Tioga County

2024 Multi-Jurisdictional Hazard Mitigation Plan Update

June 7, 2024

Prepared for:

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1 INTRODUCTION

1.1 Background

A hazard is defined by the Federal Emergency Management Agency (FEMA) as an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural losses, damage to the environment, interruption of business, or other types of harm or loss. A hazard can be natural, technological, or human-caused. Natural hazards are a source of harm created by a meteorological, environmental, or geological event. Events such as floods or earthquakes impact the built environment and pose a threat to people's lives. Human-caused or technological hazards are the result of intentional or unintentional events that are caused by humans or by materials created by humans (FEMA, 2017).

Hazard mitigation is defined by FEMA as a method for reducing or alleviating property loss, preventing damage to the environment, and limiting the number and severity of injuries that occur from hazard events through long and short-term strategies. Responsibility for implementing mitigation measures runs communitywide from individuals to industries, private business and all levels of government (FEMA, 2017).

Hazard mitigation is often considered one of four phases of emergency management after a disaster event occurs. The other phases include preparedness, response and recovery. Each of these phases relate to and rely upon each other. The overarching goal for each of these emergency management phases is the prevention or minimization of loss of life and property in disaster situations.

FEMA provides assistance through the Robert T. Stafford Disaster Relief and Emergency Assistance Act to local governments that are recovering from a hazard event. The Federal Disaster Mitigation Act of 2000 (DMA 2000) recognized the importance and cost-effectiveness of mitigation in specifying that local governments must have a FEMA approved natural hazard mitigation plan to be eligible for mitigation project funding.

To meet the federal requirements of the Disaster Mitigation Act of 2000, Tioga County completed a Multi-Jurisdictional Hazard Mitigation Plan (HMP). HMPs must be updated every five years to continue municipal eligibility for mitigation project funding. The County was awarded a Pre-Disaster Hazard Mitigation Grant from FEMA to update their 2018 HMP.

1.2 Purpose and Scope

This Multi-Jurisdictional HMP is an update to the Tioga County 2018 HMP, allowing the County to remain eligible for future mitigation funding. The purpose of this HMP is to document the natural hazards that affect Tioga County and outline practical mitigation strategies that can be implemented to reduce the effects of such hazard events.

The development of a County HMP provides the following benefits (FEMA, 2023):

- Encourages community leaders to choose actions to reduce risk that stakeholders and the public will support.
- Focuses resources on the greatest risks and vulnerabilities, including where they are needed the most, i.e. areas and populations disproportionately affected by disasters.
- Builds partnerships with diverse stakeholders. This deepens the pool of data and resources, which can help reduce workloads and achieve shared community objectives.
- Boosts awareness of threats and hazards, including their risks and the community's vulnerability to those risks.
- Aligns risk reduction with other community goals and programs like capital improvements.
- Supports socially vulnerable populations and underserved communities in achieving resilience.

The HMP Update focuses on natural hazards. Technological and human-caused hazards are not included in the scope of the HMP Update, due to the fact that mitigation projects related to such hazards are not eligible for mitigation grant funding through FEMA and will not be evaluated as part of the HMP. Additionally, the HMP Update focuses on hazard mitigation rather than preparedness, response, and recovery. According to FEMA, "Hazard mitigation is any sustained action taken to reduce or eliminate long-term risk to life and property from hazards" (FEMA, 2023). More details on mitigation vs. preparedness, response, and recovery are included in Table 1-1.

Table 1-1. The Four Phases of the Emergency Management Cycle

Phase	Description
Preparedness	Preparedness is when we develop or update activities, programs and systems before an event happens. These activities are often tested (or exercised) in non-emergency situations. This tests their effectiveness. Emergency managers also assess potential risks, hazards and vulnerabilities in this phase.
Response	Response focuses on the immediate and short-term effects of a disaster. It is usually focused on life safety and preventing immediate damage.
Recovery	Recovery is a long-term phase that looks to return a community to normal, or to a more resilient state, after a disaster.
Mitigation	Mitigation focuses on building (or rebuilding) in ways that reduce the risk more permanently. It is an activity that can occur at any point in the emergency management cycle. For example, communities can undertake mitigation actions before a disaster (the preparedness phase) or while rebuilding after a disaster (the recovery phase).

Source: Adapted from FEMA's Local Mitigation Planning Handbook (FEMA, 2023). The Tioga County 2024 Hazard Mitigation Plan Update focuses on mitigation, rather than preparedness, response, or recovery.

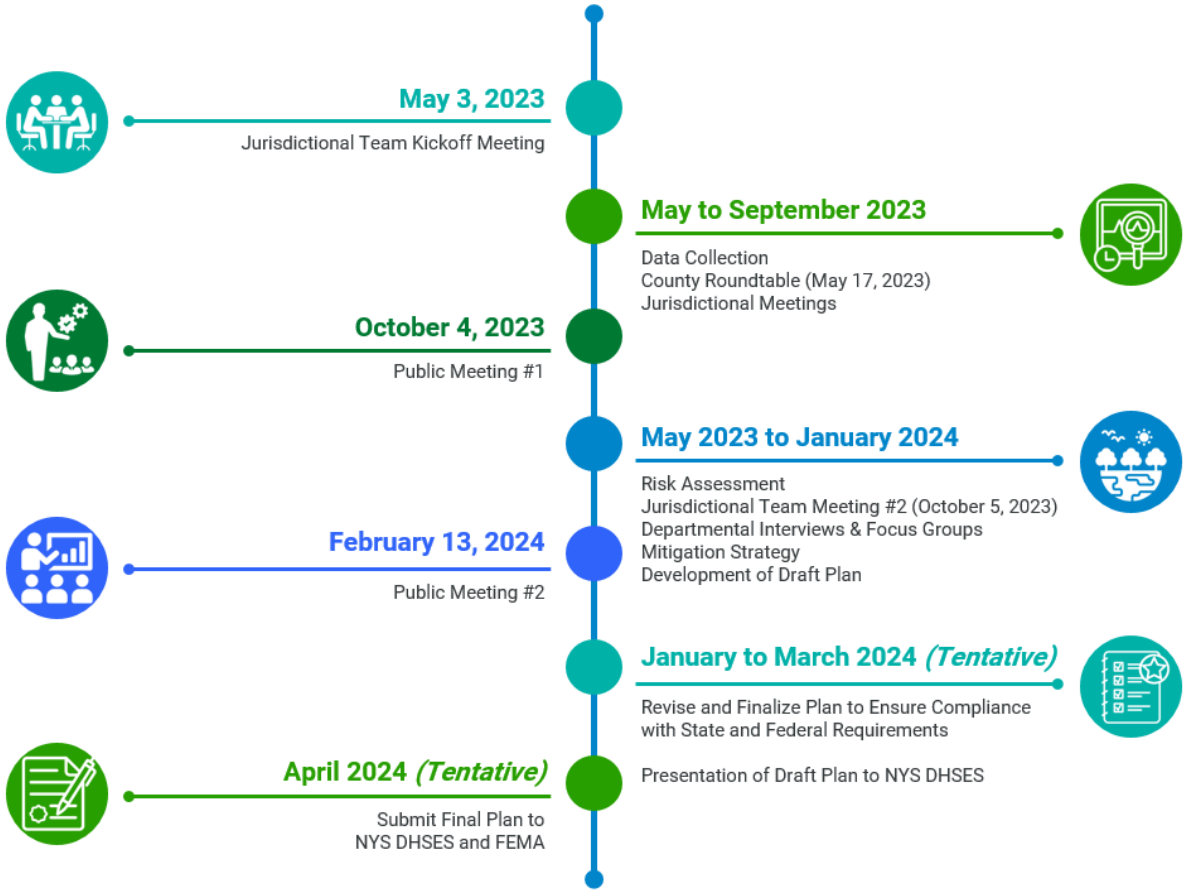
The County and each of its jurisdictions identified and ranked the hazards to which their community is most vulnerable. In addition, the HMP also includes an assessment of the risks and vulnerabilities associated with each hazard and details mitigation strategies to moderate those vulnerabilities and decrease hazard risks. The identified mitigation measures were required to be technically feasible, cost-effective, and environmentally sound.

As described in Section 10, this HMP serves as an important resource for developing and updating various plans and procedures throughout the County. This plan should be incorporated into, considered during, and referenced by future updates and efforts at the County and municipal levels concerning the existing plans, policies, ordinances, programs, studies, reports, and staff included in Section 3 of each jurisdictional annex (Appendix A).

1.3 Hazard Mitigation Planning Process

The Hazard Mitigation Plan was prepared by Barton & Loguidice, D.P.C., in consultation with a Core Planning Group, municipal representatives, stakeholders within Tioga County and neighboring counties, and the public. More information on plan participants is provided in Section 3. A schedule of activities is shown in Figure 1-1.

Figure 1-1. Project Schedule



1.4 Jurisdictions Seeking Approval

All 15 municipal jurisdictions in Tioga County, plus the County itself, are seeking FEMA approval for the adoption of this Hazard Mitigation Plan Update. These jurisdictions are listed in Table

1-2 below. Further information about jurisdictional participation in the planning process is included in Section Jurisdictional Participation3.2.

Table 1-2. Jurisdictions Seeking Approval for Plan Adoption

Jurisdiction	Seeking Approval For Plan Adoption
Tioga County	Yes
Barton, Town of	Yes
Berkshire, Town of	Yes
Candor, Town of	Yes
Candor, Village of	Yes
Newark Valley, Town of	Yes
Newark Valley, Village of	Yes
Nichols, Town of	Yes
Nichols, Village of	Yes
Owego, Town of	Yes
Owego, Village of	Yes
Richford, Town of	Yes
Spencer, Town of	Yes
Spencer, Village of	Yes
Tioga, Town of	Yes
Waverly, Village of	Yes

1.5 Review of Existing Information

The HMP update was developed in accordance with the guidelines presented in FEMA's Local Mitigation Planning Policy Guide, effective on April 19, 2023 (FEMA, 2023) and the 2022 New York State Hazard Mitigation Planning Standards (NYS DHSES, 2022). In addition to these state and federal resources, many existing plans, studies, reports, and technical information were reviewed for the development of this HMP. These sources are documented in the Works Cited in Section 11. References are given throughout the document to indicate where each source was incorporated into the HMP.

1.6 Contact Information

The Tioga County Office of Emergency Services is the coordinating agency for preparing and responding to emergency situations. According to their website, "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… programs to assist the fifteen (15) volunteer fire departments and fifteen (15) emergency squad/first responder units in Tioga County."

Comments or questions concerning this document should be addressed to:

Tioga County Office of Emergency Services
103 Corporate Drive
Lower Level
Owego, NY 13827
Main Phone: 607-687-8466
Website: https://www.tiogacountyny.com/departments/emergency-services/

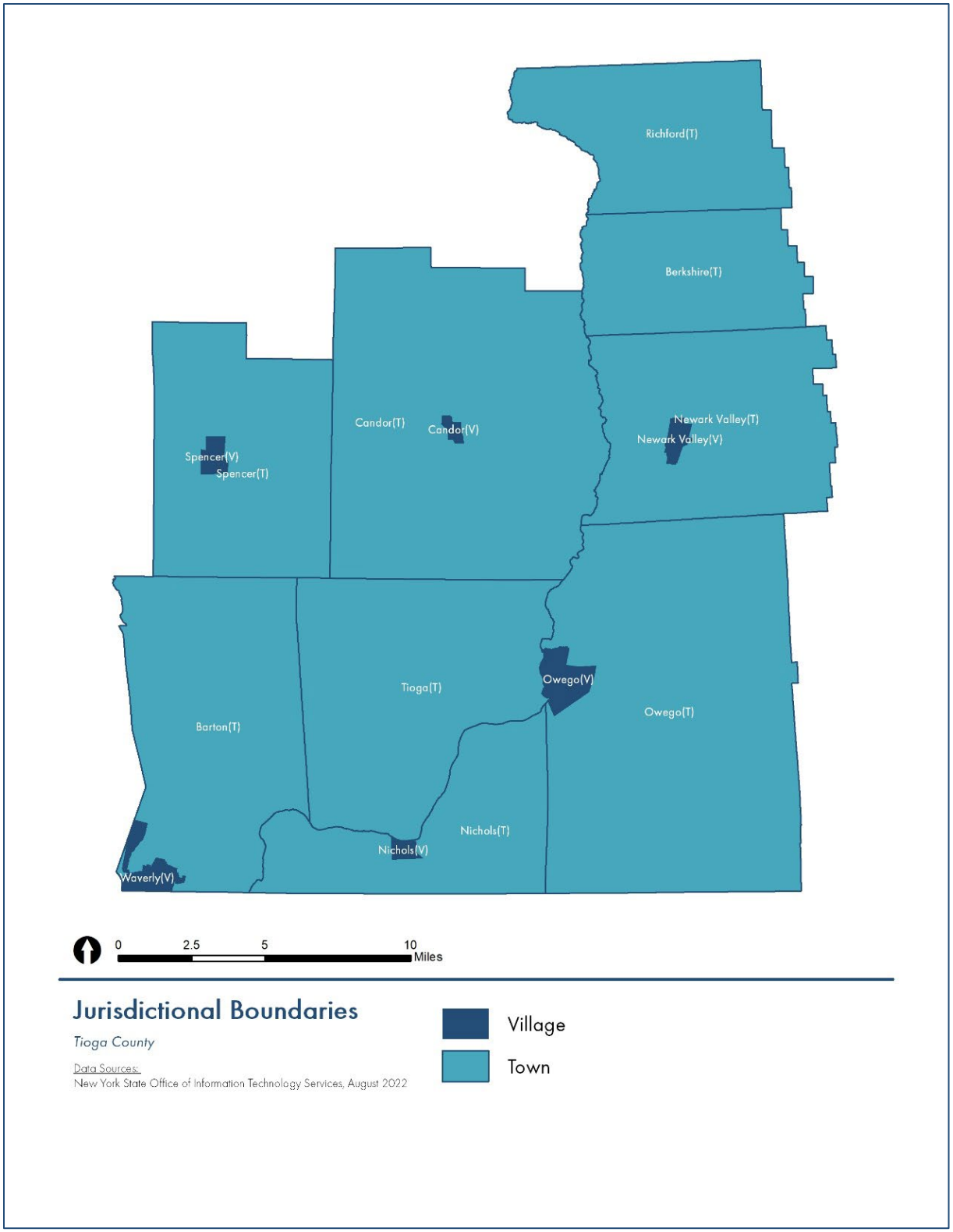
2 TIOGA COUNTY PROFILE

2.1 Geographic Context

2.1.1 Geographic Location

Tioga County is situated in the southwest part of New York State, bordered by Pennsylvania State to the south, Tompkins and Cortland Counties to the north, Broome County to the east, and Chemung County to the west. The County is considered to be within the Southern Tier region of New York State. Tioga County comprises 15 municipalities (Towns and Villages) and encloses an area of approximately 524 square miles (Tetra Tech, 2018). Figure 2-1 illustrates the County and its municipalities.

