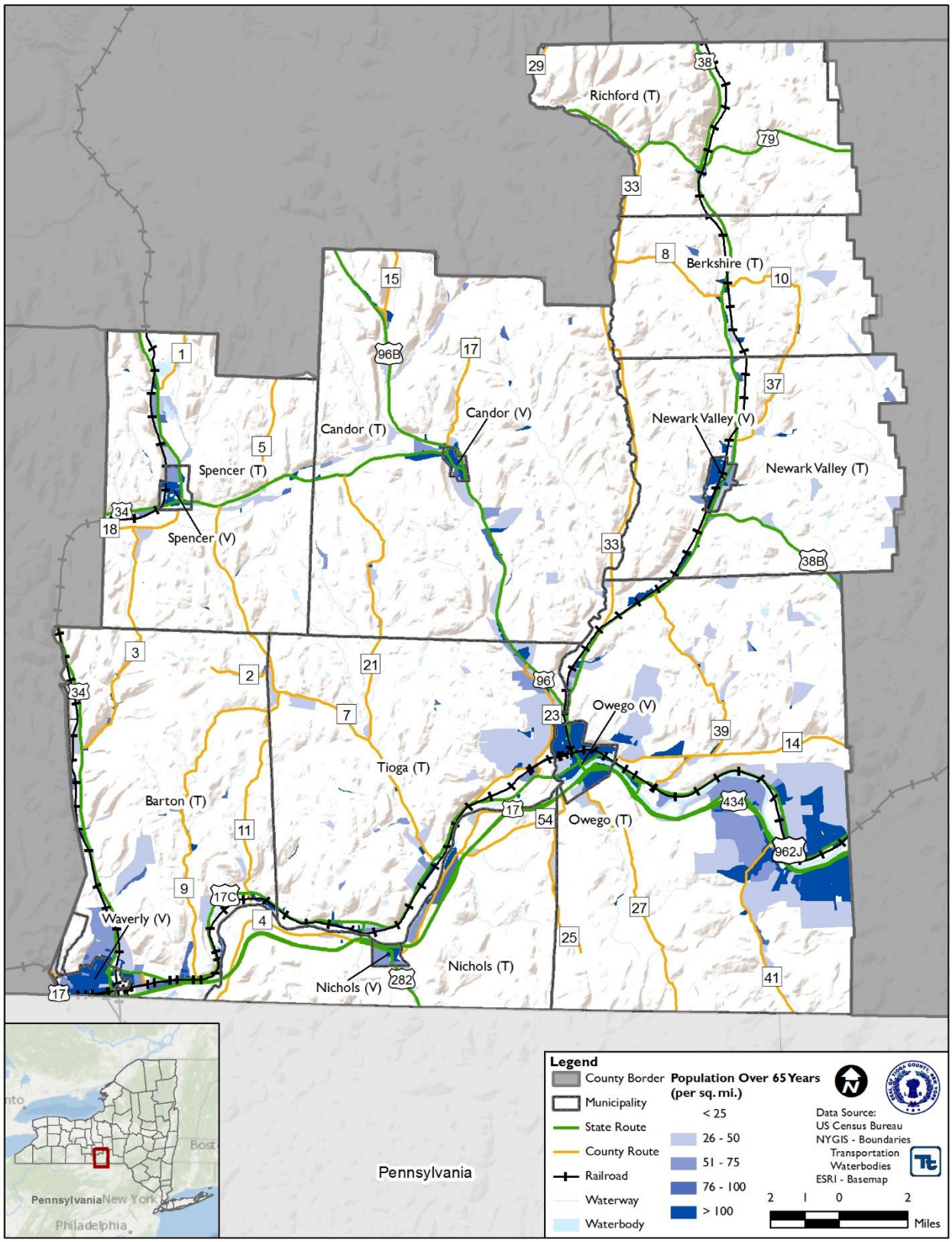
The Federal Emergency Management Agency's (FEMA) Disaster Mitigation Act of 2000 (DMA 2000) requires that hazard mitigation plans (HMP) consider socially vulnerable populations. These populations can be more susceptible to hazard events based on a number of factors, including their physical and financial ability to react or respond to a hazard, and the location and construction quality of their housing. This HMP considers two socially vulnerable population groups: (1) the elderly (persons over the age of 65) and (2) those living below the poverty level (as defined by the U.S. Census Bureau). Figure 4-8 through Figure 4-10 show the distribution of the general population density (persons per square mile), elderly population density, and low-income population density. In order to provide a context of the overall population as well as the socially vulnerable populations, the data is provided graphically in this section. For a detailed listing of population statistics, refer to Appendix E (County Profile and Risk Assessment Supplementary Data).

Figure 4-8. Distribution of General Population by Census Block for Tioga County, New York



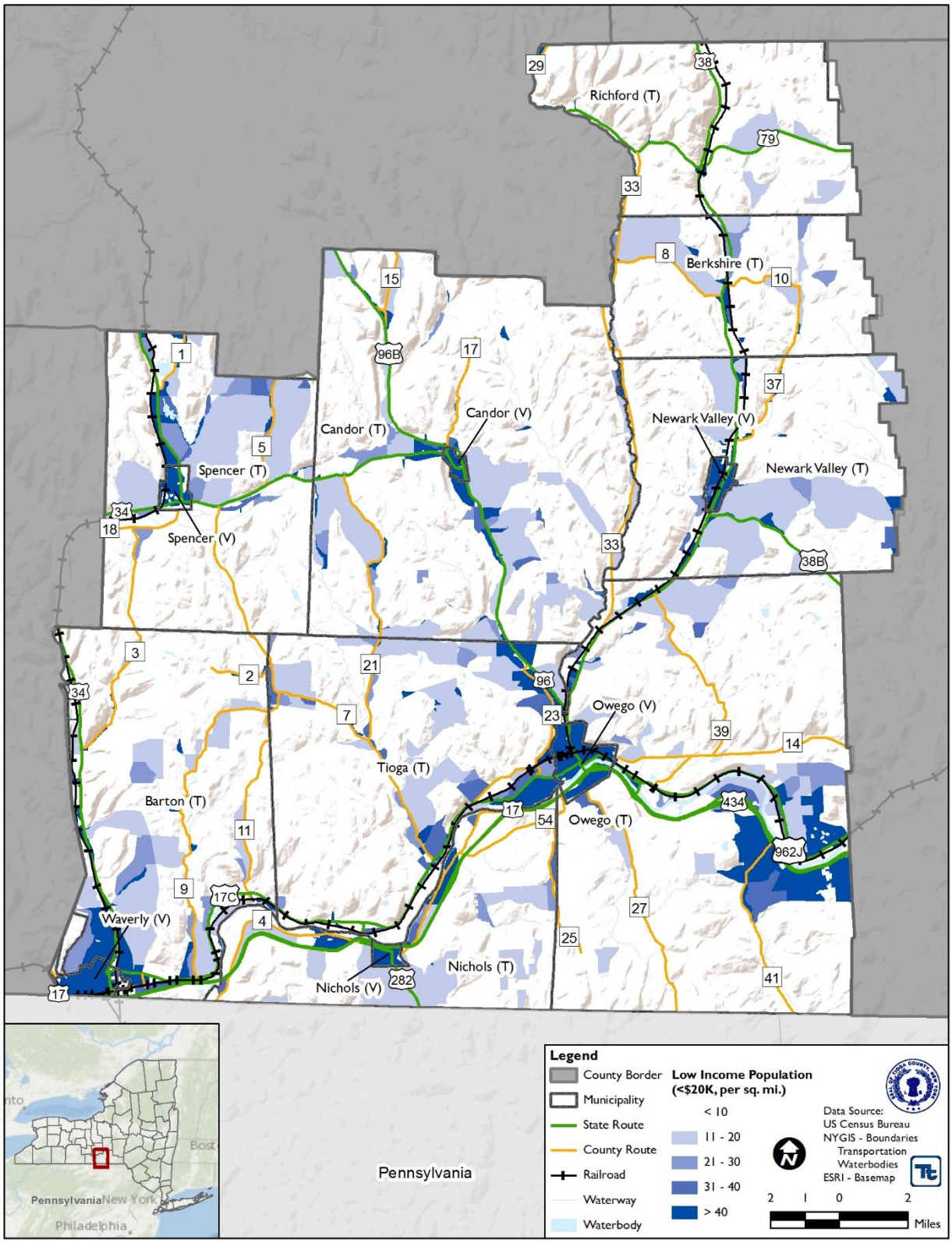
Source: HAZUS-MH V4.0, Census 2010

Figure 4-9. Distribution of Persons over the Age of 65 by Census Block in Tioga County, New York



Source: HAZUS-MH 4.0, Census 2010

Figure 4-10. Distribution of Low-Income Population by Census Block in Tioga County, New York



Source: HAZUS-MH V4.0, Census 2010

4.5 GENERAL BUILDING STOCK

In order to understand the impact of hazards identified in the plan on the built environment, the location and density of structures provides a basis for analysis. For this update, the default general building stock in HAZUS-MH was used to estimate the number of structures and replacement cost value (structure and contents) for Tioga County. The replacement cost values in HAZUS-MH are based on RS Means 2014 valuations.

For the purposes of this plan, approximately 21,926 structures were identified by the tax data and spatial data available. These structures account for a replacement cost value of approximately $7.8 billion. Approximately 92 percent of the total buildings in the county are residential, which make up approximately 70.3 percent of the total building stock value. Table 4-2 presents building stock statistics by occupancy class for Tioga County.

Table 4-2. Building Stock Count and Replacement Cost Value (RCV) by Occupancy Class

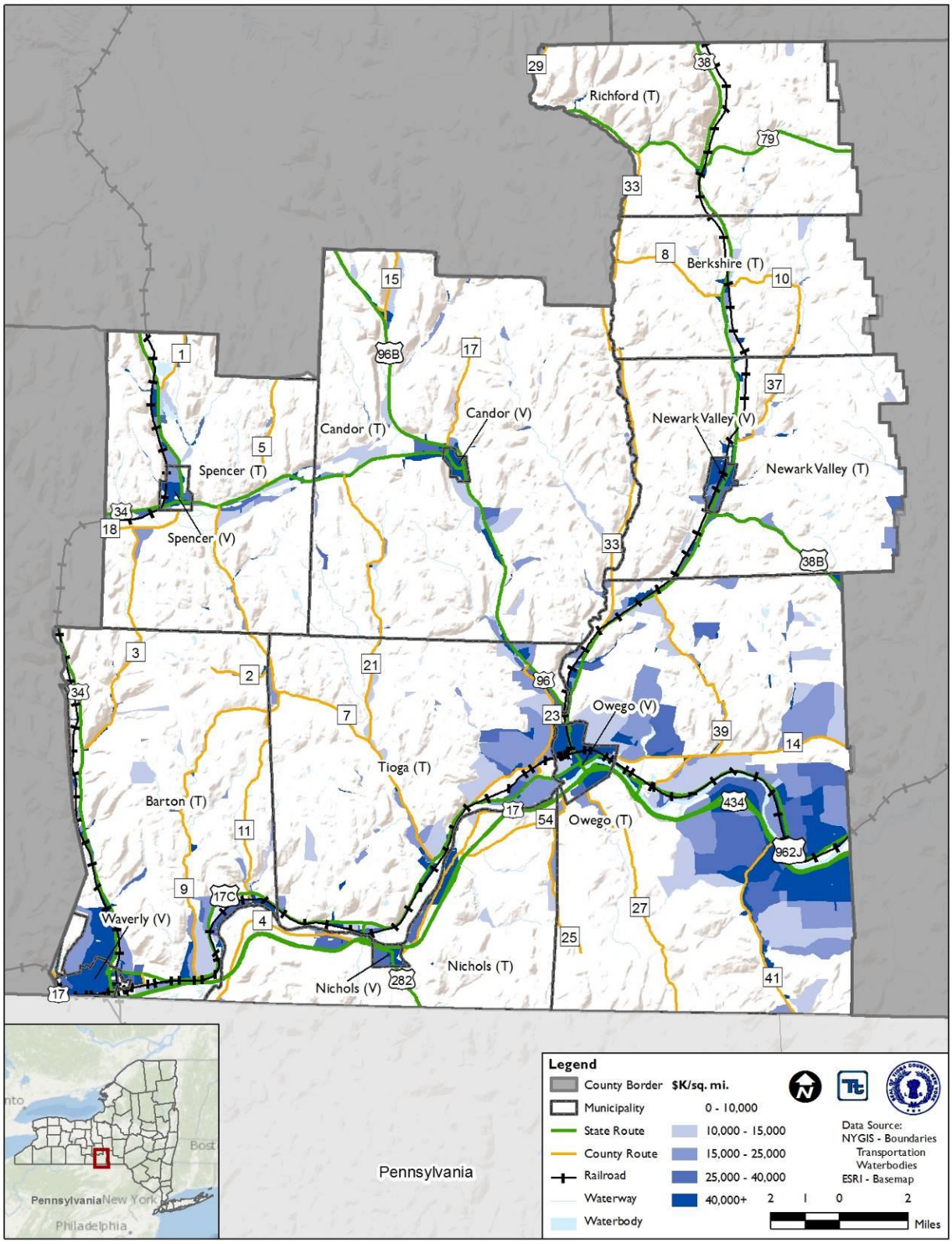
	Total		Residential		Commercial		Industrial	
Municipality	Count	RCV	Count	RCV	Count	RCV	Count	RCV
Barton (T)	1,972	$591,426,000	1,838	$387,959,000	81	$81,444,000	33	$92,458,000
Berkshire (T)	628	$143,451,000	574	$104,897,000	27	$18,309,000	11	$5,012,000
Candor (T)	2,024	$517,276,000	1,887	$418,137,000	79	$52,657,000	22	$16,266,000
Candor (V)	381	$129,173,000	332	$75,267,000	27	$17,448,000	8	$3,298,000
Newark Valley (T)	1,256	$307,152,000	1,166	$241,008,000	61	$41,003,000	15	$7,424,000
Newark Valley (V)	453	$140,422,000	415	$98,633,000	21	$21,749,000	4	$1,984,000
Nichols (T)	844	$221,033,000	787	$176,309,000	33	$28,182,000	10	$3,495,000
Nichols (V)	256	$109,051,000	221	$61,048,000	15	$16,562,000	7	$3,809,000
Owego (T)	6,675	$2,832,708,000	6,204	$2,116,977,000	290	$327,962,000	112	$279,250,000
Owego (V)	1,467	$830,668,000	1,249	$451,318,000	148	$245,142,000	31	$61,186,000
Richford (T)	582	$133,299,000	555	$97,793,000	17	$16,877,000	4	$7,712,000
Spencer (T)	1,143	$317,610,000	1,053	$254,280,000	44	$28,969,000	25	$14,975,000
Spencer (V)	355	$123,352,000	313	$68,316,000	29	$41,206,000	5	$3,456,000
Tioga (T)	2,162	$618,886,000	2,010	$457,091,000	92	$86,222,000	26	$24,683,000
Waverly (V)	1,728	$817,088,000	1,575	$495,899,000	107	$131,079,000	25	$142,627,000
Tioga County:	**21,926**	**$7,832,595,000**	**20,179**	**$5,504,932,000**	**1,071**	**$1,154,811,000**	**338**	**$667,635,000**

Source: HAZUS-MH v4.0

Notes: Industrial includes buildings associated with public utilities parcels (categorized as IND5)

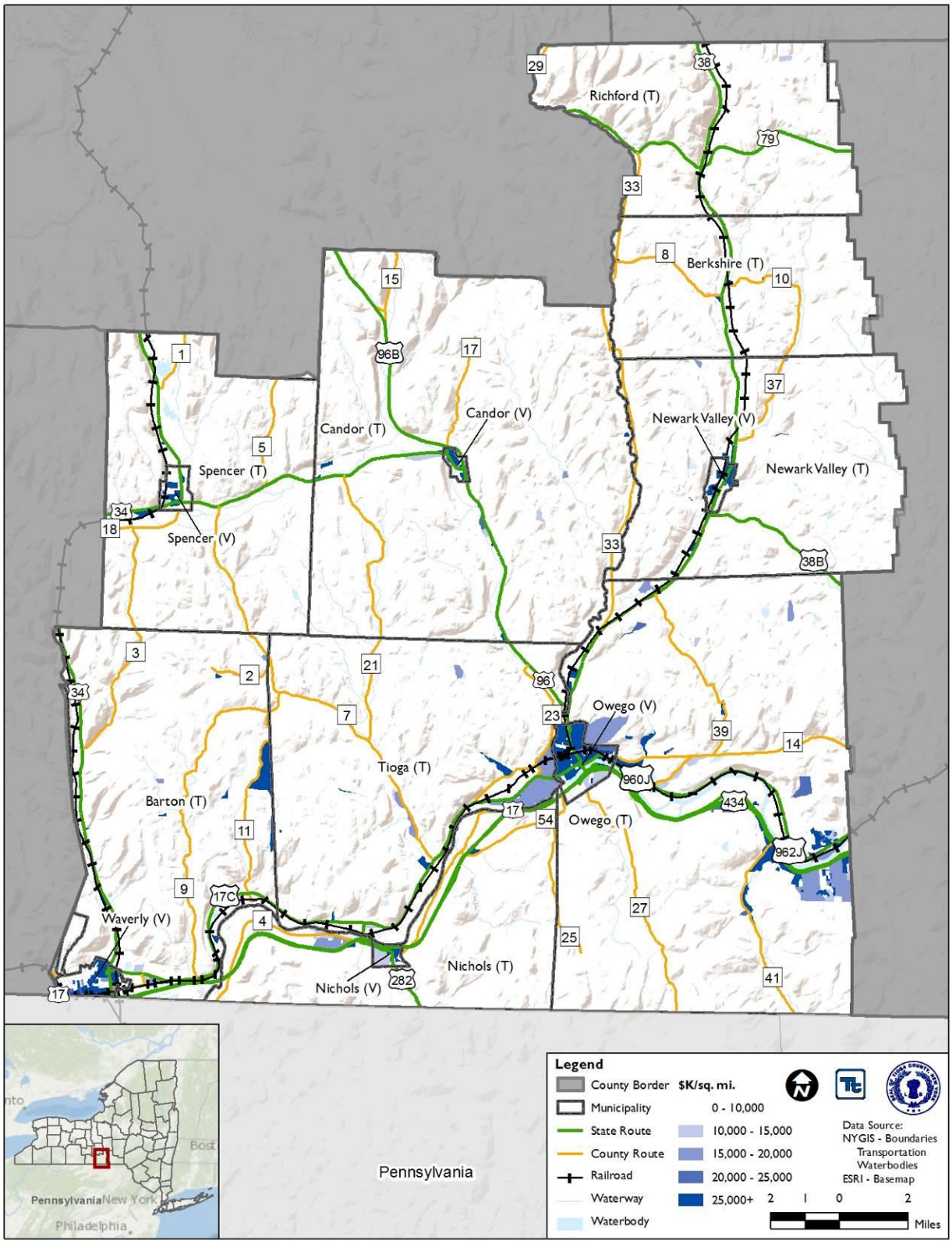
Figure 4-11 through Figure 4-13 show the distribution of value and exposure density of residential, commercial and industrial buildings in Tioga County. Exposure density is the dollar value of structures per unit area, including building content value. Generally, contents for residential structures are valued at about 50 percent of the building's value. For commercial facilities, the value of the content is generally about equal to the building's structural value. The densities are shown in units of $1,000 ($K) per square mile. Viewing exposure distribution maps can assist communities in visualizing areas of high exposure and in evaluating aspects of the study area in relation to the specific hazard risks.

Figure 4-11. Distribution of Residential Building Stock and Value Density in Tioga County



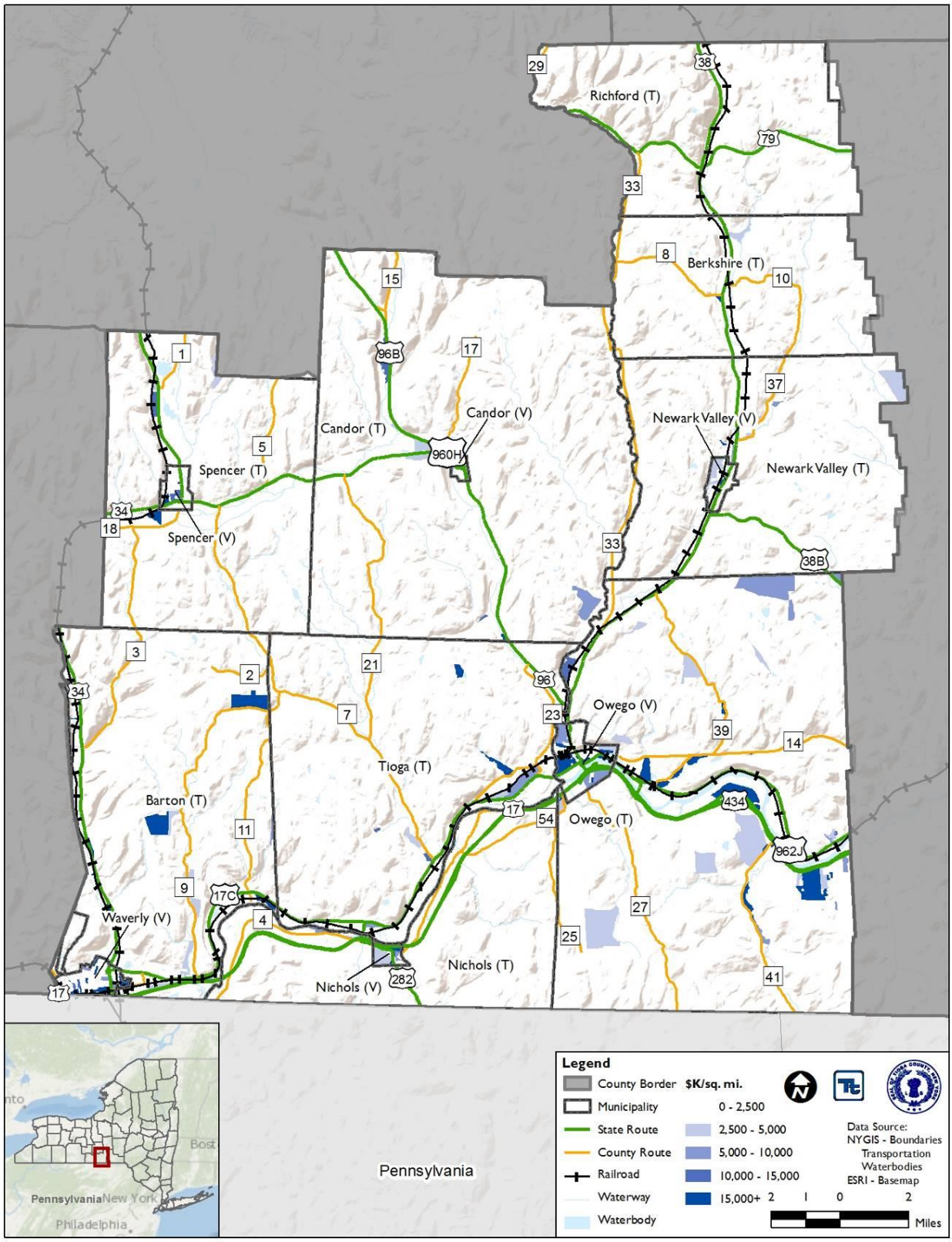
Source: HAZUS-MH V4.0

Figure 4-12. Distribution of Commercial Building Stock and Exposure Density in Tioga County



Source: HAZUS-MH V4.0

Figure 4-13. Distribution of Industrial Building Stock and Value Density in Tioga County



Source: HAZUS-MH V4.0

According to 2010 Census data, 20,350 occupied households are located in Tioga County. A household includes all the people who occupy a housing unit as their usual residence. A housing unit is a house, apartment, mobile home or trailer, a group of rooms, or a single room occupied as separate living quarters (or if vacant, intended for occupancy as separate living quarters). According to the 2012-2016 American Community Survey, the majority of housing units (69.5 percent) in Tioga County are classified as one-unit detached homes. The median price of a single-family home in Tioga County was estimated at $112,300 based on the 2012-2016 American Community Survey (U.S. Census 2010; U.S. Census 2016).

4.6 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 priority 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 and 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.

4.6.1 Land Use Trends

The following sections present an overview of the County's economy and agriculture.

Economy

The following sections present an overview of the County economy including: agriculture, retail trade, tourism, industrial, government, leisure and hospitality, and manufacturing. Figure 4-14 shows the distribution of businesses by industry in Tioga County.

The County Business Pattern is provided by the U.S. Census Bureau and is an annual series that presents sub-national economic data by industry. County Business Patterns covers most of the country's economic activity (U.S Census Bureau, 2016). According to the 2016 Tioga County Business Pattern, the County had a total of 787 business establishments. The retail trade industry had the highest number of establishments in the County, making up 16.5-percent of all businesses. Following retail trade is other services (except public administration), making up 13.2-percent of all business. The third highest industry in 2009 was construction, making up 12.4-percent of all businesses. Table 4-3 provides 2016 industry and employment information in Tioga County.

Table 4-3. 2016 County Business Pattern for Tioga County, New York

Industry	Number of Establishments	Annual payroll ($1,000)	Number of Employees*
Agriculture, forestry, fishing and hunting	2	D	a
Mining, quarrying, and oil and gas extraction	8	16,784	196
Utilities	2	D	a
Construction	98	18,015	364
Manufacturing	36	50,936	1,170
Wholesale trade	30	27,369	534
Retail trade	130	31,578	1,217
Transportation and warehousing	15	12,741	346

Industry	Number of Establishments	Annual payroll ($1,000)	Number of Employees*
Information	16	3,555	111
Finance and insurance	36	10,101	224
Real estate and rental and leasing	10	870	28
Professional, scientific, and technical services	57	10,323	229
Management of companies and enterprises	1	D	a
Administrative and support and waste management and remediation services	46	12,680	409
Educational services	6	452	22
Health care and social assistance	76	33,793	1,130
Arts, entertainment, and recreation	19	13,698	408
Accommodation and food services	92	13,778	919
Other services (except public administration)	104	6,596	365
Industries not classified	3	D	a
Total	787	264,571	7,691

Source: U.S. Census, 2016

** = An establishment is a single physical location at which business is conducted or services or industrial operations are performed. It is not necessarily identical with a company or enterprise, which may consist of one or more establishments. When two or more activities are carried on at a single location under a single ownership, all activities generally are grouped together as a single establishment. The entire establishment is classified on the basis of its major activity and all data are included in that classification.*

*** = This number only includes paid employees*

D = Withheld to avoid disclosing data of individual companies; data are included in higher level totals

E = 250-499 employees

H = 2

N = Not available

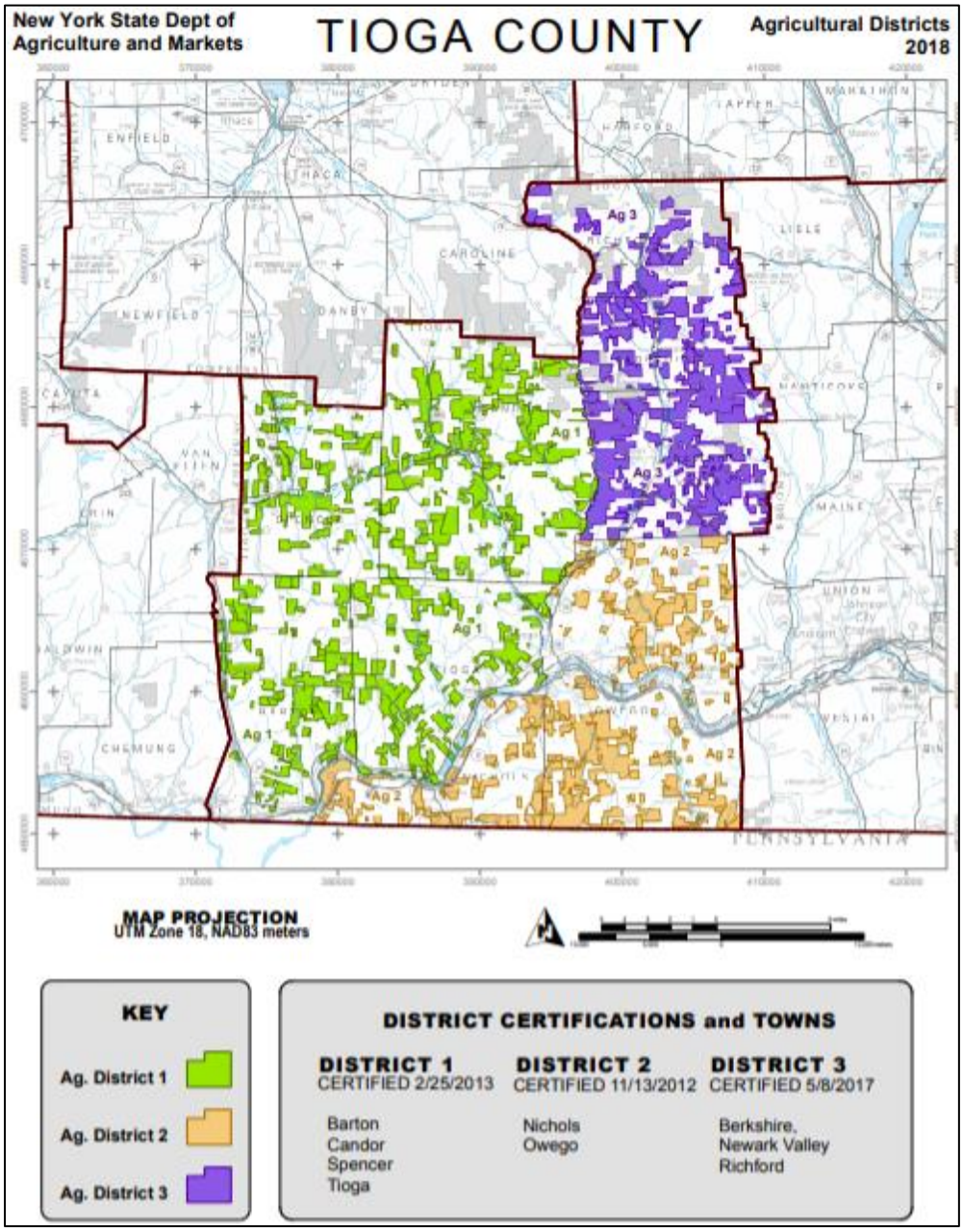
X = Not applicable

Agriculture

Over the past few decades, the number of farms and farmers within Tioga County has steadily declined. This could be due to an increase in production costs and a decrease in market values with some products (Southern Tier East Regional Planning Development Board, 2007). In 2012, there were 536 farms in the County, with a total land area of 107,873 acres. The average size of a farm was 201 acres. According to the 2012 Census of Agriculture, approximately 290 of farm operators reported farming as their primary occupation. The market value of agricultural products sold from County farms totaled over $36.7 million, with total sales averaging $68,559 per farm. Crop sales accounted for $11.3 million (31%) of total sales and livestock sales accounted for $25.4 million (69%) of total sales. The lead agricultural products sold were milk and other dairy products from cows ($27.2 million), grains, oilseeds, dry beans, and dry peas ($4.7 million), and other crops and hay ($4.6 million) (U.S. Department of Agriculture National Agricultural Statistics Service, 2012).

An overview of Tioga County Agricultural Districts is provided in Figure 4-14 which indicates three districts. The purpose of agricultural districting is to encourage and promote the continued use of farmland for agricultural production. Properties in State-certified Agricultural Districts receive partial real property tax relief (agricultural assessment and special benefit assessments), and protections against overly restrictive local laws, government funded acquisition or construction projects, and private nuisance suits involving agricultural practices.

Figure 4-14. Tioga County Agricultural Districts



Source: Cornell Institute for Resource Information Sciences (Cornell IRIS) and New York State Department of Agriculture and Markets 2018

Retail Trade

Tioga County does not have any big box retail. The County is surrounded on three sides by counties that all have the large retail that most communities are accustomed to and the population is able to access these due to an abundance of good highways to access these shopping opportunities. Retail is made up of mostly small privately-owned businesses. There is a unique shopping opportunity in the quaint Village of Owego, with many nice shops and restaurants that reside along a newly constructed river walk. The other main shopping area would be at the western end of the county in the Village of Waverly. There are many small businesses dispersed throughout the remainder of the county (Tioga County Planning Committee, 2012).

Tourism

The Tioga County Tourism Office is the official designated Tourism Promotion Agency (TPA) for the County in the State of New York. New York State provides financial assistance to county TPAs for certain expenses of local and regional tourism promotion campaigns through the I Love NY Matching Funds program administered by New York's Empire State Development Office. The Tioga County Tourism Office's mission is dedicated to growing the tourism industry of Tioga County by promoting its attractions, the rural character, quality of life, and charm of the county to attract out-of-county visitors. These goals are achieved by marketing and advertising to attract the maximum number of visitors to Tioga County based on existing attractions, services, and events, and offering marketing resources and assistance to new agri-tourism businesses. Marketing services include a website (www.visittioga.com), brochure distribution, calendar of events, an 800#, welcome bags, public/media relations, a visitor's center and regional and state associations (Tioga County Planning Committee, 2012).

Tioga County is one of the 14 counties located within the Finger Lakes Region. The Finger Lakes is a $2.6 billion industry that supports 57,650 jobs. Tioga County is 12th in visitor spending (Tioga County Planning Committee, 2012). Table 4-4 displays the totals in visitor spending within Tioga County.

Table 4-4. Tioga County Visitor Spending in the Finger Lakes Region

Visitor Spending	Total
Lodging	$9,838
Transportation	$312
Food and Beverage	$7,178
Retail & Svc	$5,192
Recreation	$2,986
Second Homes	$3,642
TOTAL	**$29,149**

Source: Tioga County Planning Committee, 2015

Other tourism in the County includes:

- Eco-Tourism (conservation education, wilderness educ., scenic views)
- Nature-based Activities (canoeing / kayaking / rowing / sculling -"paddling," hiking, x-skiing, snowshoeing, snowmobiling, hunting, fishing, birdwatching, parks)
- Agri-Tourism (farm experiences, tours, farm markets)
- Cultural Attractions (theatre, music, art)
- Historic / Heritage Attractions (museums, historic homes/villages, railroads)
- Shopping/Restaurants/Lodging
- Sports-based Attractions (golf, racing, swimming, waterskiing, biking, bowling, tennis, volleyball)
- Events (can be a combination of any of the above) (Tioga County Planning Committee, 2012)

Government

Tioga County is made up of nine (9) towns and six (6) villages. The County is governed by nine (9) elected Legislators who represent equally divided districts. They manage by a Committee system and do not have a County Manager or Administrator. The County does not have a nursing home, hospital, airport, or park system. They also do not own or manage any public sewer or water systems. There is a County jail and a County Sheriff's road patrol (Tioga County Planning Committee, 2012).

Home rule is strong in New York State and thus, each town and village have its own governing body. Towns are made up of a Town Board and Supervisor. The Villages all have a Mayor and a Board of Trustees. Along with town and village roads, any public water and sewer systems are operated by the local municipality. Each

municipality has charge over its own planning and zoning and uses the County personnel as a resource (Tioga County Planning Committee, 2012).

Manufacturing

The 2016 County Business Pattern for the County found 36 establishments that are identified as manufacturing products. Some of these establishments include:

- Lockheed Martin, located in the Town of Owego, that specializes in software integration
- Crown, Cork & Seal aluminum beverage can manufacturing facility is located in the Town of Nichols
- Raymond-Hadley Corporation in Spencer is a custom blending and private label packaging company specializing in baking and dry ingredient mixes
- ENSCO Avionics in Endicott provides safety- and mission-critical engineering and COTS HMI development toolkits to the aerospace industry, for manned and unmanned systems
- Applied Technology Manufacturing Corp in Owego has decades of experience in machining and manufacturing, as well as engineering and product development.
- Technology Research Council in Nichols provides arc flash studies and safety training to the Southern Tier of New York State.

4.6.2 Population Trends

Over the last 50 years, Tioga County has experienced a strong population growth, with a slight decline over the last decade. The population of the County is distributed among nine towns and six villages. The southern portion of the County is the densest in population.

The U.S. Census Bureau states that Tioga County's 2016 population is 46,649 persons, which is a 2.8 percent decrease from the 2010 Census population of 51,125. Between 1950 and 1990, the County has seen a growth in population. In 2000 and 2010, the County experienced a decrease in population. The largest increase was seen between the years 1950 to 1960, when the County experienced a 20.2 percent (7,636 persons) population increase. The largest decrease was seen between the years 2010 and 2016, when the County experienced a 2.8 percent (-1,478 persons) population decrease (2016 American Community Survey).

4.6.3 Future Growth and Development

Development planned within Tioga County is provided in the table below. Municipalities not indicated have not identified any significant residential/commercial, or infrastructure development within the next 5 years. Locations of development are indicated on the Hazard Area Extent and Location Maps located in the Jurisdictional Annexes (Section 9) of this plan.

Table 4-5. New Development/Potential Development by Municipality

Municipality	Property Name	Type (Residential or Commercial)	Number of Structures	Address	Block and Lot	Known Flood Hazard Zone	Description/Status
Berkshire (T)	Dollar General	Commercial	1	Route 38	-	Could not locate.	In Progress
Berkshire (T)	Playground at town park/ballfield		-	Next to town hall	-	No	In Progress
Candor (T)	Double Aught Lumber	Comm.	2	-	94.00-1-19	1% Flood Event	Complete

Municipality	Property Name	Type (Residential or Commercial)	Number of Structures	Address	Block and Lot	Known Flood Hazard Zone	Description/Status
Candor (T)	Midwest, LLC, Dollar General	Commercial	1	-	94.00-1-25.38	1% Flood Event	Complete
Candor (T)	Catatonk Golf Club	Commercial	1	-	83.00-1-53.10	1% Flood Event	Complete
Candor (T)	Bostwicks Auctions	Commercial	1	-	94.00-1-25.24	No	In process
Candor (T)	Dollar General	Commercial	1	-	61.00-1-54.11	No	Planning Board approved
Newark Valley (V)	Ladder Factory	Commercial /limited	1	5 Clinton Street	-	No	425 x 125 feet structure
Nichols (T)	Army Corps Training	Gov't	3	Stanton Hill Rd	-	No	Complete
Nichols (T)	Fed-X	Commercial	2	Buck Road	-	No	Complete
Nichols (T)	Crown Cork	Commercial	1	Berry Road	-	No	Complete
Nichols (T)	Nichols DPW Garage	Local Gov't	2	175 Buck Road	-	No	In Process
Nichols (V)	Tioga Golf Club	Commercial	1	151 Roki Blvd	159.18-2-2	0.2% Flood Event	New one-story club house –near completion
Owego (T)	Taylor Garbage Transfer Station	Commercial	1	5730 State Route 434	145.05-1-2.31	No	Completed
Owego (T)	Wagner Lumber Fire Reconstruction	Commercial	3	4060 Gaskill Road	119.00-2-2	No	Completed
Owego (T)	Upstate Shredding Microfines Recycling Plant & Dry Media Plant	Commercial	2	1 Recycle Drive	106.00-3-22.17	No	Completed
Owego (V)	Owego Gardens	Residential	1 structure with 62 apartments	130A Southside Dr, 129.09-2-18.3	129.09-2-18.3	No	Completed
Owego (V)	Owego Gardens	Residential	8 structures with 91 units	Belva Lockwood Lane	TBD	No	Planning Phase
Owego (V)	New craft brewery,	Commercial	3 -4 structures	217 – 229 North Ave	TBD	No	Planning Phase

Source: Tioga County Municipalities 2018

Note: Known hazard zone based on exposure analysis conducted as part of the risk assessment only.

TBD = To be determined.

4.7 CRITICAL FACILITIES

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 and railroads, which 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.

A comprehensive inventory of critical facilities in Tioga County was developed from various sources including Tioga County IT and Communication Services 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. The number and type of critical facilities and infrastructure identified for this plan are indicated in Figure 4-15 and summarized in Table 4-6. A complete listing of the inventory used for analysis in this plan is provided in Appendix F.

Figure 4-15. Planning Area Critical Facilities

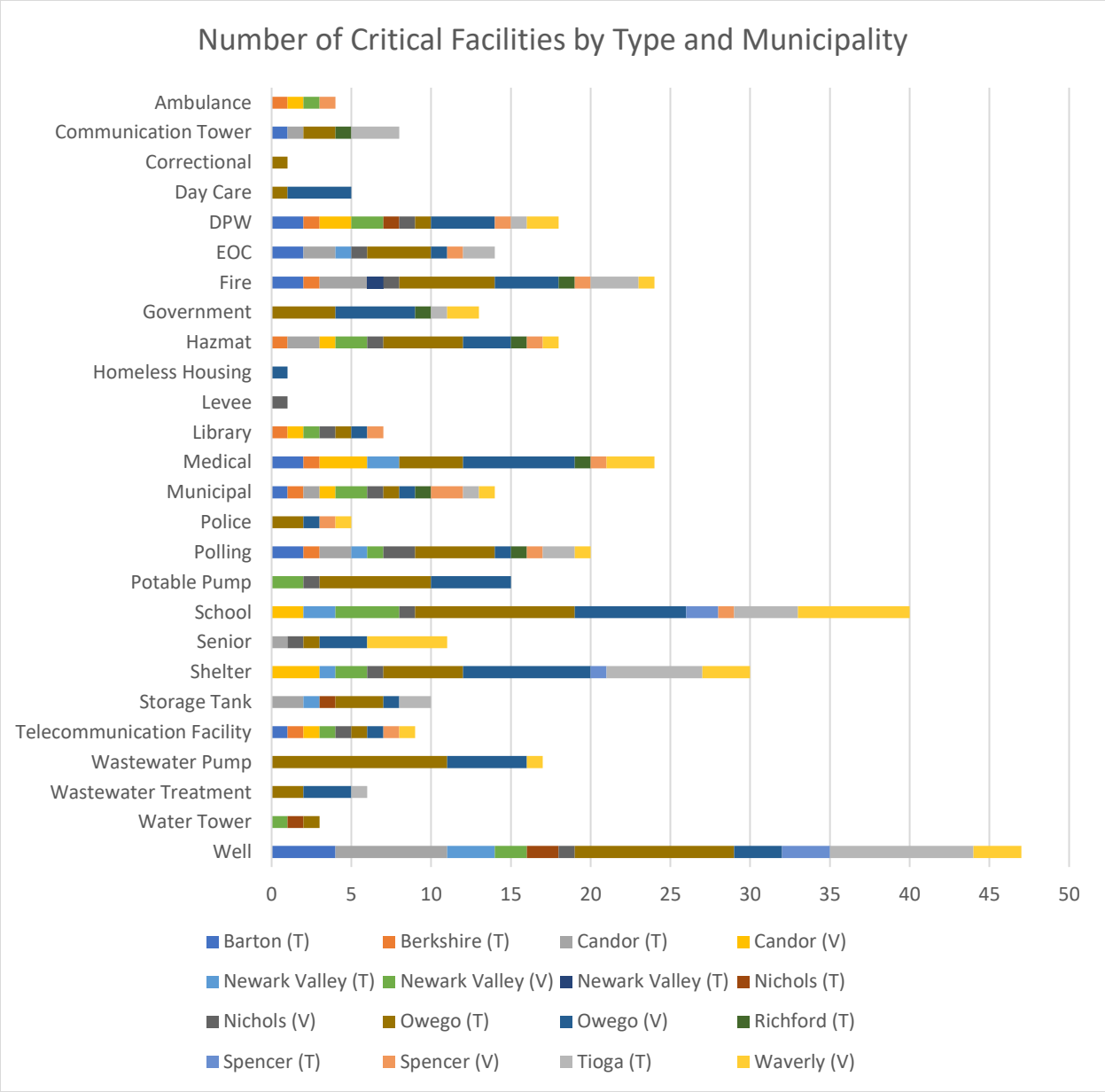


Table 4-6. Number of Critical Facilities in Each Municipality

Municipality	Facility Type																										
	Ambulance	Communication Tower	Correctional	Day Care	DPW	EOC	Fire	Government	Hazmat	Homeless Housing	Levee	Library	Medical	Municipal	Police	Polling	Potable Pump	School	Senior	Shelter	Storage Tank	Telecommunication Facility	Water Tower	Well	Wastewater Pump	Wastewater Treatment
Barton (T)	0	1	0	0	2	2	2	0	0	0	0	0	2	1	0	2	0	0	0	0	0	1	0	4	0	0
Berkshire (T)	1	0	0	0	1	0	1	0	1	0	0	1	1	1	0	1	0	0	0	0	0	1	0	0	0	0
Candor (T)	0	1	0	0	0	2	3	0	2	0	0	0	0	1	0	2	0	0	1	0	2	0	0	7	0	0
Candor (V)	1	0	0	0	2	0	0	0	1	0	0	1	3	1	0	0	0	2	0	3	0	1	0	0	0	0
Newark Valley (T)	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	1	0	2	0	1	1	0	0	3	0	0
Newark Valley (V)	1	0	0	0	2	0	0	0	2	0	0	1	0	2	0	1	2	4	0	2	0	1	1	2	0	0
Newark Valley (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
Nichols (T)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	0
Nichols (V)	0	0	0	0	1	1	1	0	1	0	1	1	0	1	0	2	1	1	1	1	0	1	0	1	0	0
Owego (T)	0	2	1	1	1	4	6	4	5	0	0	1	4	1	2	5	7	10	1	5	3	1	1	10	11	2
Owego (V)	0	0	0	4	4	1	4	5	3	1	0	1	7	1	1	1	5	7	3	8	1	1	0	3	5	3
Richford (T)	0	1	0	0	0	0	1	1	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
Spencer (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	3	0	0
Spencer (V)	1	0	0	0	1	1	1	0	1	0	0	1	1	2	1	1	0	1	0	0	0	1	0	0	0	0
Tioga (T)	0	3	0	0	1	2	3	1	0	0	0	0	0	1	0	2	0	4	0	6	2	0	0	9	0	1
Waverly (V)	0	0	0	0	2	0	1	2	1	0	0	0	3	1	1	1	0	7	5	3	0	1	0	3	1	0
Tioga County	**4**	**8**	**1**	**5**	**18**	**14**	**24**	**13**	**18**	**1**	**1**	**7**	**24**	**14**	**5**	**20**	**15**	**40**	**11**	**30**	**10**	**9**	**3**	**47**	**17**	**6**

4.7.1 Essential Facilities

This section provides information on emergency facilities, hospital and medical facilities, schools, shelters and senior care and living facilities. For the purposes of this plan, emergency facilities include police, fire, emergency medical services (EMS), and emergency operations centers (EOC). Figure 4-16 shows the location of the facilities and a list of the critical facilities is provided in Appendix F (Critical Facilities).

Emergency Facilities

The Tioga County Office of Emergency Services is responsible for coordinating the County's emergency services and emergency planning. The Office of Emergency Services works with County departments and other agencies during an emergency to help protect lives and property, assist those injured, and to provide the rapid restoration of normal services. The Office also provides support to the 15 volunteer fire departments and 15 emergency squad/fire responder units in the form of:

- EMS training
- Fire training
- Central county radio communications
- Fire investigation
- Search and rescue assistance
- Critical stress debriefing assistance
- Mutual aid coordination assistance with adjacent counties

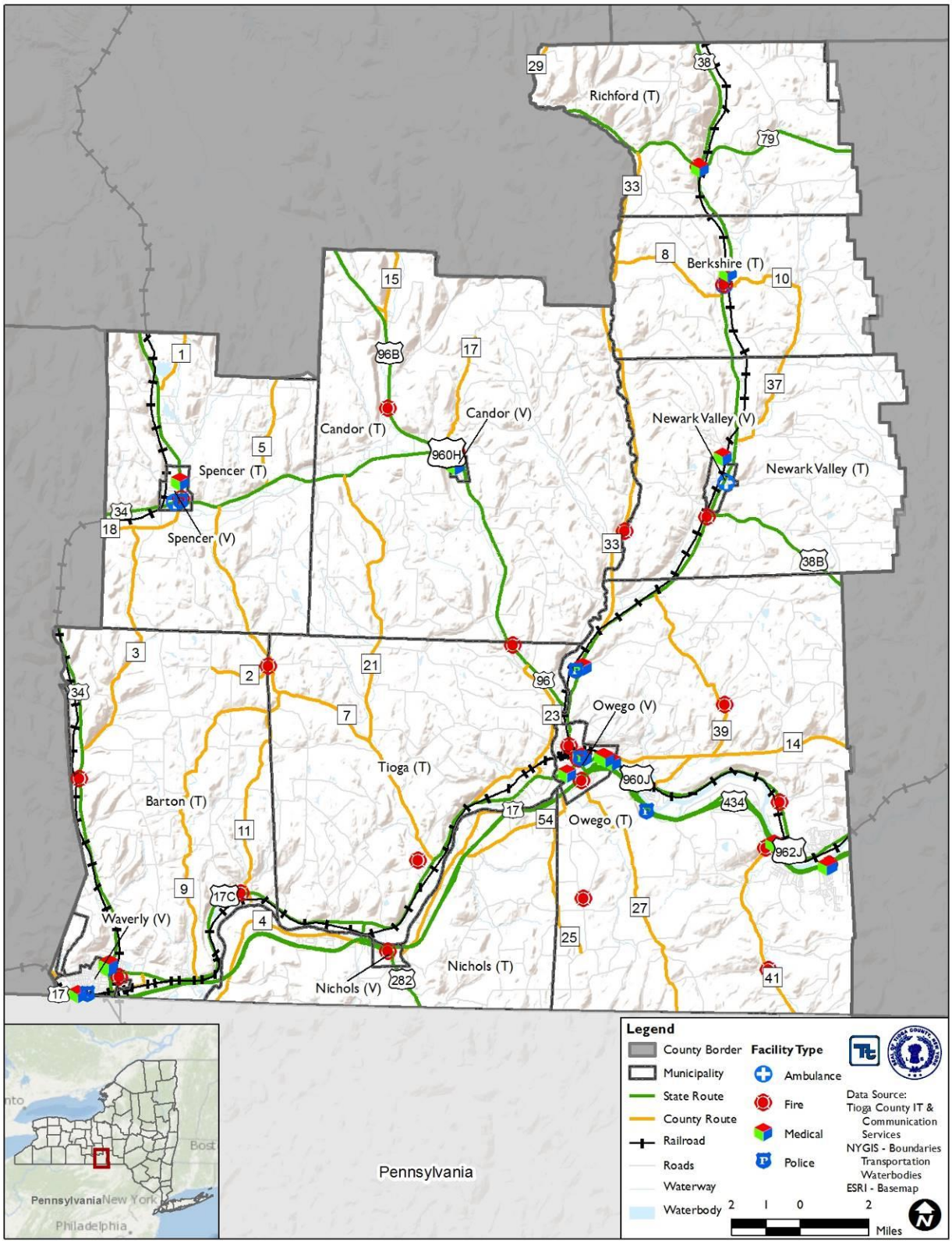
The County's E911 center is separate from the Office of Emergency Services and is the central hub for all emergency services in the County. The center is responsible for dispatching all law enforcement units, including Sheriff Patrols, State Police, Environmental Conservation Police, Owego Police, and the Waverly Police, the emergency squads/fire responder units, and the fire departments. They also dispatch the County Fire Investigation Team, County Hazmat Team, County Search and Rescue, and the Medi-Vac Helicopter. The center also performs as an after-hours link to Tioga County Mental Health, Public Health, Social Services, Municipal Highway Departments, and Animal Control.

The Tioga County Sheriff's Office, located in the Town of Owego, is the primary law enforcement agency in the County, and consists of several main operating divisions, including Road Patrol, Criminal Investigations, Corrections, and the E911 Emergency Communications Center. A few municipalities have their own police departments, including the Villages of Owego and Waverly. The New York State Police also control provide services within the County.

Hospitals and Medical Facilities

There are no hospitals located within Tioga County; however, there are several hospitals in surrounding Counties where residents can receive medical care. These include: Lourdes Hospital and Wilson Regional Medical Center in Broome County, Arnot Ogden Medical Center and St. Joseph's Hospital in Chemung County, Cortland Regional Medical Center in Cortland County, Schuyler Hospital in Schuyler County, Cayuga Medical Center at Ithaca in Tompkins County, and Robert Packer Hospital in Bradford County, PA.

Figure 4-16. Critical Facilities in Tioga County

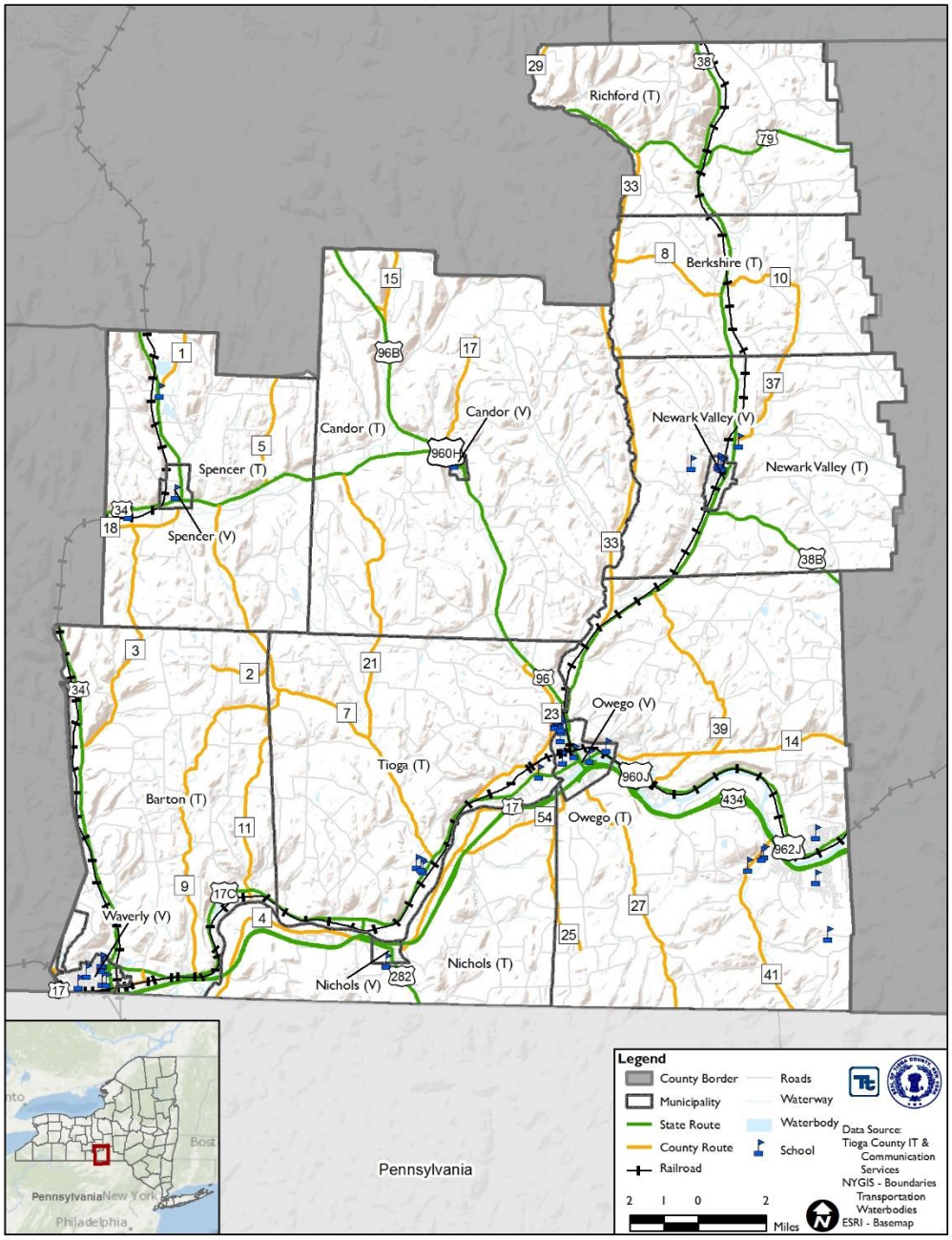


Source: Tioga County IT and Communication Services 2018

Schools

Tioga County is home to six school districts, four are kindergarten through 12th grade, and two are pre-kindergarten through 12th grade. Additionally, the Broome-Tioga Board of Cooperative Education Services provides support and educational opportunities to students in school districts of both Counties. In times of need, schools can function as shelters and are an important resource to the community. Figure 4-17 shows the location of schools within the County. For information regarding shelters, see the Shelters subsection below.

Figure 4-17. Schools within Tioga County



Source: Tioga County IT and Communication Services 2018

Senior Care and Living Facilities

Tioga County has 11 senior care facilities. The 2012-2016 American Community Survey 5-Year Estimates identified 8,900 people over the age of 65 living within Tioga County. Tioga Opportunities, Inc. – Aging Services provide aid to the elderly to help increase their self-sufficiency, safety, and well-being. They provide in-home services, including in-home care, emergency response buttons, and respite care, nutritional services, including congregate dining and home delivered meals, information and insurance counseling, and a senior employment program. Figure 4-18 indicates the location of senior care and living facilities.

Shelters

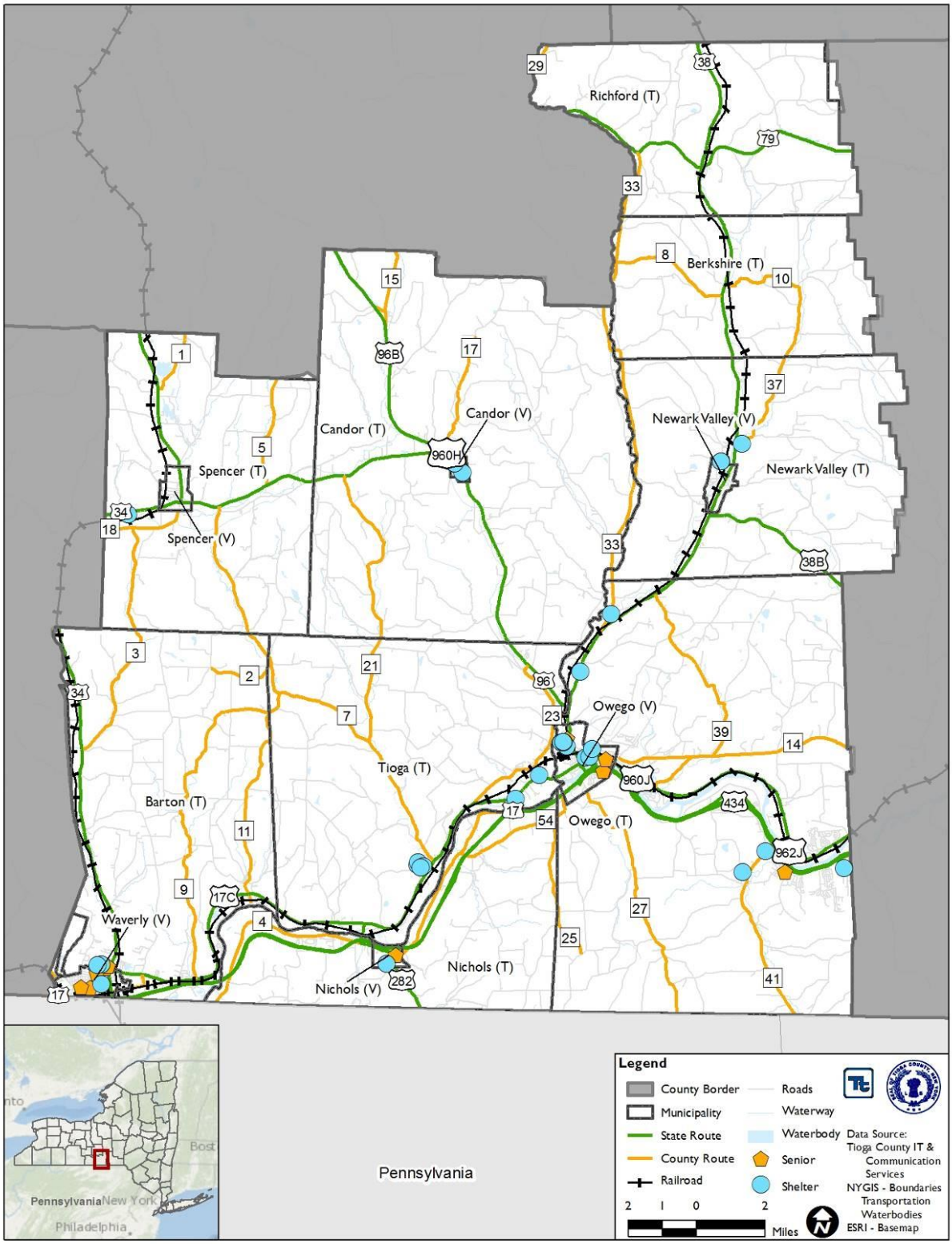
Due to the variable nature of hazard events and associated sheltering needs within the County, Tioga County relies on real-time outreach methods to inform the public of pending and active evacuations, and available sheltering resources. Outreach methods includes variable message sign boards, media (radio, television, and newspapers), and social media.

As supported by the Tioga County Department of Public Health, the County works directly with the American Red Cross and local jurisdictions (municipal fire departments and EMS) to establish and maintain an inventory of suitable shelter locations and can assist with the coordination and communication of shelter availability by the execution of the Tioga County Comprehensive Emergency Management Plan (CEMP).

Depending on the type of event and sheltering needs will determine where the shelters will be located and what facilities will be used. County-wide sheltering policies and procedures are documented in the Tioga County CEMP (refer to ESF #6 of the 2013 CEMP). The Tioga County Department of Emergency Services encourages residents to register on Hyper-Reach which sends emergency notifications directly to the cell phones and emails of those who registered. The County Public Health department sponsors the Medical Reserve Corps (MRC) that is made up of volunteers and medical professionals.

To prevent misinformation during a disaster event, a listing of shelters is not provided in this plan. Figure 4-18 displays the shelters throughout the County. Please refer to each municipality's capability assessment (Section 9 – Jurisdictional Annexes) for further information on evacuation, sheltering, and temporary housing provisions within Tioga County.

Figure 4-18. Senior Facilities and Shelters in Tioga County



Source: Tioga County IT and Communications Services 2018

4.7.2 Transportation Systems

Tioga County's transportation network offers residents and employees various options for transportation throughout the County and the region. There are no US or Interstate routes located in the County. Transportation throughout the County runs along nearly 30 County Routes and over 10 State Routes. State Routes include 34, 38, 79, 86, 96, 220, 282, 434, 17C, 38B, 96B, and W Main Street.

Bus and Other Transit Facilities

Residents of Tioga County have a few options of using public transportation. The C TRAN provides services to Chemung and Tioga Counties between Elmira and Owego, and Coach USA/Shortline has bus stops within Owego and Waverly and provides transit to locations outside the County.

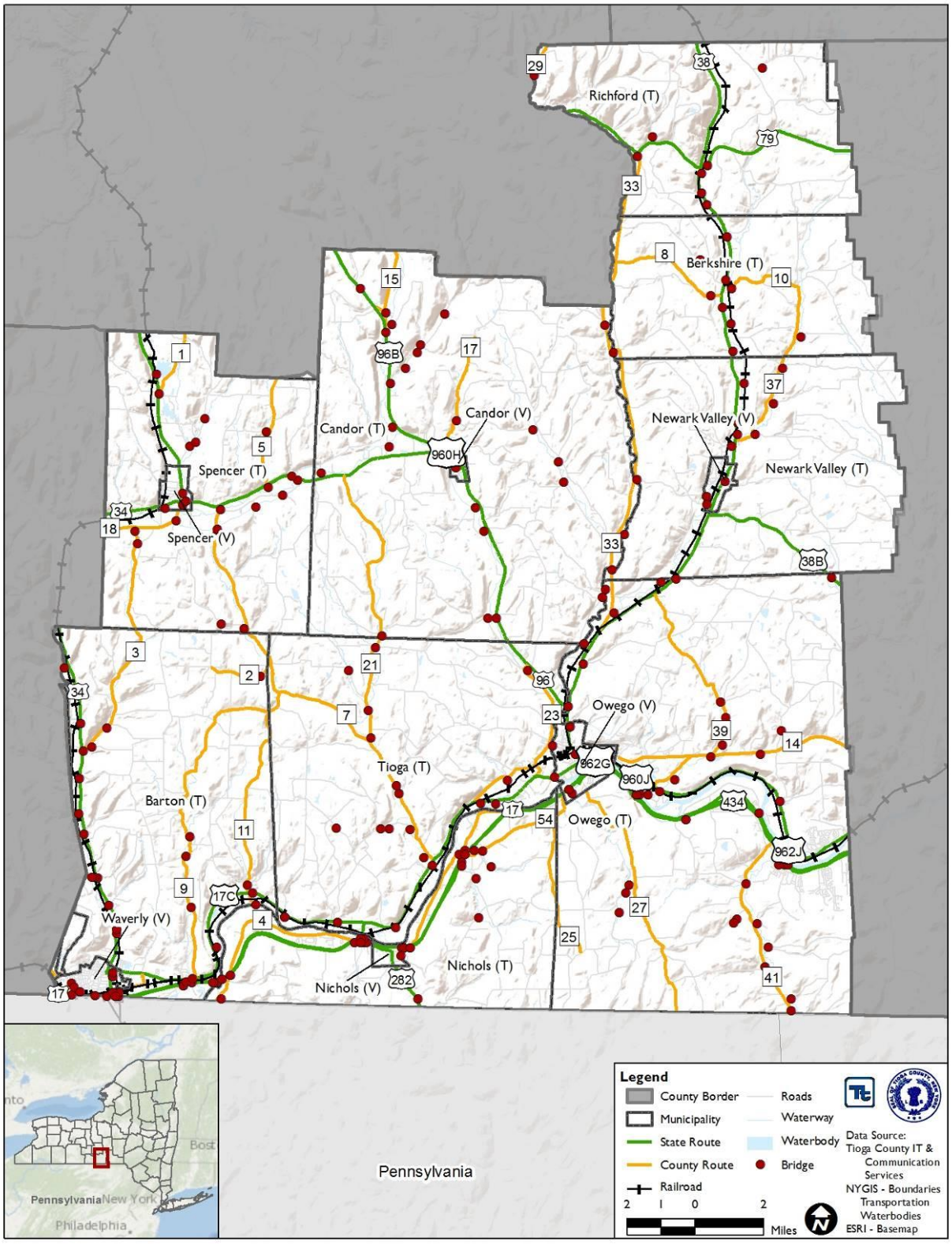
There are multiple specialized transportation services in the County. These include the Community Care Network of Nichols, Senior Information and Referral Service, Northern Tioga Neighbors Network, and Tioga Opportunities, Inc. and RSVP all provide transportation services to the elderly and special needs populations throughout Tioga County. Empire Transport, Endicott-Union Inc., Greater Valley EMS/W/C, and HTM MedTrans provide on demand ParaTransit and Medivan services to residents of Tioga County.

Individual transportation options for residents also include several taxi agencies and ride sharing programs, including Ride Share – NYS11, Southern Tier Ride Share, Finger Lakes Ride Share, Uber, and Lyft.

Railroad Facilities

Rail systems in Tioga County are limited to freight traffic. Freight lines run along the north to south from the Town of Richford to the Village of Owego and from Town of Spencer to the Village of Owego. Rail lines also run east to west from the Village of Owego and into Broome and Chemung Counties. Rail lines are primarily owned and operated by Norfolk Southern Railway, but Tioga Industrial Development Agency owns and operates a line that runs from the Village of Owego northward into Cortland County. Figure 4-19 displays the location of transportation features in the County.

Figure 4-19. Transportation Features in Tioga County



Source: Tioga County IT and Communication Services 2018

4.7.3 Lifeline Utility Systems

This section presents data and information on potable water, wastewater, energy resources, and communication utility systems. Due to heightened security concerns, local utility lifeline data, needed to complete the analysis, have only partially been obtained. Figure 4-20 through Figure 4-22 show the locations of the facilities for these various lifeline utility systems.

Potable Water

In Tioga County, there are water service areas located throughout the Villages of Candor, Newark Valley, Nichols, Owego, and Waverly and in additional locations within the Towns of Barton, Candor, Newark Valley, Nichols, Owego, and Tioga. Additional communities rely on public or private wells for water supply. Figure 4-20 identifies the areas served by public supply and wells in Tioga County. Many of the rural areas are dependent on private wells.

Wastewater Facilities

The Tioga County has individual sewer systems providing service throughout the Villages Owego and Waverly, and locations in the Towns of Nichols and Owego. Local systems are operated, maintained, and funded by local municipalities. There are six wastewater treatment plants located in the County. Sewer service is dependent on the size of the treatment plant, age of the infrastructure, and quantity being produced compared to the discharge point. Figure 4-21 identifies sewer service areas and wastewater facilities in Tioga County.

Energy Resources

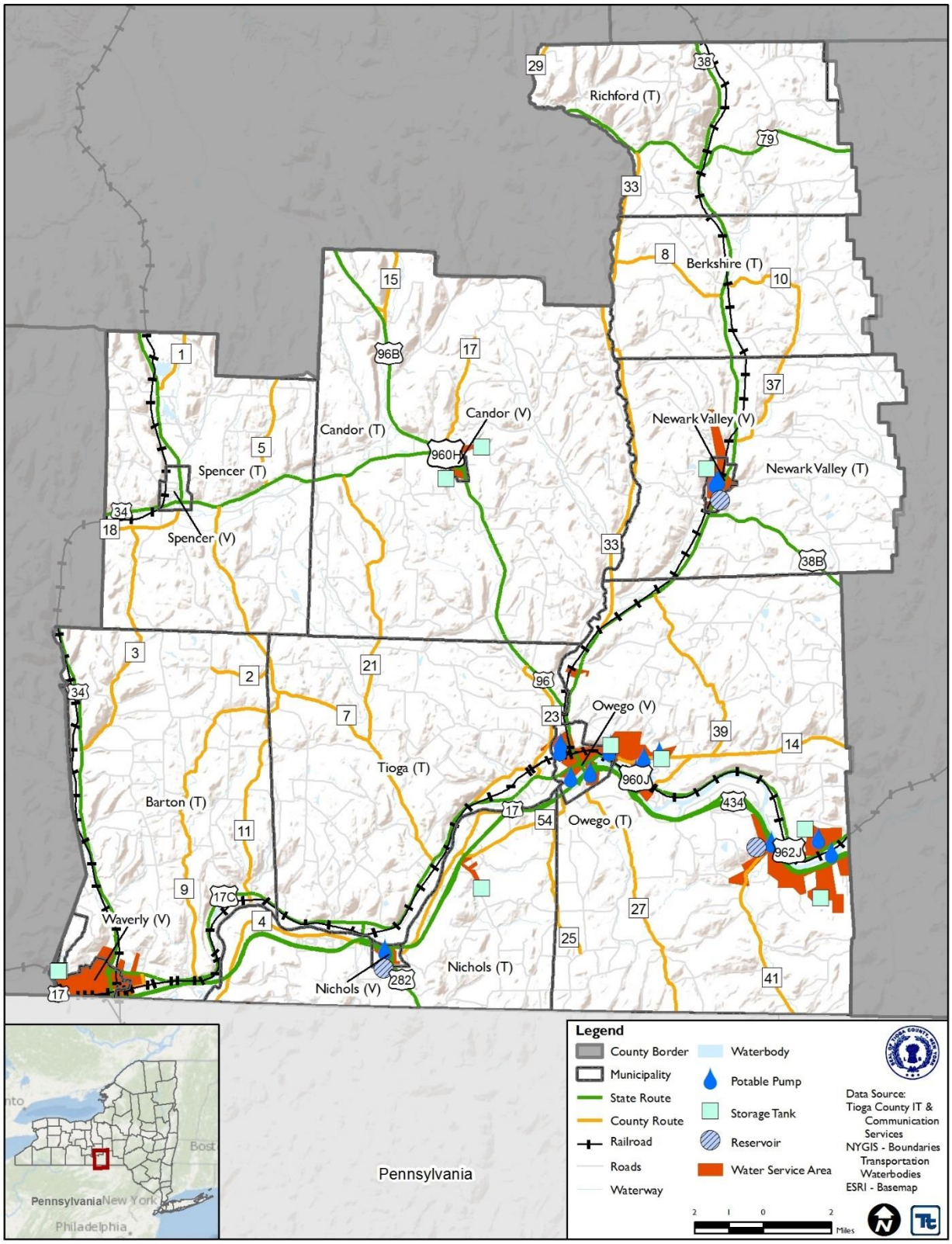
Gas and electric power in Tioga County are transmitted and distributed primarily by New York State Electric & Gas.

Communications

Tioga County is served by a variety of communications systems, including traditional land line, fiber optic, and cellular service provided by multiple companies, such as Verizon and Frontier. In addition to land line, fiber optic and cellular communications systems, Tioga County has an extensive radio communications network that is utilized by emergency services agencies, hospitals, law enforcement, public works, transportation, and other supporting organizations.

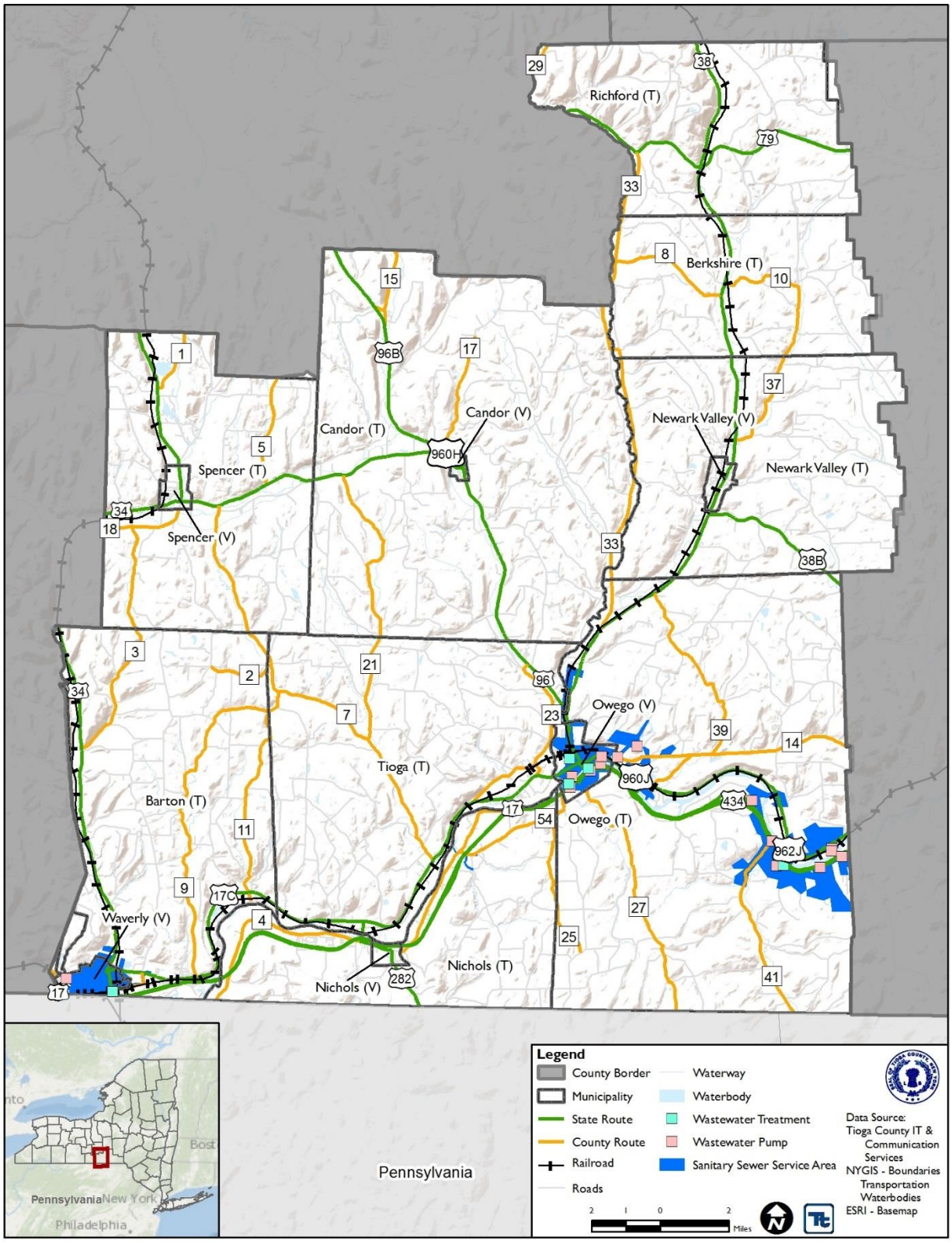
The Southern Tier Network is a not-for-profit, pen access optical fiber network that was created in January 2011 through a partnership of Southern Tier Central Regional Planning and Development, Corning Incorporated, and Broome, Chemung, Tioga, Schuyler, Steuben, and Yates Counties. The network was built to support the needs of public safety, improve broadband access in the rural areas, increase competition and the level of telecommunications services throughout the region, and create a globally competitive advantage for job creation in the Southern Tier Central region (Southern Tier Network 2018).

Figure 4-20. Potable Water Facilities in Tioga County



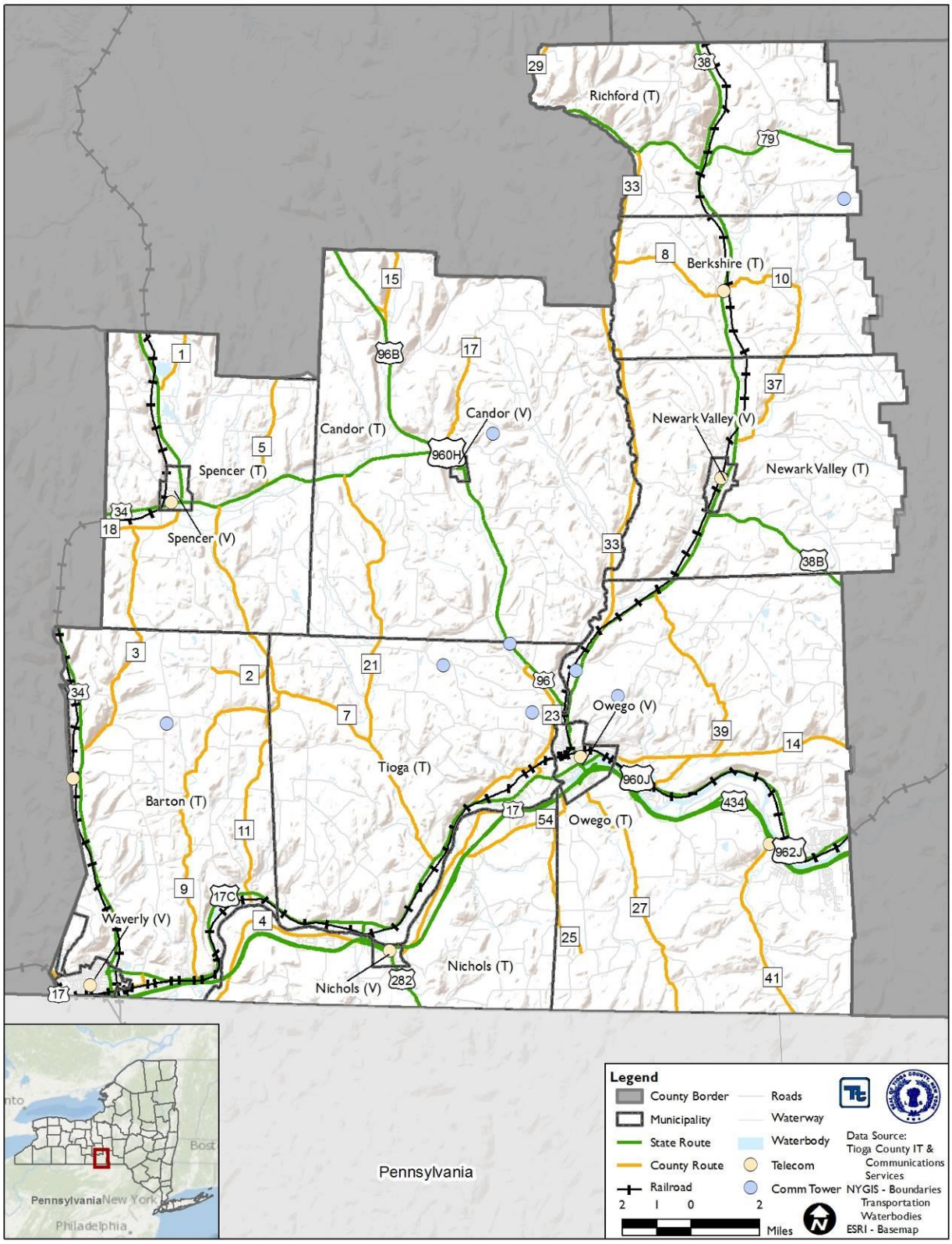
Source: Tioga County IT and Communication Services 2018

Figure 4-21. Wastewater Facilities in Tioga County



Source: Tioga County IT and Communication Services 2018

Figure 4-22. Communication Facilities within Tioga County



Source: Tioga County IT and Communication Services 2018

4.7.4 High-Potential Loss Facilities

High-potential loss facilities include dams, levees, hazardous materials (HAZMAT) facilities, nuclear power plants, and military installations. Dams and levees are discussed below.

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 and/or the environment. These sites are placed on the National Priorities List (NPL). The NPL is 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 the EPA in determining which sites warrant further investigation.

Abandoned hazardous waste sites placed on the federal NPL include those that the 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, Tioga County are no hazardous sites in the federal Superfund Program that are listed as on the NPL (CERCLIS 2018).

Superfund sites are contaminated locations, requiring a long-term response to clean up hazardous materials; NPL sites are included. The EPA Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) (Superfund) Public Access Database (CPAD) reports that there are currently no archived Superfund sites located in Tioga 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.

In addition to the hazardous waste sites, there are numerous hazardous facilities in Tioga County cataloged by the NYSDEC's Bulk Storage Program Database. The Bulk Storage Program includes three types of facilities; Petroleum Bulk Storage (PBS), Major Oil Storage Facilities (MOSF), and Chemical Bulk Storage (CBS). Registration with NYSDEC is mandatory for all PBS facilities with a total storage capacity of 1,100 gallons or more; all CBS underground tanks and all stationary aboveground tanks with a capacity of 185 gallons or more; and all MOSF sites storing more than 400,000 gallons of petroleum products. As of October 2018, 240 sites are listed in the NYSDEC's Bulk Storage Program Database in Tioga County, New York (New York State Department of Environmental Conservation [NYSDEC] 2018).

Dams and Levees

Dams

For the purposes of this hazard mitigation plan, dams are not considered critical facilities as the planning committee recognizes that these facilities are covered by other regulatory instruments. However, 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 may damage isolated homes, main highways, and minor railroads; interrupt the use of relatively important public utilities; and will 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 are often located in predominantly rural or agricultural areas but may also 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 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.

The New York State Inventory of Dams, identifies 156 dams in Tioga County: 50 low hazard, 3 intermediate hazard, 5 high hazard, and 18 negligible or no hazard classification and 50 have an unknown classification (NYS DEC 2018).

Levees

There are two levees within Toga County. The Nichols levee is maintained by the Village of Nichols and New York State Department of Environmental Conservation (NYSDEC). The Nichols system consists of approximately 1.85 miles of levee embankment extending from Main St. (Rt. 282) to Rt. 17 along the Wappasening Creek, along the left bank of the Susquehanna River (Rt. 17), and a tie out levee which runs south from the Susquehanna River for approximately 1,900 ft. and four drainage structures. A flood in the area behind the levee could impact nearly 400 people, 217 commercial and residential structures (5 critical structures) and cause an estimated $32 million of possible flood-related damages. The Nichols project has prevented an estimated $42 million in damages since its construction. A high-water event occurred in fall of 2017, which caused erosion and sediment deposition (shoaling). The Village of Nichols, NY, is located along the Susquehanna River and Wappasening Creek, in Tioga County. (USACOE, 2018)

Figure 4-23. Nichols Levee

Source: US Army Corps of Engineers, 2018

The Owego Creek levee system is unaccredited and located on the Owego Creek in the Village and Town of Owego; the left bank is located in the Village and is approximately 0.41 miles long, and the east bank is located in the Town of Owego and is approximately 0.23 miles long. The number of people at risk of a levee failure incident on the west bank is approximately 67 people with 20 structures worth approximately $6.3 million. The area behind the right bank does not include any populations or structures. Both levees are owned and maintained by the Village and Town of Owego (USACOE, 2018).

Figure 4-24. Owego Creek Levee System

Source: US Army Corps of Engineers, 2018

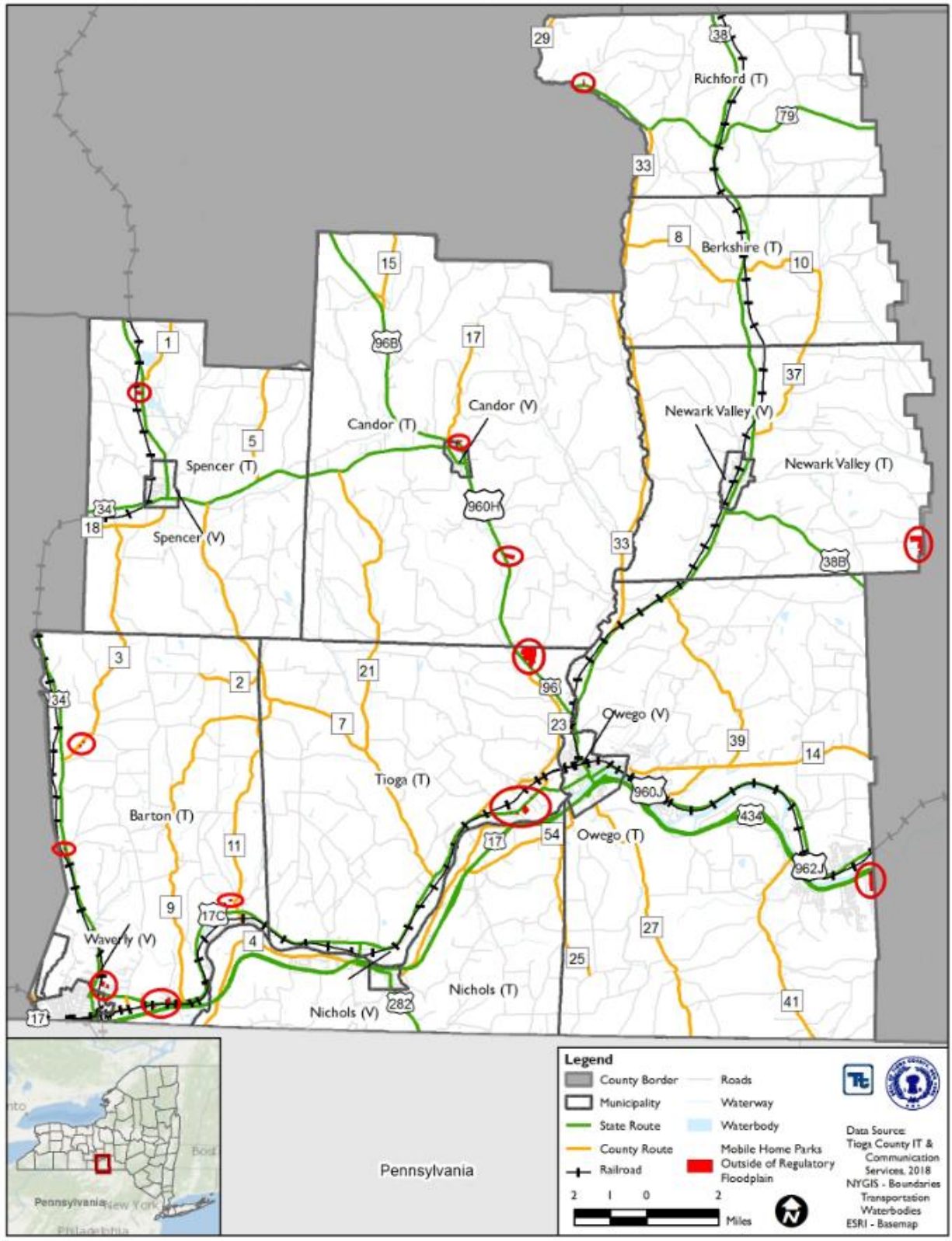
4.7.5 Housing and Relocation

Tioga 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. The County Department of Social Services provides financial and social services to eligible County residents through program development, application of the law, and encouragement of responsibility. They provide numerous programs and services to county residents, including: adult and adolescent services unit, assistance programs, child protective services and preventive services unit, child support enforcement, employment services, foster care, and adoption & home finding. Tioga Opportunities, Inc. is a private, non-profit human service agency that serves all of Tioga County. They own and manage residential apartments made available to income-eligible older residents, disabled individuals, and families.

Temporary Housing

With regard to natural hazard events, the Tioga County Department of Public Safety identified potential locations to be used as temporary housing for residents displaced by a disaster. The County identified the mobile home parks located outside the regulatory floodplain as a potential location for temporary housing, which can be utilized by all municipalities. These sites are illustrated in Figure 4-25 below. It is noted that while a community may identify suitable sites, the use (including transfer of ownership) of suitable private property would be at the discretion of the property owner.

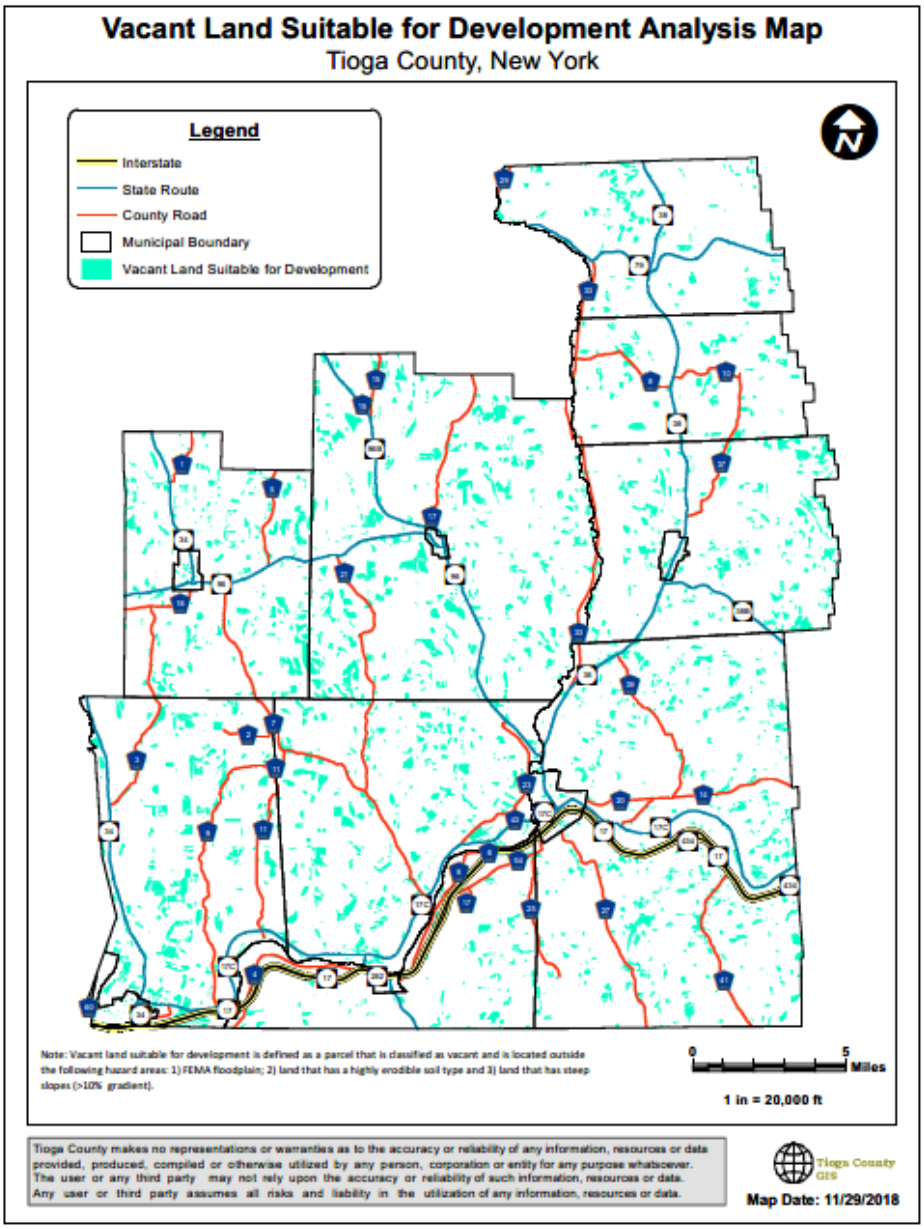
Figure 4-25. Potential Temporary Housing Locations in Tioga County



Long-Term Housing

In order to support the identification of potential sites suitable for relocating houses out of hazard areas including the floodplain and/or building new homes once properties in hazard areas or the floodplain are acquired, the County performed a buildable parcel analysis to identify 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 for which vacant land is defined as a parcel that is classified as vacant and is located outside the following hazard areas: 1) FEMA floodplain; 2) land that has a highly erodible soil type and 3) land that has steep slopes (>10% gradient) without consideration of ownership or availability.

Figure 4-26. Potential Long-Term Housing Locations in Tioga County



Evacuation Routes

As stated in the 2013 CEMP, New York State law provides broadly stated authority that permits fire and law enforcement officers to take actions necessary to protect public safety. This authority is often applied when immediate action is necessary to evacuate citizens from a hazardous or potentially unsafe area. In situations where an evacuation is of significant scope and magnitude, it is then best to carry out the evacuation using an emergency order by the chief executive (Tioga County Legislature Chairman). Evacuations that involve larger numbers of people who are evacuated for extended periods and require extensive support from multiple services are better managed and coordinated under an emergency order by the chief executive.

The primary roads and highways are the evacuation routes for Tioga County. The route used depends on the location of the incident. The geography of the County is not conducive to having established evacuation routes. Figure 4-27 illustrates the major roadways in Tioga County that would be utilized as evacuation routes in and out of the County in the event of an emergency that results in an evacuation.

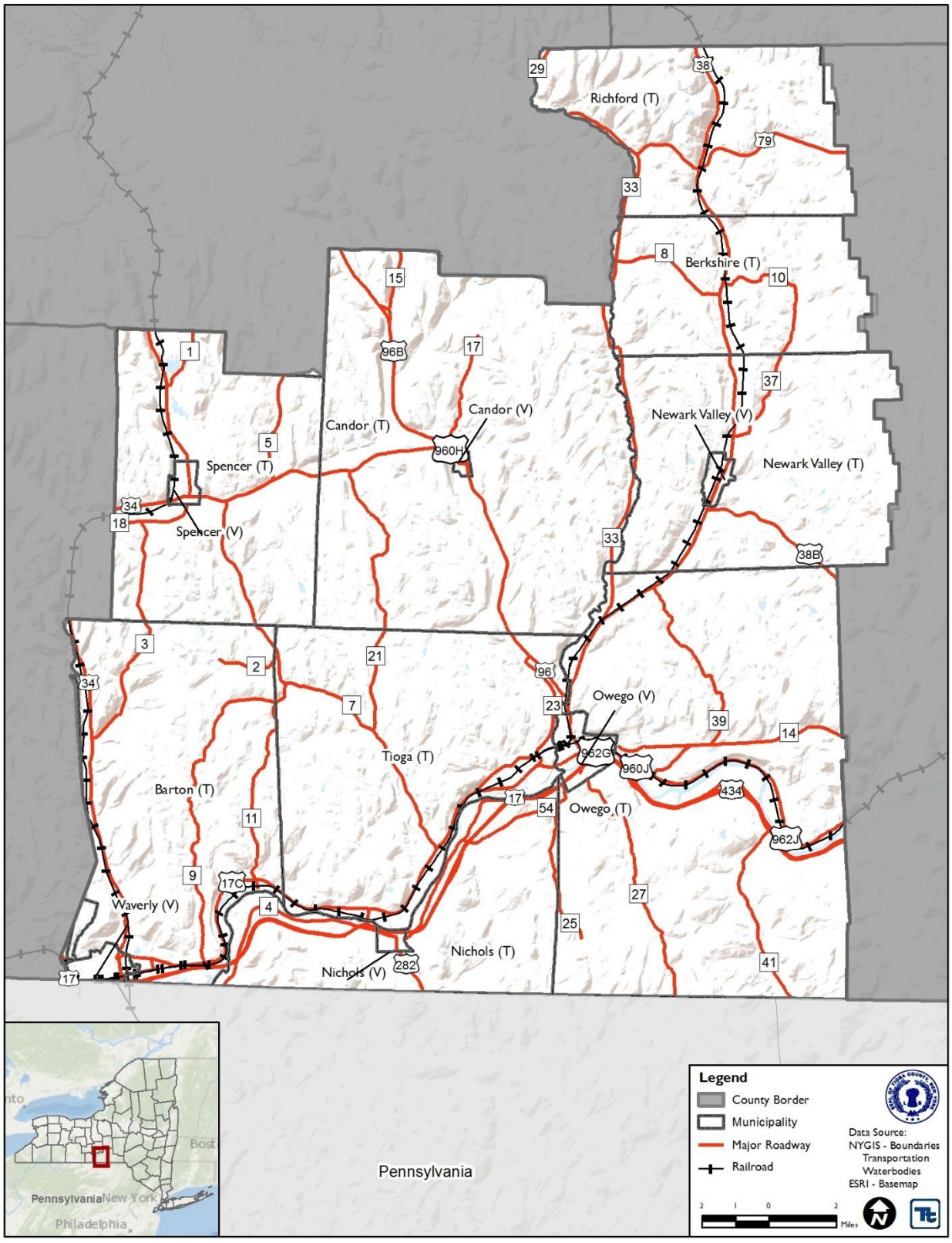
Other than evacuation plans based on the geographically-specific risks, evacuations are conducted on an event-specific basis. Due to the variable nature of such events, Tioga County Department of Emergency Services, working with local municipalities, assists with the coordination and communication of evacuation routing for the County. The County relies on real-time outreach methods, such as variable message sign boards, media (radio, newspaper, and television), and social media, to inform the public of pending and active evacuations.