Figure 2-1. Jurisdictions in Tioga County



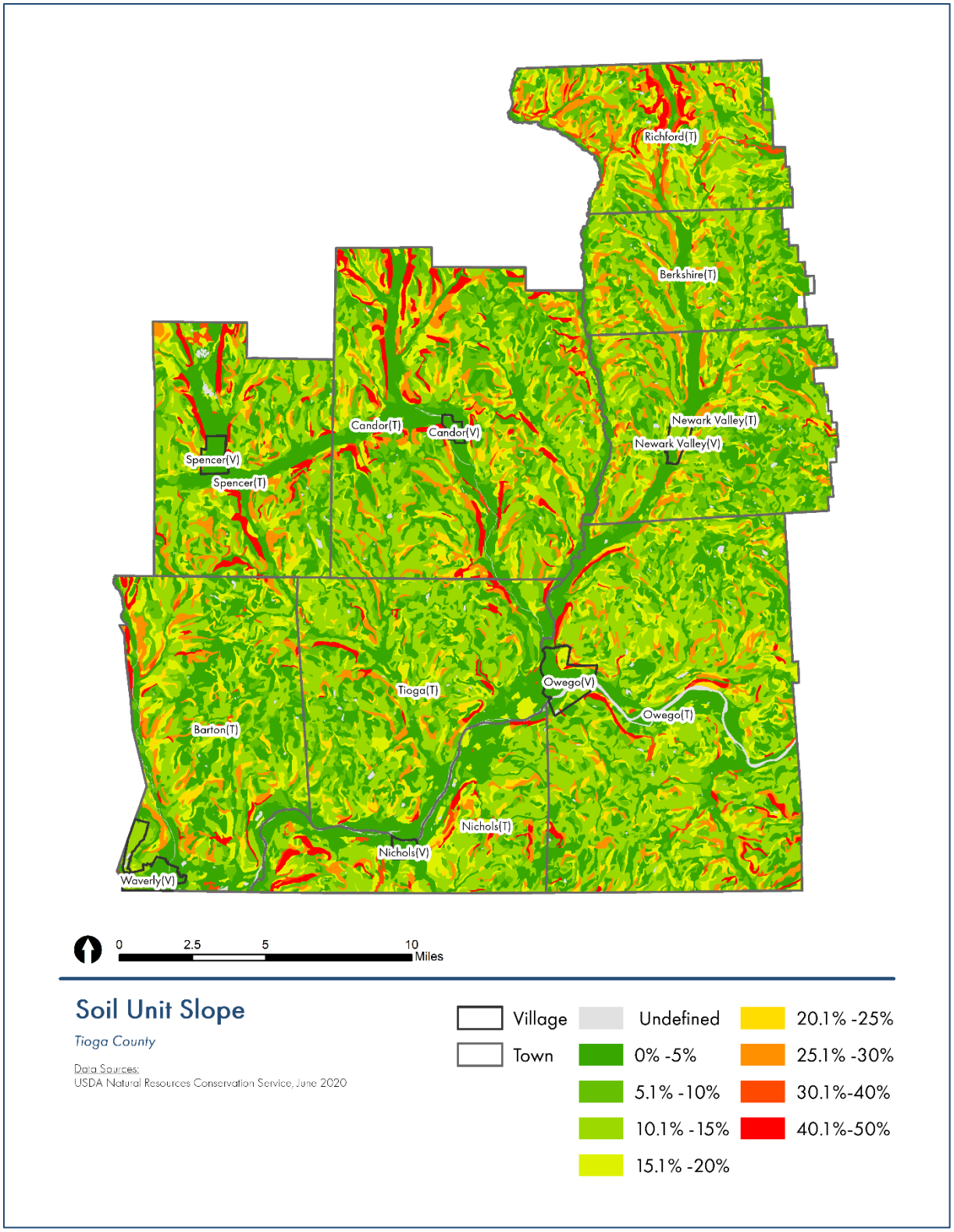
Data Source: New York State Office of Information Technology Services, August 2022

2.1.2 Topography and Geology

Tioga County is located in an area of the Appalachian Plateau that has been extensively eroded. The region is characterized by rounded slopes and flat, relatively narrow valleys, many of which are glacially derived. Soil unit slopes are depicted in Figure 2-2. The Catskill Mountains lie to the east, and the Pocono Mountains to the west. The County spans over 750 miles and is situated slightly under 1900 ft above sea level, which results in a cooler average temperature. 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, and 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.

Tioga County's geology is primarily made up of sedimentary rock, with a few isolated patches of soft to medium clays or sands bordering creeks and rivers. Over 50% of the County is made up of the Upper Walton Formation (shale, sandstone, conglomerate). 31% of the County is made up of the Roricks Glen Shale, Siltstone, and the Gardeau Formation. Shale, siltstones, and sandstones make up the majority of the rocks that cover the remaining portions of the County. Less than 50% of Tioga County is covered with soil with a lot of clays that have a mild to moderate tendency for swelling. Significant salt deposits can be found in the County (Tetra Tech, 2018).

Figure 2-2. Soil Unit Slope in Tioga County

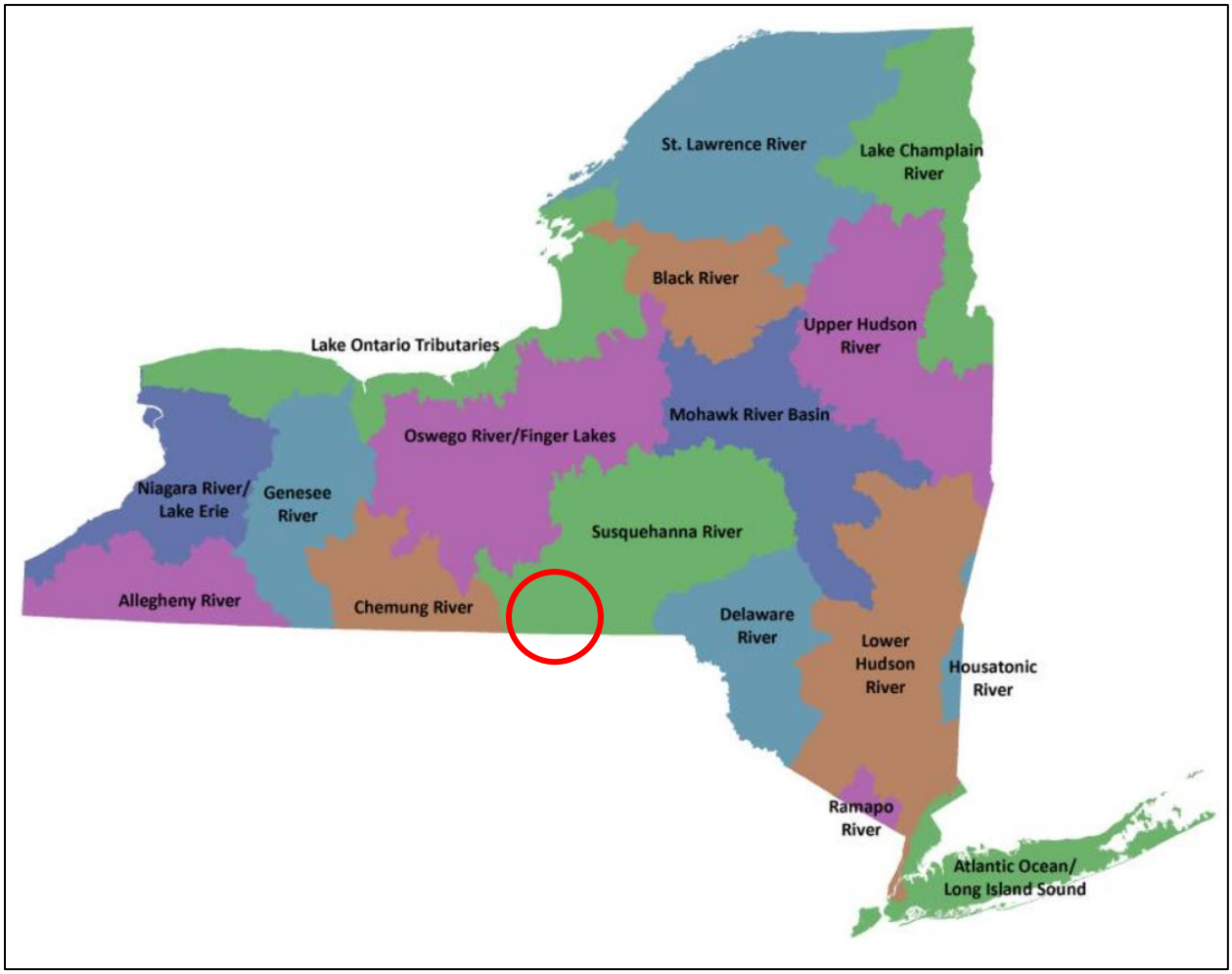


Data Sources: USDA NRCS, June 2020

2.1.3 Drainage Basins

Numerous ponds, lakes, creeks, and rivers make up the waterscape of Tioga County, which lie within one major drainage basin (Susquehanna River Basin) and three 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 2-3 depicts the 17 drainage basins found in New York State and the location of Tioga County within the state.

Figure 2-3. Drainage Basins in New York State



Source: (NYSDEC, 2014)

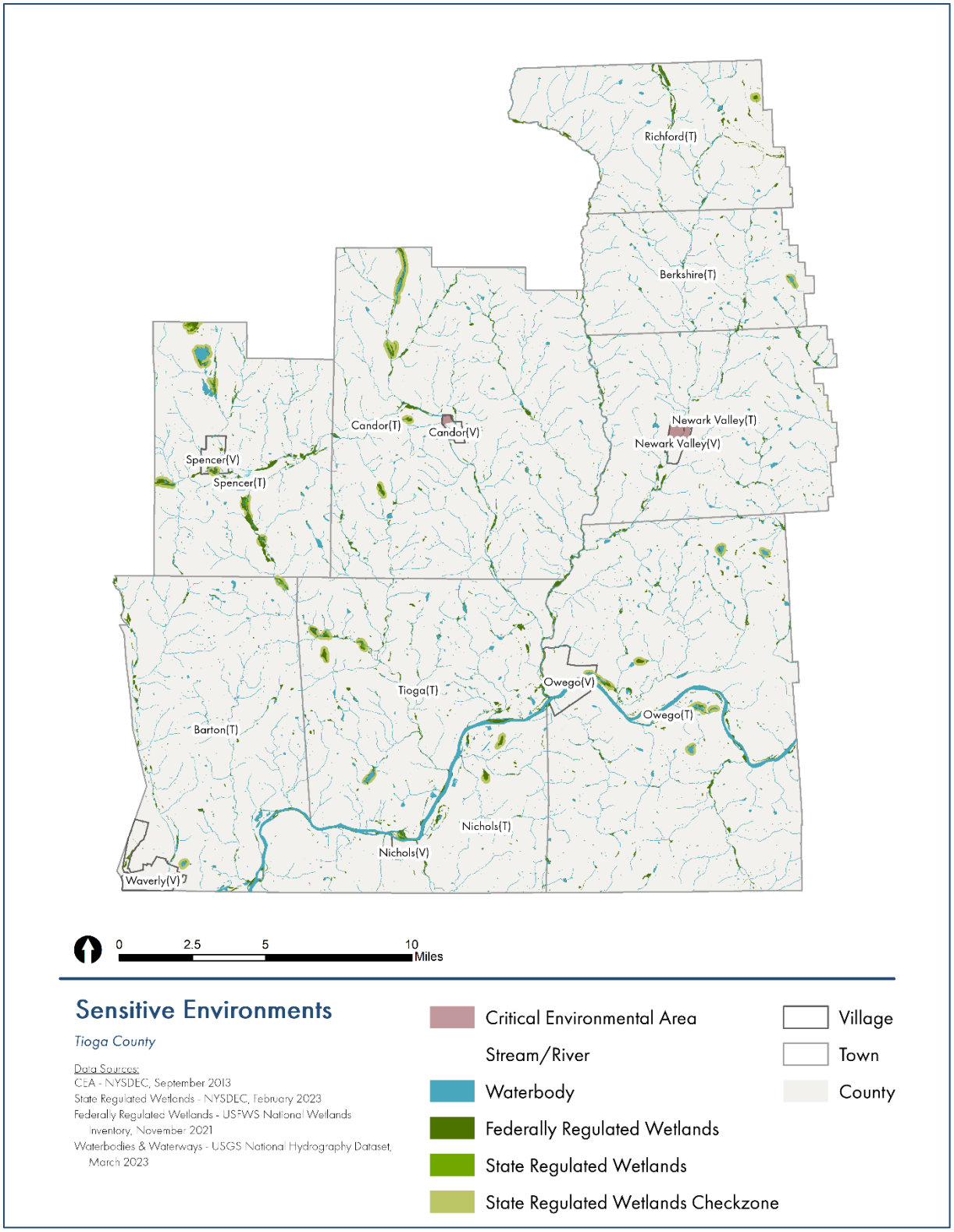
The Susquehanna River Basin is the second largest east of the Mississippi River. The 444 miles of this Basin drains 27,500 square miles covering large portions of New York State, Pennsylvania and Maryland, before emptying into the Chesapeake Bay. The Basin has 4,520 square miles of land area within New 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, 2014). The majority of the County is located in the Owego-Wappasening watershed.

2.1.4 Sensitive Environments

Tioga County has several sensitive environments, including federal and state regulated wetlands, critical environmental areas, and water bodies. These are depicted in Figure 2-4.

Figure 2-4. Sensitive Environments in Tioga County



Data Sources: NYSDEC (September 2013), NYSDEC (February 2023), USFWS National Wetlands Inventory (November 2021), and USGS National Hydrography Dataset (March 2023)

2.2 Climate

2.2.1 Existing Climate Conditions

New York State's Humid Continental climate is categorized as being quite similar to that of the majority of the Northeastern United States. The climate varies across New York State due to variations in latitude, geography, and proximity to big bodies of water. Convective storms are what make up most of the precipitation throughout the warm, growing season (April through September). These storms typically originate ahead of an approaching cold front moving east or during times of local atmospheric instability. Tropical cyclones may migrate up from southern coastal regions and dump a lot of rain. Both types of storms are often distinguished by relatively brief intervals of solid precipitation that result in significant surface runoff and minimal recharging (Cornell University, n.d.).

Large, low-pressure systems that travel northeastward over the Atlantic coast or the western side of the Appalachian Mountains are typical of the chilly season (October through March). Because of their longer duration and sporadic snowmelt, storms that develop in these systems are characterized by extended periods of steady precipitation in the form of rain, snow, or ice. They also tend to produce less surface runoff and more recharge than storms that form in the summer (Cornell University, n.d.).

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 (Tetra Tech, 2018).

2.2.2 Climate Change

Climate change is defined by the National Aeronautics and Space Administration (NASA) as the long-term (at least 30-years) shift in average weather patterns that define Earth's local, regional, and global climates (NASA, 2023). Drivers of climate change are both natural and human caused (anthropogenic). Natural drivers include variations in Earth's orbit, variation in the sun's energy, volcanic activity, cyclical oceanic patterns such as El Niño and La Niña, etc.) Anthropogenic drivers include the burning of fossil fuels, deforestation, farming livestock, and more (European Commission, 2022). The coupling of natural and anthropogenic drivers has exacerbated climate change.

Several climate change impact assessments discuss how various climate change impacts are already being observed in the state of New York and how these impacts are projected to continue and/or increase in the future. These include but are not limited to Responding to Climate Change in New York State (Rosenzweig, 2011) and DEC Observed and Projected Climate Change in NYS (NYSDEC, 2021). The effects of climate change on the impacts, extent, and frequency of each hazard profiled in this Hazard Mitigation Plan are described in Section 6.

2.3 Demographic and Economic Characteristics

2.3.1 Population Trends

According to the 2020 U.S. Census, Tioga County had a population of 48,455 people. This reflects a 5% decrease in population when compared to the County's population in the 2010 U.S. census (51,125). Table 2-1 and Table 2-2 summarize population and demographic statistics for Tioga County based on US Decennial Census data (United States Census Bureau, 2023).

Table 2-1. Population Trends in Tioga County, 2010-2020

Jurisdiction	2010 Population	2020 Population	Percent Change
Town of Barton	8,858	8,609	-3%
Town of Berkshire	1,412	1,480	5%
Town of Candor	5,305	5,149	-3%
Town of Newark Valley	3,946	3,642	-8%
Town of Nichols	2,525	2,347	-7%
Town of Owego	19,883	18,777	-6%
Town of Richford	1,172	1,043	-11%
Town of Spencer	3,153	2,968	-6%
Town of Tioga	4,871	4,440	-9%
Village of Candor	851	786	-8%
Village of Newark Valley	997	928	-7%
Village to Nichols	512	457	-11%
Village of Owego	3,896	3,654	-6%
Village of Spencer	759	719	-5%
Village of Waverly	4,444	4,373	-2%

Data Source: US Decennial Census

Table 2-2. Tioga County Demographics, 2020

Statistic	Tioga County	New York State
Total Population	48,455	20,201,249
Male Population (%)	50%	48%
Female Population (%)	50%	52%
White (%)	92%	55%
Black/African American (%)	1%	15%
American Indian and Alaska Native (%)	0%	1%
Asian (%)	1%	10%
Native Hawaiian and Other Pacific Islander (%)	0%	0%
Two or More Races (%)	5%	9%

Data Source: US Decennial Census

2.3.2 Vulnerable Populations

The Disaster Mitigation Act of 2000 (DMA 2000), which is mandated by the Federal Emergency Management Agency (FEMA), necessitates that hazard mitigation plans (HMP) take into account socially vulnerable groups. Such groups may have a higher vulnerability to hazard events due to various factors, such as their physical and financial capacity to cope with or

respond to a hazard, as well as the geographical locations and construction standards of their homes. This HMP considers two socially vulnerable population groups: (1) Potential Environmental Justice Areas (PEJA) and (2) Disadvantaged Communities.