The County Office of Emergency Services provides management of the dissemination of road closures to assist in the communication of accessible routes within the County. Information is gathered from the 911 center and local police as well as the County road department staff. In addition, information is collected from the County Sherriff and State Police who physically check road conditions and provide a list of road closures and road wash-outs. Periodically the Office of Emergency Services provides a list of road closures to the media.

The "News & Announcements" section of the County's Emergency Services website (https://www.tiogacountyny.com/departments/emergency-services/#) provides specific information and resources to inform residents of road closures and other special messages. Further, the webpage provides information on the Hyper-Reach service that provides emergency communications.

Additionally, the County GIS department has developed a smartphone app to provide real-time road closure information and is ready to beta-test this tool pending available funding.

Figure 4-27 Evacuation Routes in Tioga County



5.1 METHODOLOGY AND TOOLS

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

- **Hazard identification**—Use all available information to determine what types of hazards may affect a jurisdiction
- **Profile each hazard** – Understand each hazard in terms of:
  - Location - geographic area most affected by the hazard
  - Extent – severity of each hazard
  - Previous Occurrences and Losses
  - Probability of Future Occurrence
  - Climate Change Impacts
- **Assess Vulnerability –**
  - Exposure identification—Estimate the total number of assets in the jurisdiction that are likely to experience a hazard event if it occurs by overlaying hazard maps with the asset inventories.
  - Vulnerability identification and loss estimation—Assess the impact of hazard events on the people, property, economy and lands of the region, including estimates of the cost of potential damage or cost that can be avoided by mitigation.

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

5.1.1 Asset Inventories

Tioga County assets were identified to assess potential exposure and loss associated with the hazards of concern. For the HMP update, Tioga County assessed vulnerability of the following types of assets: population, buildings and critical facilities/infrastructure and the economy. 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.

As noted below, U.S. Census Block data has been used to provide planning level analysis. U.S. Census blocks do not follow the boundaries of the floodplain, possibly leading to gross overestimates or underestimates of exposed populations or assets from use of centroids or intersects of Census blocks with these zones. Limitations of these analyses are recognized, and thus the results are used only to provide a general estimate.

Population

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. For the purposes of this planning process, vulnerable populations in Tioga County include the elderly and low-income populations.

The 2010 U.S. Census block data layers were used to estimate exposure and potential impacts to the general population. The 2010 U.S. Census demographic data available in FEMA's Hazus model was used to estimate potential impacts to the elderly (over 65 years of age) and populations with income below the poverty threshold.

Buildings

The default general building stock data in HAZUS-MH v4.0, based on the 2010 U.S. Census and RS Means 2014 valuations, was used for the HAZUS-MH analysis and hazard exposure analysis at the municipal level.

The occupancy classes available in HAZUS-MH v4.0 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.

As per U.S. Census blocks, HAZUS-MH v4.0 Census blocks do not follow the boundaries of the floodplain, possibly leading to gross overestimates or underestimates of exposed building stock from use of centroids or intersects of Census blocks with these zones. Limitations of these analyses are recognized, and thus the results are used only to provide a general estimate.

Critical Facilities

The critical facility inventory, which includes essential facilities, utilities, transportation features and user-defined facilities as outlined in Section 4, was updated beginning with all GIS data provided by the Tioga County Information Technology and Communications Services Department and then reviewed by the Planning Committee allowing for municipal input. To protect individual privacy and the security of assets, information is presented in aggregate, without details about specific individual properties or facilities.

New Development

In addition to summarizing the current vulnerability, Tioga 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, Tioga 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.

1. **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.

2. **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 may be affected by the hazard. If the center of each asset is located in the hazard area, it is deemed exposed and potentially vulnerable to the hazard.

3. **Loss estimation** — The FEMA HAZUS modeling software was used to estimate potential losses for the Flood and Severe Storm hazards. 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	Data Analyzed			
	Population	General Building Stock	Critical Facilities	New Development
Flood	E, H	E, H	E, H	E
Severe Storm	H	H	H	Q

Hazard	Data Analyzed			
	Population	General Building Stock	Critical Facilities	New Development
Severe Winter Storm	Q	Q	Q	Q
Drought	Q	Q	Q	Q

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, probabilistic analyses were performed to develop expected/estimated distribution of losses (mean return period losses) for the flood, wind and seismic hazards. The probabilistic model generates estimated damages and losses for specified return periods (e.g., 100- and 500-year). For annualized losses, HAZUS-MH v4.0 calculates the maximum potential annual dollar loss resulting from various return periods averaged on a "per year" basis. It is the summation of all HAZUS-supplied return periods (e.g., 10, 50, 100, 200, 500) multiplied by the return period probability (as a weighted calculation). In summary, the estimated cost of a hazard each year is calculated.

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.

Drought

To assess the vulnerability of the County to drought and its associated impacts, a qualitative assessment was conducted. The United States Department of Agriculture Census of Agriculture 2012 was used to estimate economic impacts to the County. Information regarding the number of farms, land area in farms, total market value of products sold, etc. was extracted from the report and summarized in the vulnerability assessment. Additional resources from the Center for Disease Control and North Carolina State University were used to assess the potential impacts to the population from a drought event.

Flood

The 1- and 0.2-percent chance flood events were examined to evaluate Tioga 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. An exposure analysis was conducted for the 1- and 0.2-percent annual chance flood events only in the municipalities that have flood data available. The FEMA effective work map released in April 2012 for Tioga County was used to evaluate the County's exposure to this hazard. Assets (population, building stock, critical facilities, and new development) with their centroid in the hazard areas were totaled to estimate the numbers and values vulnerable to a flooding event.

A Level 2 HAZUS-MH riverine flood analysis was performed for only the 1-percent chance flood event.

The updated critical facility inventories were formatted to be compatible with HAZUS-MH v4.0 and its Comprehensive Data Management System (CDMS) and incorporated into HAZUS-MH v4.0, replacing the default essential facility (police, fire, schools, etc.) and utility inventories. Once these inventories were approved, HAZUS-MH v4.0 was updated with the final inventories and used for the risk assessment.

To estimate potential losses, the Hazards U.S. Multi-Hazard (HAZUS-MH) version v4.0 flood model was used. Since the last HMP, the FEMA DFIRM data has since become effective; the only change in the data being the classification of the 1-percemt annual chance floodplain in the Village of Nichols changing to 0.2-percent annual chance floodplain due to the certification of the levee system. For this plan, the depth grid generated during the 2013 HMP was updated to remove the 1-percent annual chance floodplain depths in the Village of Nichols. The depth grid was integrated into HAZUS-MH v4.0 and the model was run to estimate potential losses at the Census Block level using the Hazus-MH default building stock data.

HAZUS-MH v4.2 was used to estimate debris generated by the 1-percent annual chance flood event instead of HAZUS-MH v4.0. A FEMA-known error in v4.0 was detected, and the issue appears to have been resolved with the latest software release, which was released on January 29, 2018.

Severe Storm

A HAZUS-MH v4.0 probabilistic analysis was performed to analyze the wind hazard losses for Tioga County. The probabilistic hurricane hazard 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 Tioga County. HAZUS-MH v4.0 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. Annualized losses and the 100- and 500-year MRPs were examined for the wind/severe storm hazard. Default demographic and building stock and updated critical facility inventories in HAZUS-MH v4.0 were used for the analysis.

FEMA has acknowledged an issue with importing user-defined facilities in HAZUS-MH v4.0. Tioga County's user-defined facilities were appended to the Emergency Operation Centers input in HAZUS-MH Comprehensive Data Management System (CDMS) to estimate potential losses.

Severe Winter Storm

The entire general building stock inventory in Tioga 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 HAZUS-MH v4.0 default general building stock structural replacement cost value was utilized to estimate damages that could result from winter storm conditions. Using professional knowledge and the currently available information, the potential losses for this hazard are considered to be overestimated and therefore provide a conservative estimate for losses associated with winter storm events.

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	2010	Digital (GIS) format
Building stock data	HAZUS-MH v4.0	2017	Digital (GIS) format
Critical facilities	Tioga County Information Technology and Communications Services Department	2018	Digital (GIS) format
Digitized effective FIRM maps	FEMA	2012	Digital (GIS) format
Census of Agriculture	USDA	2012	Digital (PDF Report) format

Limitations

For this risk assessment, the 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

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, Tioga 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

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

To provide a strong foundation for mitigation actions considered in Sections 6 and 9, Tioga 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 2014); review of the 2013 Tioga County HMP; research and local, state, and federal information on the frequency, magnitude, and costs associated with the various hazards that have previously, or could feasibly, impact the region; and qualitative or anecdotal information regarding natural hazards and the perceived vulnerability of the study area's assets to them. Table 5.2-1 documents the process of identifying the natural hazards of concern for further profiling and evaluation.

5.2.1 Changes from 2013 Hazard Mitigation Plan

The 2013 Hazard Mitigation Plan identified earthquake as a hazard of concern. According to the FEMA document "Understanding Your Risks: Identifying Hazards and Estimating Losses", areas with 3%g should conduct a risk assessment for earthquakes. Tioga County has a PGA below 3%g. As Tioga County is below the threshold of 3%g, the County has not been included in any disaster declarations for earthquake, and none of the 189 earthquakes identified in the NYS HMP between 1973 and 2012 had an epicenter within the County, the Steering and Planning Committees decided to not include earthquake as a hazard of concern for Tioga County for the 2018 update.

5.2.2 Hazard Groupings

As per the 2013 Tioga County HMP the Planning and Steering Committees maintained the grouping of hazards, based on the similarity of hazard events, their typical concurrence or their 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; FEMA's "Multi-Hazard Identification and Risk Assessment – The Cornerstone of the National Mitigation Strategy"; FEMA's Local Mitigation Planning Handbook), and consideration of hazard grouping in the NYS HMP.

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 "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 the purpose of 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.

Technological (for example, hazardous material incidents) and man-made hazards (for example, terrorism) 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 the County and planning participants. The County may attempt to expand the scope of this HMP to include other less frequent natural

hazards and/or technological (hazardous material incidents) and man-made (terrorism, man-made dam breaches/failures) hazards as resources permit.

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

Hazard	Is this a hazard that may occur in Tioga County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
Avalanche	No	No	• Avalanches can occur in any situation where snow, slope and weather conditions combine to create proper conditions. About 90% of all avalanches start on slopes of 30 to 45 degrees and about 98% of all avalanches occur on slopes of 25 to 50 degrees. The topography of Tioga County does not support the occurrence of an avalanche. • New York State, in general, has a very low occurrence of avalanche events based on statistics provided by National Avalanche Center – American Avalanche Association (NAC-AAA) between 1998 and 2018. • Avalanche was identified as a hazard in the NYS HMP and there have been occurrences in the State; however, there have been no occurrences in Tioga County and the planning and steering committees do not consider the hazard to be a significant concern.	• NYS DHSES • NAC-AAA
Coastal Erosion	No	No	• The NYSHMP 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. Tioga County is not a coastal county and therefore, coastal erosion isn't considered a hazard of concern by the planning and steering committees.	• NYS DHSES • Input from Steering and Planning Committees
Dam Failure	Yes	Yes	• The 2014 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 Dam Incident Notification (DIN) system maintained by the National Performance of Dam Program (NPDP), there are 25 dams in Tioga County. Of the 25 dams, there are 13 classified as low hazard, 7 classified as significant hazard, and 4 are classified as high hazard. • Dam failure is included in the flood profile.	• NYS DHSES • Input from Steering and Planning Committees • NYSDEC • NYS GIS
Disease Outbreak	Yes	No	• The 2014 NYS HMP does not identify disease outbreak as a hazard of concern for New York State. • While the County has been impacted by various diseases (influenza, Lyme disease), the Steering and Planning Committees did not identify disease outbreak as a hazard of concern for Tioga County.	• NYS DHSES • NYS DEC • Input from Steering and Planning Committees

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

Hazard	Is this a hazard that may occur in Tioga County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
Drought	Yes	Yes	• The NYS HMP identifies drought as a hazard of concern for the State. Tioga County has been impacted by several drought events that have occurred in New York State. The NOAA-NCEI Storm Events Database identified 7 drought events between 1950 and 2016 in the County. • Drought conditions can cause shortages in water for human consumption, can impact agricultural production and can lead to reduced local firefighting capabilities. In the short-term, surface water supplies are affected more quickly during droughts than groundwater sources. • New York State has been included in one FEMA drought-related disaster declaration which did not include Tioga County. • Tioga County has been included in two recent drought-related USDA disaster declarations: o S3427 – Drought / Excessive Heat – 2012 o S3441 – Drought – 2012 o S4023 – Drought Fast Track– 2016 • According to the NRCC, Tioga County is located in the Eastern Plateau Climate Division. This division has been impacted by periods of severe and extreme drought including the following events: o September – November 1895 o November – December 1899 o August 1900 – February 1901 o November 1908 – January 1909 o August 1909 – January 1910 o July 1910 – September 1911 o August – September 1913 o October – December 1914 o April – June 1915 o November – December 1916 o September 1921 – February 1922 o November – December 1922 o May 1923 – January 1924 o August 1930 – June 1931 o November – December 1931 o May 1923 – January 1924 o August 1930 – June 1931 o November – December 1931 o August 1939 – February 1940	• NYS DHSES • FEMA • USDA • Input from Steering and Planning Committees • NOAA-NCEI • NRCC

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

Hazard	Is this a hazard that may occur in Tioga County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
			○ May – June 1941 ○ September 1941 – April 1942 ○ August 1964 – February 1966 ○ July – August 1966 ○ October – November 1966 ○ January – February 1967 ○ August – September 1995 ○ November 2001 – January 2002 • Based on previous occurrences and the existence of significant agricultural assets in the County, and input from the Steering and Planning Committees, drought is identified as a hazard of concern for Tioga County.	
Earthquake	Yes	No	• The NYS HMP identified earthquake as a hazard of concern for the State. • Tioga 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 has been included in one FEMA earthquake-related disaster declaration (DR-1145); Tioga County was not included in this declaration. • According to the NYS HMP, between 1973 and 2012, there have been 189 earthquakes epicentered in the State. Of those 189 events, none had an epicenter in Tioga County. • Based on previous occurrences and input from the Steering and Planning Committees, earthquake is not identified as a hazard of concern for Tioga County. Therefore it will not be further discussed in detail in this plan.	• NYS DHSES • Input from Steering and Planning Committees • USGS – Earthquake Hazards Program, Review of USGS Seismic Maps
Expansive Soils	Yes	No	• The NYS HMP identified expansive soils has a hazard of concern for New York State. However, a majority of Tioga County is underlain by soils with little to no swelling potential and less than 50% of the area is underlain by soils with abundant clays of slight to moderate swelling potential. • The Steering and Planning Committees did not identify expansive soils as a hazard of concern for Tioga County. Therefore it will not be further discussed in detail.	• NYS DHSES • Input from Steering and Planning Committees • Review of USGS 1989 Swelling Clays Map of the Conterminous United States

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

Hazard	Is this a hazard that may occur in Tioga County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
Extreme Temperature	Yes	No	• The NYS HMP identified extreme temperatures as a hazard of concern for New York State. • According to the NOAA-NCEI database, between 1950 and 2018, there have been 3 extreme temperature events in Tioga County. • Tioga County has not been included in any FEMA disaster declarations for extreme temperature-related events; however, the County has been included in two recent USDA disaster declarations: o S3249 – frosts and freezes- March 2012 o S3427 – heat – June 2012 o S3746 - freeze – February 2014 • The Steering and Planning Committees did not identify extreme temperature as a hazard of concern for Tioga County with the understanding that associated impacts with this hazard are addressed in the drought and severe winter weather hazard profiles in the plan. Therefore this hazard will not be considered a separate hazard of concern.	• NYS DHSES • Input from Steering and Planning Committees • NOAA-NCEI • USDA
Flood (riverine,, ice jam, dam failure and flash)	Yes	Yes	• The NYS HMP identified flooding as a hazard of concern for New York State. • Tioga County has been included in eighteen flood-related FEMA disaster declarations: o FEMA-DR-338 (Tropical Storm Agnes) – June 1972 o FEMA-DR-487 (Storms, Rains, Landslides & Flooding) – October 1975 o FEMA-DR-515 (Severe Storms and Flooding) – July 1976 o FEMA-EM-3107 (Severe Blizzard) – March 1993 o FEMA-DR-1095 (Severe Storms and Flooding) – January 1996 o FEMA-DR-1233 (Severe Storm and Flooding) – June & July 1998 o FEMA-DR-1335 (Severe Storms and Flooding) – May-August 2000 o FEMA-EM-3173 (Snowstorms) – December 2002-January 2003 o FEMA-DR-1534 (Severe Storms and Flooding) – May & June 2004 o FEMA-DR-1565 (Tropical Depression Ivan) – September 2004 o FEMA-DR-1589 (Severe Storms and Flooding) – April 2005 o FEMA-DR-1650 (Severe Storms and Flooding) – November 2006 o FEMA-DR-1670 (Severe Storms and Flooding) – November 2006 o FEMA-DR-1993 (Severe Storms, Flooding, Tornadoes, and Straight Line Winds) – April & May 2011 o FEMA-EM-3341 (Remnants of Tropical Storm Lee) – September 2011 o FEMA-DR-4031 (Remnants of Tropical Storm Lee) – September 2011 o FEMA-EM-3351 (Hurricane Sandy) – October & November 2012 o FEMA-DR-4322 (Severe Winter Storm and Snowstorm) – March 2017	• NYS DHSES • Input from Steering and Planning Committees • FEMA • NOAA-NCEI • USACE CRREL Ice Jam Database

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

Hazard	Is this a hazard that may occur in Tioga County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
			○ FEMA-DR-4397 (Severe Storms and Flooding) – August 2018 • Between 1780 and 2018, there have been four ice jams in the County. • Based on previous events and input from the Steering and Planning Committees identified flooding as a hazard of concern for the County.	
Hailstorm	Yes	Yes	Please see Severe Storm	
Hurricane	Yes	No	Please see Severe Storm	
Ice Jams	Yes	Yes	Please see Flood	
Ice Storm	Yes	Yes	Please see Severe Winter Storm	
Infestation	Yes	No	• The 2014 NYS HMP does not identify infestation as a hazard of concern for New York State. • According to the New York Invasive Species Map, there have been reported infestations of invasive insects in Tioga County (emerald ash borer, hemlock wooly adelgid). • After review of the available data, at this time, the Steering and Planning Committees did not identify infestations a hazard of concern for Tioga County. Therefore it will not be further discussed in detail.	• NYS DHSES • Input from Steering and Planning Committees • NYSDEC • EDDMapS
Land Subsidence	Yes	No	• 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 Tioga County. Therefore it will not be further discussed in detail.	• NYS DHSES • Input from Steering and Planning Committees • USGS
Landslide	Yes	No	• The NYS HMP includes landslide as a hazard of concern for New York State. According to the NYS HMP, 0 people in Tioga County live within a high incidence of landslide area, 1,099 people live in a moderate susceptibility/low incidence, and 6,578 people live in an area of moderate incidence. The remainder of the population lives within a low incidence area. • Between 1954 and 2018 New York State was included in one landslide-related disaster declaration which did not include Tioga County. • Based on previous occurrences and input from the Planning and Steering Committee, the landslide hazard was not identified as a hazard of concern for Tioga County. Therefore it will not be further discussed in detail.	• NYS DHSES • Input from Steering and Planning Committees • FEMA
Nor'Easters	Yes	Yes	Please see Severe Storm	

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

Hazard	Is this a hazard that may occur in Tioga County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
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: hailstorm, high wind, and hurricane. For the purpose of this County HMP, the hazards were combined into one profile. • The NOAA-NCEI Storm Events Database indicated that Tioga County was impacted by 190 severe storm-related events between 1950 and 2018. • According to the SPC, 6 tornados have impacted Tioga County between 1950 and 2017. • FEMA included Tioga County is 15 severe storm-related disaster declarations: o FEMA-DR-338 (Tropical Storm Agnes) – June 1972 o FEMA-DR-487 (Storms, Rains, Landslides & Flooding) – October 1975 o FEMA-DR-515 (Severe Storms and Flooding) – July 1976 o FEMA-DR-1095 (Severe Storms and Flooding) – January 1996 o FEMA-DR-1233 (Severe Storm and Flooding) – June & July 1998 o FEMA-DR-1335 (Severe Storms and Flooding) – May-August 2000 o FEMA-DR-1534 (Severe Storms and Flooding) – May & June 2004 o FEMA-DR-1565 (Tropical Depression Ivan) – September 2004 o FEMA-DR-1589 (Severe Storms and Flooding) – April 2005 o FEMA-DR-1650 (Severe Storms and Flooding) – November 2006 o FEMA-DR-1670 (Severe Storms and Flooding) – November 2006 o FEMA-DR-1993 (Severe Storms, Flooding, Tornadoes, and Straight Line Winds) – April & May 2011 o FEMA-EM-3341 (Remnants of Tropical Storm Lee) – September 2011 o FEMA-DR-4031 (Remnants of Tropical Storm Lee) – September 2011 o FEMA-EM-3351 (Hurricane Sandy) – October & November 2012 o FEMA-DR-4397 (Severe Storms and Flooding) – August 2018 • Based on previous occurrences and input from the Steering and Planning Committees, severe storms is an identified hazard of concern for Tioga County.	• NYS DHSES • FEMA • NOAA-NCEI • SPC • Input from Steering and Planning Committees
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. • The NOAA-NCEI Storm Events Database indicated that Tioga County was impacted by 60 winter storm events between 1950 and 2018. • FEMA included Tioga County in three winter storm-related disaster declarations: o FEMA-EM-3107 (Severe Blizzard) – March 1993 o FEMA-DR-3173 (Snowstorms) – December 2002-Janurary 2003 o FEMA-DR-4322 (Severe Winter Storm and Snowstorm) – March 2017	• NYS DHSES • FEMA • NOAA-NCEI • Input from Steering and Planning Committees

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

Hazard	Is this a hazard that may occur in Tioga County?	If yes, does this hazard pose a significant threat to the County?	Why was this determination made?	Source(s)
			• Based on previous occurrences and input from the Planning and Steering Committees, severe winter storms is an identified hazard of concern for Tioga County.	
Tornado	Yes	Yes	Please see Severe Storm	
Tsunami	No	No	• Tsunami is not identified as a hazard of concern in the NYS HMP and, therefore, the Planning and Steering Committees do not consider tsunami to be a significant concern to Tioga County and it will not be further discussed in detail.	• NYS DHSES • Input from Steering and Planning Committees
Volcano	No	No	• The NYS HMP did not identify volcano as a hazard of concern for New York State and , therefore, the Planning and Steering Committees does not consider volcano to be a hazard of concern for Tioga County and it will not be further discussed in detail.	• NYS DHSES • Input from Steering and Planning Committees
Wildfire	Yes	No	• The NYS HMP identified wildfire as a hazard of concern for New York State. • Tioga County has not been included in any FEMA wildfire-related disaster declarations. • Based on available data, the Planning and Steering Committees do not consider wildfire to be a hazard of concern for Tioga County. Therefore it will not be further discussed in detail.	• 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*
EDDMapS *Early Detection and Distribution Mapping System*
EM *Presidential Disaster Emergency Number*
FEMA *Federal Emergency Management Agency*
NCEI *National Centers for Environmental Information*
NRCC *Northeast Regional Climate Center*
NYS DHSES *New York State Division of Homeland Security and Emergency Services*
NYS HMP *New York State Hazard Mitigation Plan*
SPC *Storm Prediction Center*
USDA *U.S. Department of Agriculture*
USGS *United States Geologic Survey*

In summary, a total of four 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):

- Drought
- Flood (riverine, dam failure, flash, and ice jam)
- Severe Storm (thunderstorm, hail, wind, tornado, hurricane/tropical storm, and Nor'Easter)
- Severe Winter Storm

Other natural hazards of concern that have occurred within Tioga County, but have a low potential to occur and/or result in significant impacts, may be considered in future versions of the Plan.

5.3 HAZARD RANKING

After the hazards of concern were identified for Tioga County, the hazards were ranked to describe their probability of occurrence and their impact on population, property (general building stock including critical facilities) and the economy. Each participating town or village may have differing degrees of risk exposure and vulnerability compared to the County as a whole; therefore, each jurisdiction ranked the degree of risk to each hazard as it pertains to their community using the same methodology as applied to the County-wide ranking. This assured consistency in the overall ranking of risk process. The hazard ranking for the County and each participating district can be found in their jurisdictional annex in Volume II of this plan.

5.3.1 Hazard Ranking Methodology

The methodology used to rank the hazards of concern for Tioga County is described below. Estimates of risk for the County were developed using methodologies promoted by FEMA's hazard mitigation planning guidance and generated by FEMA's HAZUS-MH risk assessment tool.

Probability of Occurrence

The probability of occurrence is an estimate of how often a hazard event occurs. A review of historic events assists with this determination. Each hazard of concern is rated in accordance with the numerical ratings and definitions in Table 5.3-1.

Table 5.3-1. Probability of Occurrence Ranking Factors

Rating	Probability Category	Definition
1	Rare	Hazard event is not likely to occur within 100 years (>1% chance of occurrence in any given year)
2	Occasional	Hazard event is likely to occur within 100 years (1% chance of occurrence in any given year)
3	Frequent	Hazard event is likely to occur within 25 years (4% chance of occurrence in any given 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 a subjective assessment by the Planning Committee, 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: three (3) for population, two (2) for property, and one (1) for economy. This gives the impact on population the greatest weight in evaluating the impact of a hazard.

Table 5.3-2 presents the numerical rating, weighted factor and description for each impact category

Table 5.3-2. Numerical Values and Definitions for Impacts on Population, Property and Economy

Category	Weighting Factor	Low Impact* (1)	Medium Impact (2)	High Impact (3)
Population	3	14% or less of your population is exposed to a hazard with potential for	15% to 29% of your population is exposed to a hazard with potential for	30% or more of your population is exposed to a hazard with potential

Category	Weighting Factor	Low Impact* (1)	Medium Impact (2)	High Impact (3)
		measurable life safety impact, due to its extent and location	measurable life safety impact, due to its extent and location	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 your community	Property exposure is 15% to 29% of the total number of structures for your community	Property exposure is 30% or more of the total number of structures for your community
Economy	1	Loss estimate is 9% or less of the total replacement cost for your community	Loss estimate is 10% to 19% of the total replacement cost for your community	Loss estimate is 20% or more of the total replacement cost for your 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.*

Risk Ranking Value

The risk ranking for each hazard is then calculated by multiplying the numerical value for probability of occurrence by the sum of the numerical values for impact. The equation is as follows: Weighting Factor (1, 2, or 3) X Impact Value (6 to 18) = Hazard Ranking Value. Based on the total for each hazard, a priority ranking is assigned to each hazard of concern (high, medium, or low).

5.3.2 Hazard Ranking Results

Using the process described above, the risk ranking for the identified hazards of concern was determined for Tioga County. Based on the combined risk values for probability of occurrence and impact to Tioga County, a priority ranking of "high", "medium" or "low" risk was assigned. The hazard ranking for the Tioga planning area is detailed in the subsequent tables that present the step-wise process for the ranking. The county–wide risk ranking includes the entire planning area and may not reflect the highest risk indicated for any of the participating jurisdictions. The resulting ranks of each municipality indicate the differing degrees of risk exposure, and vulnerability. The results support the appropriate selection and prioritization of initiatives to reduce the highest levels of risk for each municipality. Both the County and the participating jurisdictions have applied the same methodology to develop the county-wide risk and local rankings to ensure consistency in the overall ranking of risk.

This risk ranking exercise serves two purposes: 1) to describe the probability of occurrence for each hazard, and 2) to describe the impact each would have on the people, property and economy of Tioga County. Estimates of risk for Tioga County were developed using methodologies promoted by FEMA's hazard mitigation planning guidance and generated by FEMA's HAZUS-MH risk assessment tool.

Table 5.3-3 shows the probability ranking assigned for likelihood of occurrence for each hazard.

Table 5.3-3. Probability of Occurrence Ranking for Hazards of Concern for Tioga County

Hazard of Concern	Probability	Numeric Value
Drought	Frequent	3
Flood	Frequent	3
Extreme Temperature	Frequent	3
Severe Storm	Frequent	3

Table 5.3-4 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, may have a lower impact when analyzed county-wide. Jurisdictional ranking results are presented in each local annex in Section 9 of this plan. The weighting factor results and a total impact for each hazard also are summarized.

Table 5.3-4. Impact Ranking for Hazards of Concern for Tioga 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)	
Drought	L	1	3	L	1	2	M	2	2	7
Flood	L	1	3	L	1	2	M	2	2	7
Severe Storm	L	1	3	M	2	4	L	1	1	8
Severe Winter Storm	L	1	3	L	1	2	L	1	1	6

Table 5.3-5 presents the total ranking value for each hazard.

Table 5.3-5. Total Risk Ranking Value for Hazards of Concern for Tioga County

Hazard of Concern	Probability	Impact	Total = (Probability x Impact)
Drought	3	7	21
Flood	3	7	21
Severe Storm	3	8	24
Severe Winter Storm	3	6	18

Table 5.3-6 presents the hazard ranking category by jurisdiction assigned for each hazard of concern. The ranking categories are determined by an evaluation of the total risk ranking score into three categories, low, medium, and high whereby a total score of 14 and below is categorized as low, 15 to 30 is medium, and 31 and over is considered a high risk category.

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

Table 5.3-6. Summary of Overall Ranking of Natural Hazards by Jurisdiction

Tioga County Municipalities	Drought	Flood	Severe Storm	Severe Winter Storm
Barton (T)*	Medium	High[1]	Medium[4]	High[4]
Berkshire (T)*	Medium	Medium	High	High
Candor (T)	Medium	Medium	High	High
Candor (V)	Medium	High[3]	Medium	Medium
Newark Valley (T)	Medium	Medium	Medium	Medium
Newark Valley (V)*	Medium	High	High	High
Nichols (T)*	Medium	High[3]	Medium	Medium
Nichols (V)	Medium	Medium	Medium	Medium
Owego (T)	Medium	High[1]	Medium	Medium
Owego (V)*	Medium	High[3]	Medium	Medium
Richford (T)*	Medium	Medium	Medium	Medium
Spencer (T)*	Medium	High[4]	Medium	Medium
Spencer (V)	Medium	High[3]	Medium	Medium
Tioga (T)*	Low	High[2]	Medium	Medium
Waverly (V)	Medium	Medium	Medium	Medium
Tioga County	Medium	Medium	Medium	Medium

**The overall rankings for these communities were adjusted by the community. Refer to their individual municipal annexes for an explanation of each adjustment.*

[1] *High claims*

[2] *Low property exposures*

[3] *High percent property exposure*

[4] *Local Input*

5.4.1 Flood

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

5.4.1.1 Profile

Hazard Description

Floods are one of the most common natural hazards in the U.S. 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) (Federal Emergency Management Agency [FEMA] 2007). Most communities in the U.S. have experienced some kind of flooding, after spring rains, heavy thunderstorms, coastal storms, or winter snow thaws.

Floods are the most frequent and costly natural hazards in New York State in terms of human hardship and economic loss, particularly to communities that lie within flood prone areas or flood plains of a major water source. As defined in the NYS HMP (NYS DHSES 2014), flooding is a general and temporary condition of partial or complete inundation on normally dry land from 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; and
- Coastal flooding

Many floods fall into three categories: riverine, coastal and shallow (FEMA 2007). Other types of floods may include ice-jam floods, alluvial fan floods, dam failure floods, and floods associated with local drainage or high groundwater (as indicated in the previous flood definition). For the purpose of this HMP and as deemed appropriate by the Tioga County Steering Committee, riverine, shallow, flash, ice jam, and dam failure flooding are the main flood types of concern for the County. These types of flood or 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 "a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam). However, the actual time threshold may vary in different parts of the

country. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters" (National Weather Service [NWS] 2009).

Figure 5.4.1-1. Flash Flood damages at Lower Briggs Hollow Road after July 2017 flash flood event.

Source: Tioga County SWCD March 2018

Shallow 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 a long period 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 (NYS DHSES 2014).

There are two main types of ice jams: freeze-up and breakup. Freeze-up jams occur when floating ice may slow or stop due to a change in water slope as it reaches an obstruction to movement. Breakup jams occur during periods of thaw, generally in late winter and early spring. The ice cover breakup is usually associated with a rapid increase in runoff and corresponding river discharge due to a heavy rainfall, snowmelt or warmer temperatures (NYS DHSES 2014).

Ice jams are common in the northeast U.S. and New York is not an exception. In fact, according to the USACE, New York State ranks second in the U.S. for total number of ice jam events, with over 1,500 incidents documented between 1867 and 2010. Areas of New York State that include characteristics lending to ice jam flooding include the northern counties of the Finger Lakes region and far western New York, the Mohawk Valley of central and eastern New York State, and the North Country (NYS DHSES, 2014).

The Ice Jam Database, maintained by the Ice Engineering Group at the USACE Cold Regions Research and Engineering Laboratory (CRREL), currently consists of over 19,000 records from across the U.S. According to the USACE-CRREL, Tioga County experienced 4 historic ice jam events between 1780 and 2018 (USACE 2018). Ice jams typically have formed along the Susquehanna River, Dean Creek, and Owego Creek (USACE 2018). Recent events are further mentioned in the "Previous Occurrences" section of this hazard profile.

Dam Failure Flooding

A dam 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). Dams 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);
- 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 2018a).

A break in a dam can produce extremely dangerous flood situations because of the high velocities and large volumes of water released by such a break. Sometimes they can occur with little to no warning. Breaching of dams often occurs within hours after the first visible sign of dam failure, leaving little or no time for evacuation (FEMA 2015).

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 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 a dam that has been breached or removed, or has failed or otherwise no longer materially impounds waters, or a dam that was planned but never constructed. Class "D" dams are considered to be defunct dams posing negligible or no hazard. The department may retain pertinent records regarding such dams.

According to the Dam Incident Notification (DIN) system maintained by the National Performance of Dam Program (NPDP), there are 25 dams in Tioga County. Of the 25 dams, there are 13 classified as low hazard, 7 classified as significant hazard, 4 classified as high hazard, and one classified as unknown hazard (NPDP 2018). However, these numbers differ from the New York State Inventory of Dams, which identifies 156 dams in Tioga County: 50 low hazard, 3 intermediate hazard, 5 high hazard, and 18 negligible or no hazard classification and 50 have an unknown classification (NYS DEC 2018).

Location

Flooding is the primary natural hazard in New York State because the State exhibits a unique blend of climatological and meteorological features that influence the potential for flooding. These factors include topography, elevations, latitude and water bodies and waterways. Flooding is the primary natural hazard in New York State and they occur in every part of the State. Some areas are more flood prone than others, but no area is exempt, including Tioga County. There are over 52,000 miles of river and streams in New York State, and along their banks there are 1,480 communities that are designated as flood prone. It is estimated that 1.5 million people live in these flood-prone areas. Millions more work, travel through or use recreational facilities located in areas subject to flooding. Areas outside recognized and mapped flood hazard zones can also experience flooding (NYSDHSES 2014).

The NYSDEC conducted a vulnerability assessment that depicted how vulnerable a county may be to flood hazards. This was determined by a rating score; each county accumulated points based on the value of each vulnerability indicator. The higher the indication for flood exposure, the more points assigned, resulting in a final rating score. The result of this assessment presented an indication of a county's vulnerability to the flood hazard. Tioga County's rating is 26, out of a possible 35. The rating was based on number of NFIP insurance policies, number of NFIP claims, total amount of NFIP claims, total amount of NFIP policy coverage, number of repetitive flood loss properties, and number of flood disasters (NYSDHSES 2014).

Water drains from the land surface through drainage features that range from rivulets in parking lots to large rivers like the Susquehanna River. The entire area drained by a particular body of water is called a drainage basin or watershed. In New York State, riverine flooding problems are most severe in the Delaware, Susquehanna, Chemung, Erie-Niagara, Genesee, Allegany, Hudson and Mohawk River Basins (NYSDHSES 2014). Tioga County is part of the Susquehanna River Basin (NYSDEC Date Unknown). For details regarding the drainage basins in Tioga County, refer to Section 4 (County Profile) of this plan.

Susquehanna River Basin

The Susquehanna River Basin is the second largest basin east of the Mississippi River. The 444 miles of the Basin drain approximately 27,500 square miles, covering the large portions of New York State, Pennsylvania and Maryland, before emptying into the Chesapeake Bay. In New York State, the Susquehanna River Basin encompasses most of the south-central portion of the State. The Basin drains approximately 4,520 square miles in central New York State. Within the State, the drainage area includes most of Broome, Chenango, Cortland, Otsego and Tioga Counties, portions of Delaware, Madison and Chemung Counties, and small parts of Schuyler, Tompkins, Onondaga, Oneida, Herkimer and Schoharie Counties (NYSDEC 2009). In Tioga County, the Susquehanna River flows in the southern portion of the County, from the east to the southwest.

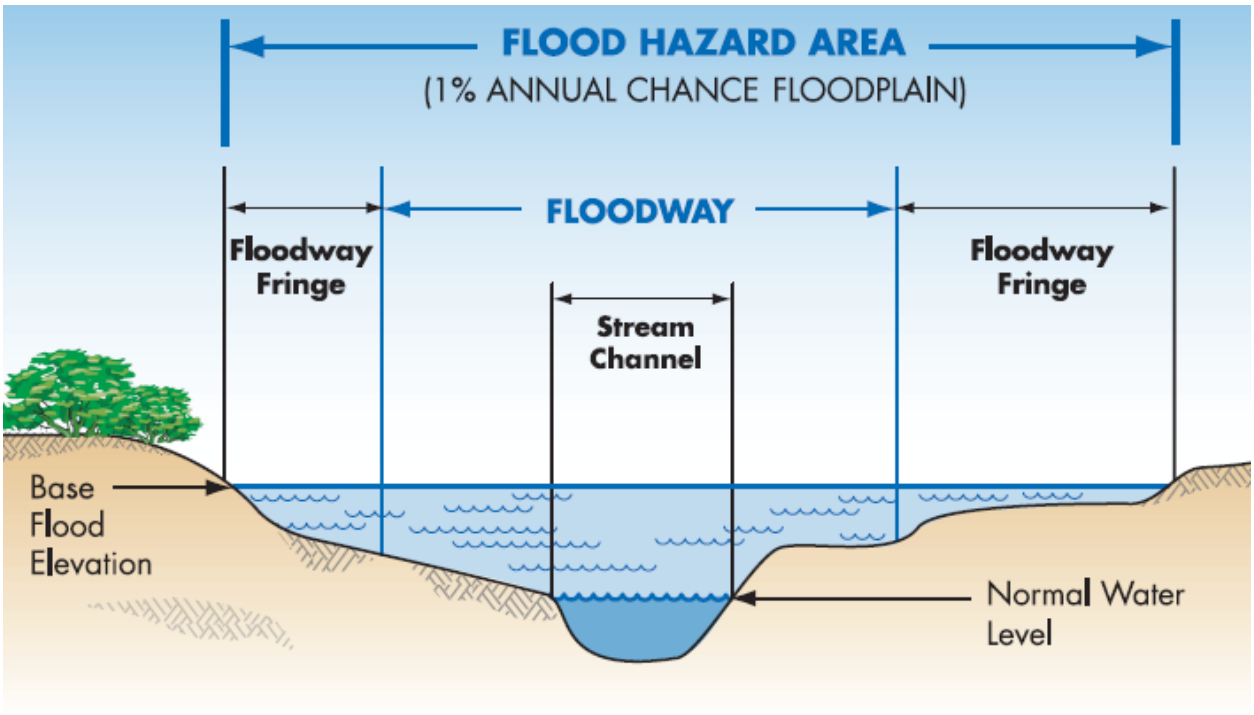
The past history of flooding along the Susquehanna River indicates that flooding can occur any time of the year. The majority of the larger floods has occurred in the late winter or early spring and has resulted from a combination of heavy rains and extensive snowmelt. This area is also susceptible to floods due to tropical storms or hurricanes moving up the Atlantic coast in the summer and fall (FEMA FIS 2012).

FEMA Flood Hazard Areas

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. Most often floodplains are referred to as 100-year floodplains. A 100-year floodplain is not a flood that will occur once every 100 years, rather it is a flood that has a 1% chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. Due to this misleading term, FEMA has properly defined it as the 1% annual chance flood. This 1% annual chance flood is now the standard used by most federal and state agencies and by the NFIP (FEMA 2003). Similarly, the 500-year floodplain will not occur every 500 years but is an event with a 0.2% chance of being equaled or exceeded each year. In Tioga County, floodplains line the rivers and streams of the County. The boundaries of the floodplains are altered as a result of changes in land use, the amount of impervious surface, placement of obstructing structures in floodways, changes in precipitation and runoff patterns, improvements in technology for measuring topographic features, and utilization of different hydrologic modeling techniques.

Figure 5.4.1-2 depicts the flood hazard area, the flood fringe, and the floodway areas of a floodplain.

Figure 5.4.1-2. The Floodplain

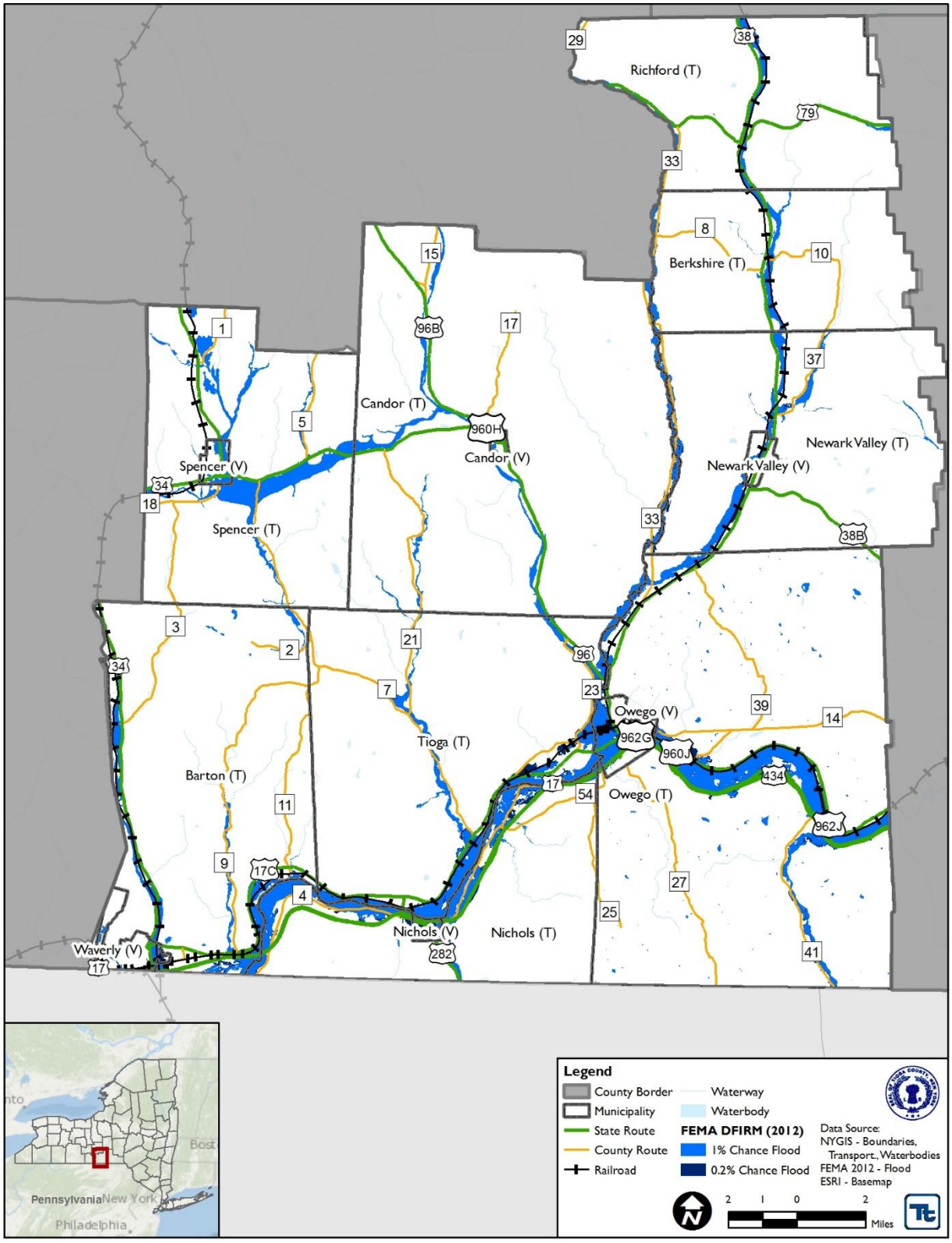


Source: NJAFM Quick Guide 2015

Figure 5.4.1-3 illustrates the FEMA flood hazard zones in Tioga County. According to this figure, the 1% annual chance of flood hazard zones are located along the bodies of water located throughout the County. The 0.2% annual chance of flood hazard zones are mainly found in southeastern Tioga County. The total land area located in the one-percent and 0.2-percent annual chance flood zones was calculated using the FEMA DFIRM for Tioga County, as presented in Table 5.4.1-1.

Please refer to Section 9 (Jurisdictional Annexes) for information regarding specific areas of flooding for each participating municipality in Tioga County.

Figure 5.4.1-3. FEMA Flood Hazard Areas in Tioga County



Source: FEMA 2012
FEMA Federal Emergency Management Agency

Table 5.4.1-1. Total Land Area in the 1-Percent and 0.2-Percent Annual Chance Flood Zones (Acres)

Municipality	Total Area (acres)	1% Flood Event Hazard Area		0.2% Flood Event Hazard Area	
		Area (acres)	% of Total	Area (acres)	% of Total
Barton (T)	36,816.2	1,823.5	5.0%	1,936.5	5.3%
Berkshire (T)	19,514.3	842.7	4.3%	842.8	4.3%
Candor (T)	60,498.2	1,917.6	3.2%	2,000.3	3.3%
Candor (V)	294.4	55.5	18.8%	55.5	18.8%
Newark Valley (T)	31,725.0	1,328.8	4.2%	1,517.1	4.8%
Newark Valley (V)	633.8	112.7	17.8%	129.3	20.4%
Nichols (T)	21,736.5	2,594.3	11.9%	2,976.4	13.7%
Nichols (V)	374.3	62.6	16.7%	254.4	68.0%
Owego (T)	65,862.6	4,043.1	6.1%	4,639.0	7.0%
Owego (V)	1,765.6	841.8	47.7%	992.1	56.2%
Richford (T)	24,205.9	781.8	3.2%	781.8	3.2%
Spencer (T)	30,849.0	2,536.8	8.2%	2,536.8	8.2%
Spencer (V)	672.4	280.5	41.7%	280.5	41.7%
Tioga (T)	37,982.2	2,924.7	7.7%	3,203.7	8.4%
Waverly (V)	1,428.7	200.9	14.1%	269.2	18.8%
Tioga County	**334,359.1**	**20,347.4**	**6.1%**	**22,415.4**	**6.7%**

Source: FEMA 2016
Note: The area presented includes the area of inland waterways and excludes bays or oceans.
(T) – Town
(V) – Village

Extent

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

- Minor Flooding - minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding - some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations. (NWS 2011)

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. The size of rivers and streams in an area and infiltration rates are significant factors. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration rates decrease and any more water that accumulates must flow as runoff (Harris 2008).

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1% chance of being equaled

or exceeded in any given year. The "annual flood" is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

One hundred-year floodplains (or 1% annual chance floodplain) can be described as a bag of 100 marbles containing 99 clear marbles and one black marble. Every time a marble is pulled out from the bag, and it is the black marble, it represents a 100-year flood event. The marble is then placed back into the bag and shaken up again before another marble is drawn. It is possible that the black marble can be picked one out of two or three times in a row, demonstrating that a "100-year flood event" could occur several times in a row (Interagency Floodplain Management Review Committee 1994).

The 1% annual chance floodplain, which is the standard used by most federal and state agencies, is used by the NFIP as the standard for floodplain management and to determine the need for flood insurance. Also referred to as the SFHA, this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. A structure located within a SFHA shown on an NFIP map has a 26% chance of suffering flood damage during the term of a 30-year mortgage.

The extent of flooding associated with a 1% annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the water elevation resulting from a given discharge level, which is one of the most important factors used in estimating flood damage.

The term "500-year flood" is the flood that has a 0.2% chance of being equaled or exceeded each year. The 500-year flood could occur more than once in a relatively short period of time. Statistically, the 0.2% (500-year) flood has a 6% chance of occurring during a 30-year period of time, the length of many mortgages.

The 500-year floodplain is referred to as Zone X500 for insurance purposes on FIRMs. Base flood elevations or depths are not shown within this zone and insurance purchase is not required in this zone.

Previous Occurrences and Losses

Per the current Tioga County Flood Insurance Study (FEMA, 2012) Based on historic data, the Susquehanna River, Apalachin Creek, Owego Creek, East Branch Owego Creek, and West Branch Owego Creek are major sources of flooding problems in Tioga County. The floodplains of the streams include developed areas. Tioga County has experienced damage from a number of floods in the past. Most notable of these floods occurred in 1935, 1936, 1940, 1942, 1948, 1964, 1972, 1977, 1979, 2005, and 2006.

The past history of flooding along the Susquehanna River indicates that flooding can occur in any month of the year. The majority of the larger floods, however, have occurred in the late winter or early spring and have resulted from a combination of heavy rains and extensive snowmelt. The area is also susceptible to floods due to tropical storms or hurricanes moving up the Atlantic coast in the summer or fall. The floods in March 1936 and June 1972. The estimated discharges of these floods were 128,000 cubic feet per second (cfs) and 121,000 cfs, respectively. Other major floods occurred in 1940, 1942, 1948, 1964, 1972, 1977, and 1979. The estimated recurrence intervals for the 1936 and 1972 floods are approximately 35 years and 25 years, respectively. The Town of Barton experienced substantial damage from the flooding of the Susquehanna River in June 1972. (FEMA 2012)

Between 1954 and 2018, FEMA included New York State in 85 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. Tioga County was included in 15 of these flood-related declarations.

Table 5.4.1-2. Presidential Declarations of Flood and Flood-Related Events in Tioga County, 1954 to 2018

Disaster Number	Declaration Date	Incident Type	Title
DR-4397	8/14/2018	Flood	Severe Storms and Flooding
DR-4031	9/13/2011	Severe Storm(s)	Remnants of Tropical Storm Lee
DR-1993	6/10/2011	Flood	Severe Storms, Flooding, Tornadoes, And Straight-Line Winds
DR-1670	12/12/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1650	7/1/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1589	4/19/2005	Severe Storm(s)	Severe Storms and Flooding
DR-1565	10/1/2004	Severe Storm(s)	Tropical Depression Ivan
DR-1534	8/3/2004	Severe Storm(s)	Severe Storms and Flooding
DR-1335	7/21/2000	Severe Storm(s)	Severe Storms and Flooding
DR-1233	7/7/1998	Severe Storm(s)	Severe Storms and Flooding
DR-1095	1/24/1996	Flood	Severe Storms and Flooding
DR-515	7/21/1976	Flood	Severe Storms & Flooding
DR-487	10/2/1975	Flood	Storms, Rains, Landslides & Flooding
DR-338	6/23/1972	Flood	Tropical Storm Agnes

Source: FEMA 2018

According to NOAA-NCEI Storm Events Database, Tioga County has been impacted by 60 flood events, causing 0 fatalities, 0 injuries, and over $597 million in property damage.

Table 5.4.1-3. Summary of Flood Events 1950-2018

Hazard Type	Number of Occurrences Between 1950 and 2018	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Flash Flood	29	0	0	$265,274,000	None reported
Flood	27	0	0	$332,245,000	None reported
Dam Failure	0	0	0	None reported	None reported
Ice Jam	4	0	0	None reported	None reported
TOTAL	**60**	**0**	**0**	**$597,519,000**	None reported

Source: NOAA-NCEI 2018

For this Plan update, flood events were summarized from 2012 to 2018. Known flood events, including FEMA disaster declarations, which have impacted Tioga County between 2012 and 2018 are identified in Table 5.4.1-4. Please note that not all events that have occurred in Tioga County are included due to the extent of documentation and the fact that not all sources may have been identified or researched. Loss and impact information 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 Update. Please see Section 9 for detailed information regarding impacts and losses to each municipality. For events that occurred prior to 2012, refer to the Appendix E (County Profile and Risk Assessment Supplementary Data) which provides the event history as documented on the 2013 Tioga County HMP.

Table 5.4.1-4. Flood Events in Tioga County, 2012 to 2018

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
July 1, 2013	Flash Flood	N/A	N/A	A stationary frontal boundary extending from the Gulf states to the Northeast provided the focus for several rounds of thunderstorms across Central New York. A near tropical environment provided the source for torrential rain in several parts of the region. In Weltonville (Town of Candor), a bridge was washed out on Frost Hollow and West Whitcomb road. $50,000 in property damages were reported.
August 8, 2013	Flash Flood	N/A	N/A	An upper level disturbance moved along a stationary front and produced numerous, slow moving clusters of thunderstorms across Central New York. This resulted in several areas of significant flash flooding around the region. In Richford, there were several road closures in the area due to flooding and $15,000 in property damages were reported.
August 9, 2013	Flash Flood	N/A	N/A	An upper level disturbance moved along a stationary front and produced numerous, slow moving clusters of thunderstorms across Central New York. This resulted in several areas of significant flash flooding around the region. In Willseyville, Catatonk Creek overflowed its banks and washed out a bridge. $75,000 in property damages were reported.
February 13, 2015	Ice Jam	N/A	N/A	A freeze up occurred on the Susquehanna River where the main (south) channel narrows at Tuffs Island.
June 14, 2015	Flash Flood	N/A	N/A	A warm front stalled across New York and northern Pennsylvania, providing the focus for repeating clusters of thunderstorms in the Finger Lakes and Southern Tier NY regions. A tropical-like airmass was in place allowing for a stripe of 2-4 inches of very heavy rain to fall in a narrow band extending from near Watkins Glen to areas north of Binghamton. Severe flash flooding was encountered with numerous roads and culverts destroyed by raging water. In some areas, homes, schools and other businesses were flooded. Cumulative damage estimates across the affected areas were about $10 Million dollars. In Richford, Michigan Hollow road was closed due to severe flooding and $400,000 in property damages were reported. In North Spencer, flood water surrounded a house on Hurlbert Hollow Road. Water also flowed across County Routes 96 and 34. $400,000 in property damages were reported. Numerous bridges and roads were washed out by severe flooding from North Spencer to Candor and Newark Valley, including a bridge on West Creek Road. Candor reported $400,000 in property damages. In Weltonville, water flooded County Route 38 at Rock Street. Several other points to the east of the Village of Newark Valley had water across roadways with numerous culvert washouts. Weltonville reported $400,000 in property damages.
July 26, 2015	Flash Flood	N/A	N/A	A stationary front provided the focus for concentrated thunderstorms across the Southern Tier of New York. Rainfall estimates of 2 to 3 inches fell in a very short

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
				period of time, causing localized flash flooding in the area. In Barton, heavy rainfall and flooding caused a culvert washout on Ellis Creek Road. $25,000 in property damages were reported.
July 14, 2017	Flash Flood	N/A	N/A	A warm front began advancing across Central New York by early in the afternoon. This feature triggered numerous rounds of heavy rain producing thunderstorms from the southern Finger Lakes through the Southern Tier of NY. Localized rainfall amounts were estimated to exceed 3 inches across southern Cortland county. Several storms moved over the same locations, contributing to areas of urban and small stream flash flooding. In Richford, water from small streams and culverts flooded over several portions of Route 79 between Richford and Center Lisle. Deep ponding of water was reported on streets in nearby towns and village centers. $50,000 in property damages were reported.
July 23-24, 2017	Flash Flood	N/A	N/A	A stationary front poised in the vicinity of central New York and northeast Pennsylvania was the focus for very warm and moist atmospheric conditions across the region. Heavy rain producing thunderstorms developed during the late afternoon and evening hours as an upper level jet stream punched into the area. Widespread thunderstorms produced swaths of 3 to 4 inches of rain in just a few hours time during the late evening and overnight hours. Rapid rises of area streams and creeks resulted in severe flash flooding for the Nichols, NY and Vestal, NY areas. Severe flooding occurred throughout the village of Nichols. Major State Route 17 was closed in both directions between Exit 62 and Exit 63 due to bridge erosion. Severe flash flooding along Wappasening Creek was reaching nearby homes and crossing over Old Route 282. Debris was collecting at the bridge and threatening its structural integrity. $284,000 in property damages was reported on the 23rd and $25,000 in damages was reported on the 24th. In South Apalachin, water rescues took place along Apalachin Creek and Harnick Roads and $20,000 in property damages were reported.
August 14-15, 2018	Severe Storms and Flooding	DR-4397	Yes	Severe storms led to flash flooding which brought devastation to Broome, Chemung, Chenango, Columbia, Delaware, Schuyler, Seneca, and Tioga Counties. The storms produced heavy rainfall, flash flooding, and strong winds. During the height of the storm, roads were impassable from flood waters which overtopped roads, bridges, and culverts. Widespread power outages impacted more than 1,500 homes. A preliminary damage assessment estimated over $36 million in infrastructure repair, debris removal, and structure damage as a result of these storms. Tioga County requested over $188,000 in public assistance. The Towns of Candor, Newark Valley, and Owego were the communities in the county that requested assistance. Rainfall totals for the August 14th event included 1.5 inches in the Town

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
				of Newark Valley. Rainfall totals for August 15th ranged from 1.13 inches in Weltonville to 2.63 inches in the Town of Candor.

Sources: *FEMA 2018; NOAA-NCEI 2018; NYS HMP 2014; SPC 2018*
Note: *The table above includes events that resulted in a FEMA declaration, damages exceeding $1,000, or resulted in injuries or fatalities.*
FEMA *Federal Emergency Management Agency*
HMP *Hazard Mitigation Plan*
Mph *Miles Per Hour*
NCEI *National Center for Environmental Information*
NOAA *National Oceanic and Atmospheric Administration*
NYS *New York State*
N/A *Not Applicable*
SPC *Storm Prediction Center*

Probability of Future Occurrences

Based on the historic and more recent flood events in Tioga County, it is clear that the County has a high probability of flooding for the future. The fact that the elements required for flooding exist and that major flooding has occurred throughout the County in the past suggests that many people and properties are at risk from the flood hazard in the future. It is estimated that Tioga County will continue to experience direct and indirect impacts of flooding events annually that may induce secondary hazards such as coastal erosion, storm surge in coastal areas, infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents and inconveniences.

As defined by FEMA, geographic areas within the 1% annual chance flood area in Tioga County are estimated to have a one-percent chance of flooding in any given year. A structure located within a 1% annual chance flood area has a 26-percent chance of suffering flood damage during the term of a 30-year mortgage. Geographic areas in Tioga County located within the 0.2% annual chance flood area boundary are estimated to have a 0.2-percent chance of being flooded in any given year (FEMA, 2007).

According to the 2014 New York State Hazard Mitigation Plan Update, between 1960 and 2012, Tioga County had 74 flooding events which resulted in three fatalities, three injuries, over $599 million in property damage and over $818,000 in crop damage. These statistics showed that the County had a 142% chance of floods occurring in the future with a recurrence interval of one (NYS DHSES 2014). However, according to the NOAA National Climate Data Center (NCEI) and the CRREL database, Tioga County experienced 60 flood events between 1950 and 2018, including 27 floods, 29 flash floods, 4 ice jams, and no dam failures. 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 Tioga County in future years (NOAA NCEI 2018).

Table 5.4.1-5. Probability of Future Occurrence of Flooding Events

Hazard Type	Number of Occurrences Between 1950 and 2018	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/Number of Events)	Probability of Event in any given year	% chance of occurrence in any given year
Flash Flood	29	0.43	2.38	0.42	42.03%
Flood	27	0.40	2.56	0.39	39.13%
Dam Failure	0	0	0	0	0%
Ice Jams	4	0.06	17.25	0.06	5.80%
TOTAL	**60**	**0.88**	**1.15**	**0.87**	**86.96%**

Source: NOAA-NCEI 2018; CRREL 2016; NPDP 2015

In Section 5.3, the identified hazards of concern for Tioga 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' (likely to occur within 25 years, as presented in Table 5.3-3).

Climate Change Impacts

The climate of Tioga County is already changing and will continue to change in the future. Climate change is beginning to affect both people and resources of the State and County and the impacts of climate change will continue. Impacts related to increasing temperatures and sea level rise are already being felt in the County. 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 (New York State Energy Research and Development Authority [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° F to 3.4° F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the State (NYSERDA 2014).

Regional precipitation across New York State is projected to increase by approximately one to eight-percent by the 2020s, three to 12-percent by the 2050s, and four to 15-percent by the 2080s. By the end of the century, the greatest increases in precipitation are projected to be in the northern areas of the State (NYSERDA 2014).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Tioga County is part of Region 3, Southern Tier. In Region 3, it is estimated that temperatures will increase by 4.4ºF to 6.3ºF by the 2050s and 5.7ºF to 9.9ºF by the 2080s (baseline of 47.5ºF, middle range projection). 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 5.4.1-6 displays the projected seasonal precipitation change for Southern Tier ClimAID Region (NYSERDA 2014).

Table 5.4.1-6. 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

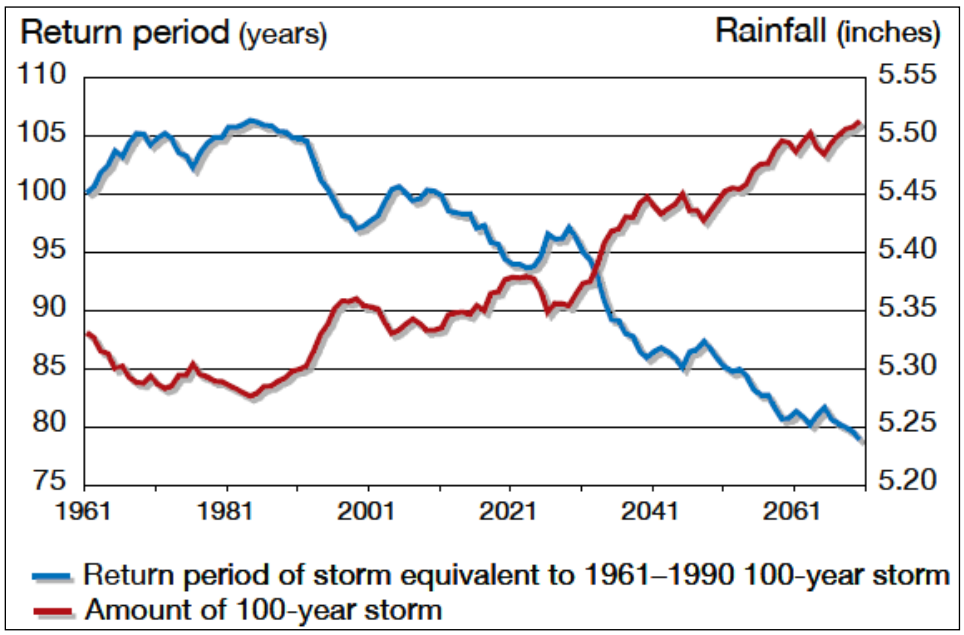
Source: NYSERDA 2011

The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. The increase in heavy downpours has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways and transportation hugs; and increase delays and hazards related to extreme weather events (NYSERDA 2011).

Increasing air temperatures intensify the water cycle by increasing evaporation and precipitation. This can cause an 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 5.4.1-4 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).

Downscaled data regarding increased intensity and frequency of precipitation in New York State with respect to climate change scenarios has been developed by the Northeast Regional Climate Center and is available online via an online tool for extreme precipitation analysis found at http://precip.eas.cornell.edu/ . For an overview of this tool refer to Section 6 (Mitigation Strategies) of this plan.

Figure 5.4.1-4. Projected Rainfall and Frequency of Extreme Storms



Source: NYSERDA 2011

5.4.1.2 Vulnerability Assessment

To assess Tioga County's risk to the flood hazard, a spatial analysis was conducted using the best available spatially-delineated flood hazard areas. The 1- and 0.2-percent annual chance flood events were examined to determine the assets located in the hazard areas and to estimate potential loss using the FEMA HAZUS-MH v4.0 and HAZUS-MH v4.2 models. These results are summarized below.

Impact on Life, Health and Safety

Impacts of flooding on life, health, and safety depend on several factors including severity of the event and whether or not adequate warning time is provided to residents. Assumedly, the population living in or near floodplain areas that could be impacted by a flood would be exposed. 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.

Using the 2010 U.S. Census blocks, there are an estimated 5,660 people residing in the 1-percent annual chance event boundary, and 7,048 people within the 0.2-percent annual chance flood boundary. These residents may be displaced by the flooding of their homes, requiring them to seek temporary shelter with friends and family or in emergency shelters. The Village of Nichols will experience the greatest impact to population with approximately 69.7% exposed in the 0.2-percent chance event and Owego Village being the most affected by the 1 percent chance event.

Table 5.4.1-7. Estimated Population Exposed to the Flood Hazard

Municipality	Total Population	1-Percent Chance Event		0.2-Percent Chance Event	
		Total Number	% of Total	Total Number	% of Total
Barton (T)	4,414	352	8.0%	364	8.2%
Waverly (V)	4,444	212	4.8%	270	6.1%
Berkshire (T)	1,412	118	8.4%	118	8.4%
Candor (T)	4,454	218	4.9%	233	5.2%
Candor (V)	851	111	13.0%	111	13.0%
Newark Valley (T)	2,949	331	11.2%	372	12.6%
Newark Valley (V)	997	95	9.5%	120	12.0%
Nichols (T)	2,013	212	10.5%	251	12.5%
Nichols (V)	512	0	0.0%	357	69.7%
Owego (T)	15,987	720	4.5%	1,146	7.2%
Owego (V)	3,896	1,923	49.4%	2,312	59.3%
Richford (T)	1,172	79	6.7%	79	6.7%
Spencer (T)	2,394	387	16.2%	387	16.2%
Spencer (V)	759	319	42.0%	319	42.0%
Tioga (T)	4,871	583	12.0%	609	12.5%
Tioga County	**51,125**	**5,660**	**11.1%**	**7,048**	**13.8%**

Sources: U.S. Census 2010; FEMA, 2012
Note: U.S. Census blocks do not follow the boundaries of the floodplain, possibly leading to gross overestimates or underestimates of exposed populations from use of centroids or intersects of Census blocks with these zones. Limitations of these analyses are recognized, and thus the results are used only to provide a general estimate.
(T) – Town
(V) – Village

Of the population exposed, the most vulnerable include the economically disadvantaged and the population over age 65. 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 flood event, and they may have more difficulty evacuating. Within the 1-percent annual chance event, there are approximately 896 and 1,088 population over the age of 65 and defined as low income, respectively (as per population reported in Table E-1 of the Appendix E (County Profile)). As for the 0.2-percent chance event, there are approximately 1,064 and 1,404 over the age 65 and below the poverty level located in the floodplain, respectively.

Using 2010 U.S. Census data, HAZUS-MH 4.0 estimates the potential sheltering needs as a result of a 1-percent chance flood event. For the 1-percent flood event, HAZUS-MH 4.0 estimates 4,053 households will be displaced, and 1,541 people will seek short-term sheltering. These statistics, by municipality, are presented in Table 5.4.1-8.

Table 5.4.1-8. Estimated Population Displaced or Seeking Short-Term Shelter from the 1-Percent Annual Chance Flood Event

Municipality	U.S. Census 2010 Population	1-Percent Annual Chance Event			
		Displaced Population	% Displaced Population	Persons Seeking Short-Term Sheltering	% Persons Seeking Short Term Shelter
Barton (T)	4,414	342	8%	49	1%
Waverly (V)	4,444	229	5%	126	3%
Berkshire (T)	1,412	198	14%	41	3%
Candor (T)	4,454	530	12%	125	3%
Candor (V)	851	245	29%	156	18%
Newark Valley (T)	2,949	189	6%	27	1%
Newark Valley (V)	997	65	7%	22	2%
Nichols (T)	2,013	229	11%	86	4%
Nichols (V)	512	29	6%	6	1%
Owego (T)	15,987	552	3%	184	1%
Owego (V)	3,896	421	11%	344	9%
Richford (T)	1,172	127	11%	14	1%
Spencer (T)	2,394	330	14%	116	5%
Spencer (V)	759	187	25%	81	11%
Tioga (T)	4,871	380	8%	164	3%
Tioga County	**51,125**	**4,053**	**8%**	**1,541**	**3%**

Source: HAZUS-MH 4.0
(T) – Town
(V) – Village

The total number of injuries and casualties resulting from flooding is generally limited based on advance weather forecasting, blockades and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning and precautions are in place. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results from persons trying to cross flooded roadways or channels during a flood.

Cascading impacts may also include exposure to pathogens such as mold. After flood events, excess moisture and standing water contribute to the growth of mold in buildings. Mold may present a health risk to building occupants, especially those with already compromised immune systems such as infants, children, the elderly and pregnant women. The degree of impact will vary and is not strictly measurable. Molds 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, 2017).

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 (CDC 2012)

Current loss estimation models such as HAZUS-MH 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

To assess potential impacts on buildings, both exposure (located in the hazard area) and estimated loss to the exposed inventory generated by HAZUS-MH v4.0 were examined for the 1- and 0.2-percent annual chance flood events. Table 5.4.1-10 and Table 5.4.1-10 summarize these results. In summary, there are 2,359 buildings located in 1-percent annual chance flood boundary with an estimated $1.1 billion of building/contents exposed. In total, this represents approximately 14.3% of the County's total general building stock inventory (approximately $7.8 billion). Based on this analysis, the Village of Owego has the greatest number of buildings and greatest percentage of building exposed to the 1-percent annual chance flood event (734 buildings – 50.0%).

There are 3,031 buildings located in the 0.2-percent annual chance flood boundary (inclusive of the 1-percent annual chance flood hazard area) with an estimated $1.5 billion of building/contents exposed. This represents approximately 18.7% of the County's total general building stock inventory. Based on this analysis, the Village of Nichols has greater than 71.9% of its buildings located in the 0.2-percent annual chance flood boundary; the Village of Owego has the greatest number of its buildings located in the 0.2-percent annual chance flood boundary (952 buildings).

Table 5.4.1-9. Estimated General Building Stock Exposure to the 1- Percent Annual Chance Flood Event – All Occupancies

Municipality	Total # Buildings	Total Replacement Cost Value (Structure and Contents)	Total (All Occupancies)			
			# Buildings	% Total	Total Replacement Cost Value (Structure and Contents	% Total
Barton (T)	1,972	$591,426,000	159	8.1%	$42,787,000	7.2%
Waverly (V)	1,728	$817,088,000	96	5.6%	$34,499,000	4.2%
Berkshire (T)	628	$143,451,000	69	11.0%	$13,832,000	9.6%
Candor (T)	2,024	$517,276,000	84	4.2%	$23,308,000	4.5%
Candor (V)	381	$129,173,000	25	6.6%	$9,718,000	7.5%
Newark Valley (T)	1,256	$307,152,000	128	10.2%	$25,506,000	8.3%
Newark Valley (V)	453	$140,422,000	49	10.8%	$17,272,000	12.3%
Nichols (T)	844	$221,033,000	65	7.7%	$18,515,000	8.4%
Nichols (V)	256	$109,051,000	0	0.0%	$0	0.0%
Owego (T)	6,675	$2,832,708,000	425	6.4%	$341,054,000	12.0%
Owego (V)	1,467	$830,668,000	734	50.0%	$425,153,000	51.2%
Richford (T)	582	$133,299,000	25	4.3%	$4,283,000	3.2%
Spencer (T)	1,143	$317,610,000	126	11.0%	$33,581,000	10.6%
Spencer (V)	355	$123,352,000	137	38.6%	$50,914,000	41.3%
Tioga (T)	2,162	$618,886,000	237	11.0%	$78,253,000	12.6%
Tioga County	**21,926**	**$7,832,595,000**	**2,359**	**10.8%**	**$1,118,675,000**	**14.3%**

Source: FEMA 2012, Hazus-MH 4.0
Note: The 1-percent flood boundary was overlaid on the HAZUS-MH v4.0 default general building stock inventory at the Census block level; the blocks with their centroids within hazard areas were totaled for each municipality.
(T) – Town
(V) – Village

Table 5.4.1-10. Estimated General Building Stock Exposure to the 0.2-Percent Annual Chance Flood Event – All Occupancies

Municipality	Total # Buildings	Total Replacement Cost Value (Structure and Contents)	Total (All Occupancies)			
			# Buildings	% Total	Total Replacement Cost Value (Structure and Contents	% Total
Barton (T)	1,972	$591,426,000	162	8.2%	$43,715,000	7.4%
Waverly (V)	1,728	$817,088,000	122	7.1%	$43,538,000	5.3%
Berkshire (T)	628	$143,451,000	69	11.0%	$13,832,000	9.6%
Candor (T)	2,024	$517,276,000	84	4.2%	$23,308,000	4.5%
Candor (V)	381	$129,173,000	25	6.6%	$9,718,000	7.5%
Newark Valley (T)	1,256	$307,152,000	148	11.8%	$30,629,000	10.0%
Newark Valley (V)	453	$140,422,000	78	17.2%	$28,180,000	20.1%
Nichols (T)	844	$221,033,000	117	13.9%	$33,389,000	15.1%
Nichols (V)	256	$109,051,000	184	71.9%	$81,042,000	74.3%
Owego (T)	6,675	$2,832,708,000	528	7.9%	$391,772,000	13.8%
Owego (V)	1,467	$830,668,000	952	64.9%	$583,410,000	70.2%
Richford (T)	582	$133,299,000	25	4.3%	$4,283,000	3.2%
Spencer (T)	1,143	$317,610,000	126	11.0%	$33,581,000	10.6%
Spencer (V)	355	$123,352,000	137	38.6%	$50,914,000	41.3%
Tioga (T)	2,162	$618,886,000	274	12.7%	$91,394,000	14.8%
Tioga County	**21,926**	**$7,832,595,000**	**3,031**	**13.8%**	**$1,462,705,000**	**18.7%**

Source: FEMA 2012, Hazus-MH 4.0
Note: The 0.2-percent flood boundary was overlaid on the HAZUS-MH v4.0 default general building stock inventory at the Census block level; the blocks with their centroids within hazard areas were totaled for each municipality.
(T) – Town
(V) – Village

The HAZUS-MH v4.2 model estimated potential damages to the buildings in Tioga County at the census block level Hazus-MH default building stock data. In total, HAZUS-MH v4.2 estimates approximately $211 billion which equates to approximately 2.7-percent of the total building stock replacement cost value. Approximately 60% of the total estimated losses are for residential and commercial structures. Potential damage estimated by HAZUS-MH v4.2 to the residential general building stock inventory associated with the 1-percent annual chance flood is approximately $74 million, or less than 1 percent of the total residential building stock replacement cost value and 35.2-percent of the total potential loss for all occupancy classes.

Table 5.4.1-11. Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event

Municipality	Total Replacement Cost Value	1% Annual Chance Event							
		All Occupancies		Residential		Commercial		Industrial, Religious, Education and Government	
		Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total
Barton (T)	$591,426,000	$32,237,000	5.5%	$6,276,000	1.1%	$3,102,000	0.5%	$22,859,000	3.9%
Berkshire (T)	$143,451,000	$3,770,000	2.6%	$2,383,000	1.7%	$912,000	0.6%	$475,000	0.3%
Candor (T)	$517,276,000	$14,689,000	2.8%	$7,684,000	1.5%	$4,240,000	0.8%	$2,765,000	0.5%
Candor (V)	$129,173,000	$18,403,000	14.2%	$4,438,000	3.4%	$2,325,000	1.8%	$11,640,000	9.0%
Newark Valley (T)	$307,152,000	$5,007,000	1.6%	$2,123,000	0.7%	$1,884,000	0.6%	$1,000,000	0.3%
Newark Valley (V)	$140,422,000	$2,924,000	2.1%	$1,029,000	0.7%	$632,000	0.5%	$1,263,000	0.9%
Nichols (T)	$221,033,000	$9,622,000	4.4%	$6,708,000	3.0%	$1,595,000	0.7%	$1,319,000	0.6%
Nichols (V)	$109,051,000	$13,528,000	12.4%	$982,000	0.9%	$860,000	0.8%	$11,686,000	10.7%
Owego (T)	$2,832,708,000	$47,017,000	1.7%	$13,162,000	0.5%	$14,495,000	0.5%	$19,360,000	0.7%
Owego (V)	$830,668,000	$22,761,000	2.7%	$9,281,000	1.1%	$9,101,000	1.1%	$4,379,000	0.5%
Richford (T)	$133,299,000	$3,607,000	2.7%	$1,697,000	1.3%	$1,716,000	1.3%	$194,000	0.1%
Spencer (T)	$317,610,000	$7,444,000	2.3%	$4,677,000	1.5%	$1,162,000	0.4%	$1,605,000	0.5%
Spencer (V)	$123,352,000	$7,675,000	6.2%	$2,372,000	1.9%	$3,506,000	2.8%	$1,797,000	1.5%
Tioga (T)	$618,886,000	$13,883,000	2.2%	$8,277,000	1.3%	$4,302,000	0.7%	$1,304,000	0.2%
Waverly (V)	$817,088,000	$8,622,000	1.1%	$3,137,000	0.4%	$3,604,000	0.4%	$1,881,000	0.2%
Tioga County	**$7,832,595,000**	**$211,189,000**	**2.7%**	**$74,226,000**	**0.9%**	**$53,436,000**	**0.7%**	**$83,527,000**	**1.1%**

Source: HAZUS-MH v4.2

NFIP Statistics

FEMA Region 2 provided a list of NFIP policies, past claims, repetitive loss properties (RL), and severe repetitive loss properties (SRL) in Tioga County. According to the metadata provided, "The (*sic* National Flood Insurance Program) NFIP Repetitive Loss File contains losses reported from individuals who have flood insurance through the Federal Government. A property is considered a repetitive loss property when there are "two or more losses reported which were paid more than $1,000 for each loss. The two losses must be within 10 years of each other and be at least 10 days apart. Only losses from (*sic* since) 1/1/1978 that are closed are considered. An SRL property is defined as a residential property covered under an NFIP flood insurance policy, and satisfying either of conditions 1 and 2, as well as condition 3 (Section 1361A of the National Flood Insurance Act 42 *United States Code* 4102a):

1. At least four NFIP claim payments for the property (including building and contents) over $5,000 each have occurred, and the cumulative amount of such claims payments exceeded $20,000.

2. At least two separate claims payments for the property (building payments only) have occurred, and the cumulative amount of the building portion of such claims exceeded the market value of the building.

3. For either of the above, at least two of the referenced claims must have occurred within any 10-year period and must have occurred more than 10 days apart.

In total, there are 979 NFIP policy holders in the County, and there have been 1,559 claims worth $61.6 million. Of the 979 policies, 707 policies (72.2% of the total) are located in the floodplain; this may indicate inaccuracies with floodplain mapping or stormwater/localized flooding issues that may not be reflected in the FEMA delineated floodplains. Single family residences account for approximately 80.9% of the total RL properties in Tioga County (FEMA Region 2 2018). Single family residences account for approximately 87.9% of the total SRL properties in Tioga County (FEMA Region 2, 2018).

Table 5.4.1-12. Occupancy Class of Repetitive Loss Structures in Tioga County

Occupancy Class	Total Number of Repetitive Loss Properties	Total Number of Severe Repetitive Loss Properties	Total (RL + SRL)
Single Family	224	29	253
Condo	2	-	2
2-4 Family	22	1	23
Other Non-Residential	29	1	30
Business Non-Residential	0	1	1
Total	**277**	**33**	**310**

Source: FEMA, 2018
Note (1): Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA and are current as of February 28, 2018 and are summarized by Community Name. Please note the total number of repetitive loss properties excludes the severe repetitive loss properties. The number of claims represents claims closed by 2/28/2018.
Note (2): Total building and content losses from the claims file provided by FEMA Region 2.
RL Repetitive Loss
SRL Severe Repetitive Loss
T Town
V Village

Table 5.4.1-13. Occupancy Class of Repetitive Loss Structures in Tioga County, by Municipality

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties				
	2-4 Family	Assumed Condo	Business Non-Residential	Other Non-Residential	Single Family	2-4 Family	Assumed Condo	Business Non-Residential	Other Non-Residential	Single Family
Barton (T)	0	0	0	0	6	0	0	0	0	2
Candor (T)	0	0	0	0	1	0	0	0	0	0
Newark Valley (T)	0	0	0	0	1	0	0	0	0	0
Newark Valley (V)	0	0	0	0	0	0	0	0	0	1
Nichols (T)	0	0	0	1	22	0	0	0	0	2
Owego (T)	1	2	0	12	64	0	0	1	0	13
Owego (V)	14	0	0	16	116	1	0	0	1	7
Spencer (T)	0	0	0	0	1	0	0	0	0	0
Spencer (V)	0	0	0	0	2	0	0	0	0	0
Tioga (T)	7	0	0	0	11	1	0	0	0	4
Tioga County	**22**	**2**	**0**	**29**	**224**	**2**	**0**	**1**	**1**	**29**

Source: *FEMA, 2018*
Note (1): *Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA and are current as of February 28, 2018 and are summarized by Community Name. Please note the total number of repetitive loss properties excludes the severe repetitive loss properties. The number of claims represents claims closed by 2/28/2018.*
Note (2): *Total building and content losses from the claims file provided by FEMA Region 2.*
Note (3): *Table only presents municipalities with repetitive loss properties.*
RL *Repetitive Loss*
SRL *Severe Repetitive Loss*
T *Town*
V *Village*

Table 5.4.1-14. NFIP Policies, Claims and Repetitive Loss Statistics

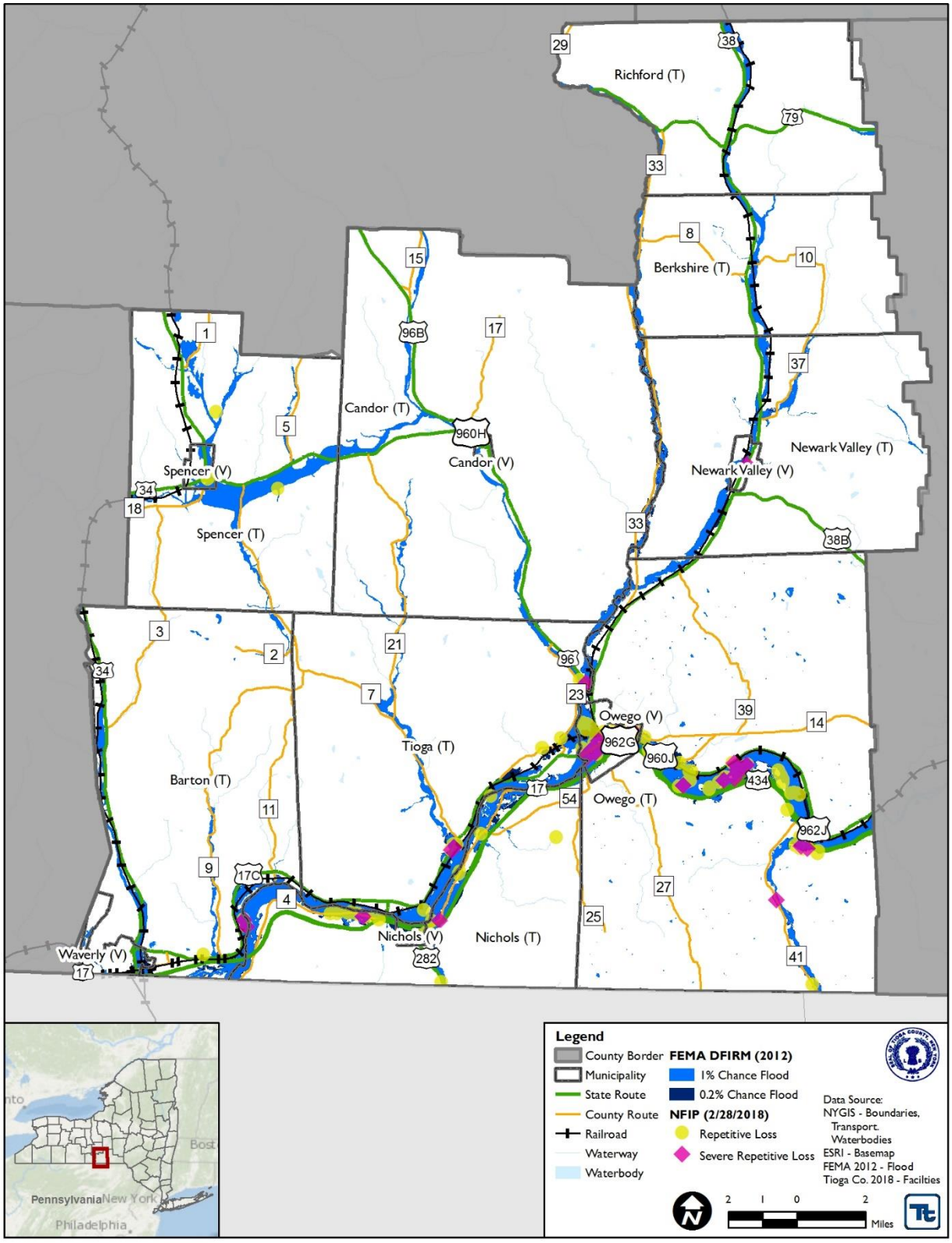
Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)
Barton (T)	21	74	$1,233,892.77	6	2	16
Berkshire (T)	20	4	$14,729.87	0	0	17
Candor (T)	33	27	$448,164.00	1	0	17
Candor (V)	4	10	$211,034.00	0	0	4
Newark Valley (T)	20	13	$183,484.00	1	0	12
Newark Valley (V)	14	14	$200,635.00	0	1	7

Table 5.4.1-14. NFIP Policies, Claims and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	Total Loss Payments (2)	# Rep. Loss Prop. (1)	# Severe Rep. Loss Prop. (1)	# Policies in the 1% Flood Boundary (3)
Nichols (T)	57	96	$2,925,307.79	23	2	50
Nichols (V)	11	4	$28,512.26	0	0	0
Owego (T)	196	433	$23,427,859.80	79	14	121
Owego (V)	448	699	$27,976,074.15	146	9	337
Richford (T)	2	4	$1,731.12	0	0	1
Spencer (T)	36	30	$634,350.03	1	0	26
Spencer (V)	35	5	$12,171.45	2	0	34
Tioga (T)	47	124	$3,466,234.45	18	5	36
Waverly (V)	35	22	$94,744.18	0	0	29
Tioga County	**979**	**1,559**	**$61,608,263.39**	**277**	**33**	707

Source: FEMA, 2018
Note (1): Policies, claims, repetitive loss and severe repetitive loss statistics provided by FEMA and are current as of February 28, 2018 and are summarized by Community Name. Please note the total number of repetitive loss properties excludes the severe repetitive loss properties. The number of claims represents claims closed by 2/28/2018.
Note (2): Total building and content losses from the claims file provided by FEMA Region 2.
RL Repetitive Loss
SRL Severe Repetitive Loss
T Town
V Village

Figure 5.4.1-5. NFIP Repetitive Loss Areas – Tioga County



Source: FEMA Region 2, 2018

Impact on Critical Facilities

It is important to determine what critical facilities and infrastructure 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 facility structures 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, including for emergency service providers needing to get to vulnerable populations or to make repairs. Major roadways that may be impacted by the 1-percent annual chance flood event include , NY-34, NY-38, NY-79, NY-86, NY-96, NY-220, NY-282, NY-434, NY-17C, NY-96B, and West Main Street. 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.

Critical facility exposure to the flood hazard was examined. In addition, HAZUS-MH was used to estimate the flood loss potential to critical facilities exposed to the flood risk. Table 5.4.1-15 summarizes these results.

Table 5.4.1-15. Critical Facility Types Located in the 1- and 0.2-percent Annual Chance Event Floodplain and Estimated Damage

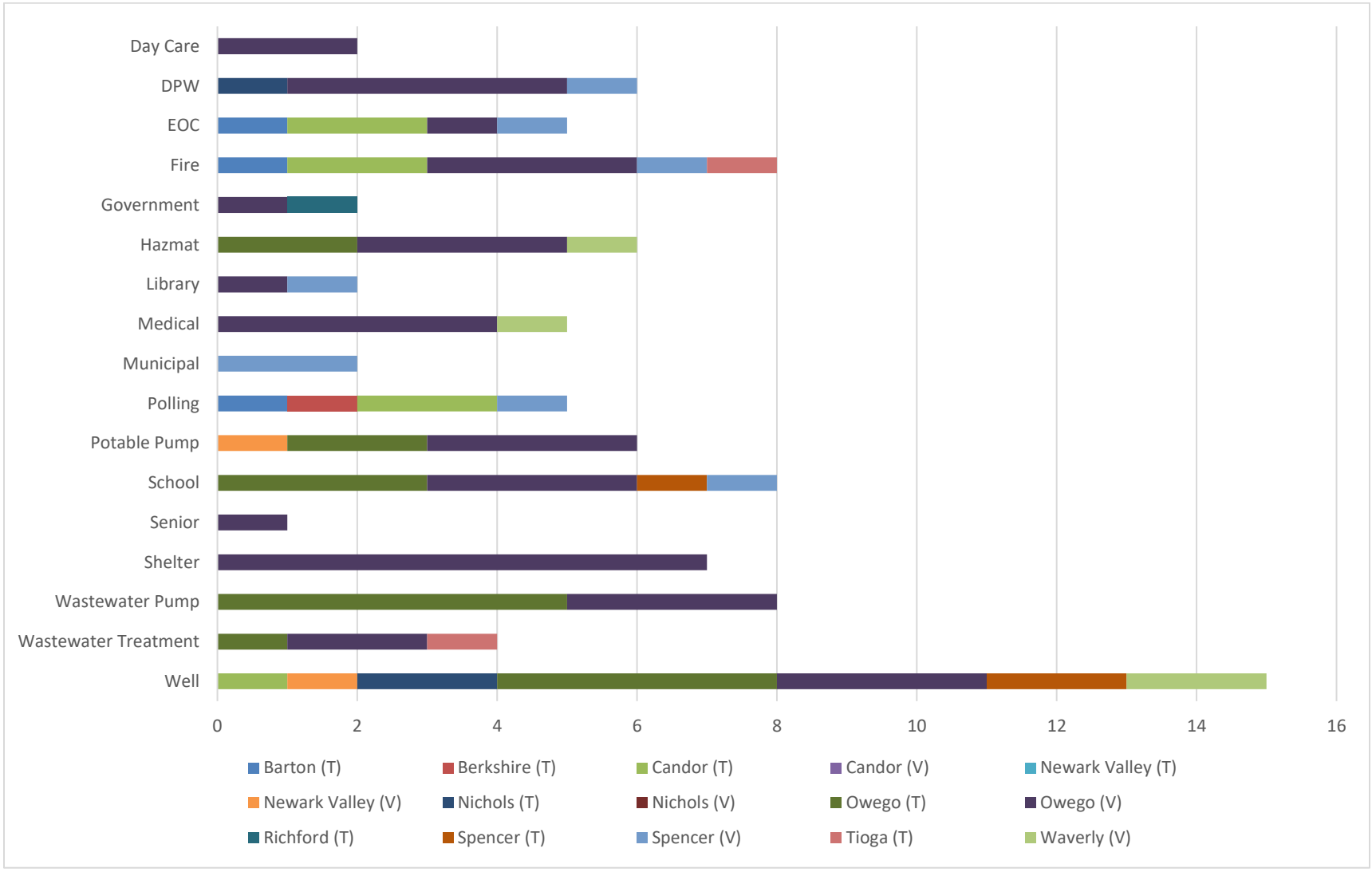
Facility Type	Number of Facilities Located in the 1-Percent Annual Chance Event	Number of Facilities Located in the 0.2-Percent Annual Chance Event	Average % of Total Value Damaged	
			Structure	Content
Bridge	91	102	None Estimated	None Estimated
Communication Tower	0	1	None Estimated	None Estimated
Dam	14	15	None Estimated	None Estimated
Day Care	2	2	None Estimated	None Estimated
Dept. of Public Works	6	7	6.5	18.1
Emergency Operation Center	5	6	18.6	31.7
Fire	8	10	29.3	23.8
Government	2	7	7.3	52.0
Hazmat	6	9	None Estimated	None Estimated
Homeless Housing	0	1	None Estimated	None Estimated
Library	2	3	13.4	77.9
Medical	5	7	0.0	0.0
Municipal	2	4	9.2	53.8
Police	0	1	None Estimated	None Estimated
Polling	5	6	7.8	45.2
Potable Pump	6	9	22.9	-
School	8	11	11.2	15.5
Senior	1	3	None Estimated	None Estimated
Shelter	7	8	5.2	35.7
Telecommunication Facility	0	2	None Estimated	None Estimated

Facility Type	Number of Facilities Located in the 1-Percent Annual Chance Event	Number of Facilities Located in the 0.2-Percent Annual Chance Event	Average % of Total Value Damaged	
			Structure	Content
Well	15	16	None Estimated	None Estimated
Wastewater Pump	8	10	None Estimated	None Estimated
Wastewater Treatment	4	5	None Estimated	None Estimated
Total/Average	**197**	**245**	**10.8**	**42.6**

Source: Tioga County, FEMA 2017, HAZUS-MH v4.2

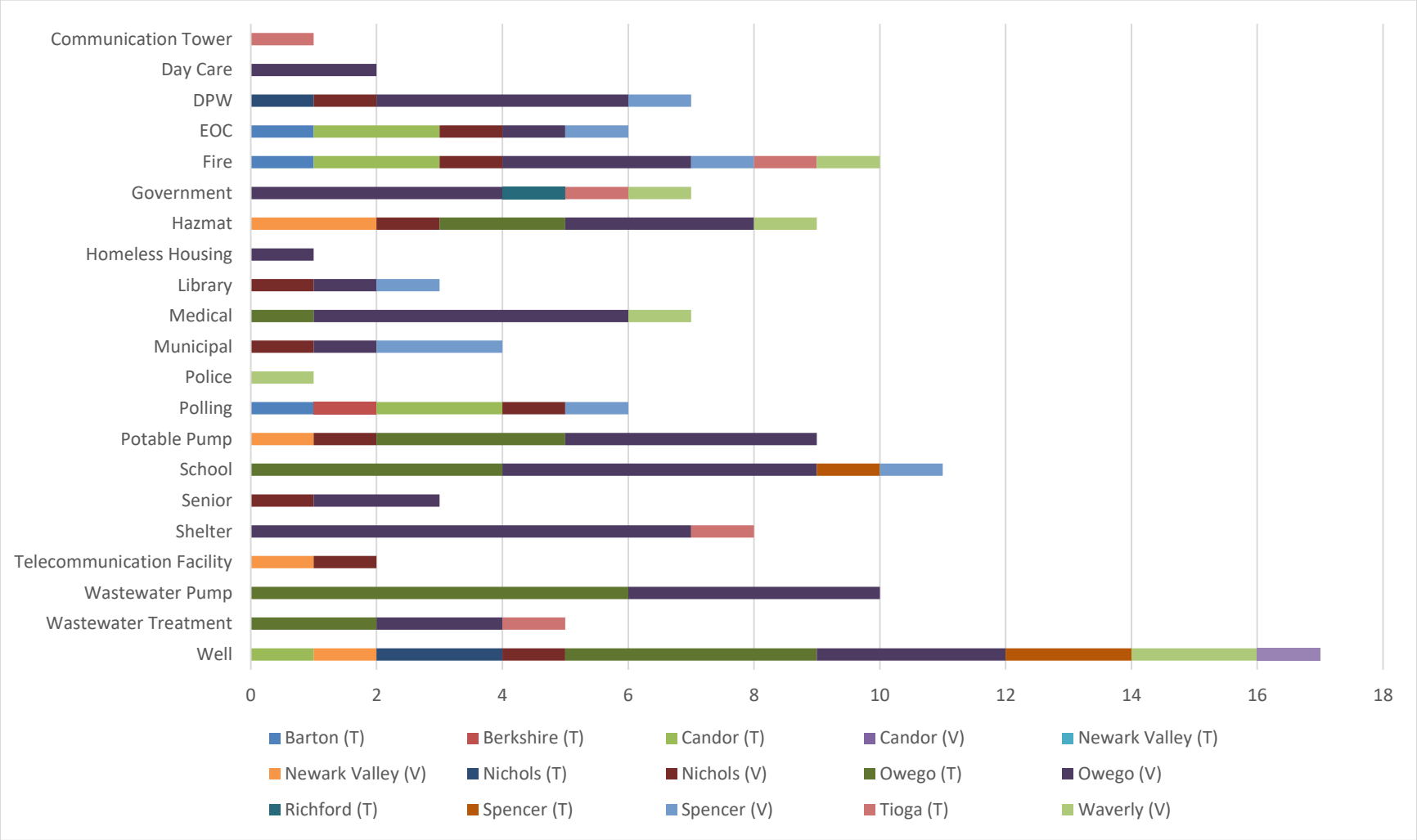
Figure 5.4.1-6 and Figure 5.4.1-7 display the number of critical facilities by type and by municipality within the 1- and 2-percent annual chance flood hazard areas, respectively. Bridges and dams were not included in the figures as they are inherently located in the floodplain.