Potential EJ Areas are U.S. Census block groups of 250 to 500 households each that, in the Census, had populations that met or exceeded at least one of the following statistical thresholds:

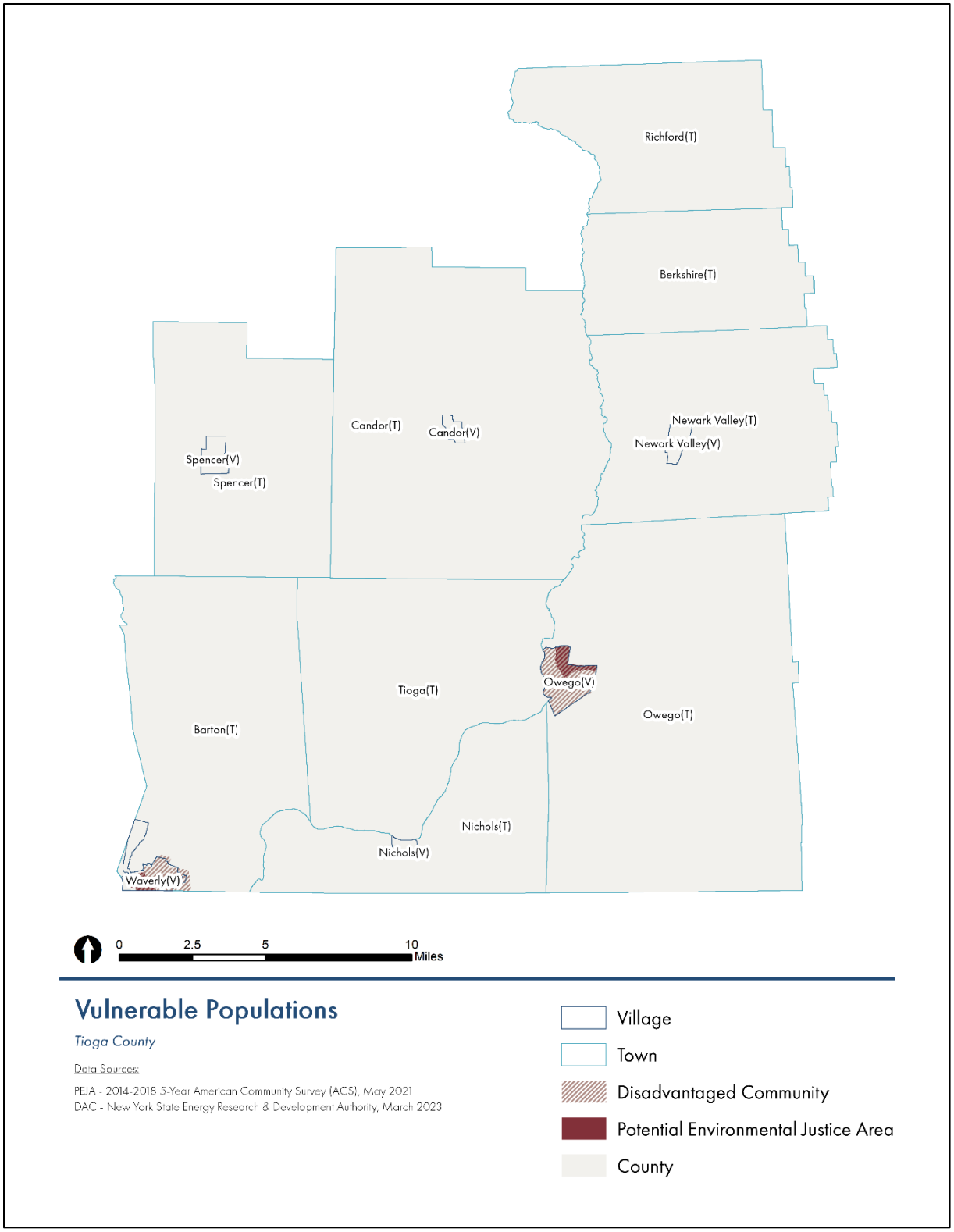
1. At least 52.42% of the population in an urban area reported themselves to be members of minority groups; or
2. At least 26.28% of the population in a rural area reported themselves to be members of minority groups; or
3. At least 22.82% of the population in an urban or rural area had household incomes below the federal poverty level (NYSDEC, 2023).

Potential Environmental Justice Areas (PEJA) have been pinpointed using data derived from the 5-year American Community Survey (ACS) spanning 2014 to 2018, conducted by the US Census Bureau (NYSDEC, 2023).

Disadvantaged Communities are areas in New York State that meet the Climate Justice Working Group's (CJWG) criteria for a disadvantaged community as of January 2021 (NYSERDA, 2021). The criteria include indicators related to potential pollution exposures, proximity to environmental burdens, potential climate change risks, income, race and ethnicity, health outcomes and sensitivities, and housing mobility and communications (NYS Climate Justice Working Group, 2022).

Environmental justice initiatives concentrate on enhancing the ecological conditions in specific communities, particularly those consisting of minority and low–income populations, and addressing any disproportionate adverse environmental effects that may be prevalent within those areas. The Climate Act in New York acknowledges the unequal impact of climate change on various communities. This legislation has entrusted the CJWG with the task of establishing criteria for identifying marginalized communities. The goal is to guarantee that communities at the forefront of environmental challenges and those that have been traditionally underserved reap the benefits of the State's significant shift towards cleaner, more sustainable energy sources, reduced pollution, improved air quality, and the economic opportunities that come with it. Figure 2-5 shows the distribution of vulnerable populations within Tioga County, based on potential Environmental Justice Area Communities and Disadvantaged Communities. Additional information about vulnerable populations in Tioga County is listed in the Engagement Strategy in Appendix C.

Figure 2-5. Vulnerable Populations in Tioga County



Data Sources: 2014-2018 5-Year ACS (May 2021) and NYSERDA (March 2023)

2.3.3 Economic Characteristics

The following tables present an overview of the County economy, including agriculture, retail trade, tourism, industry, manufacturing, and educational services.

Table 2-3. Economic Characteristics of Tioga County

Statistic	Tioga County	New York State
Unemployment Rate (16+ Years Old Civilian Labor Force)	6%	6%
Mean Travel Time to Work (Minutes)	23.8	33.5
Median Household Income	$61,965	$71,117
Poverty Rate	10%	14%

Data Source: ACS 2016-2020 5-Year Estimates (U.S Census Bureau, 2020)

Table 2-4. Jobs by Industry in Tioga County

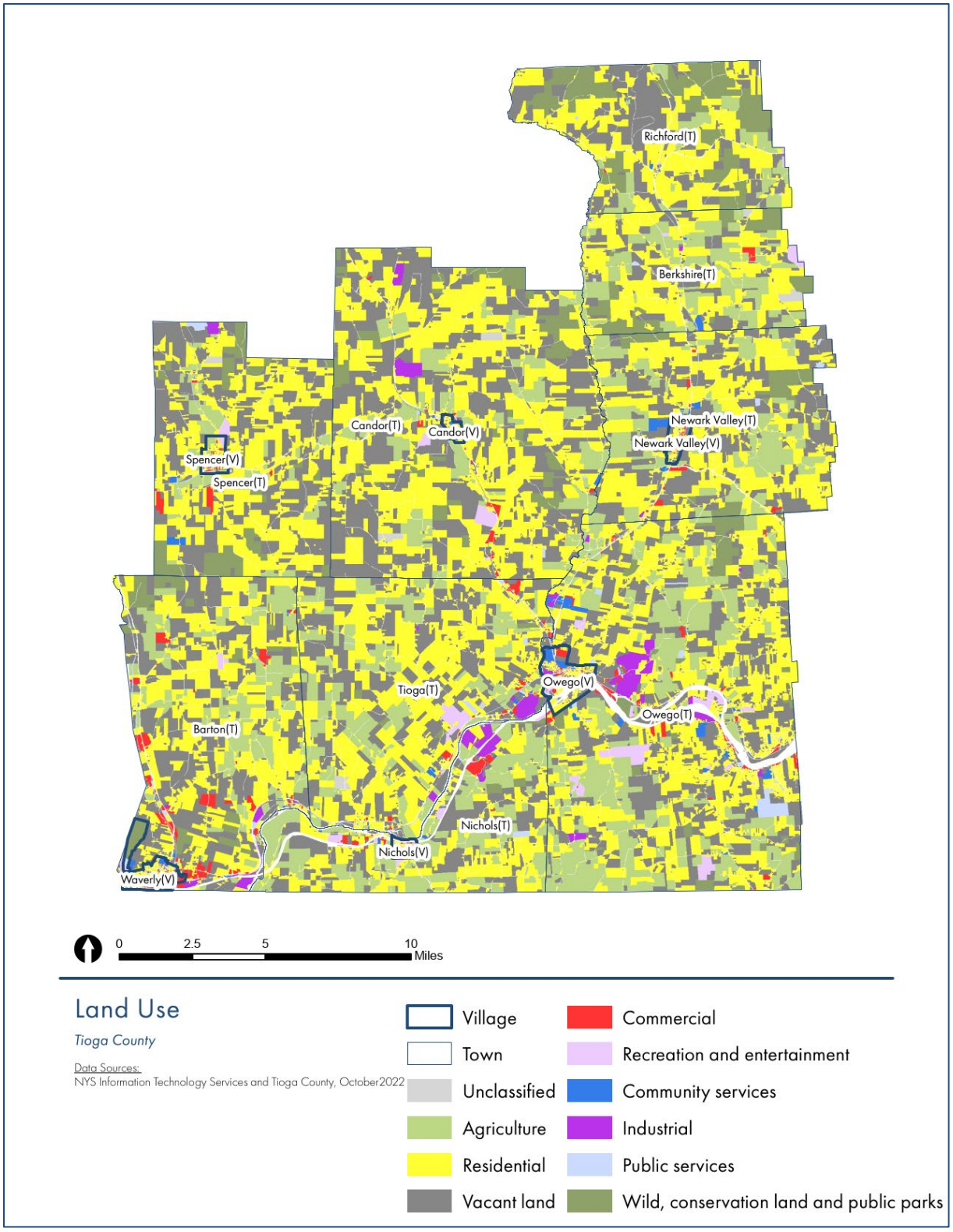
Industry	People	Share of Total Jobs
Agriculture, forestry, fishing and hunting, and mining	422	2%
Construction	1,747	8%
Manufacturing	3,614	16%
Wholesale trade	612	3%
Retail trade	2,252	10%
Transportation and warehousing, and utilities	861	4%
Information	295	1%
Finance and insurance, and real estate and rental and leasing	787	4%
Professional, scientific, and management, and administrative and waste management services	2,191	10%
Educational services, and health care and social assistance	6,054	27%
Arts, entertainment, and recreation, and accommodation and food services	1,799	8%
Other services, except public administration	1,081	5%
Public administration	848	4%

Data Source: ACS 2016-2020 5-Year Estimates (U.S Census Bureau, 2020)

2.4 Land Use and Development Trends

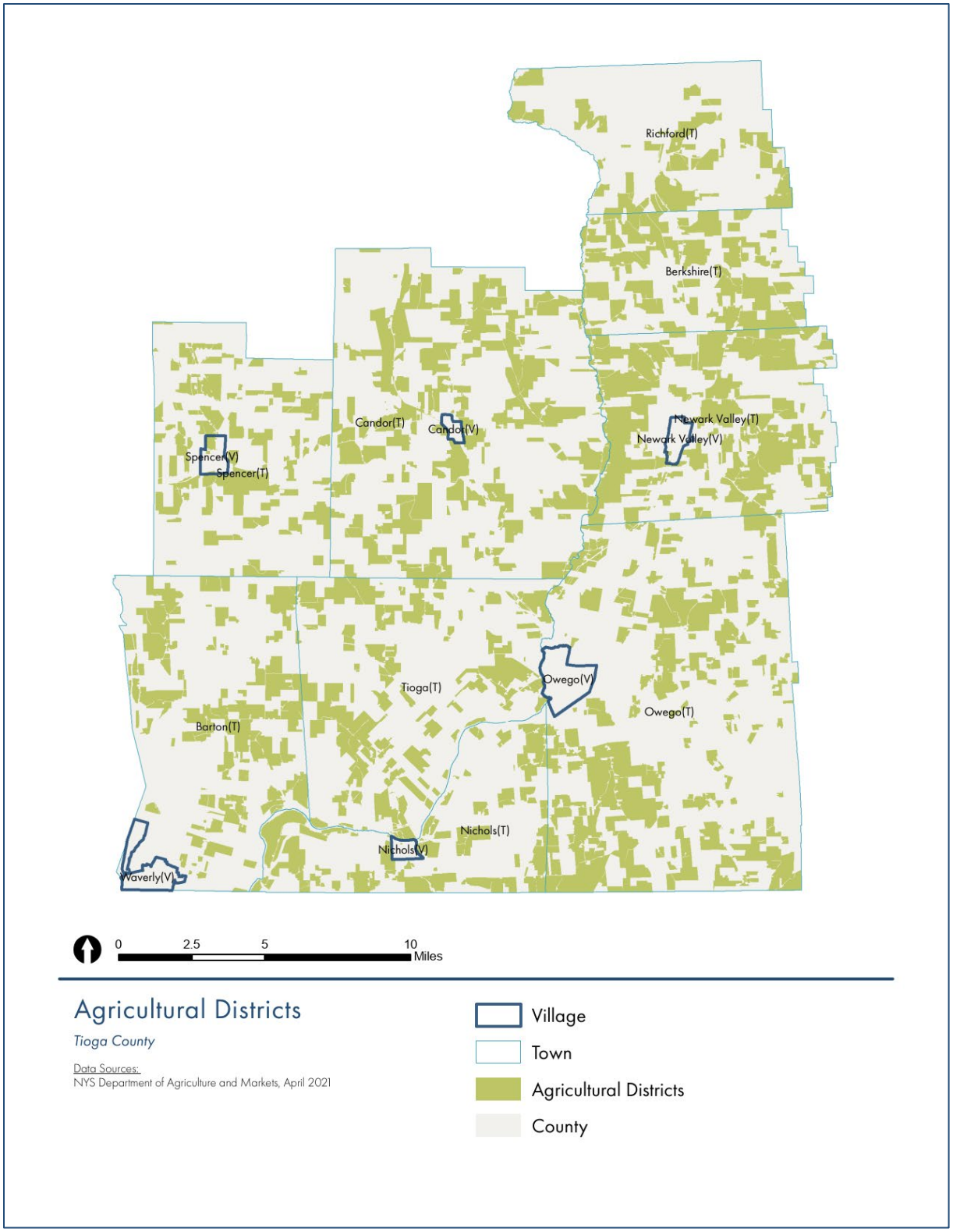
Tioga County has only grown moderately over the previous three decades, which is typical of many counties in New York State. A majority of the area within the County was built before World War II. The 1950s and 1960s saw additional construction, which primarily consumed the remaining land in the municipalities of the County. The majority of the settlements in the County's core are situated within floodplain areas since they were established during a time when waterpower was essential to industrial development or transportation. Since 1970, the majority of new housing construction in Tioga County has been small-scale, low-density rural housing consisting of one to five-house lots dispersed throughout the county. The majority of recent growth and development within the region since 1970 has occurred in areas with few identified natural or technological hazards (Tetra Tech, 2018).