Figure 5.4.1-6. Distribution of Critical Facilities in the 1-percent Annual Chance Flood Event Floodplain by Type and Municipality



Source: FEMA 2012, Tioga County
(T) – Town
(V) – Village

Figure 5.4.1-7. Distribution of Critical Facilities in the 0.2-percent Annual Chance Flood Event Floodplain by Type and Municipality



Source: FEMA 2012, Tioga County
(T) – Town
(V) – Village

Impact on the Economy

Flood events can significantly impact the local and regional economy. This includes but is not limited to general building stock damages and associated tax loss, impacts to utilities and infrastructure, agricultural losses, business interruption, and effects on tourism.

Flooding can cause extensive damage to public utilities and disruptions to the delivery of services. Loss of power and communications may occur; and drinking water and wastewater treatment facilities may be temporarily out of operation. According to Figure 5.4.1-6, 197 facilities are affected by the 1-percent annual chance flood hazard. Flooded streets and road blocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roadway and bridges (Foster, Date Unknown). In addition to travel along the roadways, public transit will be greatly impacted, causing problems for emergency responders.

In areas that are directly flooded, renovations of commercial and industrial buildings may be necessary, disrupting associated services. Refer to the section earlier which discusses direct impacts to buildings in the County.

Debris management may also be a large expense after a flood event. HAZUS-MH v4.2 estimates amount of 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 5.4.1-16 summarizes the debris estimates for the 1-percent annual chance flood event. Note, this table only estimates structural debris generated by flooding and does not include non-structural debris or additional potential damage and debris possibly generated by wind that may be associated with a flood event or storm that causes flooding.

Table 5.4.1-16. Estimated Debris Generated from the 1-Percent Flood Event

Municipality	1% Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Barton (T)	781	294	240	247
Berkshire (T)	267	113	69	85
Candor (T)	746	338	190	218
Candor (V)	957	261	367	329
Newark Valley (T)	281	126	68	87
Newark Valley (V)	153	48	55	49
Nichols (T)	653	362	149	143
Nichols (V)	72	58	8	6
Owego (T)	1,119	496	356	268
Owego (V)	482	402	47	34
Richford (T)	232	100	56	76
Spencer (T)	249	153	35	61
Spencer (V)	128	88	14	26
Tioga (T)	1,054	415	295	345
Waverly (V)	378	202	106	70
Tioga County	**7,551**	**3,454**	**2,054**	**2,043**

Source: HAZUS-MH 4.2

Impact on the Environment

Floodplains serve beneficial and natural functions on ecological/environmental, social, and economic levels. Areas in the floodplain that typically provide these natural functions and benefits are wetlands, riparian areas, sensitive areas, and habitats for rare and endangered species. Floods, however, can also lead to negative impacts on the environment. According to FEMA, well-known, water-related functions of floodplains include the following. Disruption of natural systems and the benefits they provide can have long-term consequences for entire regions.

- Natural flood and erosion control
- Provide flood storage and conveyance
- Reduce flood velocities
- Reduce flood peaks
- Reduce sedimentation
- Surface water quality maintenance
- Filter nutrients and impurities from runoff
- Process organic wastes
- Moderate temperatures of water
- Groundwater recharge
- Promote infiltration and aquifer recharge
- Reduce frequency and duration of low surface
- flows.

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 could be affected by the flood hazard if within identified hazard areas. The County intends to discourage development within vulnerable areas or to encourage higher regulatory standards on the local level. Please refer to the specific areas of development indicated in tabular form in the jurisdictional annexes in Volume II, Section 9 of this Plan Update.

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. Overall, there are three developments located in the 1-percent annual chance flood event boundary and 1 located in the 0.2-percent annual chance flood event boundary.

Projected Changes in Population

Refer to Section 4.4.2 - Population Trends in the County Profile for a discussion on trends for the County. According to population projects from the Cornell Program on Applied Demographics, Tioga County will experience a continual population decrease through 2040 (nearly 8,500 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, those that remain may move into locations that are more susceptible than others. This includes areas that are directly impacted by flood events and those that are indirectly impacted (i.e. isolated neighborhoods, floodprone roadways, etc.).

Climate Change

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as flood events. While predicting changes of flood events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Change of Vulnerability Since the 2013 HMP

The certification of the Village of Nichols levee provides the most significant change of vulnerability within the county since the 2013 HMP. This has removed the entire population within the previous regulatory floodplain in the Village. However, vulnerability to the 0.2 percent flood event continues to exist with almost 70% of the population exposed to that event. Tioga County and its municipalities continue to be vulnerable to the flood hazard.

There are several differences between the exposure and potential loss estimates between this plan update to the results in the 2013 Tioga County Hazard Mitigation Plan. As noted above, the preliminary data at the time of the 2013 HMP had since become effective with differences in vulnerability to the Village of Nichols. Regarding estimated impacts, HAZUS-MH has been updated between the previous HMP and this plan update. HAZUS-MH v4.0/4.2, which now utilize 2010 Census demographic data and updated default general building stock valuations, also use a dasymetric Census Block configuration which removes undeveloped areas from the boundaries and excludes them from the loss model. Due to these differences in the modeling, a direct comparison between plan vulnerability assessment results could not be conducted to determine if there has been a change over time to the estimated impacts.

Overall, this vulnerability assessment uses a more accurate and updated population, building inventory, and critical facility inventory which provides more accurate estimated exposure and potential losses for Tioga County.

Issues Identified

A significant number of communities have a high population exposed to flooding, with the Villages of Candor, Newark Valley, Owego and Spencer and the Towns of Newark Valley, Nichols and Tioga each having greater than 10% population exposed to flooding (the Village of Owego with approximately 50% and the Village of Spencer with over 40% of their populations residing in the regulatory floodplain). Similarly, these communities have a considerable number of structures vulnerable to flooding.

The Village of Spencer has the highest need of temporary housing (% population) in the event of a one percent chance flood event occurrence.

Some communities have identified structures outside of the regulatory floodplain which are prone to flooding which indicates the existence of stormwater flooding. In particular, the Village of Newark Valley has identified stormwater runoff along NYS Route 38 due to topography as an issue to be addressed.

Flooding issues are a regional problem crossing county borders due the location of Tioga County in the extensive Susquehanna River basin and with the confluence of the Susquehanna and Chenango rivers within its borders.

5.4.2 Severe Storms

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 weather hazard in Tioga County.

5.4.2.1 Profile

Hazard Description

For the purpose of this HMP and as deemed appropriated by the Tioga County Steering and Planning Committees, the severe storm hazard includes: thunderstorms, lightning, hail, tornadoes, high winds, and hurricanes/tropical storms, which are defined below.

Thunderstorms

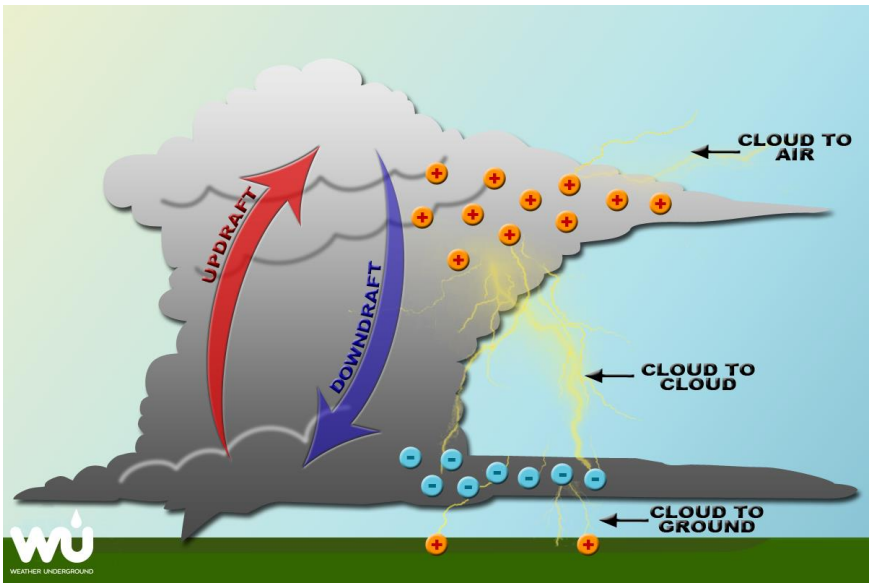
A thunderstorm is a local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder (NWS 2009d). A thunderstorm forms from a combination of moisture, rapidly rising warm air, and a force capable of lifting air such as a warm and cold front, a sea breeze, or a mountain. Thunderstorms 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 2010c).

Thunderstorms can lead to flooding, landslides, strong winds, and lightning. Roads may become impassable from flooding, downed trees or power lines, or a landslide. Downed power lines can lead to utility losses, such as water, phone and electricity. Typical thunderstorms are 15 miles in diameter and last an average of 30 minutes. An estimated 100,000 thunderstorms occur each year in the U.S., with approximately 10% of them classified as severe. During the warm season, thunderstorms are responsible for most of the rainfall.

Lightning

Lighting 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 can damage homes and injure people. It ranks as one of the top weather killers in the United States and kills approximately 50 people and injures hundreds each year. Lightning can occur anywhere there is a thunderstorm.

Figure 5.4.2-1. Lightning Formation

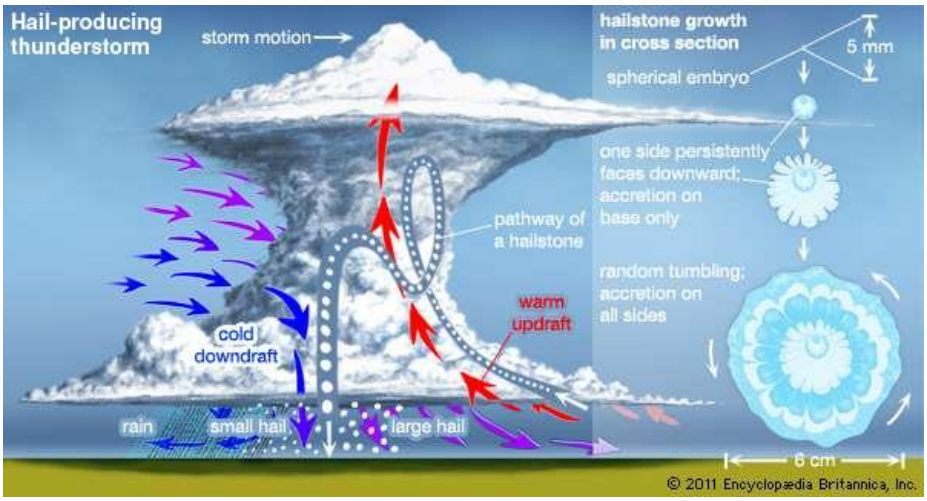


Source: Weather Underground date unknown

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 may thaw as it moves into warmer air toward the bottom of the thunderstorm. However, the droplet may be picked up again by another updraft and carried back into the cold air and 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 2010c).

Figure 5.4.2-2. Hail Formation



Source: Encyclopedia Britannica 2011

High Winds

High winds, other than tornadoes, are experienced in all parts of the United States. Areas that experience the highest wind speeds are coastal regions from Texas to Maine, and the Alaskan coast; however, exposed mountain areas experience winds at least as high as those along the coast (FEMA 1997; Robinson 2013). 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 have the potential to down trees, tree limbs and power lines which lead to widespread power outages and damaging residential and commercial structures throughout Tioga County. High winds are often associated by other severe weather events such as thunderstorms, tornadoes, hurricanes and tropical storms.

Figure 5.4.2-3. Microburst/Straight Line Wind Damage near Barton, July 2012

Source: NWS 2012

Tornadoes

Tornadoes are nature's most violent storms and can cause fatalities and devastate neighborhoods in seconds. A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 300 mph. Damage paths can be greater than one mile in width and 50 miles in length. Tornadoes typically develop from either a severe thunderstorm or hurricane as cool air rapidly overrides a layer of warm air. The average speed of a tornado is 30 mph but may vary from nearly stationary to 70 mph. The lifespan of a tornado rarely is longer than 30 minutes (FEMA 1997; NWS 2010b).

Tropical Storms/ Hurricanes

Tropical systems may develop in the Atlantic between the Lesser Antilles and the African coast or may develop in the warm tropical waters of the Caribbean and Gulf of Mexico. These storms may move up the Atlantic coast of the United States and impact the eastern seaboard or move into the United States through the states along the Gulf Coast, bringing wind and rain as far north as New England before moving offshore and heading east.

A tropical storm system is characterized by a low-pressure center and numerous thunderstorms that produce strong winds and heavy rain (winds are at a lower speed than hurricane-force winds, thus gaining its status as tropical storm versus hurricane). Tropical storms strengthen when water evaporated from the ocean is released as the saturated air rises, resulting in condensation of water vapor contained in the moist air. They are fueled by a different heat mechanism than other cyclonic windstorms such as Nor'Easters and polar lows. The characteristic that separates tropical cyclones from other cyclonic systems is that at any height in the atmosphere,

the center of a tropical cyclone will be warmer than its surroundings; a phenomenon called "warm core" storm systems (NOAA 1999). A hurricane is a tropical storm that attains hurricane status when its wind speed reaches 74 or more miles an hour.

Figure 5.4.2-4: Floodwaters associated with Tropical Storm Lee inundate North Avenue in Owego

Source: New York State Governor's Office 2012

Location

Thunderstorms and Lightning

Thunderstorms affect relatively small localized areas, rather than large regions like winter storms and hurricane events. Thunderstorms can strike in all regions of the United States; however, they are most common in the central and southern states. The atmospheric conditions in these regions of the country are ideal for generating these powerful storms. It is estimated that there are as many as 40,000 thunderstorms each day worldwide. The most thunderstorms are seen in the southeast United States, with Florida having the highest incidences (80 to over 100 thunderstorm days each year). According to NOAA, Tioga County can experience between 10 and 20 thunderstorm days each year (NOAA 2016).

Hailstorms

Hailstorms are most frequent in the southern and central plains states in the United States, where warm moist air off of the Gulf of Mexico and cold dry air from Canada collide, and thereby spawning violent thunderstorms. This area of the United States is known as hail alley and lies within the states of Texas, Oklahoma, Colorado, Kansas, Nebraska, and Wyoming. In New York State, hailstorms can occur anywhere within the State independently or during a tornado, thunderstorm or lightning event.

Tornadoes

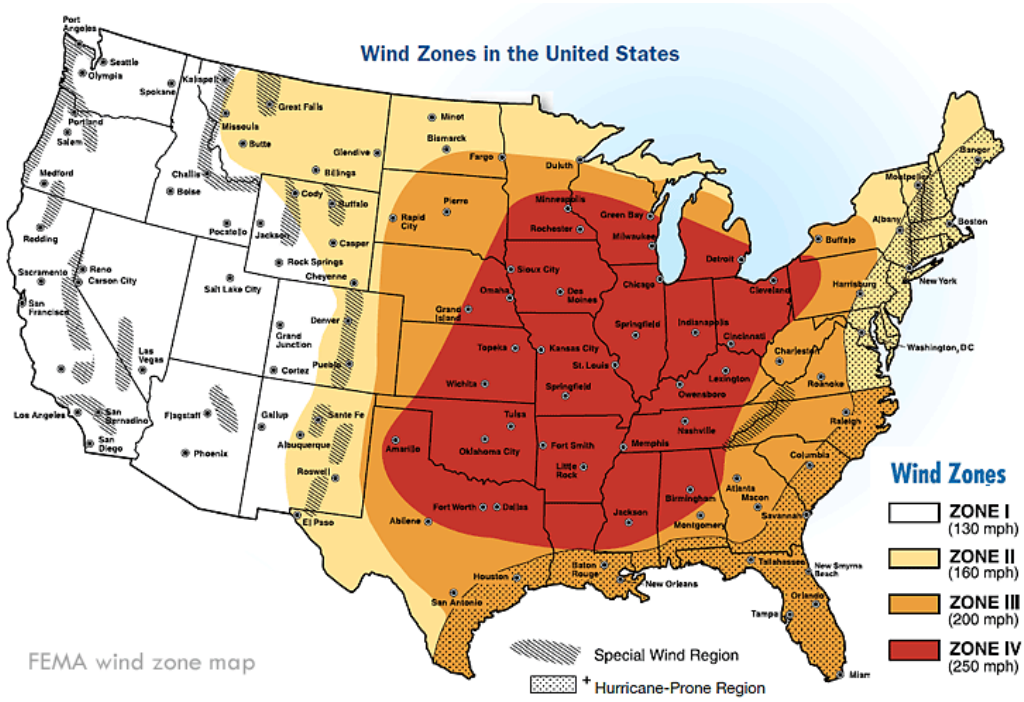
Tornadoes have been documented in every state in the United States, and on every continent with the exception of Antarctica. Approximately 1,200 tornadoes occur in the United States each year, with the central portion of the country experiencing the most. Tornadoes can occur at any time of the year, with peak seasons at different times for different states (NSSL 2013). New York State has a definite vulnerability to tornadoes. Since 1952,

over 350 tornadoes ranging from F0 to F4 have occurred throughout the State (NYS DHSES 2014). Based on statistics from 1985 to 2014, New York State has experienced an average of 10 tornadoes annually (NOAA 2016). For Tioga County, between 1950 and 2015, the County experienced one tornado, which averages approximately 0.1 tornadoes each year (SPC 2016).

High Winds

All of Tioga County is subject to high winds from thunderstorms, hurricanes/tropical storms, tornadoes, and other severe weather events. According to the FEMA Winds Zones of the United States map, Tioga County is located in Wind Zone III, where wind speeds can reach up to 200 mph. The County is just outside of the Hurricane Susceptible Region, which extends along the entire east coast from Maine to Florida, the Gulf Coast, and Hawaii but can still experience elevated winds when hurricanes and tropical systems move through the area. This figure indicates how the frequency and strength of windstorms impacts the United States and the general location of the most wind activity. This is based on 40 years of tornado data and 100 years of hurricane data, collected by FEMA.

Figure 5.4.2-5: FEMA Wind Zone Map of the United States



Source: https://www.fema.gov/pdf/library/ism2_s1.pdf

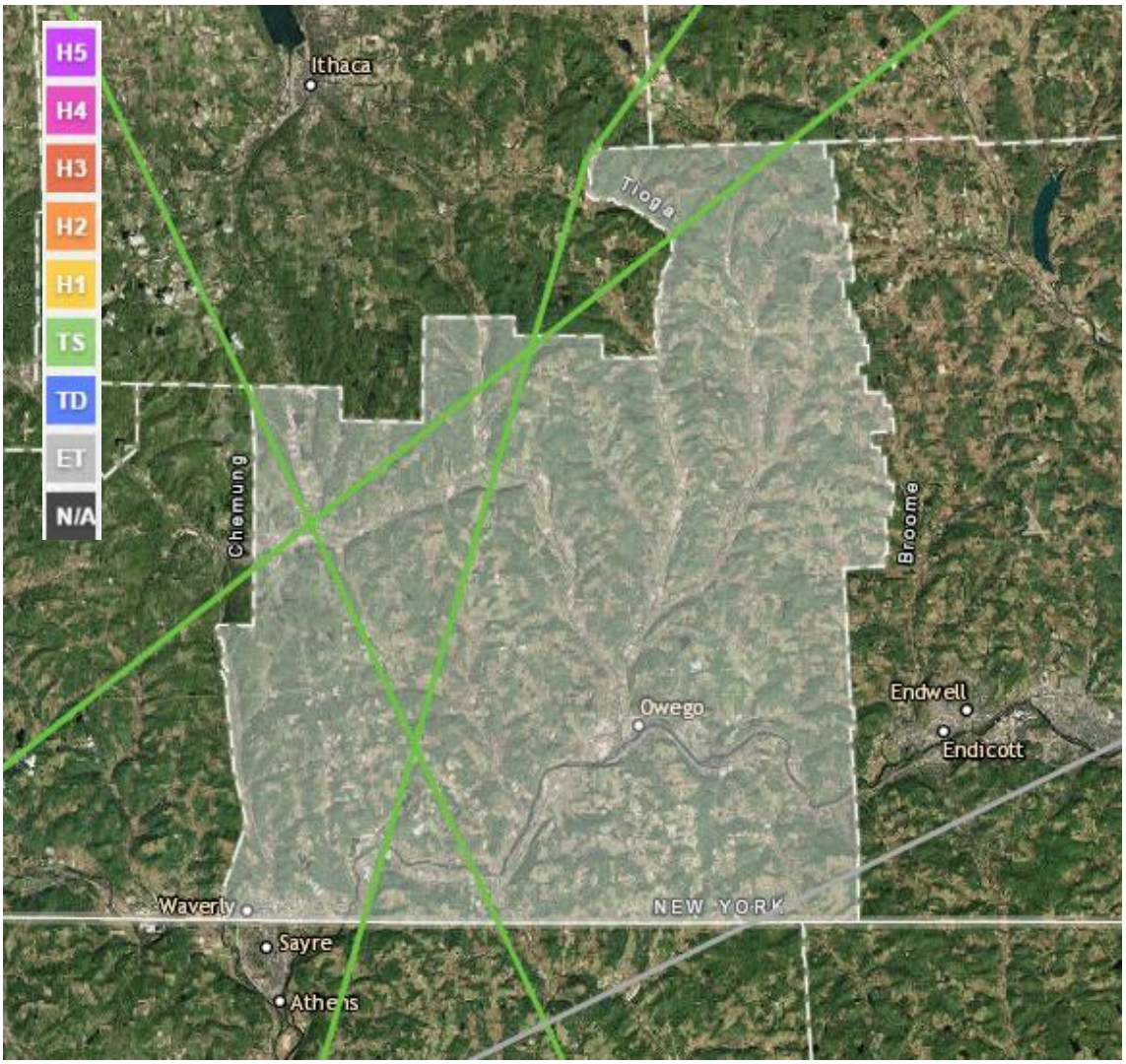
Tropical Storms/ Hurricanes/

Tropical storms and hurricanes can impact New York State from June to November, the official eastern United States hurricane season. However, late July to early October is the period hurricanes and tropical storms are most likely to impact New York State, due to the coolness of the North Atlantic Ocean waters (NYS DHSES 2014).

Tioga County is vulnerable to the impacts of hurricanes and tropical storms. However, it depends on the storm's track. Inland areas are at risk for flooding due to the heavy rain and winds produced by hurricanes and tropical storms. The majority of damage from these events often results from residual wind damage and inland flooding, most recently experienced during Hurricane Irene and Tropical Storm Lee in August and September 2011.

NOAA's Historical Hurricane Tracks tool is a public interactive mapping application that displays Atlantic Basin and East-Central Pacific Basin tropical cyclone data. This interactive tool catalogs tropical cyclones that have occurred from 1842 to 2016 (latest date available from data source). Between 1950 and 2016, 4 tropical cyclones tracked within 65 nautical miles of Tioga County, as seen in Figure 5.4.2-6.

Figure 5.4.2-6. Historical Tropical Storm and Hurricane Tracks 1950 to 2018



Source: NOAA NHC 2018

Extent

Historical data presented in Table 5.4.2-1 shows the maximum extent of severe weather in Tioga County.

Table 5.4.2-1. Severe Storm Extent in Tioga County (1950 to 2017)

Extent of Severe Storms in Tioga County	
Largest Hailstone on Record	2 inches
Strongest Tornado on Record	F3
Highest Wind Speed on Record	87 knots

Extent of Severe Storms in Tioga County	
Strongest Tropical Storm/Hurricane on Record	Tropical Storm

Hailstorms

The severity of hail is measured by duration, hail size, and geographic extent. All of these factors are directly related to thunderstorms, which creates hail. There is wide potential variation in these severity components. The most significant impact of hail is damage to crops. Hail also has the potential to damage structures and vehicles during hailstorms.

Hail can be produced from many different types of storms. Typically, hail occurs with thunderstorm events. The size of hail is estimated by comparing it to a known object. Most hailstorms are made up of a variety of sizes, and only the very largest hail stones pose serious risk to people, when exposed. Table 5.4.2-2 shows the different sizes of hail and the comparison to real-world objects.

Table 5.4.2-2. Hail Size

Size	Inches in Diameter
Pea	0.25 inch
Marble/mothball	0.50 inch
Dime/Penny	0.75 inch
Nickel	0.875 inch
Quarter	1.0 inch
Ping-Pong Ball	1.5 inches
Golf Ball	1.75 inches
Tennis Ball	2.5 inches
Baseball	2.75 inches
Tea Cup	3.0 inches
Grapefruit	4.0 inches
Softball	4.5 inches

Source: NOAA 2012; NYS DHSES 2014

High Winds

The following table provides the descriptions of winds used by the NWS during wind-producing events.

Table 5.4.2-3. NWS Wind Descriptions

Descriptive Term	Sustained Wind Speed (mph)
Strong, dangerous, or damaging	≥40
Very Windy	30-40
Windy	20-30
Breezy, brisk, or blustery	15-25
None	5-15 or 10-20
Light or light and variable wind	0-5

Source: NWS 2010
mph miles per hour

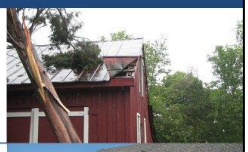
The NWS issues advisories and warnings for winds. Issuance is normally site-specific. High wind advisories, watches and warnings are products issued by the NWS when wind speeds may pose a hazard or is life threatening. The criterion for each of these varies from state to state. Wind warnings and advisories 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 (NWS 2015).

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 5.4.2-7 illustrates the relationship between EF ratings, wind speed, and expected tornado damage.

Figure 5.4.2-7. 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: NWS 2018

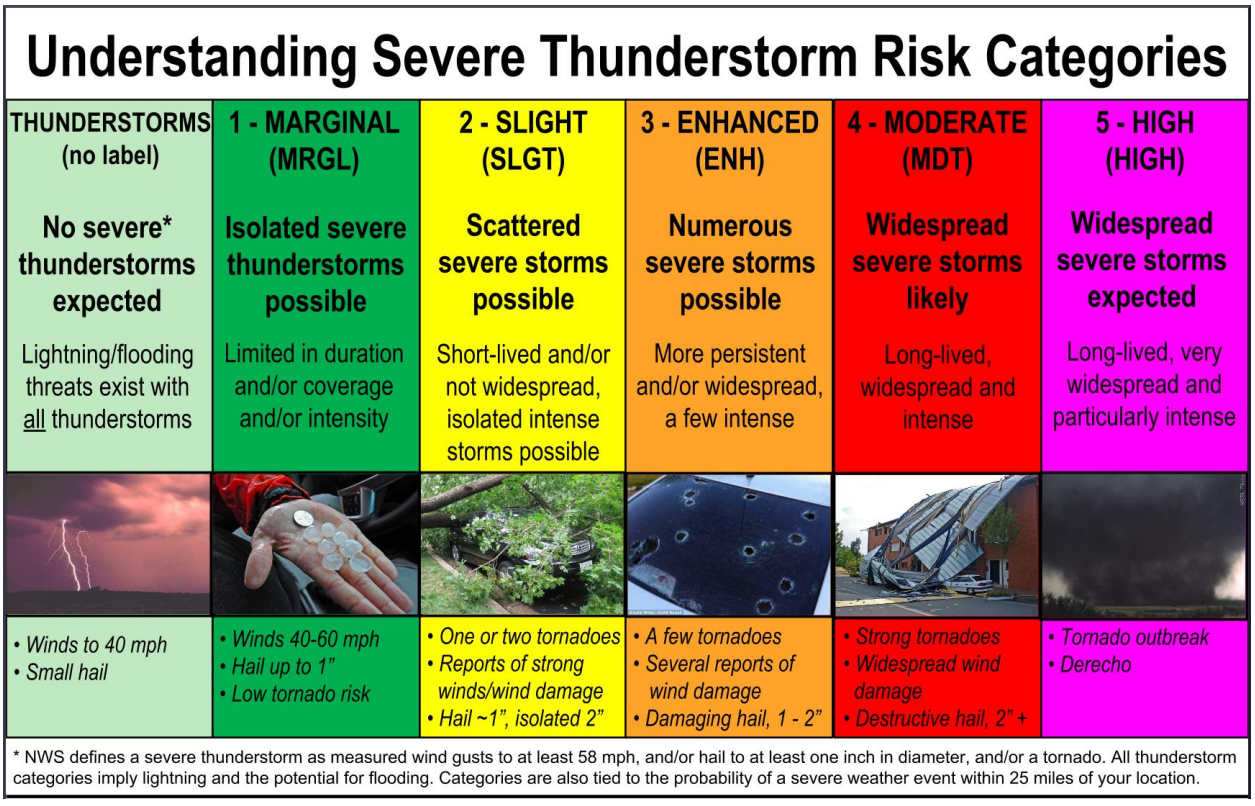
Tornado watches and warning are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar. The current average lead time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly, that little, if any, advance warning is possible (NOAA 2013; FEMA 2013).

Thunderstorms and Lightning

Severe thunderstorm watches and warnings are issued by the local NWS office and SPC. The NWS and SPC will update the watches and warnings and will notify the public when they are no longer in effect. Watches and warnings for tornadoes in New York State are as follows:

- Severe Thunderstorm Warnings are issued when there is evidence based on radar or a reliable spotter report that a thunderstorm is producing, or forecast to produce, wind gusts of 58 mph or greater, structural wind damage, and/or hail one-inch in diameter or greater. A warning will include where the storm was located, what municipalities will be impacted, and the primary threat associated with the severe thunderstorm warning. After it has been issued, the NWS office will follow up periodically with Severe Weather Statements which contain updated information on the severe thunderstorm and will let the public know when the warning is no longer in effect (NWS 2009d; NWS 2010c).
- Severe Thunderstorm Watches are issued by the SPC when conditions are favorable for the development of severe thunderstorms over a larger-scale region for a duration of at least three hours. Tornadoes are not expected in such situations, but isolated tornado development may also occur. Watches are normally issued well in advance of the actual occurrence of severe weather. During the watch, the NWS will keep the public informed on what is happening in the watch area and also let the public know when the watch has expired or been cancelled (NWS 2009; NWS 2010).
- Special Weather State for Near Severe Thunderstorms are issued for strong thunderstorms that are below severe levels, but still may 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 2010).

Figure 5.4.2-8. Severe Thunderstorm Risk Categories

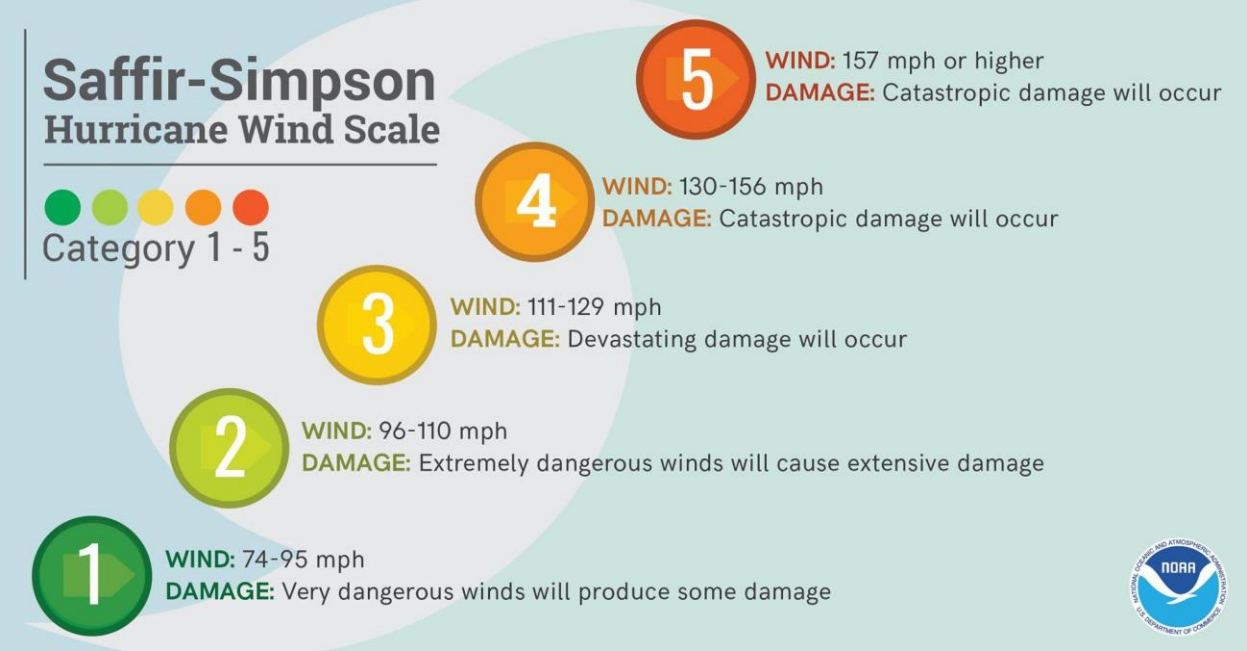


Source: NOAA SPC 2017

Tropical Storms/ Hurricanes

The extent of a hurricane is categorized in accordance with the Saffir-Simpson Hurricane Scale. The Saffir-Simpson Hurricane Wind Scale is a 1-to-5 rating based on a hurricane's 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. Category 1 and 2 storms are still dangerous and require preventative measures (NOAA 2013). Figure 5.4.2-9 presents this scale, which is used to estimate the potential property damage and flooding expected when a hurricane makes landfall.

Figure 5.4.2-9. The Saffir-Simpson Scale



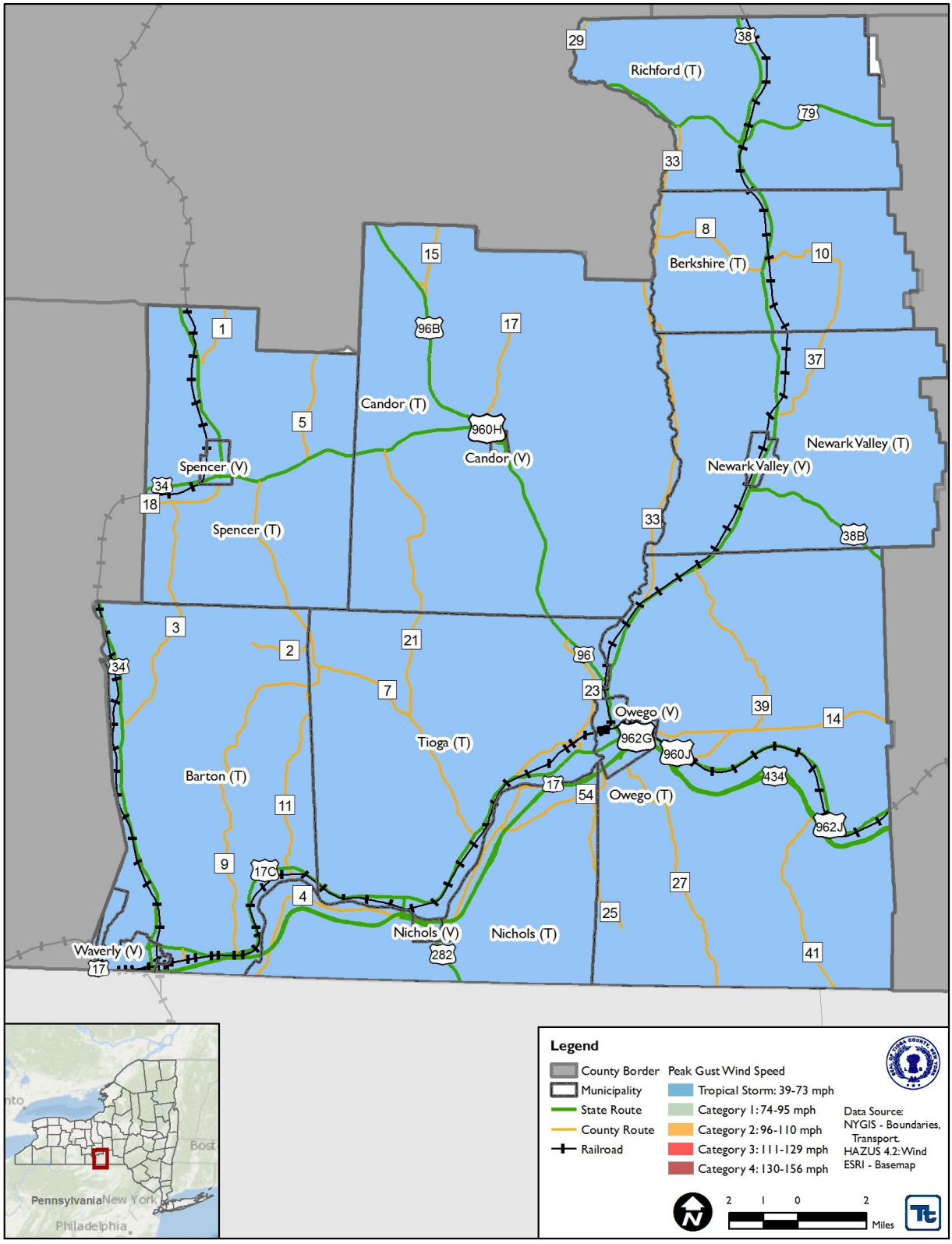
Source: Disaster Readiness Portal 2017

Mean Return Period

In evaluating the potential for hazard events of a given magnitude, a mean return period (MRP) is often used. The MRP provides an estimate of the magnitude of an event that may occur within any given year based on past recorded events. MRP is the average period of time, in years, between occurrences of a particular hazard event, equal to the inverse of the annual frequency of exceedance (Dinicola 2009).

Figure 5.4.2-10 show the estimated maximum 3-second gust wind speeds that can be anticipated in the study area associated with the 500-year MRP events. These peak wind speed projections were generated using Hazards U.S. Multi-Hazard (HAZUS-MH) model runs. HAZUS-MH v4.0 did not generate the hurricane track for the 100- and 500-year event. HAZUS-MH v4.0 estimated the maximum 3-second gust wind speeds for Tioga 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 Tioga County range from 52 to 58 mph for the 500-year MRP event. The associated impacts and losses from these 100-year and 500-year MRP hurricane event model runs are reported in the Vulnerability Assessment.

Figure 5.4.2-10. Wind Speeds for the 500-Year Mean Return Period Event



Source: HAZUS-MH v4.0

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with severe storm events throughout Tioga 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 2018, New York State was included in 43 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. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Of those declarations, Tioga County was included in 15 declarations (FEMA 2018). Table 5.4.2-4 lists FEMA DR and EM declarations for Tioga County.

Table 5.4.2-4. Severe Storm-Related FEMA Declarations for Tioga County, 1954 to 2018

Disaster Number	Declaration Date	Incident Type	Title
DR-4397	8/14/2018	Flood	Severe Storms and Flooding
EM-3351	10/28/2012	Hurricane	Hurricane Sandy
DR-4031	9/13/2011	Severe Storm(s)	Remnants of Tropical Storm Lee
DR-1993	6/10/2011	Flood	Severe Storms, Flooding, Tornadoes, And Straight-Line Winds
DR-1670	12/12/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1650	7/1/2006	Severe Storm(s)	Severe Storms and Flooding
DR-1589	4/19/2005	Severe Storm(s)	Severe Storms and Flooding
DR-1565	10/1/2004	Severe Storm(s)	Tropical Depression Ivan
DR-1534	8/3/2004	Severe Storm(s)	Severe Storms and Flooding
DR-1335	7/21/2000	Severe Storm(s)	Severe Storms and Flooding
DR-1233	7/7/1998	Severe Storm(s)	Severe Storms and Flooding
DR-1095	1/24/1996	Flood	Severe Storms and Flooding
DR-515	7/21/1976	Flood	Severe Storms & Flooding
DR-487	10/2/1975	Flood	Storms, Rains, Landslides & Flooding
DR-338	6/23/1972	Flood	Tropical Storm Agnes

Source: FEMA 2018

According to NOAA-NCEI Storm Events Database, Tioga County has been impacted by 175 severe storm events, causing 0 fatalities, 11 injuries, $9.646 million in property damage, and $5,000 in crop damage.

Table 5.4.2-5. Severe Storm Events 1950-2018

Hazard Type	Number of Occurrences Between 1950 and 2018	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Funnel Cloud	1	0	0	0	0
Hail	43	0	0	$20,000	0

Hazard Type	Number of Occurrences Between 1950 and 2018	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Heavy Rain	3	0	0	0	0
High Wind	8	0	0	$378,000	0
Tropical Cyclones*	3	0	0	0	0
Lightning	2	0	1	$2,000	0
Strong Wind	2	0	0	$10,000	0
Thunderstorm Wind	109	0	2	$766,000	$5,000
Tornado	7	0	8	$8.47 million	0
TOTAL	**177**	**0**	**11**	**$9.646 million**	**$5,000**

Source: NOAA-NCEI 2018; NHC 2018
** Number of events were collected from NHC and includes events that occurred within 65 nautical miles of Tioga County between 1950 and 2018. This includes events categorized as hurricanes, tropical storms, tropical depressions, and extratropical storms.*

For this 2018 Plan update, known severe storm events, including FEMA disaster declarations, which have impacted Tioga County between 2012 and 2018. For detailed information on damages and impacts to each municipality, refer to Section 9 (Jurisdictional Annexes). For events that occurred prior to 2012, refer to the Appendix E (County Profile and Risk Assessment Supplementary Data) which provides the event history as documented on the 2013 Tioga County HMP.

Table 5.4.2-6. Severe Storm Events in Tioga County, 2012 to 2018

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
May 29, 2012	Thunderstorm wind	N/A	N/A	With a warm front draped across northern New York and a cold front to the west, New York State was entrenched in the warm and moist warm sector as temperatures rose well into the 80s with dewpoints in the 60s during the afternoon. Showers and thunderstorms developed out ahead of the approaching cold front, with many storms becoming severe and producing large hail and damaging winds. Numerous trees and wires were blown down. West Newark reported $5,000 in property damages. Litchfield reported $1,000 in property damages.
July 26, 2012	Thunderstorm wind, Tornado	N/A	N/A	Intense straight line or microburst winds from a thunderstorm struck just west of Route 34 about 4 miles north of the village of Waverly around 414 PM EDT. The high winds took part of the roof off an open pole barn near Route 34 and knocked down and snapped many trees and tree branches along its path to the east northeast toward north Barton. The winds were mainly between 60 and 80 mph, except on Madigan Road where maximum estimated winds were around 100 mph. Numerous large pine trees and a few hardwoods were snapped and a well-constructed relatively new horse barn had its roof lifted off and thrown up to 150 yards downwind. The owner of the barn was inside the structure when the roof was lifted off and had both doors barred shut. The winds hit the barn on the side with no windows. It should be noted that the barn was made of metal siding as was the roof. The winds were strong enough to blow the doors out on the sides of the barn and tear the roof off, making it likely that winds were around 100 mph. The winds then continued up the hill to the east and weakened. The total path length of the microburst wind damage was about 2.5 miles and the width of the damage was around 2 miles wide. Barton reported $25,000 in property damages, Nichols reported $3,000 in property damages. Campville reported $2,000 in property damages. Owego reported $5,000 in property damages. This is a continuation of the 14 mile long tornado that first touched down in North Chemung, Chemung County. The tornado moved east and entered Tioga County on a hill just northwest of Lockwood and then moved through the town of Lockwood. East of Lockwood and similar to the Elmira tornado, the tornado takes a turn to the southeast doing heavy damage along Crandall Hill Road and down across Oak Hill Road ending just east of there and north of the town of Barton. The majority of damage was to softwood and hardwood trees which were uprooted or snapped. Unlike the extensive straight-line wind damage found to the south of this track, this damage clearly had signs of circular motion in a very concentrated and narrow path. The damage path averaged about 200 yards wide. Some homes, garages and sheds were damaged by wind with trim or siding torn or shingles off roofs. Some homes had more

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
				significant damage from trees falling on them. One barn was completely destroyed. Lockwood reported $60,000 in property damages.
September 6, 2012	Hail, Thunderstorm wind	N/A	N/A	. Showers and thunderstorms developed along, and ahead of a cold front that pushed through central New York during the afternoon. Several storms reached severe levels, producing isolated damaging wind reports and many reports of large hail. Some of the hail was as large as golf balls. Owego, Litchfield reported $10, 000 in property damages. Candor reported $1,000 in property damages. Apalachin reported $1,000 in property damages.
October 27, 2012	Hurricane Sandy	EM-3351	Yes	Damages and/or losses associated with this event were not identified during the update of this plan.
May 22, 2013	Thunderstorm wind	N/A	N/A	A warm front lifted north of New York State during the late morning into the evening hours of Wednesday, May 22, 2013. This front resulted in a cluster of storms that produced large hail and wind damage. Trees were snapped on Route 96 near Halsey Valley Road by thunderstorm winds.
June 2, 2013	Hail	N/A	N/A	Central New York was well into warm, moist and unstable air as a warm front was located across southern Canada. This led to the development of severe thunderstorms. Trees and wires were blown down in Owego leading to $5,000 in property damages.
June 24, 2013	Hail	N/A	N/A	Candor. An upper level disturbance in combination with an unstable airmass contributed to the development of severe thunderstorms across central New York.
June 28, 2013	Hail	N/A	N/A	A low pressure system acted on a moist and unstable airmass to bring severe thunderstorms to central New York. Nickel hail was reported. Signs were ripped out of the ground and several trees were snapped in half leading to $5,000 in property damages in Litchfield.
July 18, 2013	Thunderstorm wind	N/A	N/A	An upper level disturbance resulted in severe thunderstorms developing across the southern tier of New York. Trees and power lines were blown down. Candor reported $5,000 in property damages.
May 13, 2014	Severe Storm	DR-4180	Yes	Damages and/or losses associated with this event were not identified during the update of this plan.
May 22, 2014	Hail	N/A	N/A	Central New York was well into warm, moist and unstable air as a warm front was located across the Hudson Valley and a cold front was located over western New York. This led to the development of severe thunderstorms on Thursday, May 22nd. Gaskill, Weltonville, Spencer, Apalachin reported hail.
July 13, 2014	Thunderstorm wind	N/A	N/A	A weak frontal boundary and a strong upper level disturbance helped develop numerous severe thunderstorms. Favorable and strong wind shear in the lower and middle layers of the atmosphere resulted in damaging winds and tornadoes across central New York. Trees and wires were blown down. Spencer reported $10,000 in property damages.
September 2, 2014	Thunderstorm wind	N/A	N/A	A cold front moved through central New York during the afternoon and evening hours of Tuesday, September 2nd. This front acted on a moist and unstable air mass,

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
				resulting in the development of numerous severe thunderstorms over New York State. A 52 knot wind gust was measured.
June 12, 2015	Thunderstorm wind	N/A	N/A	A very unstable air mass was present Friday afternoon and evening as a warm front lifted north that morning across the state of Pennsylvania and New York. A shortwave aloft which was embedded within the cyclonic flow interacted with this front and showers and thunderstorms developed over central New York. Late Friday afternoon the front started to slowly shift southward as a cold front. Showers and thunderstorms continued to develop along the front into the late evening hours as it moved southward into Pennsylvania. These storms produced damaging winds and large hail. A severe thunderstorm produced severe winds as it moved across the area. The thunderstorm resulted in a roof being blown off a garage and a tree falling on a car on McMaster street. Owego reported $15,000 in property damages. Candor reported $10,000 in property damages.
July 26, 2015	Thunderstorm wind	N/A	N/A	Weak northwest flow aloft was present over the northeast Sunday, the 16th. A cold front was slowly moving southward over central New York Sunday morning and became stalled over central New York and northeast Pennsylvania Sunday evening. Showers and thunderstorms developed along this boundary. A few of these storms became severe and produced damaging winds and large hail. A severe thunderstorm produced severe winds as it moved across the area. The thunderstorm resulted in roof damage to a home and a house barn wall. The damage was located between King Hill and Russell Road. West Newark reported $24,000 in property damages.
June 7, 2016	Thunderstorm wind	N/A	N/A	An upper level storm system moved over west-central Quebec on Wednesday. This storm system produced multiple waves which dropped south across central New York and northeast Pennsylvania. Showers and thunderstorms developed over the region during the afternoon. Some of the thunderstorms became severe. A severe thunderstorm developed over the region and produced severe winds. This thunderstorm resulted in a tree falling on a house in Tioga Terrace area on Brown road. Tioga Terrace reported $5,000 in property damages.
August 13, 2016	Thunderstorm wind	N/A	N/A	Showers and thunderstorms developed across the region Saturday afternoon. These storms developed ahead of a strong storm system within a very warm, extremely moist and unstable atmosphere. As these storms moved northeast, some of these storms became severe. A thunderstorm moved across the region and became severe. This thunderstorm resulted in trees and wires being knocked over on Coddington Road, Prospect Valley Road, and Wilson Creek Road. Trees and wires were knocked over and landed on a house on Fairfield Road. Willseyville reported $6,000 in property damages. Candor reported $10,000 in property damages. East Berkshire reported $5,000 in property damages.
May 1, 2017	Lightning, Thunderstorm wind	N/A	N/A	A warm front lifted north across the region Monday morning which created an unstable air mass across the state of New York and Pennsylvania. By late Monday afternoon, a cold front moved into western New York and Pennsylvania which

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
				produced a line of thunderstorms. As the thunderstorms moved east, coverage became widespread and a major severe weather outbreak ensued for central New York and northeast Pennsylvania. Some of the thunderstorms produced winds between 70 and 100 mph. Numerous trees were knocked down and there were widespread power outages some of which lasted for several days. Apalachin reported $22,000 in property damages. Owego reported $7,000 in property damages.
June 5, 2017	Thunderstorm wind	N/A	N/A	Dense fog quickly lifted Monday morning and scattered showers developed within its wake in a very unstable air mass. Late Monday afternoon a storm system approached the region from the west and forced a cold front into western New York and Pennsylvania. This front generated a line of showers and thunderstorms. The system quickly moved east and some of these storms became severe producing damaging winds and large hail. A thunderstorm moved across the region and became severe. This thunderstorm produced severe winds and knocked over trees. Berkshire reported $4,000 in property damages.
June 18, 2017	Thunderstorm wind	N/A	N/A	A strong storm system approached the region from the west late Sunday afternoon, which resulted in a prefrontal trough that developed over western New York and Pennsylvania. The storm system moved into a very unstable atmosphere and showers and thunderstorms developed along the prefrontal trough. Some of these storms became severe as the system moved east. A thunderstorm moved across the region and became severe. This thunderstorm produced severe winds and knocked over trees on Main Street and railroad tracks. Owego reported $1,000 in property damages.
June 19, 2017	Thunderstorm wind	N/A	N/A	A cold front extended from north to south across western New York and Pennsylvania Monday morning and showers and thunderstorms were organized ahead and along the front. The front quickly moved east into a very unstable air mass and additional showers and thunderstorms developed across central New York and northeast Pennsylvania. Some of these storms became severe and produced strong winds. A thunderstorm moved across the region and became severe. This thunderstorm produced severe winds and knocked over a tree. Owego reported $1,000 in property damages.
July 20, 2017	Thunderstorm wind	N/A	N/A	A weak cold front moved across the region Thursday afternoon and interacted with a very unstable environment. A weak storm system moved across the state of New York and initiated convection along the front. Showers and thunderstorms developed along and ahead of the front and quickly became a line of storms. As the line of storms moved east, some of the thunderstorms became severe and produced damaging winds. A thunderstorm moved across the region and became severe. This thunderstorm produced severe winds and knocked over a tree across Elmira St and knocked down wires across the roadway in the vicinity of Tutlle Hill Road. Litchfield reported $2,000 in property damages. Candor reported $2,000 in property damages.
August 4, 2017	Thunderstorm wind	N/A	N/A	A strong cold front moved across the northeast as a surface low pressure system moved toward Quebec Friday morning. By Friday afternoon, a pre-frontal trough

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
				developed across New York and Pennsylvania, leading to thunderstorms in a very unstable atmosphere. As these storms propagated eastward, some became severe producing damaging winds. A thunderstorm moved across the region and became severe. This thunderstorm produced severe winds which forced down wires onto the roadway. West Newark reported $2,000 in property damages.
August 21, 2017	Thunderstorm wind	N/A	N/A	An upper level disturbance moved across the state of New York Monday afternoon within an unstable environment and generated scattered showers and thunderstorms across the area. Some of these thunderstorms became severe and caused damaging winds. A thunderstorm moved across the region and became severe. This thunderstorm produced severe winds and knocked over a few trees between Spencer and Candor. West Candor reported $5,000 in property damages.
August 14-15, 2018	Severe Storms and Flooding	DR-4397	Yes	Severe storms led to flash flooding which brought devastation to Broome, Chemung, Chenango, Columbia, Delaware, Schuyler, Seneca, and Tioga Counties. The storms produced heavy rainfall, flash flooding, and strong winds. During the height of the storm, roads were impassable from flood waters which overtopped roads, bridges, and culverts. Widespread power outages impacted more than 1,500 homes. A preliminary damage assessment estimated over $36 million in infrastructure repair, debris removal, and structure damage as a result of these storms. Tioga County requested over $188,000 in public assistance. The Towns of Candor, Newark Valley, and Owego were the communities in the county that requested assistance. Rainfall totals for the August 14th event included 1.5 inches in the Town of Newark Valley. Rainfall totals for August 15th ranged from 1.13 inches in Weltonville to 2.63 inches in the Town of Candor.

Source(s): FEMA 2018; NOAA-NCDC 2018; NWS 2016; NYS HMP 2014

Note: The table above includes events that resulted in a FEMA declaration, damages exceeding $1,000, or resulted in injuries or fatalities.

FEMA Federal Emergency Management Agency

HMP Hazard Mitigation Plan

NCDC National Climatic Data Center

NOAA National Oceanic and Atmospheric Administration

NWS National Weather Service

NYS New York State

Probability of Future Occurrences

Predicting future severe storm events in a constantly changing climate has proven to be a difficult task. Predicting extremes in New York State is particularly difficult because of the region's geographic location. It is positioned roughly halfway between the equator and the North Pole and is exposed to both cold and dry airstreams from the south. The interaction between these opposing air masses often leads to turbulent weather across the region (Keim 1997).

According to the NOAA National Centers for Environmental Information (NCEI) Storm Events Database and the National Hurricane Center Historical (NHC) Hurricane Tracks mapping tool, Tioga County experienced 179 severe storm events between 1950 and 2018. The table below shows these statistics, as well as the annual average number of events and the percent chance of these individual severe storm hazards occurring in Tioga County in future years (NOAA NCEI 2018; NHC 2018).

Table 5.4.2-7. Probability of Future Occurrence of Severe Storm Events

Hazard Type	Number of Occurrences Between 1950 and 2015	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/Number of Events)	Probability of Event in any given year	% chance of occurrence in any given year
Funnel Cloud	1	0.01	69.00	0.01	1.45%
Hail	43	0.63	1.60	0.62	62.32%
Heavy Rain	3	0.04	23.00	0.04	4.35%
High Wind	8	0.12	8.63	0.12	11.59%
Hurricane*	0	0	0	0	0
Lightning	2	0.03	34.50	0.03	2.90%
Strong Wind	2	0.03	34.50	0.03	2.90%
Thunderstorm Wind	109	1.60	0.63	1.58	100%
Tornado	7	0.10	9.86	0.10	10.14%
Tropical Depression*	2	0.03	34.50	0.03	2.90%
Tropical Storm*	2	0.03	34.50	0.03	2.90%
TOTAL	**179**	2.63	0.39	2.59	100%

Source: NOAA-NCEI 2018; NHC 2018
* *Number of events were collected from NHC and includes events that occurred within 65 nautical miles of Tioga County.*

In Section 5.3, the identified hazards of concern for Tioga 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' (event that occurs within 25 years, as presented in Table 5.3-3).

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. Impacts related to increasing temperatures and sea level rise are already being felt 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 (New York State Energy Research and Development Authority [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° F to 3.4° F

by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the State (NYSERDA 2014).

Regional precipitation across New York State is projected to increase by approximately one to eight-percent by the 2020s, three to 12-percent by the 2050s, and four to 15-percent by the 2080s. By the end of the century, the greatest increases in precipitation are projected to be in the northern areas of the State (NYSERDA 2014).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Tioga County is part of Region 3, Southern Tier. In Region 3, it is estimated that temperatures will increase by 4.4ºF to 6.3ºF by the 2050s and 5.7ºF to 9.9ºF by the 2080s (baseline of 47.5ºF, middle range projection). 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 5.4.2-8 displays the projected seasonal precipitation change for Southern Tier ClimAID Region (NYSERDA 2014).

Table 5.4.2-8. 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

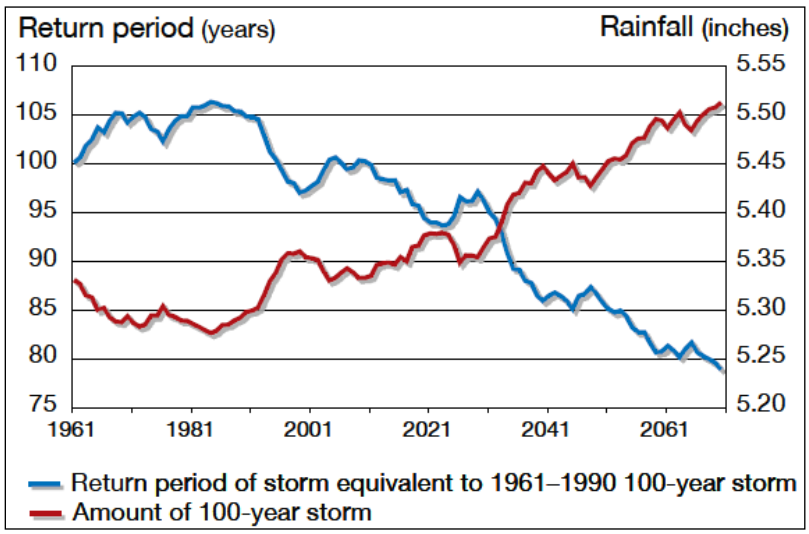
Source: NYSERDA 2011

The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. Downpours are very likely to increase in frequency and intensity, a change which has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways and transportation hubs; and increase delays and hazards related to extreme weather events (NYSERDA 2011). Less frequent rainfall during the summer months may impact the ability of water supply systems. Increasing water temperatures in rivers and streams will affect aquatic health and reduce the capacity of streams to assimilate effluent wastewater treatment plants (NYSERDA 2011).

Figure 5.4.2-11 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).

Downscaled data regarding increased intensity and frequency of precipitation in New York State with respect to climate change scenarios has been developed by the Northeast Regional Climate Center and is available online via an online tool for extreme precipitation analysis found at http://precip.eas.cornell.edu/ . For an overview of this tool refer to Section 6 (Mitigation Strategies) of this plan.

Figure 5.4.2-11. Projected Rainfall and Frequency of Extreme Storms



Source: NYSERDA 2011

5.4.2.2 Vulnerability Assessment

Wind-related severe storm vulnerability data was generated using a HAZUS-MH v4.0 analysis. A probabilistic assessment was conducted for the 100- and 500-year MRPs through a Level 2 analysis in HAZUS-MH v4.0 to analyze the earthquake hazard and provide a range of loss estimates.

Impact on Life, Health and Safety

The impact of a severe storms on life, health, and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time was provided to residents. The entire county's population (population of 49,649 people, according to the U.S. Census 2016 ACS 5-Year Population Estimate) is assumed to be exposed to this hazard.

Lightning can be responsible for deaths, injuries, and property damage. Lightning-based deaths and injuries typically involve heart damage, inflated lungs, or brain damage, as well as loss of consciousness, amnesia, paralysis, and burns, depending on the severity of the strike. Additionally, the majority of people struck by lightning survive, although they may have severe burns and internal damage. People located outdoors (i.e., recreational activities and farming) are considered most vulnerable to hailstorms, thunderstorms and tornadoes. 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.

As a result of severe storm events, residents may be displaced or require temporary to long-term sheltering. In addition, downed trees, damaged buildings and debris carried by high winds from hurricanes, tropical storms, or tornadoes can lead to injury or loss of life. Socially vulnerable populations are most susceptible, 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. HAZUS-MH v4.0 currently estimates that no residents will be displaced or require temporary shelter due to either a 100-year or a 500-year MRP event.

Economically disadvantaged populations are more vulnerable because they may evaluate the need to evacuate and make decisions based on the major economic impact to their family. The population over the age of 65 (8,900 people, according to the U.S. Census 2016 ACS 5-Year Population Estimate) is also vulnerable and may physically have difficulty evacuating. The elderly population is considered vulnerable because they 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. Section 4 provides for the statistics for these populations for Tioga County.

Impact on General Building Stock

Damage to buildings is dependent upon several factors including wind speed, storm duration, path of the storm track or tornado and distance from the tornado funnel. Depending on the size of the hail and severity of the storm, the County could see damages from hail impacting structures. Lightning can spark wildfires or building fires, especially if structures are not protected by surge protectors on critical electronic, lighting, or information technology systems. While damages to the building stock are possible as a result of lightning and hail, they are difficult to estimate and would not have as wide of an impact as a high wind or tornado event.

Building construction plays a major role in the extent of damages resulting from a severe storm event. Due to differences in construction, residential structures are generally more susceptible to wind damage than commercial and industrial structures. Wood and masonry buildings in general, regardless of their occupancy class, tend to experience more damage than concrete or steel buildings. High-rise buildings are also very vulnerable structures. Mobile homes are the most vulnerable to damage, even if tied down, and offer little protection to people inside.

The U.S. Census Bureau defines manufactured homes as "movable dwellings, 8 feet or wider and 40 feet or more long, designed to be towed on its own chassis, with transportation gear integral to the unit when it leaves the factory, and without need of a permanent foundation (U.S. Census, 2010)." They can include multi-wides and expandable manufactured homes but exclude travel trailers, motor homes, and modular housing. Due to their light-weight and often unanchored design, manufactured housing is extremely vulnerable to high winds and will generally sustain the most damage.

Table 5.4.2-9 displays the number of manufactured housing units per municipality in Tioga County. Total counts were obtained from the HAZUS-MH v4.0 default general building stock. As noted below, Otego Town has the greatest number of manufactured homes.

Table 5.4.2-9. Manufactured Housing Units per Municipality in Tioga County

Municipality	Number of Manufactured Homes
Barton (T)	549
Berkshire (T)	174
Candor (T)	498
Candor (V)	83
Newark Valley (T)	299
Newark Valley (V)	87
Nichols (T)	171
Nichols (V)	23
Owego (T)	445
Owego (V)	11
Richford (T)	189
Spencer (T)	170
Spencer (V)	64

Municipality	Number of Manufactured Homes
Tioga (T)	672
Waverly (V)	12
Tioga County	**3,447**

Source: HAZUS-MH v4.0
(T) – Town
(V) – Village

The entire county's general building stock is assumed to be exposed to the severe storm wind hazard (greater than $4.7 billion in structure only). Expected estimated building damage was estimated by HAZUS-MH a v4.0 and includes buildings damaged at the following wind damage categories: no damage/very minor damage, minor damage, moderate damage, severe damage, and total destruction. Table 5.4.2-10 summarizes the definition of the damage categories.

Table 5.4.2-10. 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
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

As noted earlier in the profile, HAZUS-MH v4.0 estimates the 100-year MRP peak gust wind speeds for Otsego County to be less than 39 mph and estimates $0 in structure damage; although the damages were not estimated in the model, damages could still occur at these wind speeds.

HAZUS-MH v4.0 estimates the 500-year MRP peak gust wind speeds for Tioga County range from 52 to 58 mph (Tropical Storm) and result in nearly $400 thousand damage to the general building stock (less than 1% of the County's total building inventory). Damages to residential buildings account for nearly 100% of the total damages. Table 5.4.2-11 summarizes the building damage (structure only) estimated for the 500-year MRP

wind-only events by municipality. Total dollar damage reflects the overall impact to buildings at an aggregate level.

Table 5.4.2-11. Estimated Building Value (Structure Only) Damaged by the 100-Year and 500-Year MRP Wind Events

Municipality	Total Replacement Cost Value (Structure Only)	Estimated Total Damages*		Percent of Total Building Replacement Value	
		Annualized Loss	500-Year	Annualized Loss	500-Year
Barton (T)	$350,553,000	<$1,000	$11,644	<1%	<1%
Berkshire (T)	$88,664,000	<$1,000	$10,577	<1%	<1%
Candor (T)	$325,537,000	<$1,000	$14,217	<1%	<1%
Candor (V)	$78,320,000	<$1,000	<$1,000	<1%	<1%
Newark Valley (T)	$192,352,000	<$1,000	$27,188	<1%	<1%
Newark Valley (V)	$86,912,000	<$1,000	$10,416	<1%	<1%
Nichols (T)	$139,722,000	<$1,000	$5,847	<1%	<1%
Nichols (V)	$63,413,000	<$1,000	<$1,000	<1%	<1%
Owego (T)	$1,739,840,000	$2,556	$264,897	<1%	<1%
Owego (V)	$486,169,000	<$1,000	$12,235	<1%	<1%
Richford (T)	$80,957,000	<$1,000	$9,709	<1%	<1%
Spencer (T)	$198,539,000	<$1,000	$9,504	<1%	<1%
Spencer (V)	$72,905,000	<$1,000	<$1,000	<1%	<1%
Tioga (T)	$381,740,000	<$1,000	$13,420	<1%	<1%
Waverly (V)	$478,913,000	<$1,000	<$1,000	<1%	<1%
Tioga County	**$4,764,536,000**	**$5,995**	**$391,135**	**<1%**	**<1%**

Source: HAZUS-MH v4.0

**The Total Damages column represents the sum of damages for all occupancy classes (residential, commercial, industrial, agricultural, educational, religious and government) based on estimated replacement cost value.*

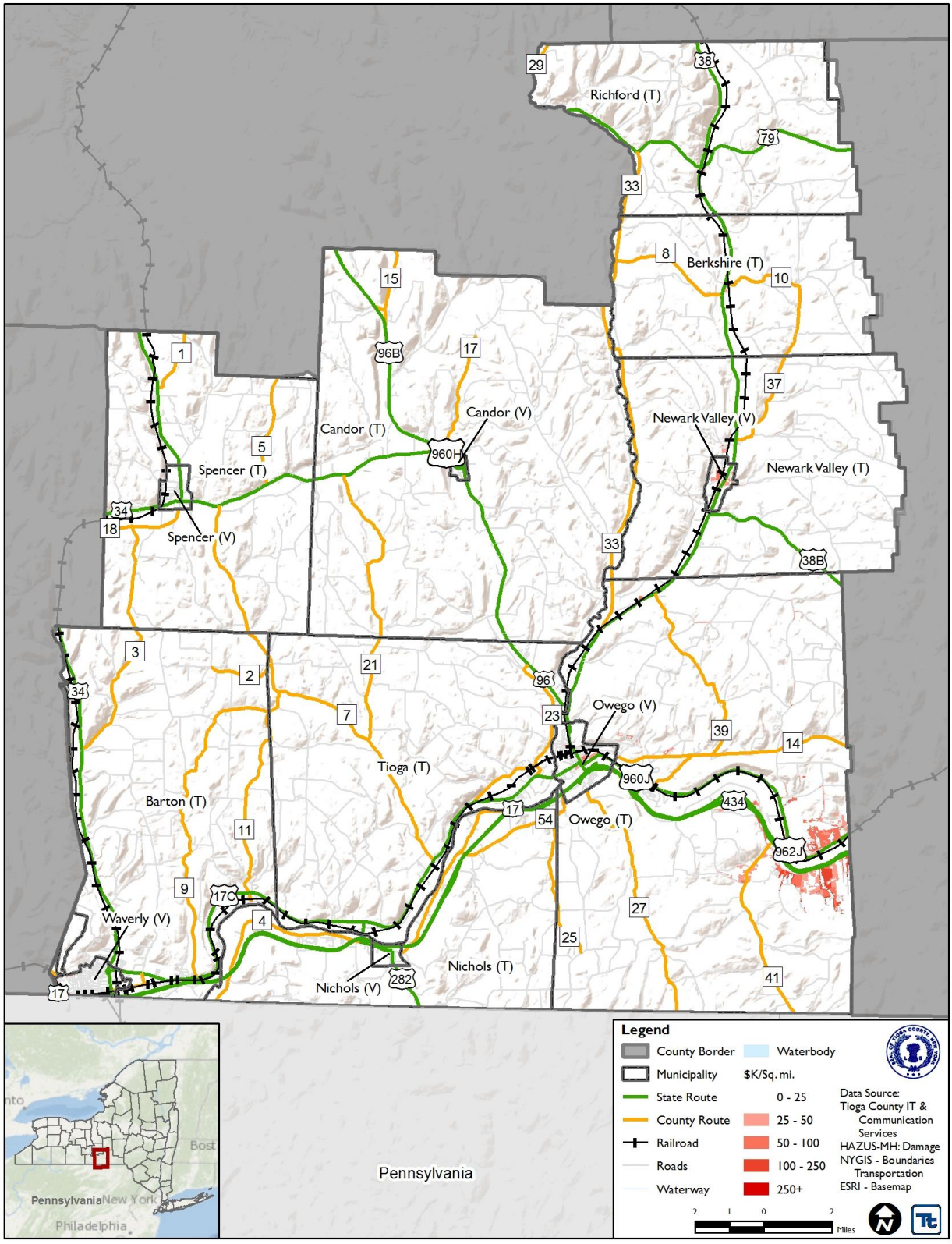
Table 5.4.2-12. Estimated Residential and Commercial Building Value (Structure Only) Damaged by the 100-Year and 500-Year MRP Wind Events

Municipality	Total Replacement Value (Structure Only)	Estimated Residential Damage	Estimated Commercial Damage
		500-Year	500-Year
Barton (T)	$350,553,000	$11,644	$0
Berkshire (T)	$88,664,000	$10,499	<$1,000
Candor (T)	$325,537,000	$14,217	$0
Candor (V)	$78,320,000	<$1,000	$0
Newark Valley (T)	$192,352,000	$27,150	<$1,000
Newark Valley (V)	$86,912,000	$10,416	$0
Nichols (T)	$139,722,000	$5,847	$0
Nichols (V)	$63,413,000	<$1,000	$0
Owego (T)	$1,739,840,000	$264,822	<$1,000
Owego (V)	$486,169,000	$12,235	$0
Richford (T)	$80,957,000	$9,709	$0

Municipality	Total Replacement Value (Structure Only)	Estimated Residential Damage 500-Year	Estimated Commercial Damage 500-Year
Spencer (T)	$198,539,000	$9,504	$0
Spencer (V)	$72,905,000	<$1,000	$0
Tioga (T)	$381,740,000	$13,420	$0
Waverly (V)	$478,913,000	<$1,000	$0
Tioga County	**$4,764,536,000**	**$390,943**	**<$1,000**

Source: HAZUS-MH v4.0

Figure 5.4.2-12. Density of Losses for Structures (All Occupancies) for the 500-Year MRP Wind Event



Source: HAZUS-MH v4.0

Impact on Critical Facilities

Utility infrastructure could suffer damage from high winds associated with falling tree limbs or other debris, resulting in the loss of power. Loss of service can impact residents and business operations alike. Interruptions in heating or cooling utilities can affect populations such the young and elderly, who are particularly vulnerable to temperature-related health impacts. Loss of power can impact other public utilities, including potable water and wastewater treatment and communications. In addition to public water services, property owners with private wells may not have access to potable water either until power is restored. Lack of power to emergency facilities, including police, fire, EMS, and hospitals, will inhibit a community's ability to effective respond to an event and maintain the safety of its citizens.

HAZUS-MH v4.0 estimates the probability that critical facilities (such as medical facilities, fire and emergency medical services, police, EOC, schools, and user-defined facilities such as shelters and municipal buildings) may sustain damage as a result of 100-year and 500-year MRP wind-only events. Additionally, HAZUS-MH estimates the loss of use for each facility in number of days. Due to the sensitive nature of the critical facility dataset, individual facility estimated loss is not provided. Overall, HAZUS-MH estimates no damage and loss of function to the critical facilities as a result of the 100-year event.

Table 5.4.2-13 summarizes the potential damages to the critical facilities in Tioga County as a result of the 500-year MRP wind event. The percent probability that each facility type may experience damage by category is indicated below.

Table 5.4.2-13. Estimated Impacts to Critical Facilities for the 500-Year Mean Return Period Hurricane-Related Winds

Facility Type	500-Year Event				
	Loss of Days	Percent-Probability of Sustaining Damage			
		Minor	Moderate	Severe	Complete
EOC	0	<1	0	0	0
Medical	0	<1	0	0	0
Police	0	<1	0	0	0
Fire	0	<1	0	0	0
Schools	0	<1	0	0	0

Source: HAZUS-MH v4.0

At this time, HAZUS-MH v4.0 does not estimate losses to transportation lifelines and utilities as part of the wind model. Transportation lifelines, including roadways, rail lines, and bridges, are not considered particularly vulnerable to the wind hazard; they are more vulnerable to cascading effects such as flooding and falling debris, which will block these corridors until the hazard is removed. Impacts to transportation lifelines affect both short-term (for example, evacuation activities) and long-term (for example, day-to-day commuting) transportation needs.

Impact on Economy

Severe storms also impact the economy; impacts include but are not limited to loss of business function, damage to inventory, relocation costs, wage loss, and rental loss due to the repair or replacement of buildings. HAZUS-MH v4.0 estimates the total economic loss associated with each probabilistic event (direct building losses and business interruption losses). Business interruption losses include losses associated with the inability to operate a business because of the wind damage sustained during a storm or the temporary living expenses for those displaced from their home because of an event.

For the 100-year MRP wind event, HAZUS-MH estimates no business interruption costs (income loss, relocation costs, rental costs and lost wages) and no inventory losses. For the 500-year MRP wind only event, HAZUS-MH estimates less than $1,000 in business interruption losses for the county, which includes loss of income, relocation costs, rental costs and lost wages, and no inventory losses.

Debris management can be costly and may also impact the local economy. HAZUS-MH v4.0 also estimates the amount of debris that may be produced a result of the 100- and 500-year MRP wind events. It estimates that no debris will be generated as a result of the 100-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 are those 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 5.4.2-14 summarizes debris production estimates for 500-year MRP wind events.

Table 5.4.2-14. Debris Production for 100- and 500-Year Mean Return Period Wind Events

	Brick and Wood (tons)		Concrete and Steel (tons)		Tree (tons)		Eligible Tree Volume (cubic yards)	
Municipality	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
Barton (T)	0	0	0	0	0	0	0	0
Berkshire (T)	0	0	393	194	0	0	393	194
Candor (T)	0	0	0	1	0	0	0	1
Candor (V)	0	0	0	0	0	0	0	0
Newark Valley (T)	0	0	1,340	511	0	0	1,340	511
Newark Valley (V)	0	0	21	99	0	0	21	99
Nichols (T)	0	0	0	0	0	0	0	0
Nichols (V)	0	0	0	0	0	0	0	0
Owego (T)	0	0	3,047	2,265	0	0	3,047	2,265
Owego (V)	0	0	0	3	0	0	0	3
Richford (T)	0	0	679	330	0	0	679	330
Spencer (T)	0	0	1	4	0	0	1	4
Spencer (V)	0	0	0	0	0	0	0	0
Tioga (T)	0	0	0	0	0	0	0	0
Waverly (V)	0	0	0	0	0	0	0	0
Tioga County	**0**	**0**	**5,481**	**3,410**	**0**	**0**	**5,481**	**3,410**

Source: HAZUS-MH v4.0

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 Sections 4 and 9, areas targeted for future growth and development have been identified across the County. 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, arguably the new development may be less vulnerable to the severe storm hazard compared to the aging building stock in the County.

Projected Changes in Population

Refer to Section 4.4.2 - Population Trends in the County Profile for a discussion on trends for the County. According to population projects from the Cornell Program on Applied Demographics, Tioga County will experience a continual population decrease through 2040 (nearly 8,500 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, those that remain may move into locations that are more susceptible than others.

Climate Change

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such as storms, including those which may bring precipitation high winds and tornado events. While predicting changes of wind and tornado events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Since the 1970s, globally there has been an increase in 'tropical cyclone destructiveness' as measured by the Power Dissipation Index. This increased tropical cyclone intensity and duration correlates with sea surface temperature. This suggests that future increases of tropical sea surface temperature may lead to future increases in tropical cyclone intensity and duration. However, there is a high level of uncertainty regarding the relationship between climate change and storm events. Future improvements in modeling smaller scale climatic processes can be expected and will lead to improved understanding of how the changing climate will alter temperature, precipitation and storms events in Pennsylvania (Shortle et. al, 2009).

Major clusters of summertime thunderstorms in North America will grow larger, more intense, and more frequent later this century in a changing climate, unleashing far more rain and posing a greater threat of flooding across wide areas (UCAR 2017). An increase in storms will produce more wind events and may increase tornado activity. Additionally, an increase in temperature will provide more energy to produce storms that generate tornadoes (Climate Central 2018.

Refer to the 'Climate Change Impacts' subsection earlier in this profile for more details on climate change pertaining to New York State.

Changes in Vulnerability Since the 2013 HMP

Tioga County continues to be vulnerable to the severe storm hazard. An updated version of the HAZUS-MH model was not used to estimate potential losses for the 2010 HMP. The best available data were used for the 2018 HMP update; probabilistic scenarios were evaluated using HAZUS-MH and critical facility inventories were developed and utilized. Loss estimates in HAZUS-MH v4.0 used for this update are based on 2010 U.S. Census data. Overall, this vulnerability assessment provides more accurate estimated exposure and potential losses for Tioga County.

Tioga County and its municipalities continue to be vulnerable to severe storms. However, there are several differences between the potential loss estimates between the 2018 HMP update and the results in the 2013 HMP. Their differences are due to changes in the HAZUS-MH model. For the 2013 plan, the HAZUS-MH v2.0 hurricane model was run for the entire county, while the 2018 HHMP update utilized HAZUS-MH v4.0; since the 2013 HMP, HAZUS-MH has received updates to the modeling parameters and updated building values to

provide more accurate estimations of loss. The HAZUS-MH v4.0 model estimated less losses than the previous HAZUS-MH v2.0 model (e.g. the reported 500-year losses were approximately 50.1-percent less than the previously reported losses). Although there was a decrease in impacts, this may be due to changes in the modeling parameters and not directly associated with the current status of the County's assets.

Overall, this vulnerability assessment presented uses a more accurate and updated population, building inventory, and critical facility inventory which provides more accurate estimated exposure and potential losses for Tioga County.

Issues Identified

High winds can create life safety issues with fallen trees, blocked roads, debris, lightening can lead to wildfires, secondary hazards such as power outages, erosion and road washouts form severe storms, traffic safety during deluges, localize flooding (stormwater and urban).

The Towns of Barton, Candor, Owego and Tioga have a significant number of manufactured homes. Manufactured or mobile homes are less able than traditional homes to withstand the effects of high winds which could affect the structural integrity of these living units.

The Towns of Owego and Newark Valley have the highest need for debris management after a severe storm event base on the estimate of debris production after a 100- or 500-year mean return period wind event.

5.4.3 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 Tioga County.

5.4.3.1 Profile

Hazard Description

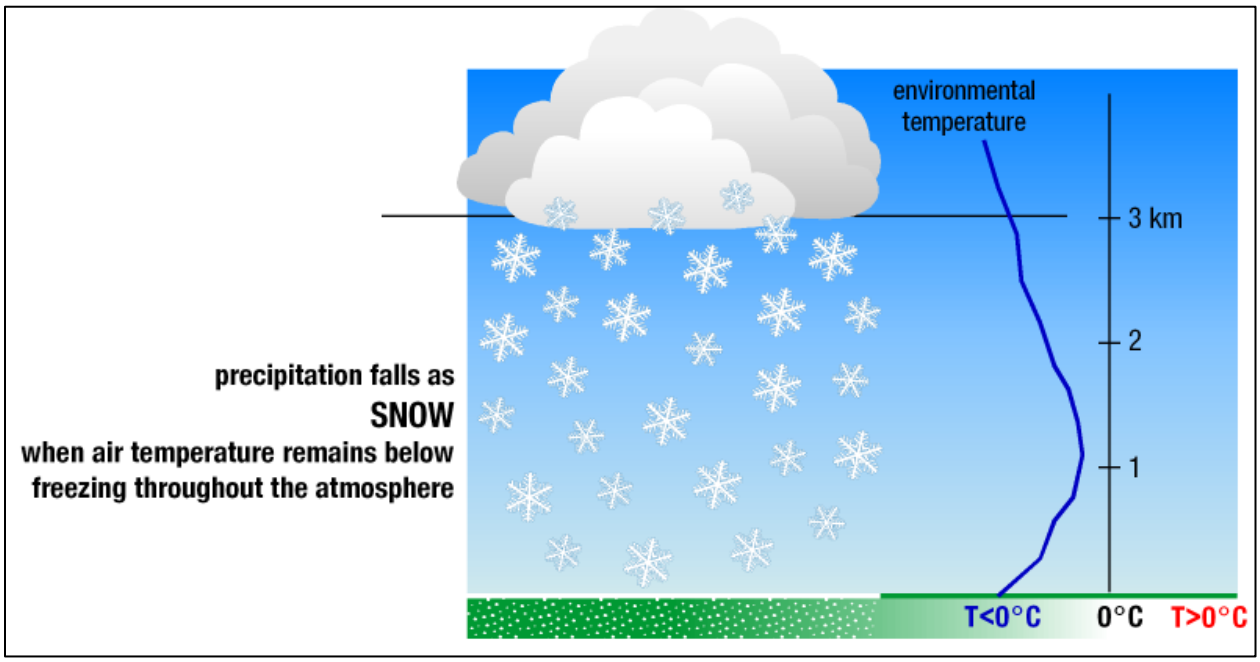
A winter storm is a weather event in which the main types of precipitation are snow, sleet or freezing rain. It can be a combination of heavy snow, blowing snow, and/or dangerous wind chills. There are three basic components needed to make a winter storm. Below freezing temperatures (cold air) in the clouds and near the ground are necessary to make snow and ice. Lift, something to raise the moist air to form clouds and cause precipitation, is needed. Examples of this is warm air colliding with cold air and being forced to rise over the cold dome or air flowing up a mountainside. The last thing needed to make a winter storm is moisture to form clouds and precipitation. Air blowing across a body of water, such as a large lake or the ocean (National Severe Storms Laboratory 2013).

Some winter storms are large enough to immobilize an entire region while others may only affect a single community. Winter storms are typically 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/or blocked roadways, downed utility lines, and power outages. In Tioga County, winter storms include blizzards, snow storms, Nor'Easters and ice storms. Extreme cold temperatures, wind chills and Nor'Easters are also associated with winter storms.

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), when 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: snowflakes, snow pellets, or sleet. Snowflakes are clusters of ice crystals that form from a cloud.

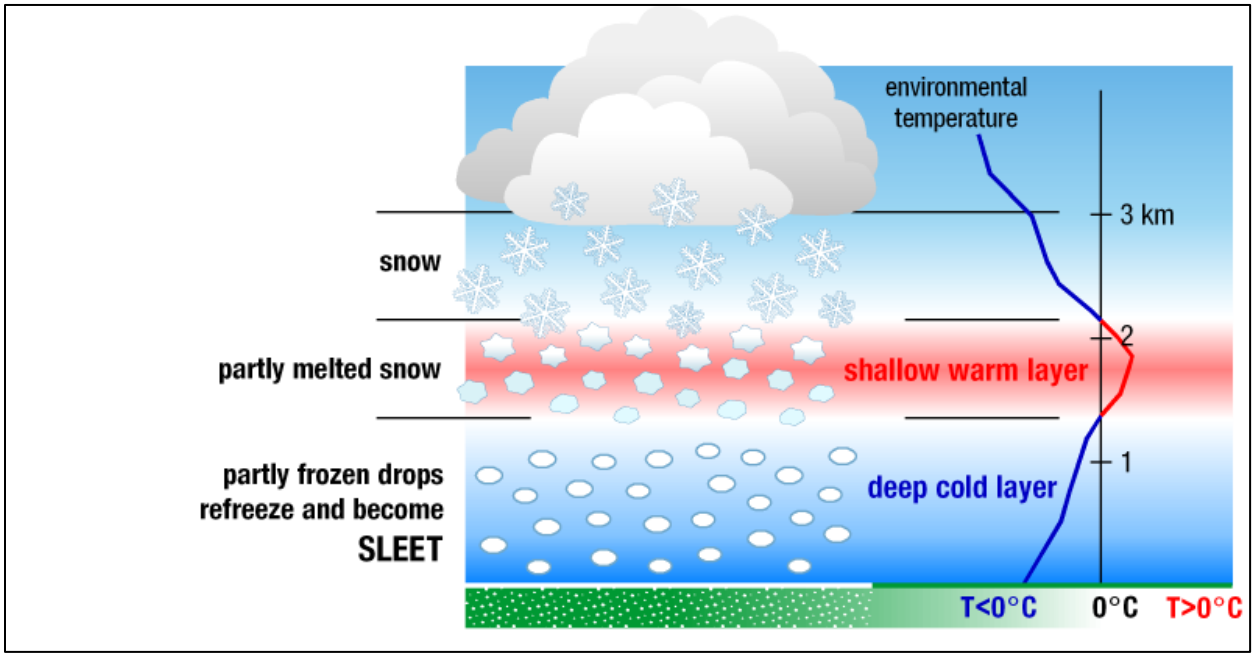
Figure 5.4.3-1. Snow Creation



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 2013).

Figure 5.4.3-2. Sleet Creation



Source: NOAA-NSSL, 2015

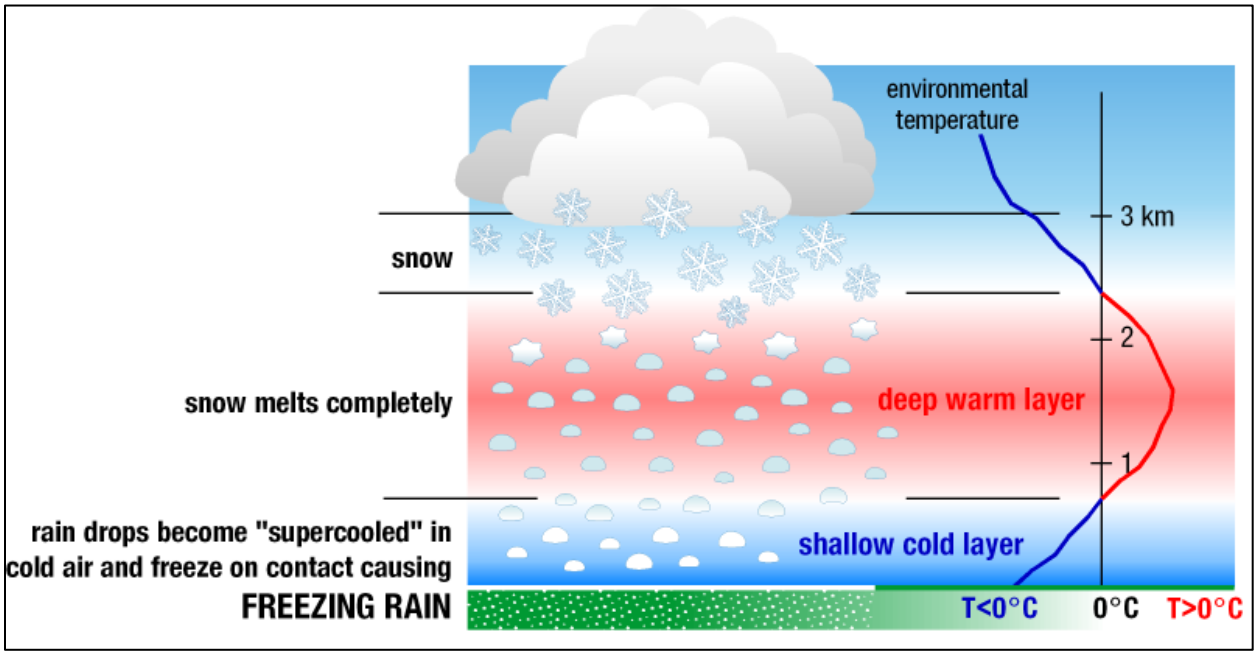
Blizzards

A blizzard is a winter snowstorm with sustained or frequent wind gusts of 35 mph or more, accompanied by falling or blowing snow reducing visibility to or below 0.25 mile. These must be the predominant conditions over a 3-hour period. Extremely cold temperatures are often 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 2012).

Ice Storms

An ice storm describes those events when damaging accumulations of ice are expected during freezing rain situations. Significant ice accumulations are typically accumulations of 0.25-inches or greater (NWS 2013). Heavy accumulations of ice can bring down trees, power lines and 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 2008).

Figure 5.4.3-3. Freezing Rain Creation



Source: NOAA-NSSL, 2015

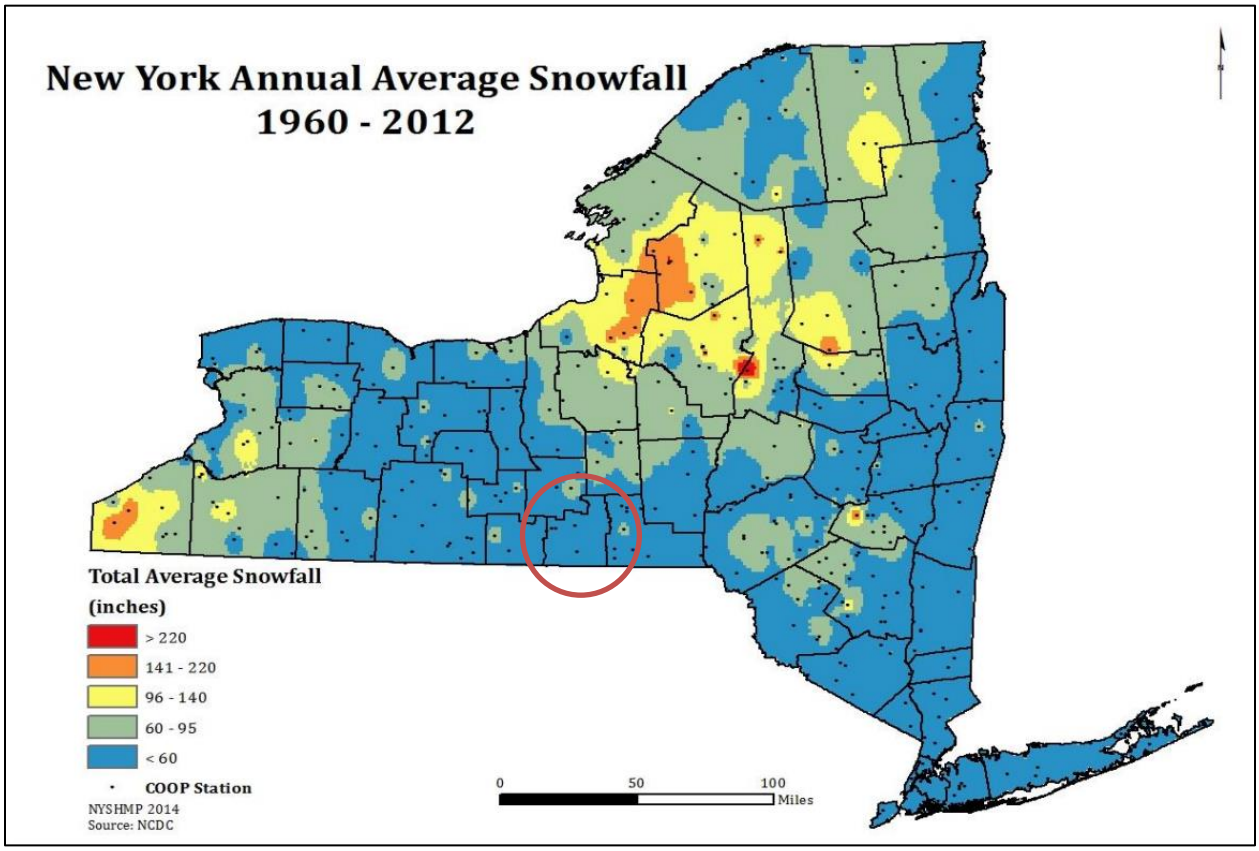
Location

Snow and Blizzards

On average, New York State receives more snowfall than any other states within the United States, with the easternmost and west-central portions of the State most likely to suffer under severe winter storm occurrences

than the southern portion. Average snowfall in the State is about 65 inches but varies greatly in the different regions of the State. Between 1960 and 2012, Tioga County had a total average snowfall of less than 60 inches (New York State HMP 2014).

Figure 5.4.3-4. New York Annual Average Snowfall, 1960-2012



Source: NYSHMP 2014, NCDC

Notes: The red circle indicates the location of Tioga County. The figure shows that Tioga County experiences an average of over 60 inches of snow each year.

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, the average annual number of days with freezing rain for Tioga County is seven days and the average annual number of hours is 18-21 (Midwest Regional Climate Center 2016).

Extent

The magnitude or severity 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 (for example, weekday versus weekend), and time of season. While sleet accumulation is measured and tracked in a method similar to snow events, the extent or severity of freezing rain or an ice storm requires a different and sometimes more challenging process. According to NWS, ice accumulation does not coat the surface of an object evenly, as gravity typically forces rainwater to the underside of an object before it freezes. Wind can also force rainwater downward prior to freezing, resulting

in a thicker coating of ice on one side of the object than the other side. Ice mass is then determined by taking the average from the thickest and thinnest portions of ice on the sample used for measurement.

The National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) produces 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 Category 1 to 5, which is similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes. RSI is based on the spatial extent of the storm, the amount of snowfall, and the combination 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-NCDC 2018). Table 5.4.3-1 presents the five RSI ranking categories.

Table 5.4.3-1. 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-NCDC 2011
Note: RSI = Regional Snowfall Index

NWS operates a widespread network of observation 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 future weather, ranging from hours to days. The models are then analyzed by NWS meteorologists who then write and disseminate forecasts (NWS 2013). While winter weather is normal during the winter season for Otsego County, the NWS uses winter weather watches, warnings, and advisories to help people anticipate what to expect in the days and hours prior to an approaching storm.

- A ***winter storm watch*** is issued when severe winter conditions (heavy snow, ice, etc.) may affect a certain area, but its occurrence, location, and timing are uncertain. A watch is issued to provide 24 to 72 hours of notice of the possibility of severe winter weather.
- A ***winter storm warning*** is issued when hazardous winter weather, in the form of heavy snow, heavy freezing rain or heavy sleet, is imminent or occurring. A warning is usually issued 12 to 24 hours before the event is expected to begin.
- A ***winter weather advisory*** is issued when a hazardous winter weather event is occurring, is imminent, or has a greater than 80 percent chance of occurrence. Advisories are used to inform people that winter weather conditions are expected to cause significant inconveniences, and that conditions may be hazardous. These conditions may refer to sleet, freezing rain, or ice storms, in addition to snow events.
- NWS may also issue a ***blizzard warning*** when snow and strong winds combine to produce the potential for blinding snow, deep drifts, and wind chill (NWS 2018).

Previous Occurrences and Losses

Many sources provided historical information regarding previous occurrences and losses associated with severe winter storm events throughout Tioga 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.

Between 1954 and October 2018, FEMA included New York State in 24 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. Tioga County was included in three of these declarations.

For this plan update, winter weather events were summarized from 2012 to 2018. For events prior to 2012, information is summarized in Appendix E (County Profile and Risk Assessment Supplementary Data). Known severe winter storm events, including FEMA disaster declarations, which have impacted Tioga County are identified in Table 5.4.3-2. For available information on damages and impacts to each municipal, refer to Section 9 (jurisdictional annexes). Please note that not all events that have occurred in Tioga County are included due to the extent of documentation and the possibility that not all sources may have been identified or researched. Loss and impact information 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 Update.

FEMA Major Disasters and Emergency Declarations

Between 1950 and 2018, FEMA included Tioga County in three severe winter major disaster (DR) or emergency (EM) declarations classified as one or a combination of the following disaster types: severe winter storm, snowstorm, and severe blizzard. Table 5.4.3-2 lists FEMA DR and EM declarations that have been declared for Tioga County.

Table 5.4.3-2. FEMA DR and EM Declarations for Severe Winter Events in Tioga County, 1950 to 2018

Disaster Number	Declaration Date	Incident Type	Title
DR-4322	7/12/2017	Snow	Severe Winter Storm and Snowstorm
EM-3173	2/25/2003	Snow	Snowstorms
EM-3107	3/17/1993	Snow	Severe Blizzard

Source: FEMA 2018

According to NOAA-NCEI Storm Events Database, Tioga County has been impacted by 62 severe winter storm events, causing 0 fatalities, 0 injuries, and $595,000 in property damage.

Table 5.4.3-3. Severe Storm Events 1950-2018

Hazard Type	Number of Occurrences Between 1950 and 2018	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Blizzard	0	0	0	$0	$0
Heavy Snow	37	0	0	$475,000	$0
Ice Storm	4	0	0	$100,000	$0
Winter Storm	17	0	0	$0	$0
Winter Weather	4	0	0	$20,000	$0
TOTAL:	**62**	**0**	**0**	**$595,000**	**$0**

Source: NOAA-NCEI 2018
Note: These numbers include events as reported to the NWS and may not include all events or losses.