Figure 2-6. Land Use in Tioga County



Data Source: NYS Information Technology Services and Tioga County (October 2022)

Figure 2-7. Agricultural Districts



Data Source: NYS Department of Agriculture and Markets (April 2021)

Table 2-5. Change in Land Use in Tioga County, 2016-2021

Land Use Type	2016 Acres	2016 % of Total Acres	2021 Acres	2021 % of Total Acres	2016-2021 Change in Acres
Open Water	2,920	0.87%	2,836	0.85%	-84
Developed, Open Space	17,830	5.33%	17,683	5.29%	-147
Developed, Low Intensity	5,838	1.75%	5,871	1.76%	33
Developed, Medium Intensity	1,926	0.58%	2,054	0.61%	129
Developed, High Intensity	668	0.20%	687	0.21%	19
Barren Land	843	0.25%	857	0.26%	14
Deciduous Forest	105,174	31.45%	106,175	31.75%	1,001
Evergreen Forest	12,745	3.81%	12,786	3.82%	41
Mixed Forest	82,432	24.65%	82,614	24.70%	182
Shrub/Scrub	1,986	0.59%	954	0.29%	-1,032
Grassland/Herbaceous	1,384	0.41%	1,242	0.37%	-142
Pasture/Hay	82,377	24.63%	82,344	24.62%	-33
Cultivated Crops	11,712	3.50%	11,634	3.48%	-77
Woody Wetlands	4,894	1.46%	4,908	1.47%	14
Emergent Herbaceous Wetlands	1,710	0.51%	1,793	0.54%	82
Total	334,440	100.00%	334,440	100.00%	0

Data Source: (USGS, 2023)

Table 2-6. Housing Vacancy Rates by Jurisdiction, 2020

Jurisdiction	Total Housing Units	Vacant Housing Units	Vacancy Rate (%)
Town of Barton	4,022	429	11%
Town of Berkshire	601	55	9%
Town of Candor	2,307	199	9%
Town of Newark Valley	1,596	1,460	9%
Town of Nichols	1,055	103	10%
Town of Owego	8,282	563	7%
Town of Richford	537	100	19%
Town of Spencer	1,366	130	10%
Town of Tioga	2,021	194	10%
Village of Candor	362	31	9%
Village of Newark Valley	424	32	8%
Village to Nichols	240	20	8%
Village of Owego	1,865	179	10%
Village of Spencer	345	24	7%
Village of Waverly	2,148	261	12%

Data Source: (United States Census Bureau, 2023)

Structural developments or redevelopments that have been proposed between 2018 and 2022 are summarized in each of the jurisdictional annexes. Based on the descriptions provided by

the County's 239 referrals, eight of the proposed developments are specified as being located in the 1% chance floodplain and four are specified as being located in the 0.2% chance floodplain (Tioga County, 2023). As described in Section 6.1.5, all of the municipalities in Tioga County participate in the NFIP program, and therefore take flooding into account when considering new developments.

3 PLAN PARTICIPATION

3.1 Core Planning Group

The Core Planning Group – composed of staff from several county departments, members of the consultant team, and representatives from New York State's Department of Homeland Security and Emergency Services (DHSES) – took the lead on the development of the HMP Update for Tioga County. The group met monthly throughout the planning process. More information is described in the Community Engagement Plan in Appendix C. Details regarding all meetings held throughout the planning process, including attendee lists, are provided in Appendix D and Appendix E.

3.2 Jurisdictional Participation

There are 15 municipal jurisdictions (9 Towns and 6 Villages) located within Tioga County, in addition to the County itself. All jurisdictions are seeking FEMA approval for this HMP Update. All jurisdictions were invited and encouraged to participate in this HMP Update, and all jurisdictions met the criteria for participation, as detailed in Table 3-1. Participation criteria was established by the Core Planning Group along with the consultant team.

Table 3-1. Jurisdiction Participation Actions

Jurisdiction	Identified Primary Project Contacts*	Attended a Jurisdictional Interview*	Attended a Jurisdictional Team Meeting	Reviewed Jurisdictional Annex*	Passed Resolution to Formally Adopt 2024 HMP Update*	Seeking Approval For Plan Adoption
Tioga County	X	X	X	X		X
Barton, Town of	X	X		X		X
Berkshire, Town of	X	X		X		X
Candor, Town of	X	X		X		X
Candor, Village of	X	X		X		X
Newark Valley, Town of	X	X		X		X
Newark Valley, Village of	X	X	X	X		X
Nichols, Town of	X	X	X	X		X
Nichols, Village of	X	X	X	X		X

Jurisdiction	Identified Primary Project Contacts*	Attended a Jurisdictional Interview*	Attended a Jurisdictional Team Meeting	Reviewed Jurisdictional Annex*	Passed Resolution to Formally Adopt 2024 HMP Update*	Seeking Approval For Plan Adoption
Owego, Town of	X	X	X	X		X
Owego, Village of	X	X	X	X		X
Richford, Town of	X	X		X		X
Spencer, Town of	X	X		X		X
Spencer, Village of	X	X		X		X
Tioga, Town of	X	X		X		X
Waverly, Village of	X	X		X		X

** Indicates required action. Note that not all attendees from the first Jurisdictional Team Meeting were captured.*

The Jurisdictional Team Meetings took place in May 2023 and October 2023, and were optional. The rest of the activities in Table 3-1 were required. The jurisdictional interview consisted of a meeting with the consultant team and County Soil & Water Conservation District (SWCD) in order to:

1. Review and update 2018 HMP data
2. Assess natural hazards and determine which have the greatest possibility of impacting the jurisdiction
3. Provide a status update on 2018 mitigation actions
4. Develop at least one mitigation action per hazard identified for inclusion in the HMP update, along with associated information

After the jurisdictional interview, jurisdictions were provided with the opportunity to review their jurisdictional annexes and provide further revisions. All jurisdictions are required to adopt the HMP update by passing a board resolution for Approvable Pending Adoption (APA) after the plan is approved by FEMA. A sample HMP adoption resolution is presented in Appendix B. Jurisdictional annexes are provided in Appendix A, which list the primary and secondary contacts from each jurisdiction and other information, such as mitigation actions for each jurisdiction. A list of the individuals who participated in an interview as part of the process of developing these annexes is provided in Table 3-2. Additional information about jurisdictional participation, including jurisdictional team meetings and jurisdictional interviews, is provided in the Community Engagement Plan (Appendix C).

Table 3-2. Jurisdictional Interview Participants

Jurisdiction	Interview Date	Participants
Tioga County	July 13, 2023	Elaine Jardine (Planning Director) Wendy Walsh (SWCD District Manager) Mike Simmons (Director of Emergency Services) Bob Williams (Emergency Services) Corinne Cornelius (Emergency Services) Kevin Clapp (NYS DHSES)
Barton, Town of	July 26, 2023	Arrah McCarty (Clerk) Fred Schweiser (Highway Superintendent) Donald Foster (Supervisor) Chris Robinson (Code Enforcement)
Berkshire, Town of	July 27, 2023	Barbara Gehm Jordan (Supervisor) Roger Howland (Board Member)
Candor, Town of	July 25, 2023	Kevin Noble (Highway Superintendent) William Strosahl (Supervisor) Jim Douglas (Council Member)
Candor, Village of	August 31, 2023	Eric Halstead (Mayor) Ron Donahue (Code Enforcement Officer)
Newark Valley, Town of	August 9, 2023	Stuart Yetter (Town Supervisor) Stephen Tennent (Highway Superintendent)
Newark Valley, Village of	August 31, 2023	Jim Tornatore (Mayor) Pam Benthin (Clerk/Treasurer) Matt Seamans (Supervisor of Public Works)
Nichols, Town of	August 14, 2023	Esther Woods (Supervisor) Brenda Fay-Pelotte (Deputy Supervisor)
Nichols, Village of	August 16, 2023	Lesley Pelotte (Mayor)
Owego, Town of	August 22, 2023	Joann Lindstrom (Planning & Zoning Administrator) Bill Carrigg (Code Enforcement Officer) Henry Hines (Deputy Highway Superintendent) Tyson Stiles (Director of Utilities) Dean Morgan (Deputy Supervisor & Councilman)
Owego, Village of	July 26, 2023	Dirk Mosher (Interim Director of Utilities WWTP) Julie Nucci (Planning Board, CSC Task Force Chair) Linda Coe (Planning Board Chair) Kevin Miller (CSC Task Force) Richard VanHall (Zoning Board of Appeals) Mark Trabucco (Zoning Board of Appeals, Owego Historic Preservation Commission) Nadine Bigsby (Owego Historic Preservation Commission) Laura Spencer (Trustee) Ron Pelton (Planning Board) Jim Mead (Merchant) Rusty Fuller (Trustee) Charles Plater (Trustee) Jeff Winchell (Police) Ashley Seyfried (ST8 CSC Regional Coordinator)
Richford, Town of	July 25, 2023	William Stell (Code Enforcement) Charles Davis (Supervisor) Harrison Marsh (Highway)
Spencer, Town of	July 27, 2023	Al Fulkerson (Supervisor)
Spencer, Village of	October 18, 2023	Gilbert Knapp (Mayor)

Jurisdiction	Interview Date	Participants
Tioga, Town of	August 14, 2023	Lewis Zorn (Supervisor) Doug Chrzanowski (Code Enforcement Officer) Tiffany Middendorf (Clerk)
Waverly, Village of	July 26, 2023	Keith Correll (Deputy Mayor) Andrew Aronstam (Mayor) Russell Buesink Jr (Chief of Police) Chris Robinson (Code)

Note: At least one member of both the Tioga County SWCD and the consultant team were also present at each jurisdictional interview.

3.3 Stakeholder Participation

A list of stakeholders identified for the HMP update is provided in Table 3-3, along with the participation activities they completed. These participation activities are further described in the Community Engagement Strategy in Appendix C. Stakeholders that gave feedback on a more detailed level included local and regional agencies involved in hazard mitigation activities (such as the Tioga County Department of Economic Development and Planning, the Tioga County Office of Emergency Services, Tioga County SWCD, Tioga County Department of Public Health, NYS DHSES, and others), agencies that inform future development (i.e. the Department of Economic Development and Planning), and Tioga Opportunities (a nonprofit). These stakeholders gave feedback through activities such as attending Core Planning Group and Steering Committee meetings, participating in focus groups or interviews, and attending jurisdictional interviews. Various County departments were also engaged in the process by being invited to participate in a survey to rank proposed County mitigation actions. Neighboring communities were invited to give feedback on the plan through a Neighboring Communities Survey, which was distributed to representatives of jurisdictions neighboring Tioga County. All stakeholders – including representatives of local businesses, organizations, and institutions and the general public of Tioga County – were welcome to participate in the two public information meetings and community survey.

Table 3-3 identifies stakeholders that were involved in the Hazard Mitigation Planning Process and how they participated. In addition to the activities listed in the table, the project team solicited feedback from stakeholders at the Local Emergency Planning Meeting via a paper survey, and presented at an additional meeting (the Council of Governments meeting) in September 2023.

Table 3-3. Stakeholder List and Participation

Name	Title/Affiliation	Member of Core Planning Group	Member of Steering Committee	Attended County Roundtable Meeting on 5/17/23	Attended a Jurisdictional Team Meeting (5/3/23 or 10/5/23) or Jurisdictional Interviews	Attended Local Emergency Planning Committee Meeting	Attended Tioga County Departmental/ Organizational Interview
Corinne Cornelius	Deputy Director of Emergency Services	X	X	X			
Gary Howard	Sheriff			X			
Elaine Jardine	Economic Development & Planning	X	X	X	X	X	X
Mike Jura	Tioga SWCD			X	X		
Alex Marks	Tioga SWCD			X	X		
Heather Vroman	Public Health Director			X			X
Denis McCann	Director of Administrative Services (Dept of Public Health)						X
Bryan Goodrich	Tioga County GIS Manager		X	X			
Shawn Yetter	Department of Social Services			X			
Ellen Pratt	Department of Sustainability			X			X
Gary Hammond	DPW Commissioner			X			
Peter DeWind	County Attorney			X			
Wendy Walsh	Tioga SWCD	X	X	X	X	X	

Name	Title/Affiliation	Member of Core Planning Group	Member of Steering Committee	Attended County Roundtable Meeting on 5/17/23	Attended a Jurisdictional Team Meeting (5/3/23 or 10/5/23) or Jurisdictional Interviews	Attended Local Emergency Planning Committee Meeting	Attended Tioga County Departmental/ Organizational Interview
Mike Simmons	Tioga Co. Emergency Services	X	X				
Bob Williams	Tioga Co. Emergency Services	X	X		X		
Daryl Scharad	Tioga Co. Department of Health				X		
Steve Solomon	Tioga Co. Emergency Services					X	
Todd Kopalek	Tioga Co. Public Health		X				
Julie Nucci	Village of Owego		X				
James Overhiser	Owego Historic Preservation Committee		X				
T Hanson	Tioga Co. CCE		X				
Kevin Clapp	NYS DHSES	X	X				
Roland Paperman	NYS DHSES	X	X				
Stephanie Chopin	NYS DHSES					X	
Erik Verfuss	NYS DHSES					X	
Rich Gorman	GFD					X	
Adam Bessem	TCSO					X	
Dave Alder	NYS OEM					X	

Name	Title/Affiliation	Member of Core Planning Group	Member of Steering Committee	Attended County Roundtable Meeting on 5/17/23	Attended a Jurisdictional Team Meeting (5/3/23 or 10/5/23) or Jurisdictional Interviews	Attended Local Emergency Planning Committee Meeting	Attended Tioga County Departmental/ Organizational Interview
Ann Smith	NYS DOH					X	
Seth Williams	Leprino Foods					X	
Carly Norton	NYSEG					X	
Curtis Hammond	Tioga County OES					X	
Mark Pellerito	NWS					X	
Abbey Ortu	Tioga Co. Economic Development & Planning					X	X
Katie Wait	Tioga Co. Public Health					X	
Jeff Rosenheck	Bradford Co., PA Emergency Management					X	
Bill Standinger	Tioga County Legislature					X	
Rob Roberts	NYSEG					X	
Paula Granger	NYS DHSES					X	
Susan Medina	Tioga County Public Health					X	
Matt Williams	Bradford County					X	
Jill Konopka						X	
H.R. Marsh						X	

Name	Title/Affiliation	Member of Core Planning Group	Member of Steering Committee	Attended County Roundtable Meeting on 5/17/23	Attended a Jurisdictional Team Meeting (5/3/23 or 10/5/23) or Jurisdictional Interviews	Attended Local Emergency Planning Committee Meeting	Attended Tioga County Departmental/ Organizational Interview
Denise Liske						X	
Sarah Hogan						X	
Christine Shaver	Tioga Opportunities – Director of Program Operations						X
Erica Bayne	Tioga Opportunities – Housing Services Coordinator						X
Amanda Kushner	Tioga Opportunities – Aging Services Coordinator						X

Note: This list excludes jurisdictional participants, who are detailed in Section 3.2.

3.4 Public Participation

Two public information meetings, an online and print survey, and focus groups provided opportunities for the public to give input on the plan. Public feedback from each of these initiatives was discussed by the Core Planning Group and subsequently incorporated into the HMP, including the mitigation action strategy where appropriate.

The two public information meetings were held to raise public awareness of the hazard mitigation planning process and solicit input. Public Information Meeting #1 was held in person at the Owego Nazarene Church Fellowship Center on October 4, 2023 at 6:00 pm, with a Zoom webinar login option available. Public Information Meeting #2 was held on February 13th via two Zoom webinar time slots (12:00 pm and 5:00 pm). Both meetings included polling exercises for public input. Flyers were developed for distribution through appropriate information channels. Public Information Meeting #1 was advertised by news outlet WBNG and the SWCD Facebook page, and Public Information Meeting #2 and the draft HMP were advertised through alerts on the OES website and the SWCD Facebook page. An email was sent to the Jurisdictional Team in advance of Public Information Meeting #2 to notify them of the public posting of the draft HMP and the upcoming meeting; the flyer was provided to Jurisdictional Team members to share with their constituents.

The online survey was advertised through social media (both through Team Tioga and through SWCD social media), on the OES website, through an email blast to County employees, and to the jurisdictional team and additional County agencies to share as they wish. The Core Planning Group had a hard copy version of the survey in order to solicit feedback from residents without readily available computer or internet access.

Focus groups were run by Tioga Opportunities and included individuals from disadvantaged communities such as older adults and individuals with disabilities.

3.4.1 Draft Plan Comment Period

The draft Plan was posted on the Tioga Co OES webpage in advance of Public Information Meeting #2 and remained there for over 30 days to allow for public review and comment. Comments and suggested revisions received were incorporated into the plan document and annexes where appropriate.