For this 2018 Plan update, known severe winter storm events, including FEMA disaster declarations, which have impacted Tioga County between 2012 and 2018. For detailed information on damages and impacts to each municipality, refer to Section 9 (Jurisdictional Annexes). For events that occurred prior to 2012, refer to the Appendix E (County Profile and Risk Assessment Supplementary Data) which provides the event history as documented on the 2013 Tioga County HMP.

Table 5.4.3-4. Severe Winter Weather Events in Tioga County, 2012 to 2018

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
December 26, 2012	Winter Storm	N/A	N/A	A low pressure system tracked from the Tennessee Valley on Wednesday to just off of the New Jersey coast on Thursday to the Canadian Maritimes on Friday. Northwest flow pulled cold and moist air behind the system with a widespread snow falling across central New York on Wednesday and Thursday. Snowfall amounts across the county ranged from 6 to 8 inches.
December 29, 2012	Winter Storm	N/A	N/A	A low pressure system tracked from the midwest on Friday to the mid-Atlantic states on Saturday. Moisture and cold air associated with this system spread snow into portions of central New York on Saturday. Snowfall amounts across the county ranged from 5 to 8 inches.
February 8, 2013	Heavy Snow	N/A	N/A	A northern system passed over our region while merging with a coastal storm, yielding a period heavy snowfall across the region late February 8 into early February 9, 2013. Snow amounts generally ranged from 5 to 11 inches. A period of heavy snow resulted in 5 to 10 inches accumulation. Highest amounts included 10.0 inches near Candor and 8.0 inches near Berkshire.
January 1, 2014	Winter Storm	N/A	N/A	A stalled frontal boundary across central New York resulted in light to moderate snowfall across central New York falling during the afternoon hours of Wednesday, January 1st. This snow intensified during the overnight and early morning hours of Thursday, January 2nd as a low pressure system tracked through the Ohio Valley and re-developed off of the eastern seaboard. The highest snowfall totals occurred in the southern tier of New York into the upper Susquehanna Region with several 13 inch reports. Snowfall amounts ranged from 8-12 inches across the county. The highest amount of 12 inches fell in Newark Valley. Windy conditions resulted in significant blowing snow and cold temperatures.
February 5, 2014	Winter Storm	N/A	N/A	A low pressure system tracked through the Ohio Valley and re-developed off of the eastern seaboard during the morning hours of Wednesday, February 5th. An intense snow band that developed produced as much as one to three inches of snow per hour during the early morning hours. Widespread snow amounts ranged from 6 to 15 inches, with the highest totals occurring across the southern tier of New York. Snowfall amounts ranged from 10-18 inches across the county. The highest amount of 18.7 inches fell in Waverly.
February 13, 2014	Winter Storm	N/A	N/A	A low pressure system tracked out of the Gulf of Mexico and along the eastern seaboard on Thursday, February 13th bringing snowfall to the region. Widespread snow amounts ranged from 8 to 18 inches, with the highest totals occurring across Sullivan county, New York. Snowfall amounts averaged around 8 inches across the county. The highest amount of 7.9 inches fell in Tioga Terrace.
November 26, 2014	Winter Storm	N/A	N/A	A low pressure system developed over the northern Gulf of Mexico and intensified as it headed toward the northeast U.S. A coastal low developed along the Atlantic seaboard on November 26th. This system spread snow, heavy at times, into the western Catskills, the Susquehanna Region and southern tier of New York during the afternoon hours of Wednesday, November 26th. The highest snowfall totals were reported from a

Table 5.4.3-4. Severe Winter Weather Events in Tioga County, 2012 to 2018

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
				Cooperstown to Coventry to Binghamton line with double-digit snowfalls common along this route. Snowfall amounts ranged from 5-10 inches across the county. The highest amount of 9.6 inches fell at Tioga Terrace in Apalachin.
February 1, 2015	Heavy Snow	N/A	N/A	A winter storm tracked from the central Plains on Sunday February 1st to the upper Ohio Valley and western Pennsylvania by Monday morning the 2nd. The storm then moved east off the New Jersey coast and out to sea by Monday evening. This storm spread snow to central New York during the evening hours of the 1st. The snow lasted through the overnight and tapered to snow showers by Monday afternoon. The winter storm brought a general 6 to 12 inches of snow to central New York with locally higher amounts. Snowfall of 5 to 9 inches occurred with this winter storm. The highest snowfall was reported in Owego with 9.3 inches.
November 19, 2016	Lake-Effect Snow	N/A	N/A	A strong cold front crossed central New York on Saturday afternoon the 19th. Much colder air followed this front and was accompanied by several inches of snow, especially over the higher terrain. A slow-moving upper air low, which followed this front, slowly tracked across New York into northern New England from Sunday the 20th to Tuesday the 22nd. A northwest flow of cold moist air around this upper level low combined with moisture from the Great Lakes leading to a prolonged period of heavy lake effect snow. The lake effect snow affected an unusually large part of central New York including the southern tier counties, which typically do not see heavy lake effect snow. Hardest hit areas in central New York saw between 2 and 3 feet of snow over a 4 day period between November 19th and 22nd. At the Greater Binghamton Airport, 27.6 inches of snow fell in this period which was a record snowstorm. The heaviest lake effect snow affected the southern tier region on Sunday afternoon and night and then affected areas between Binghamton and Syracuse Monday into Monday night. All the snow tapered down on Tuesday the 22nd by midday. Snowfall totals ranged from 8 to 16 inches in the northern part of the county. Much less snow fell south to the Pennsylvania border.
March 14, 2017	Heavy Snow	DR-4322	Yes	A major winter storm developed over eastern North Carolina during the early morning hours of March 14th. The winter storm tracked northeast during the day on the 14th reaching the Gulf of Maine by the late evening of the 14th. This storm spread a heavy record breaking snowstorm to a large part of central New York and northeast Pennsylvania with blizzard conditions from the Catskills in New York to the Poconos of northeast Pennsylvania and in the greater Scranton Wilkes-Barre area. The snow spread from south to north across northeast Pennsylvania and central New York between midnight and 6 am on the 14th. The snow quickly became very heavy especially east of a Rome, New York to Towanda, Pennsylvania Line. Snowfall rates reached up to 5 inches per hour. The heavy snow continued through the day on the 14th and tapered off by late evening in most of northeast Pennsylvania but continued through the 15th as moisture from Lake Ontario combined with northwest winds behind the storm to prolong snowfall for central New York and the far northern tier of eastern Pennsylvania.

Table 5.4.3-4. Severe Winter Weather Events in Tioga County, 2012 to 2018

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
				Between 30 and 48 inches of snow fell from Bradford, Susquehanna and Wyoming Counties in northeast Pennsylvania through the Greater Binghamton area to Utica and Cooperstown NY, with 1 and 2 day snowfall records broken at many locations. Binghamton and Scranton set their 1 day snowfall records with 32.4 inches and 22.1 inches respectively. There were blizzard conditions from Scranton and Wilkes-Barre areas through the Poconos and Catskills during the late morning and afternoon of the 14th with frequent wind gusts over 35 mph and a peak wind of 61 mph at Monticello. Many other parts of central New York and northeast Pennsylvania had between 1 and 2 feet of snow and all areas had gusty winds and considerable blowing and drifting snow. Many municipalities, and counties declared states of emergencies and/or travel bans. New York state also declared a state of emergency. Pennsylvania reduced speed limits on the interstates. The heavy snow collapsed two roofs and there were two small avalanches that closed roads. There were no storm-related injuries or deaths. Snowfall ranged between 18 and 36 inches in Tioga County with the highest amounts in the far southeast part of the county.

Sources: *FEMA 2018; NOAA-NCEI 2018*

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*

Probability of Future Occurrences

Winter storm hazards in New York State are virtually guaranteed yearly since the State is located at relatively high latitudes resulting in winter temperatures that range between 0°F and 32 °F for a good deal of the fall through early spring season (late October until mid-April). In addition, the State is exposed to large quantities of moisture from both the Great Lakes and the Atlantic Ocean. While it is highly probable that a number of significant winter storms will occur during the winter and fall season, what is not easily determined is how many such storms will occur during that time frame (NYS DHSES 2014).

The 2014 New York State Hazard Mitigation Plan Update (HMP) suggests that, based on historical snow related disaster declaration occurrences, New York State can expect a snow storm of disaster declaration proportions, on average, once every three to five years. Similarly, for ice storms, based on historical disaster declarations, it is expected that ice storms of disaster proportions will occur, on average, once every seven to 10 years within the State (NYS DHSES 2014).

According to the NOAA National Centers for Environmental Information (NCEI) Storm Events Database, Tioga County experienced 62 winter weather events between 1950 and 2018, including 37 heavy snow events, four ice storms, 17 winter storms, and four winter weather events. Please note that this table might not include all winter storm events due to the fact that not all storms were reported to the NWS. The table below shows these statistics, as well as the annual average number of events and the percent chance of these individual severe winter storm hazards occurring in Tioga County in future years (NOAA NCEI 2018).

Table 5.4.3-5. Probability of Future Occurrence of Severe Winter Weather Events

Hazard Type	Number of Occurrences Between 1950 and 2018	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/Number of Events)	Probability of Event in any given year	% chance of occurrence in any given year
Blizzard	0	0.00	0	0	0
Heavy Snow	37	0.54	1.86	0.54	53.62
Ice Storm	4	0.06	17.25	0.06	5.8
Sleet	0	0.00	0	0	0
Winter Storm	17	0.25	4.06	0.25	24.64
Winter Weather	4	0.06	17.00	0.06	5.88
Total	**62**	**0.91**	**1.11**	**0.90**	**89.86**

Source: NOAA-NCEI 2018

In Section 5.3, the identified hazards of concern for Tioga 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 winter storms in the County is considered 'frequent' (event that occurs within 25 years, as presented in Table 5.3-3).

Climate Change Impacts

New York State averages 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 is more than 165 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.

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already being felt 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 (New York State Energy Research and Development Authority [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° F to 3.4° F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the State (NYSERDA 2014).

Regional precipitation across New York State is projected to increase by approximately one to eight-percent by the 2020s, three to 12-percent by the 2050s, and four to 15-percent by the 2080s. By the end of the century, the greatest increases in precipitation are projected to be in the northern areas of the State (NYSERDA 2014).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Tioga County is part of Region 3, Southern Tier. In Region 3, it is estimated that temperatures will increase by 4.4ºF to 6.3ºF by the 2050s and 5.7ºF to 9.9ºF by the 2080s (baseline of 47.5ºF, middle range projection). 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 5.4.3-6 displays the projected seasonal precipitation change for Southern Tier ClimAID Region (NYSERDA 2014).

Table 5.4.3-6. 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

It is uncertain how climate change will impact winter storms. Based on historical data, it is expected that the following will occur at least once per 100 years:

- Up to eight inches of rain fall in the rain band near the coast over a 36-hour period
- Up to four inches of freezing rain in the ice band near central New York State, of which between one and two inches of accumulated ice, 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 (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 (NYSDEC Date Unknown). Overall winter temperatures in New York State are almost five degrees warmer than in 1970 (NYSDEC Date Unknown). The State has seen 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 to 50% 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).

Some climatologists believe that climate change may 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.

5.4.3.2 Vulnerability Assessment

For the severe winter storm hazard, all of Tioga County has been identified as the hazard area. Therefore, all assets in the County (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are vulnerable to a winter storm. The following text evaluates and estimates the potential impact of the severe winter storm hazard on the County.

Impact on Life, Health and Safety

According to the NOAA National Severe Storms Laboratory (NSSL); every year, winter weather indirectly and deceptively kills hundreds of people in the U.S., primarily from automobile accidents, overexertion and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow and extreme cold temperatures and dangerous wind chill. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. People can die in traffic accidents on icy roads, heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold. Heavy accumulations of ice can bring down trees and power lines, disabling electric power and communications for days or weeks. Heavy snow can immobilize a region and paralyze a city, shutting down all air and rail transportation and disrupting medical and emergency services. Storms near the coast can cause coastal flooding and beach erosion as well as sink ships at sea. The economic impact of winter weather each year is huge, with costs for snow removal, damage and loss of business in the millions (NSSL 2006).

Heavy snow can immobilize a region and paralyze a city, 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 may be isolated for days, and unprotected livestock may be lost. In the mountains, heavy snow can lead to avalanches. The cost of snow removal, repairing damages, and loss of business can have large economic impacts on cities and towns (NSSL 2006).

Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces (NSSL 2006).

For the purposes of this HMP, the entire population of Tioga County (49,649 people, according to U.S. Census 2012-2016 American Community Survey 5-Year Estimate) is exposed to severe winter storm events (U.S. Census Bureau, 2016). Snow accumulation and frozen/slippery road surfaces increase the frequency and impact of traffic accidents for the general population, resulting in personal injuries. Refer to Appendix E for population statistics for each participating municipality.

The elderly are considered most susceptible to this hazard due to their increased risk of injuries and death from falls and overexertion and/or hypothermia from attempts to clear snow and ice. In addition, severe winter storm events can reduce the ability of these populations to access emergency services. Residents with low incomes may not have access to housing or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply).

Impact on General Building Stock

The entire general building stock inventory is exposed and vulnerable to the severe winter storm hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Table 5.4.3-7 presents the total exposure value for general building stock for each participating municipality.

Current modeling tools are not available to estimate specific losses for this hazard. As an alternate approach, this plan considers percentage damages that could result from severe winter storm conditions. Table 5.4.3-7 below summarizes percent damages that could result from severe winter storm conditions for the Planning Area's total general building stock. Given professional knowledge and the currently available information, the potential loss for this hazard is many times considered to be overestimated because of varying factors (building structure type, age, load distribution, building codes in place, etc.). Therefore, the following information should be used as estimates only for planning purposes with the knowledge that the associated losses for severe winter storm events vary greatly.

Table 5.4.3-7. General Building Stock Exposure and Estimated Losses from Severe Winter Storm Events

Municipality	Total (All Occupancies)	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Barton Township	$350,553,000	$3,505,530	$17,527,650	$35,055,300
Berkshire Township	$88,664,000	$886,640	$4,433,200	$8,866,400
Candor Township	$325,537,000	$3,255,370	$16,276,850	$32,553,700
Village of Candor	$78,320,000	$783,200	$3,916,000	$7,832,000
Newark Valley Township	$192,352,000	$1,923,520	$9,617,600	$19,235,200
Village of Newark Valley	$86,912,000	$869,120	$4,345,600	$8,691,200
Nichols Township	$139,722,000	$1,397,220	$6,986,100	$13,972,200
Nichols Village	$63,413,000	$634,130	$3,170,650	$6,341,300
Owego Township	$1,739,840,000	$17,398,400	$86,992,000	$173,984,000
Owego Village	$486,169,000	$4,861,690	$24,308,450	$48,616,900
Richford Township	$80,957,000	$809,570	$4,047,850	$8,095,700
Spencer Township	$198,539,000	$1,985,390	$9,926,950	$19,853,900
Spencer Village	$72,905,000	$729,050	$3,645,250	$7,290,500
Tioga Township	$381,740,000	$3,817,400	$19,087,000	$38,174,000
Waverly Village	$478,913,000	$4,789,130	$23,945,650	$47,891,300
Tioga County	**$4,764,536,000**	**$47,645,360**	**$238,226,800**	**$476,453,600**

Source: HAZUS-MH 3.2

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 the flood hazard profile (Section 5.4.1). Generally, losses resulting from flooding associated with severe winter storms should be less than that associated with a 100-year flood. Please refer to the severe storm profile (Section 5.4.2) 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. Because power interruption can occur, backup power is recommended. Infrastructure at risk for this hazard includes roadways that could be damaged due to the application of salt and intermittent freezing and warming

conditions that can damage roads over time. Severe snowfall requires the clearing roadways and alerting citizens to dangerous conditions; following the winter season, resources 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. Another impact on the economy includes impacts on commuting into, or out of, the area for work or school. The loss of power and closure of roads prevents the commuter population traveling to work within and outside of the County.

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 Sections 4 and 9, 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.

Current New York State land use and building codes incorporate standards that address and mitigate snow accumulation. Some local municipalities in the State have implemented the following activities to eliminate loss of life and property and infrastructure damages during winter storm events:

- Removal of snow from roadways
- Removal of dead trees and trim trees/brush from roadways to lessen falling limbs and trees
- Ensure proper road signs are visible and installed properly
- Bury electrical and telephone utility lines to minimize downed lines
- Removal of debris/obstructions in waterways and develop routine inspections/maintenance plans to reduce potential flooding
- Replace substandard roofs of critical facilities to reduce exposure to airborne germs resulting from leakage
- Purchase and install backup generators in evacuation facilities and critical facilities to essential services to residents
- Install cell towers in areas where limited telecommunication is available to increase emergency response and cell phone coverage (NYS DHSES, 2014)

Projected Changes in Population

Refer to Section 4.6.2 - Population Trends in the County Profile for a discussion on trends for the County. According to population projects from the Cornell Program on Applied Demographics, Tioga County will experience a continual population decrease through 2040 (nearly 8,500 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 may move into more densely populated areas of the County, which will increase the need

for Public Works and Highway Departments to maintain and treat the roadways in these areas due to the increased travel need.

Climate Change

Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Both globally and at the local scale, climate change has the potential to alter the prevalence and severity of extremes such winter storms. While predicting changes of winter storm events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA], 2013).

The 2011 'Responding to Climate Change in New York State' report was prepared for New York State Energy Research and Development Authority to study the potential impacts of global climate change on New York State. According to the synthesis report, it is uncertain how climate change will influence extreme winter storm events. Winter temperatures are projected to continue to increase. In general, warmer winters may lead to a decrease in snow cover and an earlier arrival in spring; all of which have numerous cascading effects on the environment and economy. Annual average precipitation is also projected to increase. The increase in precipitation is likely to occur during the winter months as rain, with the possibility of slightly reduced precipitation projected for the late summer and early fall. Increased rain on snowpack may lead to increased flooding and related impacts on water quality, infrastructure, and agriculture in the State. Overall, it is anticipated that winter storms will continue to pass through New York State (NYSERDA, 2011). Future enhancements in climate modeling will provide an improved understanding of how the climate will change and impact the Northeast.

Changes in Vulnerability Since the 2013 HMP

Overall, the entire County remains vulnerable to severe winter storms. A damage estimate was not conducted as part of the 2013 Tioga County Hazard Mitigation Plan risk assessment. The updated vulnerability assessment provides a more current risk assessment and analysis for the County.

Issues Identified

As noted above, although it is uncertain how climate change will impact winter storms, based on historical data, it is expected that there will be a increase in precipitation which could result in greater impact to structures and transportation systems and greater stress on social support services for vulnerable populations.

5.4.4 Drought

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

5.4.4.1 Profile

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.

There are four different ways that drought can be defined or grouped:

- ***Meteorological*** drought is a measure of departure of precipitation from normal. It is defined solely on the relative degree of dryness. Due to climatic differences, what might be considered a drought in one location of the country may not be a drought in another location.
- ***Agricultural*** drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced ground water or reservoir levels, and other parameters. It occurs when there is not enough water available for a particular crop to grow at a particular time. Agricultural drought is defined in terms of soil moisture deficiencies relative to water demands of plant life, primarily crops.
- ***Hydrological*** drought is associated with the effects of periods of precipitation shortfalls (including snowfall) on surface or subsurface water supply. It occurs when these water supplies are below normal. It is related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- ***Socioeconomic*** drought is associated with the supply and demand of an economic good with elements of meteorological, hydrological, and agricultural drought. This differs from the aforementioned types of drought because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts. The supply of many economic goods depends on weather (for example water, forage, food grains, fish, and hydroelectric power). Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply (National Drought Mitigation Center 2014).

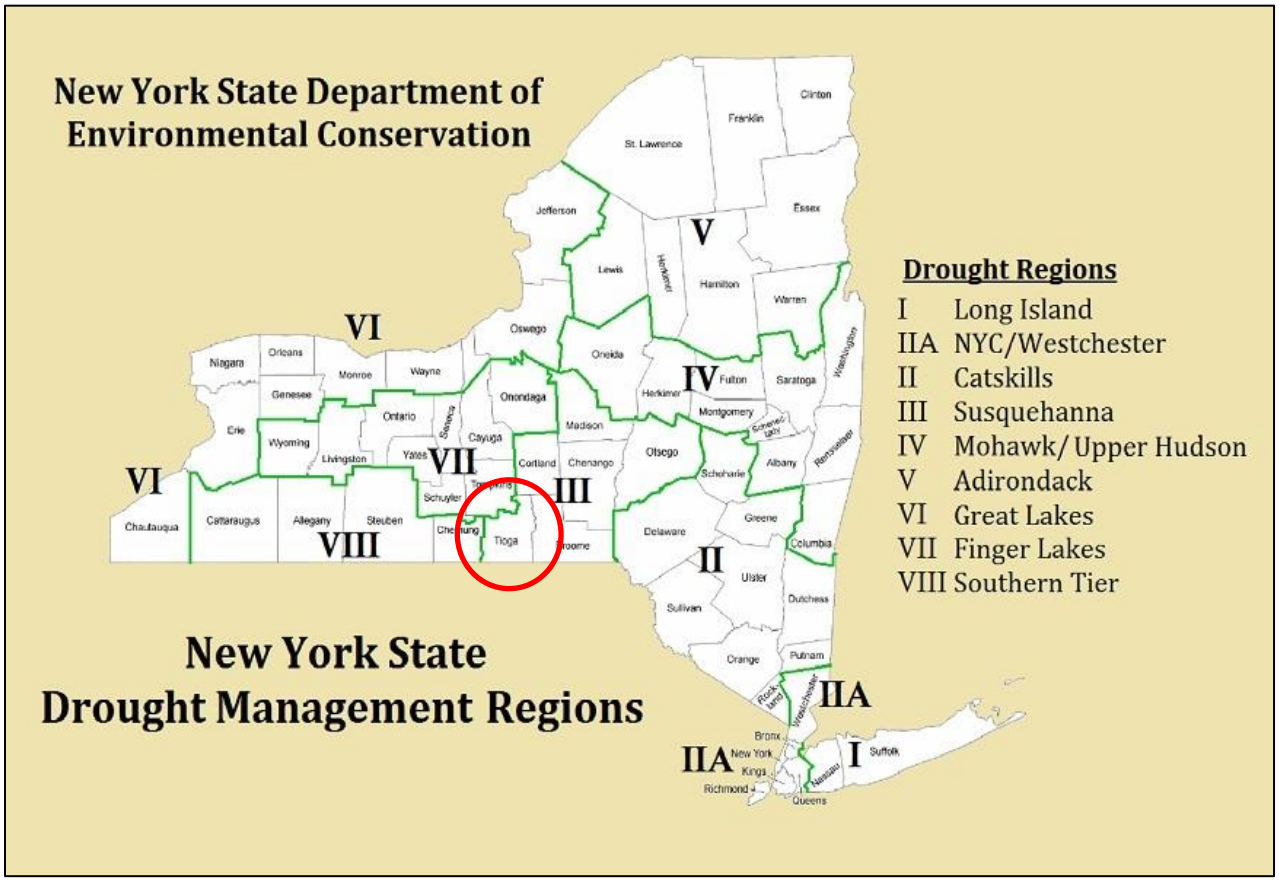
Location

Droughts can occur in all parts of the United States and any time of the year. Drier regions are more susceptible to long term or extreme drought conditions, while other areas tend to be more susceptible to short term, less severe droughts. In New York State, there is an abundant supply of water found throughout the State with streams, lakes, and coastal areas that have an average precipitation ranging from 60 inches in the Catskills to 28 inches in the Lake Champlain Valley. Variations in the normal amounts can lead to periods of dry weather and periods of drought (NYSDHSES 2014).

The National Oceanic and Atmospheric Administration (NOAA) has divided the United States into 344 climate divisions. According to NOAA, New York State is made up of 10 climate divisions: Western Plateau, Eastern Plateau, Northern Plateau, Coastal, Hudson Valley, Mohawk Valley, Champlain Valley, St. Lawrence Valley, Great Lakes, and Central Lakes (NOAA 2016a). Tioga County is located in the Eastern Plateau Climate Division.

The New York State Department of Environmental Conservation (NYSDEC) has divided New York State into nine drought management regions based roughly on drainage basins and county lines. NYSDEC monitors precipitation, lake and reservoir levels, stream flow, and groundwater level at least monthly in each region and more frequently during periods of drought. NYSDEC uses this data to assess the condition of each region, which can range from "normal" to "drought disaster" (NYSDEC 2016a). Figure 5.4.4-1 shows the drought regions of New York State with Tioga County circled. Tioga County is located within the Susquehanna Drought Region (Region II).

Figure 5.4.4-1. Drought Regions of New York State



Source: *NYSDEC 2016b*
Note: *The red circle indicates the location of Tioga County*

Extent

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts (NOAA 2000). The NYSDEC and the New York State Drought Management Task Force identifies droughts in the following four stages:

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. (NYS DEC 2018a).

The second methodology used by New York State was developed by the NYSDEC and is referred to as the State Drought Index (SDI). The SDI evaluates drought conditions on a more comprehensive basis by measuring whether numerous indicators reach dire thresholds. The data collected is compared against critical threshold values to show a normal or changeable drought condition. The indicators are weighted on a regional basis to reflect the unique circumstances of each drought management region (NYS DHSES 2014).

Previous Occurrences and Losses

Between 1954 and 2018, New York State experienced one FEMA declared drought-related major declaration (DR) classified as a water shortage (DR-204). Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Tioga County was not included in this declaration (FEMA 2018).

Agriculture-related drought disasters are quite common. One-half to two-thirds of the counties in the U.S. have been designated as disaster areas in each of the past several years. The USDA Secretary of Agriculture 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 2012 and 2018, Tioga County has been included in 12 USDA declarations; however, only six of them were a result of drought conditions (S3427 and S3441 in 2012 and S4023, S4031, S4038, and S4062 in 2016).

For this plan update, known drought events, including FEMA and USDA disasters, that have impacted Tioga County between 2009 and 2018 are identified in Table 5.4.4-1. For events prior to 2012, refer to Appendix E (County Profile and Risk Assessment Supplementary Data). Please note that not all events that have occurred in the County are included due to the extent of documentation and the fact that not all sources may have been identified or researched. Loss and impact information 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 Update.

Table 5.4.4-1. Drought Events Impacting Tioga County, 2012 to 2018

Date(s) of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Losses / Impacts
June 1, 2012	Drought	N/A	N/A	USDA declarations S3427 and S3441 were declared as agriculture-related drought disaster. No indemnities were reported.
April 1, 2016	Drought	N/A	N/A	USDA declaration S4062 was declared as an agriculture-related drought disaster. No indemnities were reported.
July 1, 2016	Drought	N/A	N/A	A significant lack of rain since May 2016 found many areas in the Finger Lakes and Southern Tier New York regions with as little as 25 percent of normal rainfall through the end of July. Significant dryness due to lack of rainfall saw short term drought conditions deteriorating from Moderate to Severe Drought according to the U.S. Drought Monitor. Indemnities totaled $2,170. USDA declarations S4031 and S4038 were declared.
August 1, 2016	Drought	N/A	N/A	Drought persisted and became worse over parts of the Finger Lakes region and Central Southern Tier of New York during August. Rainfall since the late Spring was only recording up to 50 to 80 percent of normal. According to the U.S. Drought Monitor, portions of the area deteriorated from severe to extreme drought. Agricultural interests reported significant stress to non-irrigated crops, and several communities began to place voluntary and mandatory water restrictions on their residents. According to the U.S. Drought Monitor, conditions deteriorated from severe to extreme drought over the northwest portion of the county. Indemnities totaled $16,419. USDA declaration S4023 was declared.
September 1, 2016	Drought	N/A	N/A	Drought worsened over parts of the Finger Lakes region and Central Southern Tier of New York during September. September rainfall amounts were again considerably below the average long term monthly trends. According to the U.S. Drought Monitor, drought conditions continued to deteriorate, and more of the region was classified in extreme drought. Agricultural interests reported significant stress to non-irrigated crops, with many areas reporting expected losses to corn, soybean and hay yields. More communities began to place voluntary and mandatory water restrictions on their residents. Drought conditions ranged from moderate drought over the far southeastern portion of the county to extreme drought across the northwest.
October 1, 2016	Drought	N/A	N/A	A moderate to heavy rain event on the 21st of the month helped to ease the drought across the Finger Lakes Region and Central Southern Tier. The U.S. Drought Monitor Extreme Drought classification was improved to just long term Severe Drought in areas extending from west of Binghamton to Penn Yan, New York. Moderate Drought surrounds the rest of the counties. The county remained in a D2 - Severe drought status through the month. USDA declarations and S4023, S4031, and S4062 were declared in 2016.

Source(s): FEMA 2018; NYSDHSES 2014; NOAA-NCEI 2018; USDA 2018; NYSDEC 2018

FEMA *Federal Emergency Management Agency*
NCEI *National Centers for Environmental Information*
NOAA *National Oceanic and Atmospheric Administration*
NYSDEC *New York State Department of Environmental Conservation*
NYSDHSES *New York State Division of Homeland Security and Emergency Services*
USDA *U.S. Department of Agriculture*

Probability of Future Occurrences

Based upon risk factors for and past occurrences, it is likely that droughts will occur across New York State and Tioga County in the future. In addition, as temperatures increase (see climate change impacts), the probability for future droughts will likely increase as well. Therefore, it is likely that droughts will occur in the State and County of varied severity in the future.

According to the 2014 New York State Hazard Mitigation Plan Update, between 1960 and 2012, Tioga County had three drought events that resulted in over $38,000 in property damage and over $4,825,000 in crop damage. These statistics showed that the County had a 6% chance of droughts occurring in the future with a recurrence interval of 17 (NYS DHSES 2014).

For the 2018 HMP update, the most up-to-date data was collected to calculate the probability of future occurrence on drought events, of all magnitudes, for Tioga County. Information from the New York State Hazard Mitigation Plan, the previous Tioga County Hazard Mitigation Plan, NOAA-NCEI storm events database and the NRCC drought database were used to identify the number of drought events that occurred between 1895 and 2017. Using these sources ensures the most accurate probability estimates possible. The table below shows these statistics, as well as the annual average number of events, and the estimated percent chance of an incident occurring in any given year.

Table 5.4.4-2. Probability of Future Occurrence of Drought Events

Hazard Type	Number of Occurrences Between 1895 and 2017	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/Number of Events)	Probability of Event in any given year	% chance of occurrence in any given year
Drought	15	0.12	8.20	0.12	12.20

Source: NOAA NCEI 2018, NYS DHSES 2014, NRCC 2018, Tioga County 2013

It is estimated that Tioga County will continue to experience direct and indirect impacts of drought and its impacts on occasion, with the secondary effects causing potential disruption or damage to agricultural activities and creating shortages in water supply within communities.

In Section 5.3, the identified hazards of concern for Tioga 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 drought in the County is considered 'frequent' (likely to occur within 25 years, as presented in Table 5.3-3).

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. Impacts related to increasing temperatures and sea level rise are already being felt 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 (New York State Energy Research and Development Authority [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° F to 3.4° F by the 2020s, 4.1° F to 6.8° F by the 2050s, and 5.3° F to 10.1° F by the 2080s. By the end of the century, the greatest warming is projected to be in the northern section of the State (NYSERDA 2014). According to the ClimAID

report, it is likely that late-summer short-duration droughts will increase in New York State by the end of the century.

However, each region in New York State, as defined by ClimAID, has attributes that will be uniquely affected by the impacts of climate change. Tioga County is part of Region 3, Southern Tier, which may experience invasive insects, weeds, and other pests moving north, among other issues, due to climate change (NYSERDA 2011). In Region 3, it is estimated that temperatures will increase by 4.4ºF to 6.3ºF by the 2050s and 5.7ºF to 9.9ºF by the 2080s (baseline of 47.5ºF). Precipitation totals will increase between 4 and 10% by the 2050s and 6 to 14% by the 2080s (baseline of 35.0 inches). Table 5.4.4-3 displays the projected seasonal precipitation change for the Southern Tier ClimAID Region (NYSERDA 2014).

Table 5.4.4-3. 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

The frequency of heat waves and drought are also projected to increase in Region 3. With the increase in temperatures, heat waves will become more frequent and intense, increasing heat-related illness and death and posing new challenges to the energy system, air quality and agriculture. Summer droughts are projected to increase, affecting water supply, agriculture, ecosystems, and energy projects (NYSERDA, 2011). Table 5.4.4-4 displays the projected changes in these events and includes the minimum, central range and maximum days per year.

Table 5.4.4-4. Changes in Extreme Events in Region 3 – Heat Waves and Drought Conditions

Event Type	# Days Per Year	Baseline	2020s	2050s	2080s
Heat Waves	**Number of Days per year with maximum temperature exceeding: minimum, (central range), and maximum**				
	90°F	10 days	15 (17 to 21) 23	22 (26 to 41) 47	28 (33 to 67) 79
	Number of heat waves per year	1 event	2 (2 to 3) 3	3 (3 to 6) 6	3 (4 to 9) 9
	Average duration	4 days	4 (5 to 5) 5	5 (5 to 5) 6	5 (5 to 6) 7

Source: NYSERDA 2014

5.4.4.2 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For the drought hazard, all of Tioga County has been identified as exposed. Therefore, all assets in the County (population, structures, critical facilities and lifelines), as described in the County Profile (Section 4), are exposed and potentially vulnerable to a drought. The following text evaluates and estimates the potential impact of the drought hazard on the County.

Impact on Life, Health and Safety

The entire population of Tioga County is vulnerable to drought events (population of 49,649 people, according to U.S. Census 2012-2016 American Community Survey 5-Year Estimate) (U.S. Census Bureau 2016). Drought conditions can affect health and safety, including 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.

Droughts may have devastating effects on communities and the surrounding environment. The amount of devastation depends on the strength and duration of a drought event. One impact of drought is its impact on water supply. When drought conditions persist with little to no relief, water restrictions may be put into place by local

or state governments. These restrictions can include watering of lawns, washing cars, etc. In exceptional drought conditions, watering of lawns and crops may not be an option. If crops are not able to receive water, farmland will dry out and crops will die. This can lead to crop shortages, which, in turn, increases the price of food (North Carolina State University 2013).

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

The impacts on public health from drought can be severe which includes increase in heat-related illnesses, waterborne illnesses, recreational risks, limited food availability, and reduced living conditions. Those individuals who rely on water, such as farmers, may experience financial-related stress. Decreased amounts and quality of water during drought events have the potential to reduce the availability of electricity (hydropower, coal-burning and nuclear) (North Carolina State University 2013).

Drought conditions can affect people's health and safety including health problems related to low water flows and poor water quality; and health problems related to dust. Droughts also have the potential to lead to loss of human life (NDMC 2016). Other possible impacts to health due to drought include increased recreational risks; effects on air quality; diminished living conditions related to energy, air quality, and sanitation and hygiene; compromised food and nutrition; and increased incidence of illness and disease. Health implications of drought are numerous. Some drought-related health effects are short-term while others can be long-term (CDC 2012).

As previously stated, drought conditions can cause shortages in water for human consumption. Droughts can also lead to reduced local firefighting capabilities. The drought hazard is a concern for Tioga County because the County's water supply comes from both groundwater and surface water supplies. Nearly all the water supply for the County is derived from precipitation that falls within the County borders. Periods of below average precipitation can result in mandatory water restrictions. In the short-term, surface water supplies are affected more quickly during droughts than groundwater sources.

Impact on General Building Stock

No structures are anticipated to be directly affected by a drought event. However, droughts contribute to conditions conducive to wildfires and reduce fire-fighting capabilities. Risk to life and property is greatest in those areas where forested areas adjoin urbanized areas (high density residential, commercial and industrial) also known as the wildfire urban interface (WUI). Therefore, all assets in and adjacent to, the WUI zone, including population, structures, critical facilities, lifelines, and businesses are considered vulnerable to wildfire.

Impact on Critical Facilities

Water supply facilities may be affected by short supplies of water. As mentioned, drought events generally do not impact buildings; however, droughts have the potential to impact agriculture-related facilities and critical facilities that are associated with potable water supplies.

Impact on the Economy

When a drought occurs, the agricultural industry is most at risk in terms of economic impact and damage. During droughts, crops do not mature leading to a lessened crop yield, wildlife and livestock are undernourished, land values decrease, and ultimately there is financial loss to the farmer (FEMA 1997).

Based on the 2012 Census of Agriculture, there were 536 farms in Tioga County, with 107,873 acres of total land in farms. The average farm size was 201 acres. Tioga County farms had a total market value of products sold of

over $36.7 million (over $11.3 million in crop sales and over $25.4 million in livestock sales), averaging $68,559 per farm. The Census indicated that 290 farm operators reported farming as their primary occupation (USDA 2012). Table 5.4.4-5 shows the acreage of agricultural land exposed to the drought hazard.

Table 5.4.4-5. Agricultural Land in Tioga County in 2012

Number of Farms	Land in Farms (acres)	Total Cropland (acres)	Harvested Cropland (acres)	Irrigated Land (acres)
536	107,873	50,700 (47%)	41,176 (38.2%)	672 (0.6%)

Source: USDA 2012

The 2012 Census of Agriculture for Tioga County indicated that the top crop items, by acres, in the County are forage-land used for all hay and haylage, grass silage, and greenchop (30,363 acres) and corn for silage (4,981 acres) (USDA 2012).

A prolonged drought can have a serious economic impact on a community. Increased demand for water and electricity may result in shortages and a higher cost for these resources (FEMA 2005). Industries that rely on water for business may be impacted the hardest (e.g., landscaping businesses). Even though most businesses will still be operational, they may be impacted aesthetically. These aesthetic impacts are most significant to the recreation and tourism industry. As stated above, if there are periods of lower than average precipitation in the County, mandatory water restrictions may be enforced. In addition, droughts in another area could impact the food supply/price of food for residents in 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 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 could be potentially impacted by the drought hazard because the entire County is exposed and vulnerable to droughts. Future growth could impact the amount of potable water available due to a drain on the available water resources. Other areas that could be impacted include agriculture and recreational facilities such as golf courses, farms, and nurseries.

Projected Changes in Population

Refer to Section 4.6.2 - Population Trends in the County Profile for a discussion on trends for the County. According to population projections from the Cornell Program on Applied Demographics (Cornell PAD, 2018), Tioga County will experience a continual population decrease through 2040 (nearly 5,500 people). This decrease will reduce the overall vulnerability of the County's population over time. While less people will reside in the County, populations may move into more densely populated areas of the County, increasing the stress on the water supplies in those locations.

Climate Change

Nearly every region in the country is facing some increased risk of seasonal drought. Climate change can significantly affect the sustainability of water supplies in the future. As parts of the United States get drier, the amount and quality of water available will likely decrease, impacting people's health and food supplies. With climate change, the entire country will likely face some level of drought. A report by the Natural Resources Defense Council (NRDC) found that 1,100 counties (one-third of all counties in the contiguous 48 states) face higher risks of water shortages by mid-century as a result of climate change. More than 400 of these counties will face extremely high risks of water shortages.

Refer to the 'Climate Change Impacts' subsection earlier in this profile for more details on climate change pertaining to New York State.

Changes in Vulnerability Since the 2013 HMP

When examining the change in the County's vulnerability to drought events from the original HMP to this update, it is important to look at each entity that is exposed and vulnerable. Although the total population across the County has decreased over the past few years, the agricultural sector continues to place stress on the water supply during a drought event. In terms of the agricultural industry for Tioga County, while there has been about a 5% decrease in the total number of farms since 2007, there has been approximately a 1% increase in land in farms. (USDA 2012).

Issues Identified

The potential drought effects on the sustainability of the significant agricultural base in the County provides a potential issue to be addressed by the County. In addition, as noted above, droughts contribute to conditions conducive to wildfires and reduce fire-fighting capabilities.

SECTION 6. MITIGATION STRATEGIES

This section presents mitigation actions for Tioga 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.

This section includes:

1. Background and Past Mitigation Accomplishments
2. General Planning Approach
3. Review and Update of Mitigation Goals and Objectives
4. Capability Assessment
5. Mitigation Strategy Development

Hazard mitigation reduces the potential impacts of, and costs associated with, emergency and disaster-related events. Mitigation actions address a range of impacts, including impacts on the population, property, the economy, and the environment.

Mitigation actions can include activities such as: revisions to land-use planning, training and education, and structural and nonstructural safety measures.

6.1 BACKGROUND AND PAST MITIGATION ACCOMPLISHMENTS

In accordance with the requirements of the Disaster Mitigation Act of 2000 (refer to Page 1-1 for more detail on DMA 2000), 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. The County, through previous and ongoing hazard mitigation activities, has demonstrated that it is pro-active 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 and 2013 update of the Tioga County Multi-Jurisdictional All-Hazards Mitigation Plan. The current planning process represents the regulatory five-year plan update process, which includes participation of all 15 municipal governments in the County, along with key county and regional stakeholders.
- All municipalities participating in this HMP update participate in the National Flood Insurance Program (NFIP), which requires the adoption of FEMA floodplain mapping and certain minimum standards for building within the floodplain.
- The County has contracted with the Tioga County Soil and Water Conservation District to fulfill the position of Hazard Mitigation Coordinator to ensure that hazard mitigation is addressed and integrated into County and municipal operations to support implementation of mitigation projects on a timely basis. This position is unique among counties in New York State as it demonstrates a serious commitment to reducing risk in the County and provides an ongoing focus on mitigation planning and project implementation on a consistent basis.
- Exposure in the floodplain as been significantly decreased with the successful funding of the following property acquisitions:
    - Town of Owego - 23 buyouts, 3 elevations; Application for funding for 4 repetitive loss properties on Marshland Rd. was submitted in 2015 and awaiting on approval as of 2017.
    - Town of Tioga - 13 buyouts, 2 new houses built above flood level, 2 houses elevated.
    - Village of Owego - 6 elevations finished and 2 pending, 34 homes bought out, 24 demolitions complete as of December 2016.
    - Village of Spencer - 1 home elevated.
- Town of Barton- 19 buyouts and 1 opted out. Two houses were elevated. The town has also adopted a higher regulatory standard for construction in the floodplain, requiring 4 foot freeboard in the floodplain.

- The County and municipalities have implemented, or sought to implement through efforts to secure available funding resources, mitigation actions to protect critical facilities and infrastructure throughout the planning area, including:
    - The Village of Nichols successfully completed certification of its levee funded by NY Rising/CDBG-DR funds.
    - County 911 telecommunications towers: Fortified buildings, added generators, and installed fencing to protects this equipment at all sites from weather and other damage prevention through a Statewide Interoperable Communications Grant.
    - Wet-proofed County Courthouse and Court Annex, raised electric system at 56 Main Street (County Office Building), protected elevators and boilers sub-ground level at 56 Main Street and Court Annex, generator installed at Highway's automotive repair center. These were all done as recommended in a 2013 consultant-developed Structural Hazard Mitigation Plan for County Facilities impacted by the 2011 flood. County pays for all this up-front via the Capital Fund with expected future reimbursement. To date reimbursements have come from FEMA and NYSERDA
- In the past five years municipal officials in Tioga County have become increasingly aware and mindful of mitigation principles in their daily operations, particularly relating to flooding. Most municipal highway departments have realized that the size of culverts is inadequate. Most have an unwritten policy of up-sizing culverts when they need replacement. All municipalities now consult with Tioga County Soil & Water Conservation District before attempting debris removal in streams, bridge construction projects, or other stream projects to ensure the projects will be constructed in a sustainable and environmentally-sensitive manner that will have long-lasting performance and benefits.
- Municipalities have actively participated in available mitigation grant funding opportunities to implement mitigation projects, as identified in their jurisdictional annexes in Section 9 - Annexes.
- Reports, plans and studies relating to or including information on natural hazards or natural hazard policies affecting Tioga County, and have been reviewed and incorporated into this plan update as appropriate (see Section 3 – Planning Process and References).
- During the performance period of the 2012 plan, FEMA issued a new Flood Insurance Study (FIS) as well as new effective digital mapping (Flood Insurance Rate Maps or FIRMs) for Tioga County. These maps have been incorporated into municipal floodplain ordinances by reference.
- Municipalities in Tioga 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 Department of Economic Development and Planning** facilitates and supports activities which increase job opportunities, maximize the quality of life, and foster a vibrant rural economy within the County. The planning division works with municipalities within Tioga County on planning and zoning issues, in order to prepare for future economic development. There are also several county-level plans that guide the policy and direction of development for Tioga County. In this role the planning division has taken a lead in developing the Tioga County HMP Update and in continuing to maintain an awareness within the County and communities of the importance of mitigation to reduce the impacts of natural hazards. To this end, the planning department has supported integration of the mitigation plan into municipal comprehensive plan updates. These include the Town of Newark Valley, Town of Tioga and Town/Village of Spencer (first-time

The Planning Department supports integration of hazard mitigation into municipal comprehensive plan updates as part of their commitment to teaching communities the importance of reducing natural hazards impacts throughout Tioga County.

comprehensive plans) and the Towns of Berkshire, Candor and Richford, and the Village of Owego (updated comprehensive plans. The County Planning Director assisted each of the municipalities during the development or update of their plans. When doing so, it was recommended that each municipality incorporate some phrasing or section regarding hazard mitigation, and in particular flooding. Additional accomplishments of the planning division include:

  - The County Planning Director utilizes hazardous features in the County's GIS system in GML 239 referrals. The County Planning Director conducts thorough analyses on these site plan review referrals for the Tioga County Planning Board. When proposed development is located within a floodplain, there is always a condition written that the applicant must comply with the municipality's Flood Damage Prevention law, and that the Local Flood Plain Administrator must issue a floodplain development certificate.
  - The County Planning Board makes recommendations on planning/zoning cases referred by municipalities. Hazardous features such FEMA's Special Flood Hazard Areas are consistently assessed to make sure the proposed projects will comply with local regulations such as Flood Damage Prevention local laws. The County also has a new Local Emergency Planning Committee that will include managing natural hazard risk among its functions.

- **The County Department of Emergency Services** coordinates emergency response activities and resources during hazard events and analyzes the response efforts after hazards to evaluate performance, make improvements and identify additional resources required and opportunities for mitigation action. The County's Comprehensive Emergency Management Plan refers to the Hazard Mitigation Plan. The County has a Post-Disaster Recovery Plan for debris management and removal, as well as cleanup of county facilities. The Plan does not currently refer to the HMP but will incorporate this HMP update.
- The **Tioga County Soil and Water Conservation District (SWCD or District)** instructs on topics pertinent to Agricultural Environmental Management and natural resource conservation for public and municipalities. Other trainings that deal with stormwater management to improve water quality and reduce water quantity are offered as well. The Tioga County SWCD serves as the County level mitigation liaison to communities, providing support for implementation of mitigation projects by overseeing development, distribution and maintenance of the Hazard Mitigation Plan. The SWCD provides review and update municipal and County project annexes based on field visits with municipal and county officials. The SWCD continues to be the leader on post disaster recovery through ESI (Emergency Stream Intervention training and protocol); pre-disaster resiliency work (through the Hazard Mitigation Plan) and continues to work with private citizens and municipalities through public education, training, technical assistance, grant writing and coordination, project design, hiring and oversight. It continues to work with municipalities to assess current culvert conditions for stability and environmental value, capacity, public safety and costs. This will allow a prioritization of sites to seek additional funding to rectify the problem areas. As of April 2019, the District is planning to apply for funding through the NYS Climate Resilient Farming Program to complete a streambank stabilization project along with buffer and wetland implementation on a farm in the Town of Spencer.

SWCD serves as the Tioga County mitigation liaison, supporting communities with the implementation of mitigation projects and the distribution and maintenance of the HMP. Each year, SWCD facilitates the HMP annual review process, working with Tioga County and its communities.

Specific accomplishments include numerous projects implemented to reduce erosion and flood impacts such as:

- Organizing individual meetings with each municipality to review their municipal project annexes. Notes from that meeting were distributed to each municipality for review with additional project information needs identified to provide updates for inclusion in the HMP five-year regulatory update.
- Upon request of individual municipalities for stream permitting, culvert assessments and general technical assistance to conduct site visits to potential hazard prone areas with municipal officials to identify opportunities to reduce hazard impacts, conducted several site visits, This included culvert assessments for the Town of Spencer (1), Tioga (1), Newark Valley (3) and Nichols (1); stream permit assistance for the Town of Spencer, Fisher Settlement Road Bridge repair and Hulbert Hollow culvert replacement, Town of Owego Sewer Repair Access on Apalachin Creek, and County DPW emergency permit for Salmi Property on Hulbert Hollow.
- Provided technical assistance to the OACSD on a streambank erosion problem occurring on Owego Creek, as well as numerous site visits with Town and County officials to address stream crossing issues. Also, SWCD monitored existing FEMA funded stream stabilization and rehabilitation projects after heavy rain events with no major issues identified
- Completed 11 hydroseeding projects, for a total of 3.75 acres.
- Facilitated planting over 677 acres of cover crops and 325.6 acres of conservation tillage acres to address soil erosion. No-till farming is an agricultural technique which increases the amount of water that infiltrates into the soil and increases organic matter retention and cycling of nutrients in the soil. In many agricultural regions it can reduce or eliminate soil erosion.
- Facilitated the funding of 77 acres of riparian buffer planting and 440 acres of prescribed grazing through the USC Buffer Pilot Program
- Held 6 stream training events throughout the USC Watershed and published the Stream Corridor Assessment Guide.
- Assisted landowners and municipalities with several stream stabilization and rehabilitation projects. Funding came from a variety of sources including: municipal highway funds (flash flood recovery), landowner match, WQIP grant, Dire States grant, Part C funding, and NRCS EQIP.
- Assisted towns with flash flood recovery: permits, tech advice and oversight.
- Completed 24 stream projects.
- Provided 4,780 linear feet of stream bank protection.

- Conducted culvert/ESI training with highway departments, demonstrated on a live flood recovery site in Nichols.

Above: Eroding stream bank threatening pasture land on Lyon Farm, Town of Candor. Before and After.

Above: Eroding stream bank threatening Barnyard on Moyer Farm, Town of Owego. Before and After.

Source: TCSWCD, 2018

- The **Tioga County Law Department** worked with FEMA representatives to close out the last Project Worksheets (PWs) from the 2011 flood. With the mitigation and document restoration work completed, final submission was made for all PWs. Only two PWs remain to be approved and paid.

- The **County GIS Department** worked to contract the construction of a County Fiber Ring fiber-optic cable to complete a "ring" configuration for the County's network. This configure will significantly enhance the resiliency of the County's data network in the event of a disaster.

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:

- 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)
- 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 of this section:

- Review and update mitigation goals and objectives
- Identify mitigation capabilities and evaluate their capacity and effectiveness to mitigate and manage hazard risk
- Prepare an implementation strategy, including:
    - Identification of progress on previous County and local mitigation strategies
    - Development of updated County and local mitigation strategies, and
    - Prioritization projects and initiatives in the updated mitigation strategy

6.3 REVIEW AND UPDATE OF MITIGATION GOALS AND OBJECTIVES

This section documents the efforts to develop hazard mitigation goals and objectives 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 have been developed based on the risk assessment results, discussions, research, and input from amongst the committee, existing authorities, polices, programs, resources, stakeholders and the public.

For the purposes of this plan, goals and objectives are defined as follows:

Goals are general guidelines that explain what is to be achieved. They are usually broad, long-term, policy-type statements and represent global visions. Goals help define the benefits that the plan is trying to achieve. The success of the plan, once implemented, should be measured by the degree to which its goals have been met (that is, by the actual benefits in terms of hazard mitigation).

Objectives are short-term aims which, when combined, form a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

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.

During the 2018 plan update process, the Steering Committee reviewed the goals and objectives established in the 2010 HMP. These goals and objectives were reviewed in consideration of the hazard events and losses since the 2010 plan, the updated hazard profiles and vulnerability assessment, the goals and objectives established in the New York State 2014 HMP, County and local risk management plans, as well as direct input on how the County and municipalities need to move forward to best manage their hazard risk. Amendments include additions/edits to goals and/or 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 NYS 2014 HMP update as identified in the table below.

As a result of this review process, the Goals and Objectives for the 2018 update have been amended, as presented in Table 6-1. *Italicized* text indicates the updates for this plan.

Table 6-1. Tioga County Hazard Mitigation Plan Goals and Objectives

Goal	Objective
Goal 1: Protect Life and Property	*Objective 1-1:* Protect critical facilities and infrastructure.
	Objective 1-2: Address repetitive and severe repetitive loss properties throughout the County.
	Objective 1-3: Encourage the establishment of *resiliency-based* policies to help ensure the prioritization and implementation of mitigation actions and/or projects designed to benefit essential facilities, services, and infrastructure.
	Objective 1-4: Implement mitigation actions that enhance the capabilities of the County to better profile and assess exposure to hazards including update of mapping information.
	Objective 1-5: Improve the understanding the hydrology of major rivers and streams and improve capacity of these water features to reduce flood vulnerability through improvements to water courses and improving natural floodplain resources
	Objective 1-6: Develop, maintain, strengthen and promote enforcement of ordinances, regulations, plans and other mechanisms that facilitate *resiliency and* hazard mitigation.
	Objective 1-7: Integrate the recommendations of this plan into existing regional and local programs.
	Objective 1-8: Ensure that development is done according to modern and appropriate standards, including the consideration of natural hazard risk *by using sustainable construction and design measures that address resiliency.*
	Objective 1-9: Identify and pursue funding opportunities to develop and implement local and county mitigation activities.
	Objective 1-10: Improve and Promote detection, warning and communication systems.
	Objective 1-11: Improve communication of emergency directives before, during, and after disaster events.
Goal 2: Increase Public Awareness and Preparedness / Understanding of Natural Hazards and their Risks	*Objective 2-1:* Develop and implement program(s) to increase the public's level of individual and household preparedness.
	Objective 2-2: Develop and implement additional ongoing education and outreach programs to increase public awareness of hazard areas and the risks associated with hazards, and to educate the public on specific, individual preparedness activities and promote awareness among homeowners, renters, and businesses about obtaining insurance coverage available for natural hazards (i.e., flooding).
	Objective 2-3: Implement mitigation actions that enhance the capabilities of the County and communities to better profile and assess exposure to hazards.
	Objective 2-4: Create and implement an educational strategy and training component on stream processes and stream corridor management.
	Objective 2-5: Provide information to the public on tools, partnership opportunities, funding resources, and current government initiatives to assist in implementing mitigation activities.
Goal 3: Reduce Hazard Impact on the Economy (throughout the County)	*Objective 3-1:* Where *appropriate*, coordinate and integrate hazard mitigation actions with existing local emergency operations plans.
	Objective 3-2: Promote suitable, *sustainable and resilient* land development practices.
	Objective 3-3: Support education and outreach to businesses and agricultural businesses to increase the understanding of vulnerability to natural hazards and to reduce potential interruptions in business operations or business closures.
	Objective 3-4: Support business and agricultural business awareness of available flood insurance and incentives to mitigate business assets against natural hazards.
Goal 4: Protect Open Space, Agricultural	*Objective 4-1:* Conserve, protect, and enhance streams and river systems so that channels and floodplains provide beneficial functions for flood damage prevention, habitat and water quality.
	Objective 4-2: Maintain and restore the connections between streams and their floodplains utilizing science-based approaches when stream systems are disturbed.
	Objective 4-3: Protect and preserve environmentally sensitive and critical areas.

Goal	Objective
Land, the Environment and Natural Resources	*Objective 4-4:* Protect and restore natural lands and features that serve to mitigate losses (including wetlands, floodplains, stream corridors, hillsides and ridge lines). Such lands should be clearly mapped and identified for protection.
	Objective 4-5: Continue to preserve, protect and acquire open space, particularly in high hazard areas. Include hazard considerations into the prioritization schema for land acquisition.
	Objective 4-6: Promote the continued use of natural systems and features, open space preservation, and land use development planning for natural hazard mitigation activities wherever possible to anticipate and reduce long term costs and maximize hazard mitigation effectiveness.
Goal 5: Promote and Support Partnerships	*Objective 5-1*: Strengthen inter-jurisdiction and inter-agency communication, coordination, and partnerships to foster hazard mitigation actions and/or projects including encouragement of shared services in acquiring, maintaining, and providing emergency services and equipment.
	Objective 5-3: Coordinate, create, and maintain, where applicable or required, natural hazard mitigation efforts natural risk management activities with adjacent jurisdictions' agencies.
Goal 6: Enhance Emergency Management Preparedness, Response, and Recovery	*Objective 6-1:* Encourage the establishment of *resiliency-based* policies to help ensure the prioritization and implementation of mitigation actions *and*/or projects designed to benefit essential facilities, services, and infrastructure.
	Objective 6-2: Identify the need for, and acquire, any special emergency services, training, equipment, facilities and infrastructure to enhance response capabilities for specific hazards.
	Objective 6-3: Ensure continuity of governmental operations, emergency services, and essential facilities at the local level during and immediately after disaster and hazard events.
	Objective 6-4: Maintain and expand shared services in acquiring maintaining and providing emergency services and equipment.

6.4 CAPABILITY ASSESSMENT

According to FEMA Mitigation Planning How-To Guide #3, a capability assessment is an inventory of a community's missions, programs and policies; and an analysis of its capacity to carry them out. This assessment is an integral part of the planning process. The assessment process enables identification, review and analysis of local and state programs, policies, regulations, funding and practices currently in place that may either facilitate or hinder mitigation.

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 may exist on undertaking actions;
- The range of local and/or state administrative, programmatic, regulatory, financial and technical resources available to assist in implementing their mitigation actions;
- Actions deemed infeasible as they are currently outside the scope of capabilities;
- Types of mitigation actions that may 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 may be found in the Capability Assessment section of each jurisdictional annex in Section 9 - Annexes.

Within each annex, participating jurisdictions identified how they have 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.

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 Tioga 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 - Annexes. The Tioga County Department of Economic Development & Planning (TCEDP) and the Tioga County Soil and Water Conservation District (TCSWCD) both provide local land use planning support to the municipalities (see Section 6.4.3).

Section 239 of New York State General Municipal Law (GML) requires the referral of certain local planning actions to the County Planning Board for the examination of possible inter-municipal impacts. TCEDP, along with the County Planning Board, fulfil the requirements under Section 239-M of the law. TCEDP coordinates local approvals processes for development projects. It provides professional planning, technical assistance to municipalities for development and update of comprehensive plans, local land use laws, and zoning. It provides professional support to the County Planning Board on review of development projects that have intermunicipal or countywide significance.

TCEDP provides technical planning assistance for municipalities within the County. The County Planning Board reviews all aspects of the projects referred to them and often discusses natural hazard risks regarding floodplains as well as stormwater management. The Board makes recommendations on local projects to approve, disapprove, or approve with modification– it does not have the authority to make determinations. Municipalities consider County recommendations but may vote against them with a super-majority vote is disapproval or approval with modification. All municipalities within the County have some form of land use regulations.

The TCSWCD District Manager serves as the Hazard Mitigation Coordinator and as such provided continuous support for the implementation of mitigation projects and mitigation educational outreach and serves as a resource to the County and municipalities.

Emergency and Evacuation Plans

The Tioga County Office of Emergency Services plays a lead role in planning, mitigation, coordination, and response and recovery for natural disasters such as floods and winter weather storm events. The Office of Emergency Services maintains the Tioga County Comprehensive Emergency Management Plan (CEMP) which establishes the framework for an effective system to ensure the County and its municipalities will be adequately prepared to respond to an occurrence of natural, manmade, and/or technological related emergencies or disasters. It is updated every three years. The CEMP provides protocol for sheltering and evacuation of residents in the event of an emergency (refer to the Emergency Operations Center guidelines of the CEMP).

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 U.S. 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% less damage annually than those not built in compliance (FEMA, 2008).

All municipalities in Tioga County actively participate in the NFIP. As of April 30, 2018, there were 979 NFIP policies in Tioga County. There have been 1559 claims made, totaling over $61.6 million for damages to structures and contents. There are 277 NFIP Repetitive Loss (RL) property and 33 Severe Repetitive Loss (SRL) properties in the County. Further details on the County's flood vulnerability may be found in the flood hazard profile in Section 5.4.2 - Flood.

Municipal participation in and compliance with the NFIP is supported at the federal level by FEMA Region II and the Insurance Services Organization (ISO), 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 may be found in the flood hazard profile (Section 5.4.2 - Flood).

The state and municipalities within it may 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 may 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 may 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 (NYDEC 2018). Communities may 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% of the building's pre-improvement value to be permitted without meeting the flood protection requirements. Over the years, a community may 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 may 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 program.

Currently there are no municipalities in Tioga County participating in the CRS program.

New York State Floodplain Management

There are two departments that have statutory authorities and programs that affect floodplain management at the local jurisdiction level in New York State: the New York State Department of Environmental Conservation (NYSDEC) and the Department of State's Division of Code Enforcement and Administration (DCEA).

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.

Tioga County noted that will work with the Floodplain Management Section to develop local floodplain administrators training for the administrators in Tioga County. This will help support municipal compliance with the NFIP, improve floodplain identification and mapping in the communities, and provide flood insurance outreach to residents.

6.4.3 Administrative and Technical Capabilities - County and Local

Tioga County Department of Emergency Services

The Office of Emergency Services coordinates the County's efforts to prepare for and respond to emergency situations. In an emergency situation, the Office of Emergency Services works with County departments and

external agencies to respond to the needs of citizens by helping to protect lives and property, assist those injured or whose normal lives have been disrupted by events, and to provide for the rapid restoration of normal services. Additionally, the Office of Emergency Services provides and/or supports the following programs to assist the fifteen (15) volunteer fire departments and fifteen (15) emergency squad/first responder units in Tioga County:

- EMS training
- Fire training
- Central county radio communications (dispatching 911 calls)
- Fire investigation
- Search and rescue assistance
- Hazardous materials assistance
- Critical stress debriefing assistance
- Mutual aid coordination assistance with adjacent counties (fire services, highway departments, Chemung County)

The Office of Emergency Services website (https://www.tiogacountyny.com/departments/emergency-services/) provides dates of trainings and meetings, news and announcements, and plans and programs related to the department. The website also provides information on how to register for Hyper-Reach, an emergency notifications system that sends messages to cell phones and emails. During a disaster, the website provides disaster-related information to residents including road closures.

Tioga County Soil & Water Conservation District (TC SWCD)

The Tioga County Soil and Water Conservation District was created on November 27, 1944 and is one of the 58 Soil and Water Conservation District located in New York State. A Board of Directors made up of representatives from Grange, the Farm Bureau, two County legislators, and an at-large member governs the District. The District staff members are committed to providing technical assistance to the residents of Tioga County in the areas of soil, water, and other natural resource conservation issues.

The mission of the Tioga County Soil and Water Conservation District is to assist individual landowners, groups and units of government with any natural resource concern that is brought before it. This may take the form of technical advice, technical assistance or finding a solution through another entity.

The Tioga County Soil and Water Conservation District's main goal is to provide technical assistance relative to natural resource conservation and water quality to residences of the county. This assistance is available on a one on one basis and may include soils info, drainage, water storage, critical area seeding, tree planting for reforestation, fish stocking, and pond/lake management and protection. Tioga County SWCD will develop and implement programs and services necessary to address the needs of the county. SWCD will further assist in the implementation of decisions by seeking and coordinating technical and financial assistance from federal, state, and local governments, and private sources.

The District assists both public and private landowners with identifying and addressing Hazard Mitigation issues through their various programs. The District has directly assisted communities with hazard mitigation through grants to reduce soil migration, stream corridor improvements and stormwater runoff reduction. The District does not have a specific budget item for hazard mitigation projects. Projects that fall under the hazard mitigation umbrella have been funded from current natural resource grants that have been awarded to the SWCD and which are justifiable expenses from the grant requirements.

Tioga County Department of Planning and Economic Development (TPED)

The Economic Development & Planning office facilitates and supports activities which increase job opportunities, maximize the quality of life, and foster a vibrant rural economy within the County. he Planning division works with municipalities within Tioga County on planning and zoning issues, in order to prepare for future economic development. There are also several county-level plans that guide the policy and direction of development for Tioga County.

The TCEDP provides the following services:

- Planning and administrative support services to the Tioga County Planning Board for monthly review meetings
- Providing technical services to and hosts training for local planning and zoning boards for matters related to community master plans, zoning ordinances and related land use regulations
- Design and implementation of planning initiatives involving multiple municipalities
- Provides informational services to County departments, municipalities, consulting firms, not-for-profits and the general public
- Keeps records of existing town and village comprehensive plans, land use controls, subdivision law, and zoning law if they have been provided by the local municipalities
- Provides assistance to local municipalities regarding the Tioga County Planning Board's referral process and acts as an informational center for General Municipal Law §239-M
- Identifies, communicates and provides technical assistance with grant opportunities that may be constructive to the planning, growth and improvement of our County.
- Provides site location and assistance with local approval processes to interested business and industrial companies.

Tioga County Department of Public Works (TCDPW)

TCDPW maintains County-owned roadways, buildings, bridges, and other infrastructure throughout Tioga County. Public Works also houses the Buildings and Grounds Department and the Solid Waste Department. The Solid Waste Department runs the County-Wide Curbside Recycling and Household Hazardous Waste Programs. Responsibilities include overseeing all county road, highway, and bridge design and construction, and maintenance of the county's capital facilities, vehicle fleet, and equipment. The department also performs brush cutting, ditching, snow removal, and tree removals within the highway right of way.

Within the DPW, the highway department is responsible for the maintenance of 144 miles of county highways and 77 county bridges. Its construction crews use County-owned and rented equipment to install and maintain culverts throughout the County. The DPW Engineering section inspects catch basins and quantifies amounts of sediment removed at county facilities and assists in the preparation of the MS4 Annual Reports.

The DPW upholds a working relationship with other County departments as well as all Towns, Villages, and the Soil and Water District within the County in support of their own individual missions.

Tioga County DPW has an Engineering Section that is involved in various activities related to the improvement of highway and bridge infrastructure throughout the County, which includes a Plan of Action for Scour Critical Bridges.

Tioga County Attorney

The office of the County Attorney represents the County in all legal matters, serves as legal counsel for the County Legislature and Department Heads, and works with the Department of Social Services to handle family

court cases involving child abuse, neglect, support, juvenile delinquent and PINS cases, and other in-house matters.

In addition, the County Attorney supervises the County Safety Office which assists in ensuring the safety and well-being of County residents, employees and the general public. This includes minimizing damage to and/or loss of County owned property and equipment and mitigating overall risk to employees and the public in the conduct of County operations.

The County Attorney represents the County's legal needs. The Office of the District Attorney handles criminal prosecutions, and the Office of the Public Defender handles court-appointed attorney services.

Tioga County Department of Public Health

The Public Health Department is responsible for health promotion, disease prevention and community needs assessment. The Public Health Department supports the citizens of the County through Environmental Health, Dental Health, Disease Control, Nursing Services, Emergency Preparedness and Health Education programs

Shelters

Due to the variable nature of hazard events and associated sheltering needs within the County, Tioga County relies on real-time outreach methods to inform the public of pending and active evacuations, and available sheltering resources. Outreach methods includes variable message sign boards, media (radio, television, and newspapers), and social media.

As supported by the Tioga County Department of Public Health, the County works directly with the American Red Cross and local jurisdictions (municipal fire departments and EMS) to establish and maintain an inventory of suitable shelter locations and can assist with the coordination and communication of shelter availability by the execution of the Tioga County Comprehensive Emergency Management Plan (CEMP).

Depending on the type of event and sheltering needs will determine where the shelters will be located and what facilities will be used. County-wide sheltering policies and procedures are documented in the Tioga County CEMP (refer to ESF #6 of the 2013 CEMP). The Tioga County Department of Emergency Services encourages residents to register on Hyper-Reach which sends emergency notifications directly to the cell phones and emails of those who registered. The County Public Health department sponsors the Medical Reserve Corps (MRC) that is made up of volunteers and medical professionals.

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. It was approved by FEMA in 2014 and it keeps New York eligible for recovery assistance in all

Public Assistance Categories A through G, and Hazard Mitigation assistance in each of the Unified Hazard Mitigation Assistance Program's five grant programs. 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 2014 New York State HMP was used as guidance in completing the Tioga County HMP Update. The State HMP can be found here: http://www.dhses.ny.gov/recovery/mitigation/plan.cfm

New York State Department of Environmental Conservation (NYSDEC) – Division of Water - Bureau of Flood Protection and Dam Safety

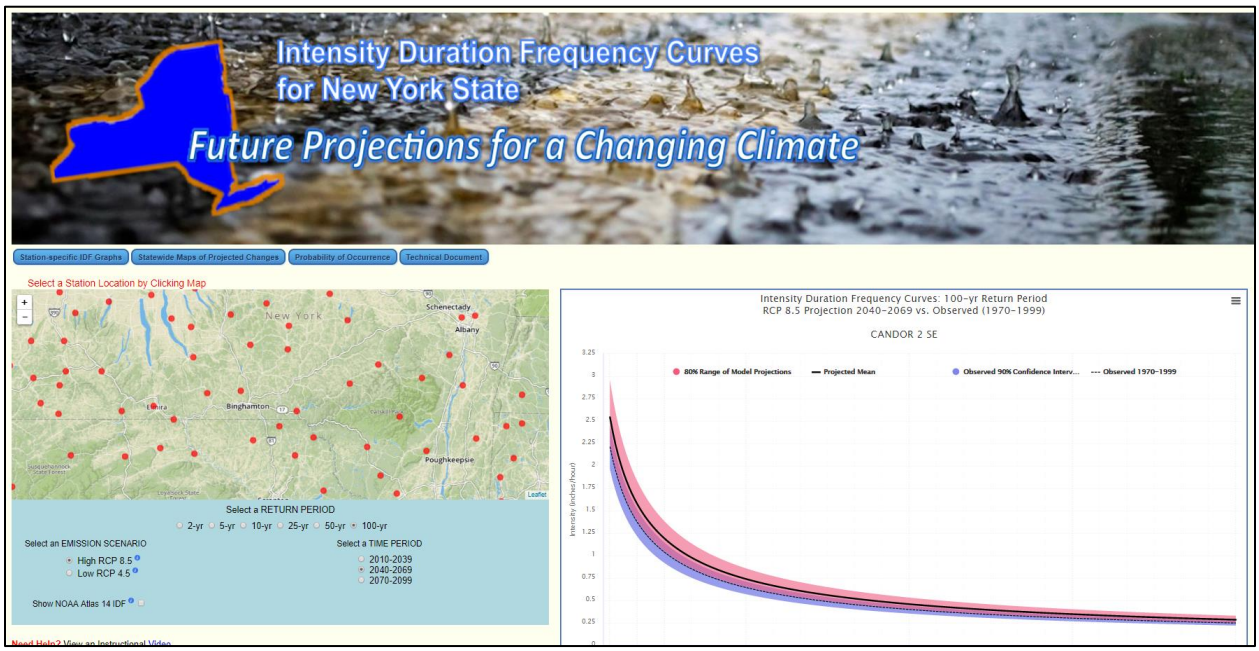
Within the NYSDEC – Division of Water, the Bureau of Flood Protection and Dam Safety (http://www.dec.ny.gov/about/61432.html) cooperates with federal, state, regional, and local partners to protect lives and property from floods, coastal erosion and dam failures through floodplain management and both structural and non-structural means; and, provides support for information technology needs in the Division. The Bureau consists of the following Sections:

- Coastal Management: Works to reduce coastal erosion and storm damage to protect lives, natural resources, and properties through structural and non-structural means.
- Dam Safety: Is responsible for reviewing repairs and modifications to dams and assuring that dam owners operate and maintain dams in a safe condition through inspections, technical reviews, enforcement, and emergency planning.
- Flood Control Projects: Is responsible for reducing flood risk to life and property through construction, operation and maintenance of flood control facilities.
- Floodplain Management: 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.

Northeast Regional Climate Center

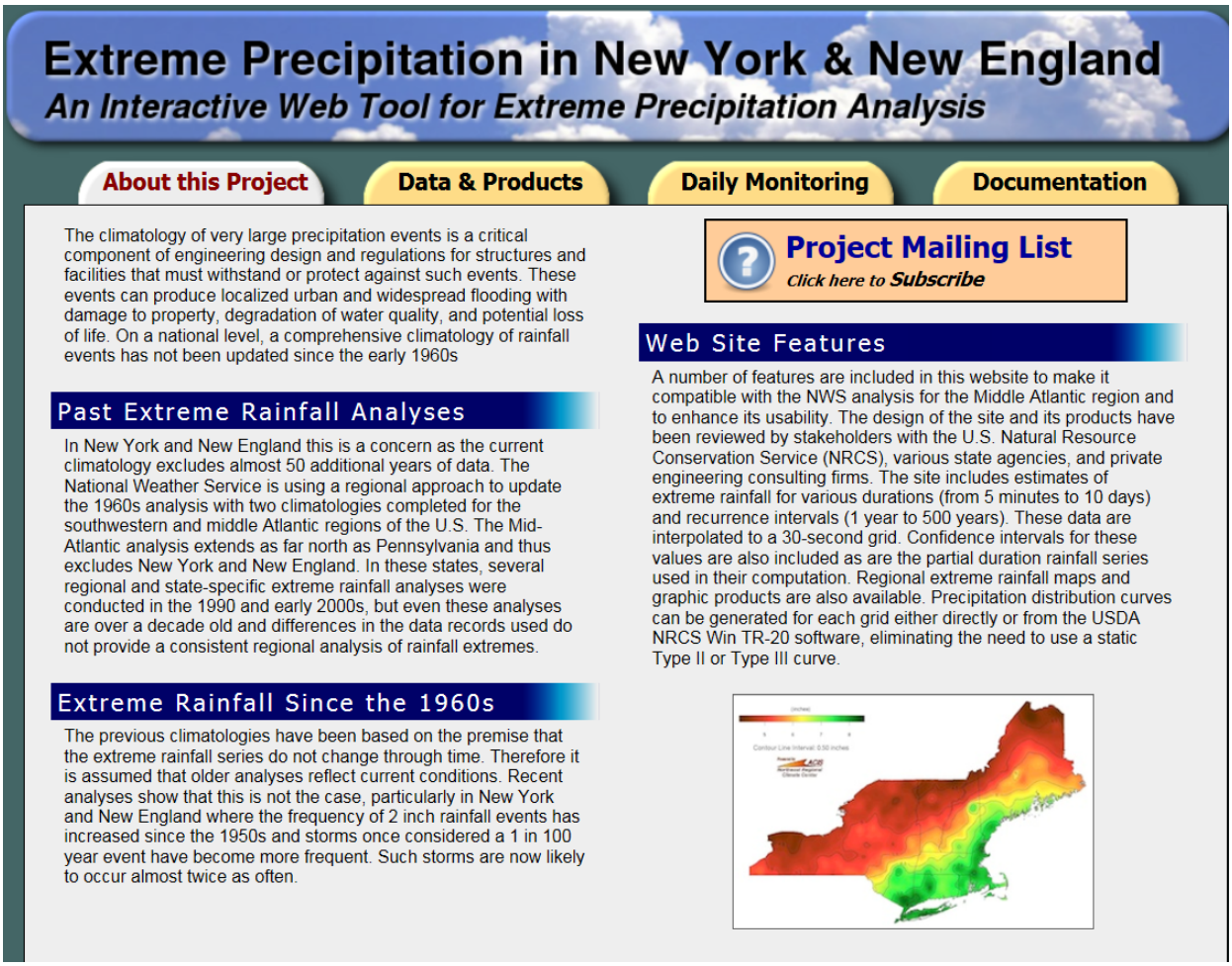
The Northeast Regional Climate Center (NRCC) partnered with the New York State Energy Research and Development Authority (NYSERDA) to compare various methods of downscaling global climate model (GCM) output and create extreme precipitation projections for New York State. These projections will ultimately 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, among others. 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). The figure below displays the screenshot of the website.

Figure 6-1. Screenshot of the IDF Curves for New York State



NRCC also maintains the Extreme Precipitation in New York & New England website. It is an interactive tool for extreme precipitation analysis. The site includes estimates of extreme rainfall for various durations (from 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 also included as are the partial duration rainfall series used in their computation. Regional extreme rainfall maps and graphic products are also 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. The figure below shows a screenshot of the website.

Figure 6-2. 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 has published 14 technical bulletins including two recent bulletins with guidance related to flood hazard areas: Electrical Systems and Equipment in Flood-damaged Structures and Accessory Structures. One archived bulletin from January 2003, Flood Venting in Foundations and Enclosures Below Design Flood Elevation, refers to the out-of-date edition of FEMA Technical Bulletin 1 and to American Society of Civil Engineers (ASCE) 24-98, which is not the edition referenced by the current codes.

Forms and Publications

The DCEA posts several model reporting forms and related publications on its web page. The Building Permit Application requests the applicant to indicate whether the site is or is not in a floodplain and advises checking with town clerks 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

Municipal Fiscal Capabilities

Tioga County municipalities are able to fund mitigation projects though existing local budgets, local appropriations (including referendums and bonding), and through 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 have continued 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

Refer to Section 4 of the 2014 New York State Hazard Mitigation Plan for information pertaining to the various funding sources available for mitigation projects:
http://www.dhses.ny.gov/recovery/mitigation/documents/2014-shmp/Section-4-Mitigation-Strategy.pdf

Federal Hazard Mitigation Funding Opportunities

Federal mitigation grant funding is available to all communities with a current hazard mitigation plan (this plan); however most of these grants require a "local share" in the range of 10-25% of the total grant amount. Details about this program and a further description 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. It is made available to states by FEMA after each Federal disaster declaration. The HMGP can provide up to 75% funding for hazard mitigation measures. The HMGP can be used to fund cost-effective projects that will protect public or private property in an area covered by a federal disaster declaration or that will reduce the likely damage from future disasters. Examples of projects include acquisition and demolition of structures in hazard prone areas, flood-proofing or elevation to reduce future damage, minor structural improvements and development of state or local standards. Projects must fit into an overall mitigation strategy for the area identified as part of a local planning effort. All applicants must have a FEMA-approved Hazard Mitigation Plan (this plan).

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 and placed in rank order for available funding and submitted to FEMA for final approval. Eligible projects not selected for funding are placed in an inactive status and may be considered as additional HMGP funding becomes available.

For additional information regarding HMGP, please refer to: https://www.fema.gov/hazard-mitigation-grant-program

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%. At most 25% of the total eligible costs must be provided by a non-federal source. Of this 25%, 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.

For additional information regarding the FMA program, please refer to: https://www.fema.gov/flood-mitigation-assistance-grant-program

Pre-Disaster Mitigation (PDM) Program

The PDM program is an annually funded, nationwide, competitive grant program. No disaster declaration is required. Federal funds will cover 75% of a project's cost up to $3 million. As with the HMGP and FMA, a FEMA-approved local Hazard Mitigation Plan is required to be approved for funding under the PDM program.

In some cases, whereby the local Hazard Mitigation Plan is under development, but not formally approved by FEMA, the jurisdiction my request a Letter of Extraordinary Circumstance in enable consideration of the grant application. According to the FEMA Hazard Mitigation Assistance Guidance (2015), for Hazard Mitigation Grant Program (HMGP) project subawards, the FEMA Regional Administrator may grant an exception to the local mitigation plan requirement in extraordinary circumstances when justification is provided. 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 Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) project subawards, the Region may grant an exception to the local mitigation plan requirement in extraordinary circumstances.

For additional information regarding the PDM program, please refer to: https://www.fema.gov/pre-disaster-mitigation-grant-program .

Extraordinary Circumstances

For PDM and FMA project subawards, the (FEMA) Region may 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, PDM, 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 PDM and FMA the Region must coordinate and seek concurrence prior to granting an exception:

- The jurisdiction meets the small impoverished community criteria (see Part VIII, B.2).
- 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, PDM, 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 may 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. Among the general types of assistance that may be provided should the President of the United States declare the event a major disaster includes the following:

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 may 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 may borrow up to $200,000 to repair or replace real estate, $40,000 to cover losses to personal property and an additional 20% for mitigation. For businesses, loans may 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, private universities, etc. are also eligible. An Economic Injury Disaster Loan provides necessary working capital until normal operations resume after a physical disaster. These loans are restricted, by law, to small businesses only. For additional information regarding IA, please refer to: 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. For additional information regarding PA, please refer to: https://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

Small-Business Administration (SBA) Loans

Small Business Administration (SBA) provides low-interest disaster loans to homeowners, renters, business of all sizes, and most private nonprofit organizations. SBA disaster loans can be used to repair or replace the following items damaged or destroyed in a declared disaster: real estate, personal property, machinery and equipment, and inventory and business assets.

Homeowners may apply for up to $200,000 to replace or repair their primary residence. Renters and homeowners may borrow up to $40,000 to replace or repair personal property-such as clothing, furniture, cars, and appliances – damaged or destroyed in a disaster. Physical disaster loans of up to $2 million are available to qualified businesses or most private nonprofit organizations. For additional information regarding SBA loans, please refer to: 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 Social Services Block Grant funding. The State will distribute $200,034,600 through a public and transparent solicitation for proposals. The State is also allocating $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. For additional information regarding the SSBG program, please refer to: https://www.acf.hhs.gov/ocs/programs/ssbg

Department of Homeland Security

The Homeland Security Grant Program (HSGP) plays an important role in the implementation of the National Preparedness System by supporting the building, sustainment, and delivery of core capabilities essential to achieving the National Preparedness Goal of a secure and resilient nation. The FY 2017 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 2017). 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. For additional information regarding HSGP, please refer to: 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, as 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, planning, and administration. Public improvements may 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 may 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. For additional information regarding CDBG, please refer to: https://www.hudexchange.info/programs/cdbg-entitlement/

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 in 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 and development facilities. Through its Economic Adjustment Program, USEDA administers its Revolving Loan Fund (RLF) 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. Please refer to the USEDA website (https://www.eda.gov/) for additional information.

Federal Highway Administration - Emergency Relief

The Federal Highway Administration Emergency Relief is a grant program that may 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. $30 Million in funding was released in October-November of 2012 for emergency repair work conducted in first 180 days following Hurricane Sandy. Another $220 Million in additional funding became available February 2013. 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. For information regarding the FTA Emergency Relief Program, please refer to: https://www.transit.dot.gov/funding/grant-programs/emergency-relief-program/emergency-relief-program

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. For additional information regarding Empire State Development, please refer to: https://esd.ny.gov/

New York State Department of Transportation (NYSDOT)

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 nine presidentially declared disasters due to extreme weather, many involving severe flooding (NYSDOT 2014).

For this initiative, 105 scour critical/flood prone bridges (https://www.dot.ny.gov/main/business-center/cbow/repository/CBOW_list_2014.pdf) 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).

All of 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).

Through HMGP, 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 (FPE). For additional information regarding the EWP, please refer to:
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 may 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 (DSR) 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 may 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 may 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 Climate Smart Communities (CSC) program is jointly sponsored by the following six New York State agencies: Department of Environmental Conservation; Energy Research and Development Authority; Public Service Commission; Department of State; Department of Transportation; 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 (GHG) 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 2016, more than 170 communities, representing 6.6 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, they receive an advantage in accessing some state assistance programs. They can call on the help of other local governments that already have adopted climate smart practices and policies, and their climate-smart accomplishments receive statewide recognition. Key elements of the Climate Smart Communities program are described below.

For additional information regarding the CSC program, please refer to:
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 Tioga County municipalities adopted the Climate Smart Communities Pledge, nor have they achieved certification.

Climate Smart Communities Certification (CSC) Program

The Climate Smart Communities Certification (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.

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 also 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 also available for **certification projects** that advance several specific actions aligned with Climate Smart Communities Certification requirements:

- 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 http://www.dec.ny.gov/energy/96511.html. For implementation projects involving property (construction, improvements, restoration, rehabilitation) – if the property is not owned by the grant recipient, they must obtain a climate change mitigation easement.

The round 3 of the Climate Smart Communities Grant Program was available through the NYS Consolidated Funding Application from May 1, 2018 through July 27, 2018. Applications for the third round of funding were due July 27, 2018.

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, and 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 Water Quality Improvement Project (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 may 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% for salt storage projects; and up to 40% for general wastewater infrastructure improvement projects. Eligible activities include:

- Wastewater treatment improvement
- Non-agricultural nonpoint source abatement and control
- Land acquisition for source water protection
- Salt storage
- Aquatic habitat restoration
- Municipal separate storm sewer systems (MS4)

Details regarding this program are available here - 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 Wastewater Infrastructure Engineering Planning Grant will assist municipalities with the engineering and planning costs of CWSRF-eligible water quality projects. Municipalities with a Median Household Income (MHI) of $65,000 or less in REDC regions of Capital District, Southern Tier, North Country, Mohawk Valley, Central NY, Finger Lakes, or Western NY OR with a Median Household Income of $85,000 or less in REDC regions of Long Island, New York City or Mid-Hudson are eligible to apply. Grants with a 20 percent required local match will be provided to finance activities including engineering and/or 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. Funding priorities go to projects that are:

- Required by an executed Order on Consent; or
- Required by a draft or final State Pollutant Discharge Elimination System (SPDES) permit; or
- Upgrading or replacing an existing wastewater system; or
- Constructing a wastewater treatment and/or collection system for an area with failing onsite septic systems; or
- Identified in a Total Maximum Daily Load (TMDL) Implementation Plan

Details regarding this program can be found here - https://www.dec.ny.gov/pubs/81196.html

New York State Department of Transportations

BRIDGE NY

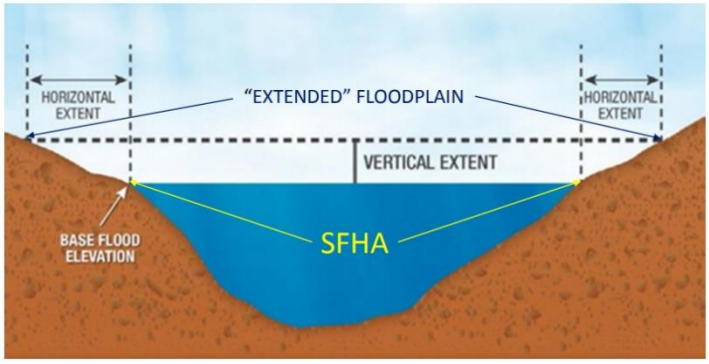
The BRIDGE NY program, administered by the New York State Department of Transportation (NYSDOT), is open to all municipal owners of bridges and culverts. Projects will be awarded through a competitive process and will support all phases of project development. Projects selected for funding under the BRIDGE NY Initiative will be 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 here – https://www.dot.ny.gov/BRIDGENY

New York State Climate Resilient Farming (CRF) Program

The CRF Program was started in 2015 and has provided more than $5 million to 40 projects statewide. Farms have used the funding to reduce greenhouse gas emissions, promote energy savings, and mitigation water and soil quality concerns. The goal of the CRF Program is to reduce the impact of agriculture on climate change (mitigation) and to increase the resiliency of New York State farms in the face of a changing climate (adaptation). The program makes funds available, through New York State Department of Agriculture and the New York State Soil and Water Conservation Committee, to support climate change mitigation and adaptation/resiliency in farms across New York State. The funding comes from the Environmental Protection Fund, within the *Climate Change Mitigation and* Adaptation account. The CRF Program allows Soil and Water Conservation Districts to submit proposals to fund projects that mitigate the impacts of agriculture on climate change and enhance the on-farm adaptation and resiliency to project climate conditions. Additional information on the CRF program can be found here - https://www.nys-soilandwater.org/programs/crf.html

Community Risk and Resiliency Act (CRRA)

On September 22, 2014, Governor Andrew Cuomo signed bill A06558/S06617-B, the Community Risk and Resiliency Act (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. The bill's provisions will apply to all applications and permits no later than January 1, 2017. CRRA includes five major provisions:



- Official Sea-level Rise Projections - CRRA requires the Department of Environmental Conservation (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 consider 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 (DOS), to develop guidance on the use of natural resources and natural processes to enhance community resiliency.
- Model Local Laws Concerning Climate Risk - CRRA requires DOS, in cooperation with DEC, to develop model local laws that include consideration of future risk due to sea-level rise, storm surge and/or flooding. These model local laws must be based on available data predicting the likelihood of extreme-weather events, including hazard-risk analysis (NYSDEC 2018).

CRRA requires NYSDEC, in consultation with DOS, 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).

For additional details on the CRRA, please refer to: https://www.dec.ny.gov/energy/102559.html

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 (2013) plan. For each action, municipalities were asked to indicate the status of each action ("No Progress/Unknown", "In Progress/Not Yet Complete", "Continuous", "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 provides a table identifying their 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", have been removed from the updated strategies. Those local actions that municipalities identified as "No Progress/Unknown", "In Progress/Not Yet Complete" as well as certain actions/initiatives identified as "Continuous", have been 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 (see 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 July 2018, 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:

- Local Plans and Regulations – These actions include government authorities, policies or codes that influence the way land and buildings are being developed and built.

- Structure and Infrastructure Project- 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 also involves projects to construct manmade structures to reduce the impact of hazards.

- Natural Systems Protection – These are actions that minimize damage and losses, and also 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 may also 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 by NYSDHSES and FEMA Region II representatives on July 11, 2018, for all participating jurisdictions to support the development of focused problem statements based on the impacts of natural hazards in the County and their communities. These problem statements are intended to provide a detailed description of the problem area, including its impacts to the municipality/jurisdiction; past damages; loss of service; etc. 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 have been eliminated from the updated strategy unless accompanied by discrete actions, projects or initiatives.

Certain continuous or ongoing strategies that represent programs that are, or since prior and existing plans have become, 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. These actions have been proposed in consideration of protection against 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 may 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, it must be recognized that the County and municipalities have limited authority over privately-owned critical facility owners with regard to mitigation at any level of protection.

Overall a comprehensive-range of specific mitigation initiatives were considered by each plan participant to pursue in the future to reduce the effects of hazards. Some of these initiatives may be previous actions carried forward for this plan update. These initiatives are dependent upon available funding (grants and local match availability) and may be modified or omitted at any time based on the occurrence of new hazard events and changes in municipal priorities. The four FEMA mitigation action categories are listed in the table below to further demonstrate the wide-range of activities and mitigation measures selected. Table 6-2. Comprehensive Range of Mitigation Actions lists the common mitigation actions identified across a majority of the communities.

Table 6-2. Comprehensive Range of Mitigation Actions

Jurisdiction	Structure and Infrastructure Project	Local Plans and Regulations	Natural Systems Protection	Education and Awareness Programs
Tioga County	X	X		X
Town of Barton	X		X	X
Town of Berkshire	X	X		
Town of Candor	X	X	X	X
Village of Candor	X			
Town of Newark Valley	X			
Village of Newark Valley	X	X	X	X
Town of Nichols	X	X	X	X
Village of Nichols	X			X
Town of Owego	X			X
Village of Owego	X	X		X
Town of Richford	X			
Town of Spencer	X		X	X
Village of Spencer	X	X	X	X
Town of Tioga	X	X	X	
Village of Waverly	X			X

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 2013 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 of the County-level actions/initiatives from the 2013 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", "Continuous", "Completed", or "Discontinued"), and provide review comments on each.

Projects/initiatives identified as "Complete", as well as though 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 "Continuous" 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 have been identified. These were identified through:

- 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:
    - Tioga County Soil and Water Conservation District (TC SWCD)
    - Tioga County Department of Emergency Services (TCDES)
    - Tioga County Department of Planning and Economic Development (TCPED)
    - Tioga County Department of Public Works
- 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 have included mitigation actions to address vulnerable critical facilities. These actions have been proposed in consideration of protection against 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 may be influenced by cost-effectiveness as determined through a formal benefit-cost analysis. In the case of "self-funded" projects, local government authority may affect the ability to implement. Further, it must be recognized that the County has limited authority over privately-owned critical facility owners with regard to 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 particular mitigation action.

The Steering Committee applied an action evaluation and prioritization methodology which includes an expanded set of fourteen (14) criteria to include the consideration of cost-effectiveness, availability of funding, anticipated timeline, and if the action addresses multiple hazards.

The fourteen (14) evaluation/prioritization criteria used in the 2018 update process are:

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)? Or 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 or 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 2018 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 brief 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 may have additional considerations that could influence their overall prioritization of mitigation actions.

It is noted that jurisdictions may 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 (2013) Tioga 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 44CFR 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 may 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 may 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 may 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

Where quantitative estimates of costs and/or benefits were not available, qualitative ratings using the following definitions were used:

Table 6-3 Qualitative Cost and Benefit Ratings

Costs	
High	Existing funding levels are not adequate to cover the costs of the proposed project, and implementation would require an increase in revenue through an alternative source (e.g., bonds, grants, and fee increases).
Medium	The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
Low	The project could be funded under the existing budget. The project is part of or can be part of an existing, ongoing program.
Benefits	
High	Project will have an immediate impact on the reduction of risk exposure to life and property.
Medium	Project will have a long-term impact on the reduction of risk exposure to life and property or will provide an immediate reduction in the risk exposure to property.
Low	Long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-effective.

For some of the Tioga County initiatives identified, the planning partnership may seek financial assistance under FEMA's Hazard Mitigation Assistance (HMA) programs. These programs require detailed benefit/cost analysis as part of the application process. These analyses will be performed when funding applications are prepared, using the FEMA BCA 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.

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.	Annually 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.	Annually 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	Updated progress report completed annually	Steering Committee; Plan Maintenance element	Jurisdictional points of contacts identified in Section 9 (Jurisdictional Annexes)
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	Tioga 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.

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 Tioga County HMP Coordinator is designated as:

Wendy Walsh, CPESC, CCA, District Manager
Tioga County SWCD
183 Corporate Drive, Owego, NY 13827
Phone: 607-687-3553
Fax: 607-687-9440
email: walshw@co.tioga.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, 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 (Volume II, Section 9) of this plan, by contacting persons responsible for initiating and/or overseeing the mitigation projects.

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,
- Progress on the implementation of mitigation actions, including efforts to obtain outside funding,
- Obstacles or impediments to implementation of actions,
- Additional mitigation actions believed to be appropriate and feasible,
- Public and stakeholder input.

7.1.2 Integration 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 Tioga County Planning Committee was tasked with identifying how hazard mitigation is integrated into existing planning mechanisms during the 2019 planning process. 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 Committee representatives will 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 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 Tioga 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.

Table 7-2. Planning Integration Checklist

Planning Mechanisms	Do you do this? Yes	No	Notes: If yes, how is it being done? If no, will this be utilized in the future?
Operating Budget • When constructing upcoming budgets, hazard mitigation actions will be funded as budget allows. Construction projects will be			

Planning Mechanisms	Do you do this? Yes	No	Notes: If yes, how is it being done? If no, will this be utilized in the future?
evaluated to see if they meet the hazard mitigation goals.			
Municipal Budget • Adopted each year, the municipality will look at mitigation actions when allocating funding.			
Capital Improvement Program and Budget • 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. • Does it 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? • Does the budget 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 land use, 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? • Does it contain natural overlay zones that set conditions for land use within those zones? • Does the ordinance require developers to take additional actions to mitigate natural hazard risk? • Do rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use? • Do the ordinances prohibit development within, of filling of, wetlands, floodways, and floodplains?			

Planning Mechanisms	Do you do this? Yes	No	Notes: If yes, how is it being done? If no, will this be utilized in the future?
• Does the building code contain provisions to strengthen or elevate construction to withstand hazard forces?			
Subdivision Regulations • Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas? • Do the regulations provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources? • Do the regulations allow density transfers where hazard areas exist?			
Comprehensive Plan • Are the goals and policies of the plan related to those of the County HMP?			
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? • 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			

Planning Mechanisms	Do you do this? Yes	No	Notes: If yes, how is it being done? If no, will this be utilized in the future?
• 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 may 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 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 Tioga County HMP Coordinator will advise Planning Committee members of the meeting date, agenda and expectations of the members.

The Tioga County HMP Coordinator will be responsible for calling and coordinating the annual plan review meeting and assessing 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, 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 Mitigation 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 (see the "Implementation of Mitigation Plan through Existing Programs" subsection later in this Section). 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 may refer to the evaluation forms, Worksheets #2 and #4 in the FEMA 386-4 guidance document, to assist in the evaluation process. Further, the Planning Committee may 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 Planning Committee 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 5-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 may require additional funding.

This report shall apply to all planning partners, and as such, shall be developed according to an agreed format and with adequate allowance for input and comment of each planning partner prior to completion and submission to the State Hazard Mitigation Officer. Each planning partner will be responsible for providing this report to its governing body for their review. During the annual Planning Committee meeting, the planning partners shall establish a schedule for the draft development, review, comment, amendment and submission of the Annual HMP Progress Report to NYS DHSES.

The Annual HMP Progress Report shall be posted on the Tioga County Hazard Mitigation website to keep the public apprised of the plan's implementation (https://www.tiogacountyny.com/departments/emergency-services/). Additionally, the County's Emergency Services webpage has been providing details on the HMP update planning process (https://www.tiogacountyny.com/departments/emergency-services/). For communities who may choose to join the NFIP Community Rating System (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 the end of September 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 Tioga 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 Tioga 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 Tioga 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 Tioga County HMP Coordinator shall be responsible for assuring that needed resources are secured.

Following each five-year update of the mitigation plan, the updated plan will be distributed for public comment. After all comments are addressed, the HMP will be revised and distributed to all planning group members and the New York State Hazard Mitigation Officer.

7.2 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 Chapter 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 have identified how they have 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").

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.

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

Tioga 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.tiogacountyny.com/departments/emergency-services/). 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 flood hazards and severe storm events. 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 Tioga 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 5-year plan update. The Tioga 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 may 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 Tioga 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 Tioga 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 Tioga 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.