3.5 Key Takeaways

Key takeaways from public, jurisdictional, and stakeholder participation included the following:

- The public requested clear communication from County in advance of an emergency, including knowing what to do, where to go, who to contact, and how to get transportation. The public requested that the County share the emergency plan with residents in advance of emergency (e.g. mailing to residents) and making it accessible to those without internet access

- Clearing soot and debris out of rivers and creeks was mentioned by several survey respondents. Some jurisdictions mentioned that creeks and streams often have limited space for high levels of water to go (for instance if they have high amounts of gravel), and can cause flooding and infrastructure/property damage.
- There is a general concern among residents related to vulnerable populations such as older adults, people with disabilities, lower income residents, people without vehicles, and homeless populations.
- Vulnerable groups themselves were concerned about having food, water, and access to medical care during emergencies.
- People who served vulnerable groups were concerned about power outages' effects on residents, the lack of transportation, the lack of safety plans, the lack of mobility of some vulnerable individuals and lack of access to those individuals, the lack of access to air conditioning and assistance programs, the lack of a support network for many vulnerable individuals, and snow removal.
- Infrastructure investment and maintenance was a priority for many survey respondents and jurisdictions. These included roads, water and sewer systems, and electrical infrastructure, all of which can be damaged by storms and flooding in particular.
- Many residents had specific locations that they would like to see better maintained in the face of flooding and storms.
- Debris creation during flooding was listed as a concern during many jurisdictional interviews and by stakeholders in the emergency services field. Many items can become sources of pollution during a flood and even can be dangerous if large items start to float.
- Many jurisdictions wanted strategies for implementing and maintaining the actions included in the HMP. Additionally, many jurisdictions and the stakeholders were concerned about obtaining adequate funding to help reduce the impact of hazards on the populations they serve.
- Many areas are susceptible to flooding, which causes road damages and property damages.
- Many culverts are undersized, plugging, and/or do not adequately deal with flooding.
- Tree debris (for example, from dead and dying ash trees) can cause power outages, block roads, and fill streams, increasing the severity of severe storms and flooding. Severe storms can cause downed trees and fallen branches.
- Dams outside of Tioga County pose a flood concern. For example, if the East Sidney Dam in Delaware County were breached, it would flood Tioga County in a matter of hours. The County has an existing action to establish a stream gauge system to provide early alert of flooding, and has added the East Sidney Dam to this action.
- Some jurisdictions were interested in creating intermunicipal agreements to help with hazard preparedness and response, such as agreements for snow removal.

Some of the requests were focused more on preparedness than on mitigation, and therefore were communicated with the appropriate departments instead of being incorporated into the mitigation strategy.

More detail on these efforts is provided in the Community Engagement Plan (Appendix C). Stakeholder and public outreach documentation is provided in Appendix E.

4 CAPABILITIES

4.1 County Capabilities

Tioga County implements many initiatives related to hazard mitigation and emergency preparedness and response. Capabilities related to hazard mitigation are listed in the County's jurisdictional annex and in each municipality's jurisdictional annex. While the focus of this document is on hazard mitigation, it is also important to note that the County and municipalities also have related capabilities and initiatives to address emergency preparedness and response, many of which represent potential opportunities for synergy with hazard mitigation actions. A few of these County initiatives include:

- Citizen Preparedness Events – Periodic Citizen Preparedness Classes are held throughout the County. The Citizens Preparedness Class is a collaborative effort between the NYS DHSES OEM, NYS National Guard, Tioga County Emergency Services and the local municipalities (Government/Police/Fire), School Districts, and potentially community organizations. It is a way to educate residents on how to prepare for various hazards. If there are 50 or more registrants, the NYS OEM and The National Guard will distribute Preparedness Back Packs to attendees at the event.
- Emergency Stream Intervention Trainings – The County SWCD helps municipalities identify when is right time to remove debris and gravel from streams. Municipalities can contact the SWCD for input.
- Updates to Emergency Plans – The Tioga County Emergency Services Office works along with NYS OEM to assist Towns and Villages with their comprehensive emergency plans. For example, the County may attend monthly meetings, or communicate by phone and e-mail.

4.2 State and Federal Resources

The following are examples of additional resources available to municipalities. Some of these resources relate primarily to emergency preparedness and response, rather than hazard mitigation. Additionally, a list of federal and state funding resources is included in Section 9.5.

- Emergency Warnings – NY Alert is available to all residents. Residents need to set up an account and sign-in to set up their preferences to receive messages.
- Emergency Plans – In addition to County assistance, the NYS OEM provides direct technical assistance to the municipalities with writing their emergency plans and annexes. Municipalities have worked with Dave Alder from the NYS OEM in the past.
- Intermunicipal Agreements – The Office of the State Comptroller has published guidance on shared service agreements, with related resources (Division of Local Government and School Accountability, 2009). The NYS Office of Emergency Services and DHSES may also be able to assist municipalities with creating intermunicipal shared service agreements or provide further direction.

- Army Reserve Resources – The Army Reserve can provide resources during and after emergencies, including transporting people to safety, clearing roads and debris, pumping floodwater, and more. Municipalities are encouraged to meet with their local Army Reserve centers before a disaster strikes. A nearby Army Reserves office is located in Horseheads NY. More information can be found on the Army Reserve Website (U.S. Army Reserve, 2022) (U.S. Army Reserve, 2023).

4.3 Municipal Capabilities

Table 4-1 gives an overview of local laws and regulations for each municipality in Tioga County that may relate to hazard mitigation planning. This overview is based on documents that were publicly available on municipal websites, ecode360.com, and the Department of State's Local Laws Search engine (https://locallaws.dos.ny.gov/search/laws), as well as documents that were provided to the project team. More information and additional municipal capabilities are included in Section 3 of each jurisdiction's annex.

Table 4-1. Local Laws and Regulations for Municipalities in Tioga County

Municipality	Zoning Regulations	Subdivision Requirements	Site Plan Review/ Regulations	Design Standards*	Overlay Districts/ Wellhead Protection	Stormwater Management	Erosion and Sediment Control	Flood Damage Prevention/ NFIP	Wetland and Watercourse Protection	Environmental Quality Review	Historic Preservation	Natural Area Protection/ Land Use and Open Space Plans	Renewable Energy Goals	Other
Town of Barton		Chapter 125	Chapter 117					Chapter 83						Junk Storage (Chapter 90), Junkyards (Chapter 91), Vehicles, Junked (Chapter 135)
Town of Berkshire			Local Law 1 of 2022					Local Law 1 of 2012						Junkyard Licensing Law (Local Law 3 of 2012), Unregistered Vehicle Local Law (Local Law 1 of 2018)
Town of Candor		Local Law 8 of 2011	Local Law 2 of 2020					Local Law No. 1 of 2012						Local Law No. 7 of the year 1990 (adopted 1997): Automobile Junkyard and the Accumulation of Junk, Local Law 5 of 2011 - Accumulation of Junk, Local Law 2 of 2016 - 9-month Moratorium on Solar Farms, Solar Energy Systems: Appendix B of Local Law 2 of 2020 (Site Plan Review Law)
Town of Newark Valley								Local Law 1 of 2012						Solar Energy Requirements (Local Law 1 of 2017, Local Law 3 of 2021)
Town of Nichols	Zoning Ordinance (Ch. 194 of Town Code, amended by Local Law 3 of 2017)		Section 8 of Zoning Code (Ch. 194 of Town Code) - created by Local Law 6 of 2018					Chapter 114/ Local Law 1 of 2012 (amended by Local Law 1 of 2018)				Agriculture & Farmland Protection Plan (not in code), Campgrounds and Recreational Parks (88-2; Local Law No. 3 of 2000)		Solar Energy Systems (Local Law 2 of 2022), Interim High Density Development and Commercial Farming Moratorium (Local Law 1 of 2005), Junk Vehicle Local Law (1991, amended by Local Law 3 of 1998)
Town of Owego	Chapter 125	Chapter 103				Chapter 99		Chapter 125 Article XVI						Solar Energy Systems (Chapter 98), Vehicles, Junk (Chapter 112)
Town of Richford		Local Law No. 1 of 2019	Local Law 1 of 2004					Local Law 1 of 2012						Comprehensive Plan (2015), Junk Storage Law (2007)
Town of Spencer		Chapter 128	Chapter 117					Chapter 77						Junk and Junkyards (Chapter 87)
Town of Tioga								Local Law 1 of 2012						Junkyard Ordinance (amended 2004), Regulation of Windmills (Local Law 1 of 2010, Local Law 2 of 2017), Right to Farm (Local Law 1 of 2023)
Village of Candor					Local Law No. 1 of 2011 - designates a Critical Environmental Area for wellhead protection			Local Law No. 2 of 2012						

Municipality	Zoning Regulations	Subdivision Requirements	Site Plan Review/ Regulations	Design Standards*	Overlay Districts/ Wellhead Protection	Stormwater Management	Erosion and Sediment Control	Flood Damage Prevention/ NFIP	Wetland and Watercourse Protection	Environmental Quality Review	Historic Preservation	Natural Area Protection/ Land Use and Open Space Plans	Renewable Energy Goals	Other
Village of Newark Valley		Chapter 144	Chapter 130		Chapter 164 - Wellhead Protection			Chapter 83						Community Choice Aggregation Program (Chapter 78), Junkyards and Unlicensed Vehicles (Chapter 95), Trees and Shrubs (Chapter 154), Parks and Public Places (Chapter 112)
Village of Nichols			Local Law 1 of 2005		Local Law 1 of 2004 - Wellhead Protection			Local Law No. 1 of 2017						Junk Cars (Local Law 3 of 2011)
Village of Owego	Chapter 195	Chapter 175						Chapter 117			Chapter 126			Junked Vehicles (Chapter 190)
Village of Spencer			Local Law 1 of 2021, Local Law 2 of 2008					Local Law 1 of 2012						Community Choice Aggregation Program (Local Law 1 of 2018)
Village of Waverly	Chapter 153							Chapter 80						Trees (Chapter 137)

**Excludes NYS regulations*

Note: The jurisdictional annexes (Appendix A) also identify each municipality's applicable land use regulations.

In addition to the above local laws and regulations, many municipalities in Tioga County engage in community planning activities that support natural hazard mitigation, preparedness, and response. For example, the following communities were documented as having an emergency plan:

1. Town of Barton – Emergency Operations Plan
2. Town of Berkshire – Comprehensive Emergency Management Plan (2013)
3. Town of Candor – Emergency Plan (2023)
4. Town of Owego – Emergency Plan (2023)
5. Town of Tioga – Emergency Plan
6. Village of Newark Valley – Chapter 10 Emergency Disaster Plan (adopted 1981, revised 1993)
7. Village of Owego – Emergency Plan
8. Village of Spencer – Emergency Plan (2022)
9. Village of Waverly – Comprehensive Emergency Management Plan (2013)

The Tioga County Office of Emergency Services can be a key source of support and guidance for local municipalities that are developing or updating an emergency plan. If desired and appropriate, the emergency planning process can serve as an avenue for establishing or formalizing existing arrangements to share equipment and/or services between municipalities in the event of a natural hazard event. While not specific to hazard mitigation, this form of intermunicipal planning would help to address some of the preparedness and response capacity concerns raised during the hazard mitigation planning process.

5 HAZARD IDENTIFICATION AND RANKING

5.1 Introduction to Risk Assessment

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 (Section 5) —Use all available information to determine what types of hazards may affect a jurisdiction
- Hazard Profiling (Section 6) – Understand each hazard in terms of:
  - Description – what the hazard is
  - Location - geographic area most affected by the hazard
  - Extent – severity of each hazard
  - Impacts and Vulnerability – how the hazard affects the jurisdiction's people and property
  - Previous Occurrences, Losses, and Damages
  - Probability of Future Occurrence
- Identify Assets (Section 7) – Identify what is valuable to the County – for instance, people, economic activities, infrastructure, natural resources, historic and cultural resources – in order to understand who and what could be affected by these hazards
- Assess Overall Vulnerability (Section 8) – Understand the overall impacts of hazards to the assets identified in the jurisdiction, based on the sections above, and identify particular vulnerabilities of concern

The HMP Update excludes technological and human-caused hazards from the scope, due to the fact that mitigation projects related to such hazards are not eligible for mitigation grant funding through FEMA and will not be evaluated as part of the HMP. FEMA states that technological hazards and human-caused threats align more with a Threat and Hazard Identification and Risk Assessment (THIRA), as described in the Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) Guide (FEMA, 2018).

Tioga County is vulnerable to numerous natural hazards. The County conducted a County Emergency Preparedness Assessment (CEPA) analysis in 2020, which was facilitated by the NYS Division of Homeland Security and Emergency Services (NYS DHSES). During the CEPA update, the County ranked several natural and technological hazards. The 2020 CEPA (Tioga County, 2020), the National Risk Index (FEMA, 2023), the 2018 Tioga County Hazard Mitigation Plan Update (Tetra Tech, 2018), and the 2018 New York State Hazard Mitigation Plan (NYS DHSES and AVAIL, 2019) were used to inform natural hazard selection and ranking for the HMP update. Details regarding the natural hazards considered are provided within this section of the HMP.

5.2 Hazard Evidence Analyzed

5.2.1 Tioga County 2020 CEPA Results

Tioga County conducted a County Emergency Preparedness Assessment (CEPA) on October 14, 2020. This event updated the County's previous CEPA that was conducted in 2017. CEPA is a program that was developed by NYS DHSES to analyze hazard risks and the County's capabilities during emergency and disaster events. The hazard analysis completed during the CEPA was used to inform the County's risk and vulnerability assessment for the HMP update.

A number of natural hazards were evaluated during the 2020 CEPA update. The CEPA update also considered multiple technological or human-caused hazards, but these hazards were not considered further for the HMP update. The group analyzed all hazards determined to affect Tioga County. The CEPA rated each hazard based on the likelihood and consequence ranging from Very High (score of 5) to Very Low (score of 1). Likelihood and Consequence scores are multiplied to provide the overall risk ranking. The Risk Assessment scores are representative of the conversation that Tioga County had at this most recent CEPA session.

From the 28 hazards analyzed as part of the CEPA, eight natural hazards were chosen for profiling in the HMP update, and were further grouped into 4 categories: Flood, Drought, Severe Storm, and Extreme Temperatures. Four additional natural hazards included in the 2020 CEPA were not included in the HMP Update: animal disease/foreign animal disease, wildfire, landslides, and earthquakes. Animal disease/foreign animal disease did not align well with any of FEMA's natural hazard categories. Wildfire was not included because no instances of wildfire have occurred between 1950 and the time of writing of this HMP (NOAA National Centers for Environmental Information, 2023). Landslides and earthquakes were not included because they had a low likelihood and consequence.

The natural hazards listed in the CEPA report are presented in Table 4-1 below, along with their associated CEPA Likelihood and Consequence rankings and groupings in the HMP Update. These hazards were grouped into the Flood, Drought, Severe Storm, and Extreme Temperatures categories, along with additional sub-hazards as described in Section 5.2.4.

Table 5-1. Tioga County Hazard Selection for HMP Update

Hazard in CEPA (2020)	CEPA Likelihood Category (2020)	CEPA Consequence Category (2020)	Relative Risk Score	Category in 2024 HMP Update
Flooding	High	High	16 – High	Flood
Flash Flooding	High	High	16 – High	Flood
Severe Winter Snowstorms	High	High	16 – High	Severe Storm
Extreme Temperatures	High	High	16 – High	Extreme Temperatures
Animal Disease/Foreign Animal Disease	Very High	Medium	15 – High	Not Included
Severe Wind/Tornado (tornado rare)	High	Medium	12 – Medium	Severe Storm

Hazard in CEPA (2020)	CEPA Likelihood Category (2020)	CEPA Consequence Category (2020)	Relative Risk Score	Category in 2024 HMP Update
Wildfire	High	Medium	12 – Medium	Not Included
Drought	Medium	Medium	9 – Medium	Drought
Ice Storms (at least a 1/2 inch or more)	Low	High	8 – Medium	Severe Storms
Hurricanes/Tropical Storm (Wind and Surge)	Low	High	8 – Medium	Severe Storm
Landslides	Low	Low	4 – Low	Not Included
Earthquakes	Very Low	Low	2 – Low	Not Included

5.2.2 National Risk Index

The National Risk Index for Tioga County profiled the risk that 18 different hazards pose to the County's physical and agricultural assets (FEMA, 2023). According to the report, the County has a risk score of 74.1, which corresponds to Relatively Low. Tioga County's risk score is at the 74th percentile for the US and at the 69th percentile for New York, meaning that its risk score is higher than 74.1% of all census tracts in the nation and higher than 69.4% of the census tracts in New York (FEMA, n.d.). The rankings for the 18 hazards and their status in the HMP Update are provided in Table 5-2.

Table 5-2. Tioga County Natural Hazard Risk Rating and Score

Hazard	Risk Index Rating	Risk Index Score (as a percentile)	Included in 2024 HMP Update?
Riverine Flooding	Relatively High	97.2	Yes (under Flood)
Cold Wave	Relatively Moderate	71.9	Yes (under Extreme Temperatures)
Ice Storm	Relatively Moderate	62.1	Yes (under Severe Storm)
Hurricane	Very Low	58.2	Yes (under Severe Storm)
Heat Wave	Relatively Low	42	Yes (under Extreme Temperatures)
Tornado	Relatively Low	41.6	Yes (under Severe Storm)
Wildfire	Very Low	41.6	No
Drought*	Very Low	35	Yes (under Drought)
Landslide	Relatively Low	33.2	No
Hail	Very Low	32.5	Yes (under Severe Storm)
Strong Wind	Relatively Low	29	Yes (under Severe Storm)
Earthquake	Very Low	26.9	No
Lightning	Very Low	26.7	Yes (under Severe Storm)
Winter Weather	Very Low	5.5	Yes (under Severe Storm)
Avalanche	Not Applicable	N/A	No

Hazard	Risk Index Rating	Risk Index Score (as a percentile)	Included in 2024 HMP Update?
Coastal Flooding	Not Applicable	N/A	No
Tsunami	Not Applicable	N/A	No
Volcanic Activity	Not Applicable	N/A	No

**National Risk Index is based on Agricultural (crop only) impacts.*
Source: National Risk Index (FEMA, 2023).

5.2.3 Presidential Disaster Declarations

The President of the United States can make an emergency and/or major disaster declaration under the Stafford Act. If a natural disaster causes a severe amount of damage beyond the State and local government response capabilities, the Governor of the impacted State can request a major disaster declaration from the President. The request from the Governor must include an estimate of the amount and severity of damage to public and private sectors, a description of the State and local efforts and resources used to respond to the disaster, an estimate of the type and amount of Stafford Act assistance needed, and certification that the State and local governments will comply with all applicable cost sharing requirements. Counties typically have to meet a per capita threshold of damage that is set by the Federal government to be eligible for assistance. Major disaster declaration assistance generally provides three types of aid: Individual Assistance, Public Assistance, or Hazard Mitigation Assistance. Most declarations will provide either Individual or Public Assistance along with Hazard Mitigation Assistance.

Tioga County has been included in 22 Presidential Declared Disasters between 1954 (date of earliest records) and 2022. Five of these events occurred between 2018 and 2022. Details of these events are provided in Table 5-3.

Table 5-3. Federal Disaster Declarations Including Tioga County, 1954-2022

Disaster Number	Declaration Date	Incident Type	Title
DR-4625	10/8/2021	Severe Storm(s), Flood	Remnants of Tropical Storm Fred
DR-4480	3/20/2020	Biological	Covid-19 Pandemic
EM-3434	3/13/2020	Biological	Covid-19
DR-4472	12/19/2019	Severe Storm(s), Flood	Severe Storms, Straight-line Winds, and Flooding
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

Disaster Number	Declaration Date	Incident Type	Title
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

Sources: (Tetra Tech, 2018) (FEMA, 2023)

5.2.4 2018 HMP

The 2018 Tioga County Hazard Mitigation Plan Update profiled the following hazards:

- Flood, including riverine flooding, flash flooding, shallow flooding, ice jam flooding, and dam failure flooding
- Drought
- Severe Storm, including thunderstorms, hail, lightning, tornadoes, hurricanes, tropical storms, and Nor'Easters
- Severe Winter Storm, including heavy snowfall, blizzards, freezing rain/sleet, and ice storms

5.3 Hazards Selected

Based on the results from Tioga County's 2020 CEPA analysis, the National Risk Index, and Presidential Disaster Declarations, as well as Tioga County's 2018 HMP Update and the NYS 2019 HMP, as detailed above, members of the Tioga County HMP Steering Committee selected the hazards to be profiled in the 2024 HMP update. The hazards selected for profiling in the 2024 HMP Update are as follows:

- Flooding – Flooding includes but is not limited to 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.
- Drought – A drought is defined as a shortage of water from lack of rain over an extended period of time (NYS DHSES and AVAIL, 2019).
- Severe Storm – 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, lightning, hail, tornadoes, high winds, hurricanes, tropical storms, severe winter storms (such as heavy snowfall, blizzards, and ice storms), and any other storm event.
- Extreme Temperatures (Heat/Cold Wave) – The "Extreme Temperatures" category includes both heat waves and cold waves.

This selection includes hazards that are commonly recognized to affect the County, and includes consideration of the relative risks of the hazards, as discussed in Section 5.2. It excludes hazards which pose a low risk to the County, such as landslides, earthquakes, and wildfires. It also excludes technological and human-caused hazards, as discussed in Section 5.1.

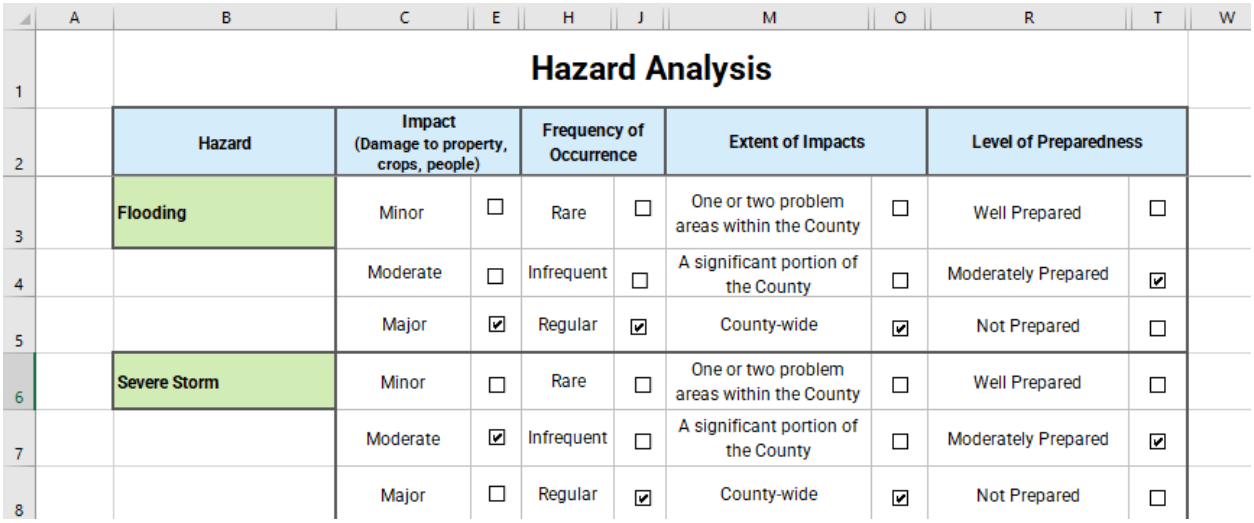
The Core Planning Group and Steering Committee maintained the grouping of hazards from the 2018 Tioga County HMP Update, with two changes: 1) The Severe Winter Storm category was folded into the Severe Storm category and 2) Extreme Temperatures was added as a category. These changes reflect the Core Planning Group and Steering Committee's desire to streamline the planning process for more targeted mitigation strategies, as well as concerns about climate change which will present new challenges due to extreme temperatures. Hazard groupings were based on the similarity of hazard events, their typical concurrence or their impacts, consideration of hazard grouping in the NYS HMP (NYS DHSES and AVAIL, 2019), and consideration of how hazards have been grouped in Federal Emergency Management Agency (FEMA) guidance documents (FEMA, 2023) (FEMA, 2001) (FEMA, 1997).

5.4 Hazard Ranking

Once the hazards were selected, the Steering Committee completed an updated hazard analysis in 2023 to rank the hazards selected for profiling in the HMP Update. A hazard analysis spreadsheet was created to assess the vulnerability of each municipality in Tioga County to various hazards (Figure 5-1). The hazard analysis table was organized by the hazards in rows and the criteria for ranking the vulnerability in columns.

For each hazard, four different criteria were analyzed: impact (damage to property, crops, and people), frequency of occurrence, extent of impacts, and level of preparedness. Each of the criteria have three ranking options for measuring their vulnerability. The options for the criteria are as follows: impact - minor, moderate, or major; frequency of occurrence - rare, infrequent, or regular; extent of impacts – one or two problem areas within the county, a significant portion of the county, or county-wide; and level of preparedness - well prepared, moderately prepared, or not prepared.

Figure 5-1. Snapshot of Tioga County Hazard Analysis Spreadsheet



	A	B	C	E	H	J	M	O	R	T	W
1		Hazard Analysis									
2		Hazard	Impact (Damage to property, crops, people)		Frequency of Occurrence		Extent of Impacts		Level of Preparedness		
3		Flooding	Minor	☐	Rare	☐	One or two problem areas within the County	☐	Well Prepared	☐	
4			Moderate	☐	Infrequent	☐	A significant portion of the County	☐	Moderately Prepared	☑	
5			Major	☑	Regular	☑	County-wide	☑	Not Prepared	☐	
6		Severe Storm	Minor	☐	Rare	☐	One or two problem areas within the County	☐	Well Prepared	☐	
7			Moderate	☑	Infrequent	☐	A significant portion of the County	☐	Moderately Prepared	☑	
8			Major	☐	Regular	☑	County-wide	☑	Not Prepared	☐	

As shown in Table 5-4Table 5-5, the ranking options for each criteria are all associated with a value of 1, 2 or 3. The lowest value (1) represents a low vulnerability and the highest value (3) represents a high vulnerability. The ranking options that have a value of 1 are minor, rare, one or two problem areas within the County, and well prepared. The ranking options with a value of 2 are moderate, infrequent, a significant portion of the County, and moderately prepared. The ranking options with a value of 3 are major, regular, County-wide, and not prepared.

Table 5-4. Hazard Analysis Criteria

Score	Impact (Damage to property, crops, people)	Frequency	Extent	Level of Preparedness	Total Score	Overall Vulnerability
1	Minor	Rare	One or two problem areas within the County	Well Prepared	4 to 5	Low
2	Moderate	Infrequent	A significant portion of the County	Moderately Prepared	6 to 8	Moderate
3	Major	Regular	County-wide	Not Prepared	9 to 12	High

After checking off the rank of each criteria for each hazard, the values that correspond to the ranking option are displayed in another table in the spreadsheet, as shown in Table 5-5. Based on the ranking options described above, each criteria for each hazard is assigned a value of either 1, 2, or 3. In addition, the table contains an overall vulnerability column as well as a jurisdiction rank column. The overall vulnerability column is the sum of all of the values for each specific hazard. If the overall total vulnerability score has a value of 4-5, the overall vulnerability is considered low. It is considered moderate vulnerability if the total score has a value of 6-8. If the overall vulnerability score has a value of 9-12, the vulnerability is

considered high. The jurisdiction rank column is numbered 1, 2, 3… to show which hazard events have the highest to lowest ranking, with a ranking of 1 being the highest and signifying a greater priority to the jurisdiction. The 2023 hazard analysis results for the County are summarized in Table 5-5.

Table 5-5. Hazard Vulnerability by Event for Tioga County

Hazard Event	Impact (Damage and Injuries)	Frequency of Occurrence	Extent of Impacts	Level of Preparedness	Overall Vulnerability	Jurisdiction Rank
Flooding	3	3	3	2	11 – High	1
Drought	2	2	3	3	10 – High	2
Severe Storm	2	3	3	2	10 – High	2
Extreme Temperatures (Heat/Cold Wave)	1	2	3	2	8 – Moderate	3

5.4.1 Comparison to Previous Plans

Table 5-6 provides a comparison of the hazard rankings for the HMP update alongside the 2018 HMP and 2020 CEPA hazard analyses. Technological and human-caused hazards are excluded, as this 2024 HMP Update focuses on natural hazards.

Table 5-6. Hazard Ranking Comparison

Hazard	Hazard Category	2018 HMP Rank	2020 CEPA Rank	2024 HMP Update Rank	Affected by Climate Change
Flooding	Natural	Medium	High	High	Yes
Drought	Natural	Medium	Medium	High	Yes
Severe Storm	Natural	Medium	Varies (Medium to High)	High	Yes
Extreme Temperatures (Heat/Cold Wave)	Natural	Not Evaluated	High	Moderate	Yes

6 HAZARD PROFILES

The natural hazards that were selected for profiling in the HMP Update are further detailed below. The following sections include a description of the hazard, geographic extent and frequency within Tioga County, historical occurrences and damage estimates, and the probability of future hazard events. Hazards are discussed in the order that they were categorized by the County, from highest to lowest.

Hazard event information was compiled from publicly available data from the National Oceanic and Atmospheric Administration National Climatic Data Center, or NCDC (NOAA National Centers for Environmental Information, 2023). The NCDC data incorporates damage estimates for many events. The NCDC damage estimates are subject to the NCDC disclaimer that while the National Weather Service makes an effort to use the best available information to document the occurrence of storms and other significant weather data, some information may be unverified. The National Weather Service (NWS) estimates damage costs using all available data, but property and crop damages listed for individual storms are considered broad estimates and total damages are often higher than those reported by the NCDC.

6.1 Flood

6.1.1 Description

Floods are natural events that occur when excess water from snowmelt, rainfall, or storm surges accumulates and overflows onto the banks and adjacent floodplains of waterbodies. As mentioned above, the "Flood" hazard includes riverine flooding, flash flooding, shallow flooding, ice jam flooding, and dam failure flooding.

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.

Several factors determine the severity of floods, including intensity and duration of rainfall, and topography of the watershed. A large amount of rainfall over a short time can result in flash flood conditions. Even a small amount of precipitation can result in flood events in

locations where the soil is already saturated or in areas with large amounts of impervious surfaces (i.e., large parking lots, roadways, or areas of high-density development). Topography and land cover also contribute to the severity of flood events. Runoff tends to be greater in areas with steep slopes with limited vegetative cover. The frequency of flood inundation depends on the climate, soil, and slope of a particular area.

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. For the purpose of this HMP and as indicated in the 2018 HMP Update, riverine, shallow, flash, ice jam, and dam failure flooding are the main flood types of concern for the County. These types of flood are further discussed below.

Riverine (Inland) and Flash Flooding

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

Flash floods are "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, 2009).

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 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 US and New York is not an exception. 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).

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, 2007). 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, 2018).

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, 2018).

High Hazard Potential Dams

According to the NYSDEC Division of Water Bureau and Flood Protection and Dam Safety, there are four 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:

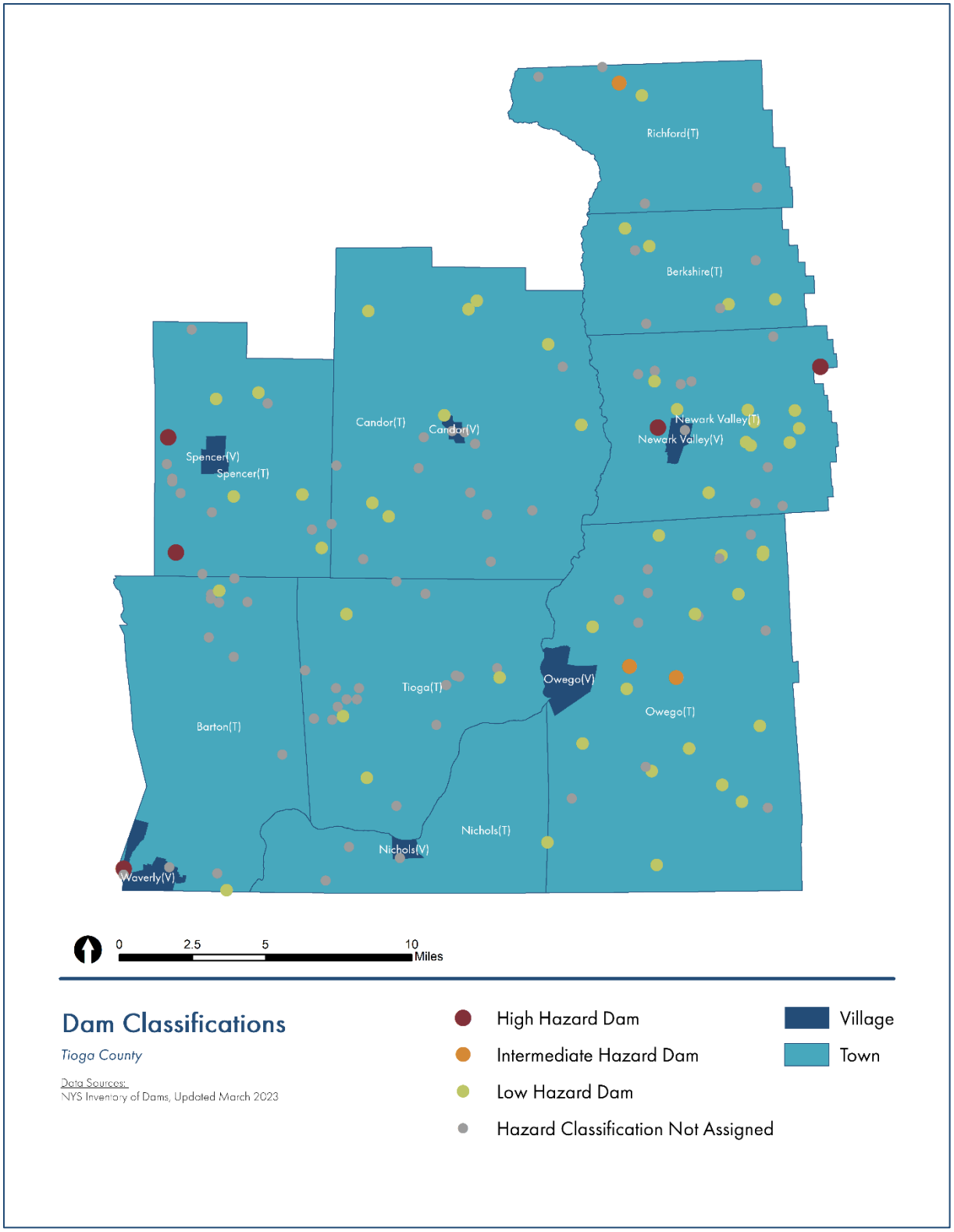
- Low Hazard (Class A) is a dam located in an area where failure is likely to damage nothing more than isolated buildings, undeveloped lands, or township or county roads and/or will cause no significant economic loss or serious environmental damage. Failure or operation problems would result in no probable 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 essential public utilities, and cause significant economic loss or serious environmental damage. Failure or operation problems would result in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. Class B dams 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; essential 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.
- 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. (NYSDEC Division of Water) (FEMA, 2004)

The New York State Inventory of Dams identifies 138 dams in Tioga County: 50 low hazard, 3 intermediate hazard, 5 high hazard, and 80 with an unknown classification (U.S. Army Corps of Engineers, 2023). Table 6-1 displays the High Hazard Potential Dams in Tioga County, and Figure 6-1 displays the dams in Tioga County and their classifications.

Table 6-1. High Hazard Potential Dams in Tioga County

Dam Name	Location	Owner	Year Completed	Construction Type	Purpose	Date of Last EAP Revision
Waverly Lower Reservoir Dam	Village of Waverly	Village of Waverly	1880	RE - Earth	Water Supply	Jan 31, 2013
Ed Pylkas Dam	Town of Spencer	Tioga County Soil and Water Conservation District	1955	RE - Earth	Flood risk reduction	March 31, 2013
Pelto Dam	Town of Spencer	Tioga County Soil and Water Conservation District	1955	RE - Earth	Flood risk reduction	March 19, 2020
Nanticoke Creek Site 7b Dam	Town of Newark Valley	Broome County - Broome County Department of Parks and Recreation	1970	RE - Earth	Flood risk reduction	Jan 14, 2020
Alexander Lake Dam	Town of Newark Valley	Newark Valley Central School District	1965	RE - Earth	Recreation	Aug 01, 2020

Figure 6-1. Dams in Tioga County



Source: NYS Inventory of Dams (March 2023)

Dams Outside Tioga County

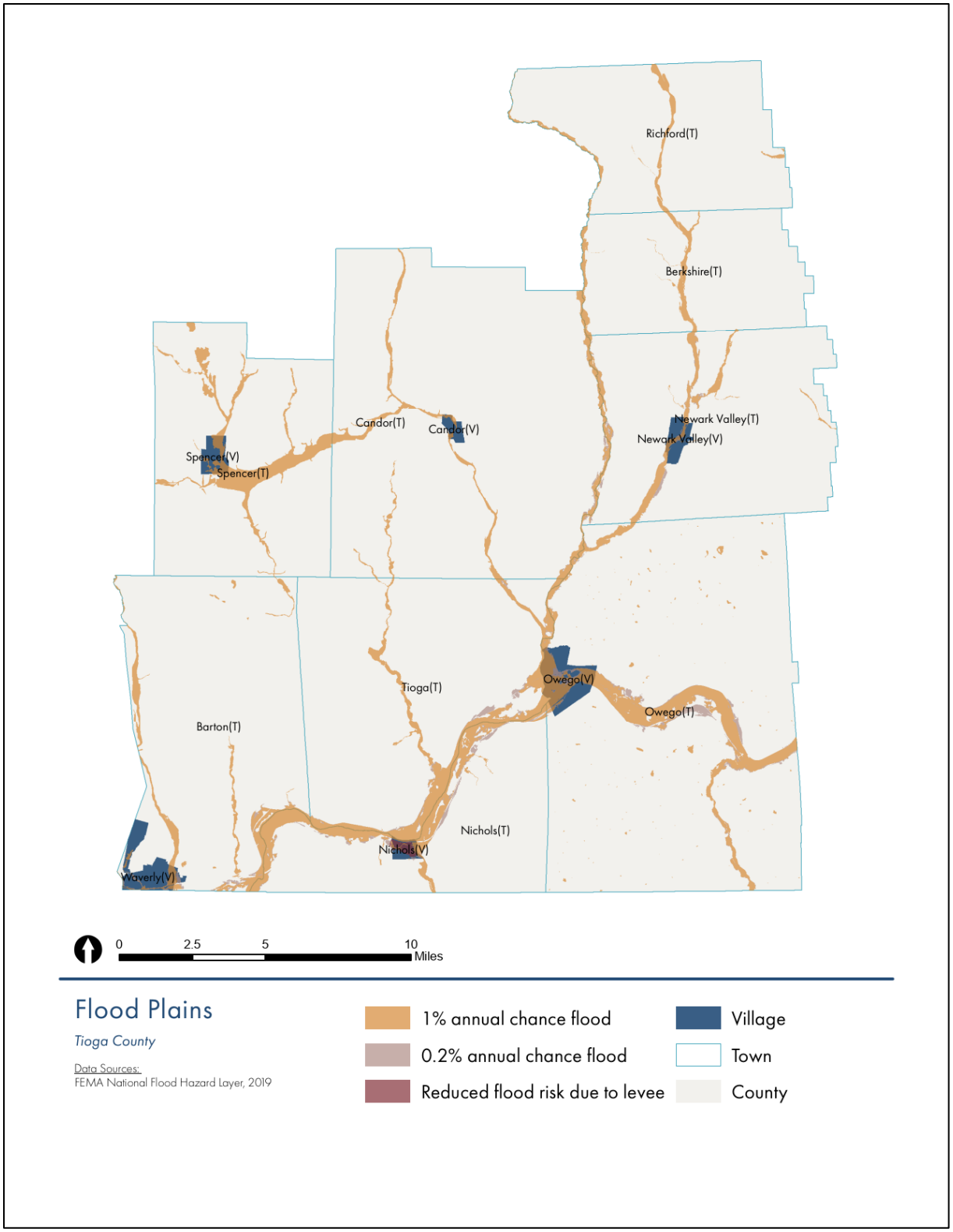
Dams outside of Tioga County also pose a flood concern. For example, if the East Sidney Dam in Delaware County were breached, it would likely flood Tioga County in a matter of hours. The County has an existing action to establish a stream gauge system to provide early alert of flooding, and has added the East Sidney Dam to this action. There are additional dams, such as one in Pennsylvania, that also pose a risk to the County.

6.1.2 Location

Several areas throughout Tioga County are located within the flood zones of the Susquehanna River as well as along various rivers and streams. The Villages of Waverly, Nichols, and Owego are partially located within floodplains of the Susquehanna River and are subject to significant flood risk. The Villages of Spencer, Candor, and Newark Valley are also subject to significant flood risk from various rivers and streams.

Mapped floodplains in Tioga County are shown in Figure 6-2. According to this figure, the 1% and 0.2% annual chance of flood hazard zones are located along the bodies of water located throughout the County. Approximately 6.10% of the County is in a mapped 1% annual chance flood event area, and 0.56% of the County is in a mapped 0.2% annual chance flood event area. Please refer to the Jurisdictional Annexes for information regarding specific areas of flooding for each participating municipality in Tioga County.

Figure 6-2. Floodplains in Tioga County



Data Source: FEMA National Flood Hazard Layer (2019)

6.1.3 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 (National Weather Service, 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.

100-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 special flood hazard area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. A structure located within an 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.

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, 2014). For details regarding the drainage basins in Tioga County, refer to Section 2.1.3.

6.1.4 Impacts and Vulnerability

According to the County's hazard analysis in Section 5.4, Tioga County is highly vulnerable to floods based on this hazard's major impact (high potential for damage to property, crops, and/or people), regular occurrence, large extent (county-wide extent of impacts), and moderate level of preparedness. This assessment is backed by additional information in Section 6.1. Among other impacts described in that section, floodwaters can inundate homes and businesses, disrupt utilities, and cause safety hazards and transportation delays. Table 6-2 shows the number and estimated structure value of parcels in the County that intersect 100-year and 500-year floodplains.

Table 6-2. Estimated Structure Value of Parcels within Mapped Floodplains in Tioga County

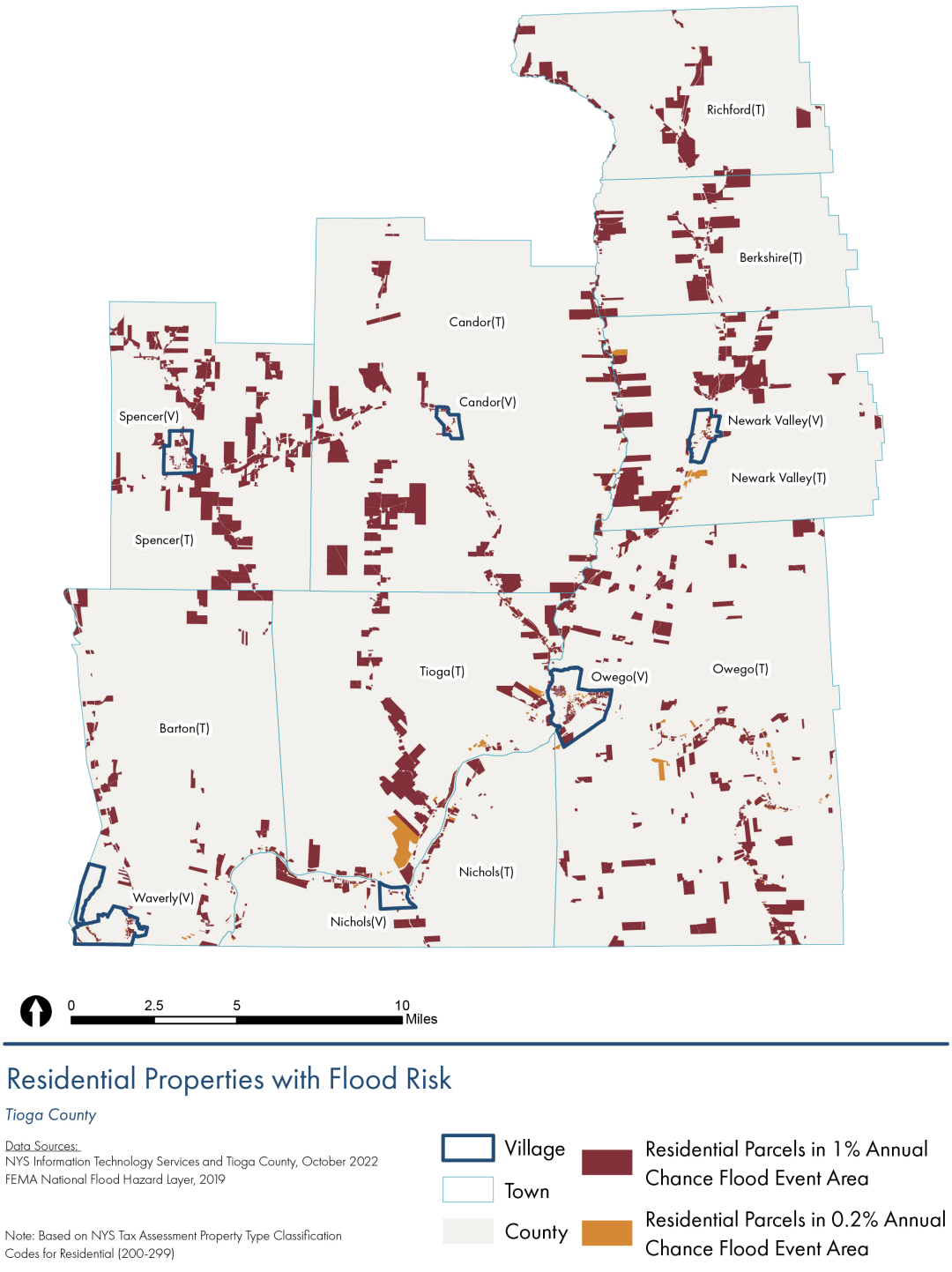
Property Class	Number of Parcels in 100-Year Floodplain	Approx. Structure Value* in 100-Year Floodplain	Number of Parcels in 500-Year Floodplain	Approx. Structure Value* in 500-Year Floodplain
Agricultural	267	9,153,760	88	2,165,210
Commercial	407	65,272,015	347	45,474,781
Community Services	99	109,979,900	62	69,302,600

Property Class	Number of Parcels in 100-Year Floodplain	Approx. Structure Value* in 100-Year Floodplain	Number of Parcels in 500-Year Floodplain	Approx. Structure Value* in 500-Year Floodplain
Industrial	41	84,710,410	32	84,386,610
Parks and Open Space	31	325,860	8	39,500
Public Services	71	92,909,311	44	38,409,647
Residential	2,818	162,602,521	1,279	62,910,071
Vacant	1,332	2,071,980	470	675,220
Recreation	49	13,730,800	27	10,920,500
Total	**5,115**	**540,756,557**	**2,357**	**314,284,139**

Note: Structure Value estimated by subtracting parcel Land Assessed Value from Total Assessed Value

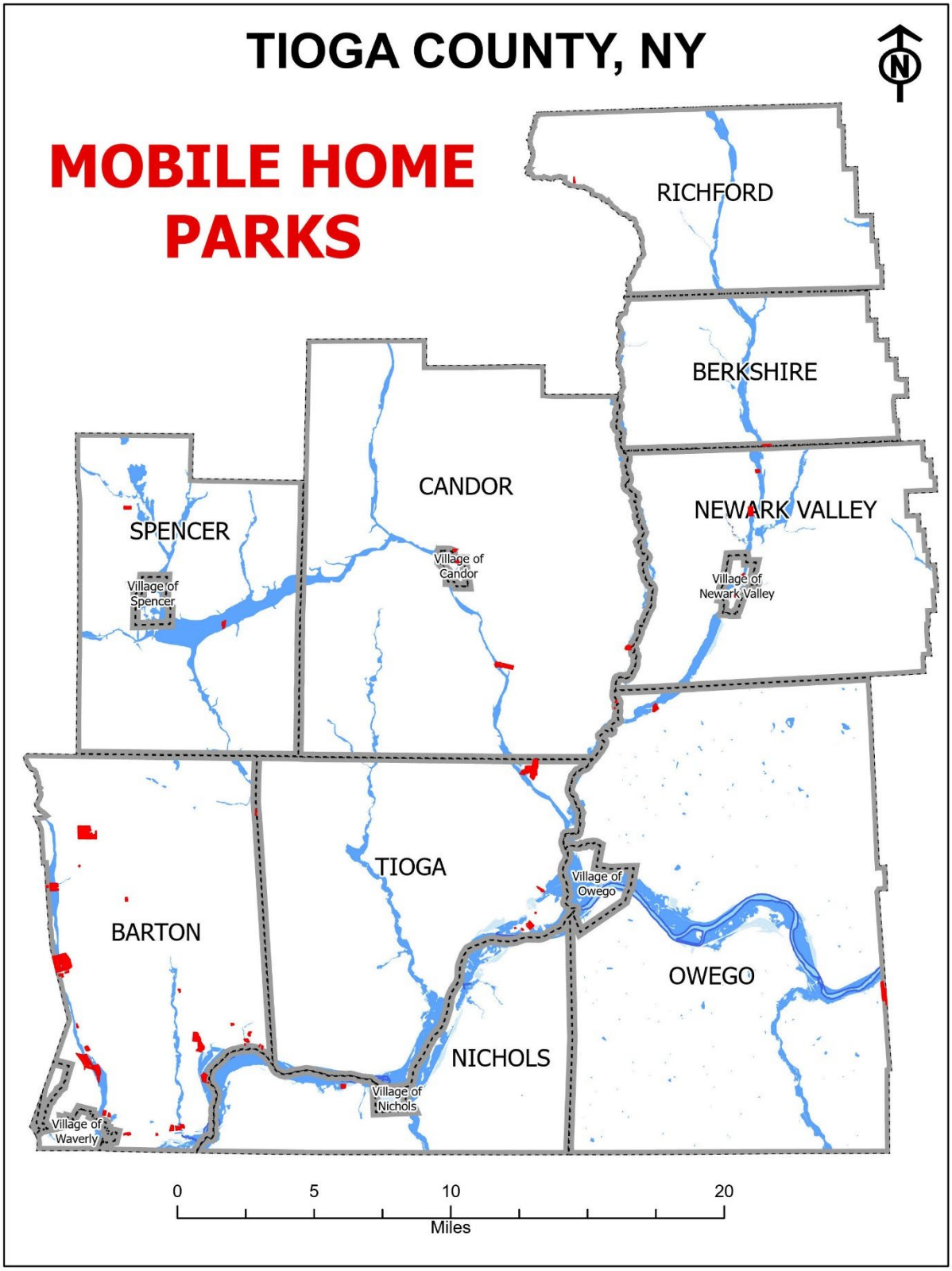
Residential parcels that are located within the 1% or 0.2% annual chance flood event area, based on the table above, are depicted in Figure 6-3. As depicted in Figure 6-4, mobile home parks in Tioga County are commonly located within or adjacent to the 1% or 0.2% annual chance flood event area.

Figure 6-3. Residential Properties with Flood Risk



Data sources: NYS ITS and Tioga County (October 2022) and FEMA NFHL (2019)

Figure 6-4. Mobile Home Parks and Floodplains



Data Source: Tioga County Department of Economic Development & Planning

The County's overall vulnerability to hazards in this Hazard Mitigation Plan Update is described in Section 8.

6.1.5 National Flood Insurance Program

Long-term mitigation of potential flood impacts can be best achieved through comprehensive floodplain management regulations and enforcement at a local level. The National Flood Insurance Program (NFIP), (regulated by FEMA), aims to reduce the impact of flooding on private and public structures by providing affordable insurance for property owners. The program encourages local jurisdictions to adopt and enforce floodplain management regulations in order to mitigate the potential effects of flooding on new and existing infrastructure (FEMA, 2023).

Communities that participate in the NFIP adopt floodplain ordinances. If an insured structure incurs damage costs that are over 50% of its market value, the owner must comply with the local floodplain regulations when repairing or rebuilding the structure. A structure could be rebuilt at a higher elevation, or it could be acquired and demolished by the municipality or relocated outside of the floodplain. Insured structures that are located within floodplains identified on FEMA's Flood Insurance Rate Maps (FIRMs) may receive payments for structure and content losses if impacted by a flood event.

The NFIP and other flood mitigation actions are important for the protection of public and private property and public safety. Flood mitigation is valuable to communities because it:

- Creates safer environments by reducing loss of life and decreasing property damage;
- Allows individuals to minimize post-flood disaster disruptions and to recover more quickly (homes built to NFIP standards generally experience less damage from flood events, and when damage does occur, the flood insurance program protects the homeowner's investment); and
- Lessens the financial impacts on individuals, communities, and other involved parties.

Tioga County Floodplain Mapping

In Tioga County, all municipalities' floodplains are mapped out in their entirety via FEMA's Flood Insurance Rate Map (FIRM) panels, which are the official flood maps utilized in the NFIP. For the entire County, these FIRM panels are also available in digital format for download and use in geographic information systems (GIS). FEMA floodplain mapping information and products, including those related to Tioga County, can be accessed via FEMA's Map Service Center and National Flood Hazard Layer (NFHL) ArcGIS Viewer: https://www.fema.gov/flood-maps/national-flood-hazard-layer.

Tioga County National Flood Insurance Program (NFIP) Participation

All 15 municipalities within Tioga County participate in the NFIP. None of the municipalities in Tioga County are Community Rating System eligible communities. The CRS is a voluntary incentive program that recognizes and encourages floodplain management activities at the community level. Flood insurance premiums are discounted in CRS communities to reflect the

reduced flood risk that results from community actions to meet the program goals: reduce flood loss, facilitate accurate insurance ratings, and promote flood insurance awareness (FEMA, 2023).

NFIP Policy and Claims Statistics

NFIP policy and claims data as of October 13, 2023 was provided by FEMA to support the development of this HMP. Table 6-3 summarizes the NFIP policy data, while Table 6-3 summarizes the NFIP claims data. Overall, the Village of Owego has the largest number of active policies (279) and the largest number of claims (704). Following the Village of Owego is the Town of Owego with the second largest number of policies (125) policies and the second largest number of claims (414). Specific information for each municipality is also summarized in each jurisdictional annex (Appendix A).

Table 6-3. NFIP Policy Statistics for Tioga County

Community Name	Number of Policies	Total Premium/Total Paid	Average of Total Premium/Total Paid
Barton, Town of	12	$14,776	$1,231
Berkshire, Town of	16	$17,481	$1,093
Candor, Town of	24	$23,803	$992
Candor, Village of	3	$2,434	$811
Newark Valley, Town of	11	$12,335	$1,121
Newark Valley, Village of	6	$6,036	$1,006
Nichols, Town of	35	$38,731	$1,107
Nichols, Village of	6	$4,054	$676
Owego, Town of	125	$187,550	$1,500
Owego, Village of	279	$476,698	$1,709
Richford, Town of	None reported	N/A	N/A
Spencer, Town of	17	$17,211	$1,012
Spencer, Village of	25	$23,205	$928
Tioga, Town of	26	$23,792	$915
Waverly, Village of	22	$32,708	$1,487
Unspecified	133	$260,384	$1,958
Total	**740**	**$1,141,198**	**$1,542**

Source: FEMA-provided data, October 13, 2023. Note: Records were organized based on the NFIP Community Book's Community ID and Name convention.

Table 6-4. NFIP Claims Statistics for Tioga County

Community Name	Number of Claims	Total Premium/Total Paid	Average of Total Premium/Total Paid
Barton, Town of	51	$1,215,047	$23,824
Berkshire, Town of	4	$2,030	$507
Candor, Town of	29	$214,043	$7,381
Candor, Village of	13	$483,248	$37,173
Newark Valley, Town of	14	$268,485	$19,178

Community Name	Number of Claims	Total Premium/Total Paid	Average of Total Premium/Total Paid
Newark Valley, Village of	18	$263,473	$14,637
Nichols, Town of	99	$2,976,675	$30,067
Nichols, Village of	4	$28,512	$7,128
Owego, Town of	414	$23,104,615	$55,808
Owego, Village of	704	$27,793,032	$39,479
Richford, Town of	2	$1,731	$866
Spencer, Town of	38	$650,655	$17,123
Spencer, Village of	15	$217,846	$14,523
Tioga, Town of	114	$3,403,660	$29,857
Waverly, Village of	13	$76,341	$5,872
Unspecified/Unknown	19	$498,088	$26,215.16
Total	**1551**	**$61,197,482**	**$39,457**

Source: FEMA-provided data, October 13, 2023. Note: Records were organized based on the NFIP Community Book's Community ID and Name convention.

Repetitive and Severe Repetitive Loss Statistics

According to FEMA, a repetitive loss structure is an NFIP-insured structure that has had at least two paid flood losses of more than $1,000 each in any 10-year period since 1978. In Tioga County, between 1983 and August 24, 2023, there have been a total of 803 repetitive losses spread between 319 properties, as shown below in Table 6-5. Based on the first loss for each property, 269 of these properties were single-family residential homes, 19 were two-four family residential homes, one was some other type of residential home, four were nonresidential businesses, and 26 were some other type of nonresidential use. Collectively, these properties have incurred payments totaling $34,605,771, with an average payment of $43,096 per loss. The majority of repetitive loss properties, total losses, and total payments have occurred within the Village of Owego, followed by the Town of Owego. Of the 319 repetitive loss properties, 34 are designated as severe repetitive loss properties.

Table 6-5. NFIP Repetitive Loss Statistics for Tioga County

Community Name	Number of Repetitive Loss Properties	Total Losses	Total Paid
Barton, Town of	6	22	$705,248
Berkshire, Town of	None reported	N/A	N/A
Candor, Town of	1	3	$94,792
Candor, Village of	None reported	N/A	N/A
Newark Valley, Town of	3	8	$197,105
Newark Valley, Village of	1	7	$135,025
Nichols, Town of	27	57	$1,908,370
Nichols, Village of	None reported	N/A	N/A
Owego, Town of	87	222	$13,862,231
Owego, Village of	163	409	$15,049,171
Richford, Town of	None reported	N/A	N/A
Spencer, Town of	6	12	$135,251

Community Name	Number of Repetitive Loss Properties	Total Losses	Total Paid
Spencer, Village of	2	6	$166,571
Tioga, Town of	21	52	$2,077,013
Waverly, Village of	None reported	N/A	N/A
Unspecified/Unknown	2	5	$274,993
Total	**319**	**803**	**$34,605,771**

Source: FEMA-provided data, August 24, 2023. Note: Records were organized based on the NFIP Community Book's Community ID and Name convention.

6.1.6 Historical Hazard Occurrences and Damage Estimates

Table 6-6 shows the flood events that the County has experienced between 2018 and 2022, and their estimated damages. Three flood events in that time period were given federal disaster declarations, as shown in Section 5.2.3.

Table 6-6. Flood Event Records, 2018-2022

Location	Event Type	Date	Magnitude	Estimated Property Damage	Estimated Crop Damage
Litchfield	Flash Flood	7/25/2018	N/A	$20,000	$0
Litchfield	Flash Flood	7/25/2018	N/A	$200,000	$0
Glencairn	Flash Flood	7/25/2018	N/A	$5,000	$0
Nichols	Flash Flood	8/14/2018	N/A	$15,000	$0
Owego	Flash Flood	8/14/2018	N/A	$10,000	$0
Apalachin	Flash Flood	8/14/2018	N/A	$25,000	$0
Apalachin	Flash Flood	8/14/2018	N/A	$12,000	$0
North Spencer	Flash Flood	9/18/2018	N/A	$20,000	$0
Litchfield	Flash Flood	9/18/2018	N/A	$8,000	$0
Tioga Center	Flash Flood	9/18/2018	N/A	$250,000	$0
Litchfield	Flash Flood	6/19/2019	N/A	$5,000	$0
Nichols	Flash Flood	10/31/2019	N/A	$25,000	$0
Owego	Flood	4/30/2020	N/A	$5,000	$0
Owego	Flood	4/30/2020	N/A	$0	$0
Owego	Flash Flood	12/24/2020	N/A	$5,000	$0
Barton	Flood	12/25/2020	N/A	$20,000	$0

Source: (NOAA National Centers for Environmental Information, 2023). There were no coastal flood events or lakeshore flood events listed.

According to the FEMA National Risk Index's Expected Annual Loss ($) Data, flooding is expected to cause $5,925,585.98 in annual total losses (FEMA, 2023).

HAZUS Overview

HAZUS was used as an additional tool to analyze potential damages to Tioga County from flooding. HAZUS is a nationally standardized, open-source, GIS-based risk modeling software developed by the Federal Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The HAZUS program is a multi-hazard loss estimation model capable of identifying areas that are vulnerable to a variety of natural hazards including floods, tsunamis,

hurricanes, and earthquakes. HAZUS can quantify and map risk vulnerability information including physical damages, economic losses, cost-effectiveness, and social impacts, and is a useful tool in hazard mitigation, recovery, preparedness, and response planning. HAZUS was utilized to assess what areas, infrastructure, and populations are most vulnerable to selected natural hazards using the flood modeling tool.

A HAZUS study region was developed for Tioga County, which consisted of approximately 523 square miles and included 1,617 census blocks. The region contains over 19,875 households with a total population of 48,430 according to the 2010 Census Bureau data utilized by the model. The model's building stock inventory estimates a total of 23,466 buildings in the region with a total replacement value of over $9.71 million, excluding building contents. Approximately 90.39% of the buildings and 63.81% of the building value included in the study area's building inventory are associated with residential housing. No additional user-defined infrastructure inventory data was added to the model.

Flood Model Methodology

The HAZUS flood model was set up using United States Geological Survey Digital Elevation Model (DEM) coverage for the study area, the extent and source of which are determined within HAZUS' model setup resources. Due to the geographic setting of the study region and the lack of coastal areas, the model was set up for riverine flood hazard analysis only. The study region's stream network was determined using the model's automated stream network development routine which utilized a user-defined drainage area of three square miles for stream density determination. The DEM coverage and developed stream network were processed by the model for riverine hydrologic analysis and floodplain extents. Following the establishment of the study region's hydrology and floodplains, the model was run to determine the physical, economic, and social impacts of flood events for the 100- and 500-year return periods. HAZUS analysis was run on the County-level, and model output represents Countywide damages, economic losses, and social impacts. The HAZUS flood model summary reports are provided in Appendix F.

HAZUS Flood Model Results

HAZUS estimates total economic annualized losses for buildings in Tioga County to be $1226.37 million and $1485.16 million for the 1% annual chance flood and 0.2% annual chance flood return periods, respectively. The HAZUS loss estimates are much greater than damages that have been reported with historic severe flood events. Direct economic annualized losses estimated for the 1% chance flood and 0.2% chance flood return periods are summarized below in Table 6-7, including capital stock losses of buildings and their contents, as well as associated income losses.

Table 6-7. HAZUS Flood Model: Direct Economic Annualized Losses for Buildings

Return Period	Capital Stock Losses (Millions of Dollars)			Income Losses (Millions of Dollars)				Total Loss (Millions of Dollars)
	Building Loss	Contents Loss	Inventory Loss	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	
1% Annual Chance Flood Event	158.48	302.50	25.45	97.83	143.88	457.28	40.95	$1226.37
0.2% Annual Chance Flood Event	211.51	384.27	39.09	117.21	168.15	515.20	49.74	$1485.16

HAZUS estimated the total debris generated from 1% annual chance and 0.2% annual chance flood events to be 7,772 tons and 11,040 tons, respectively. The estimated tonnage of debris generated from the 1% chance flood and 0.2% chance flood return periods are summarized in Table 6-8, including debris generated from building finishes, structure, and foundation.

Table 6-8. HAZUS Flood Model: Debris Generation

Return Period	Debris Generated (Tons)			
	Finishes	Structure	Foundation	Total Debris
1% Annual Chance Flood Event	6,156	598	1,018	7,772
0.2% Annual Chance Flood Event	8,596	978	1,466	11,040

HAZUS estimates the total population displaced from a 1% annual chance and 0.2% annual chance flood events to be 6,826 and 8,364 people, respectively. These results suggest that between 14.09% and 17.27% of the total study region population would be displaced as a result of a 1% annual chance flood event and 0.2% annual chance flood event. Within these displaced populations, some individuals will require short-term accommodation in temporary public shelters. HAZUS results indicate that between 1.39% and 1.56% of the study region population would require shelter as a result of a 1% chance and 0.2% chance flood event. A summary of the estimated number of displaced persons and persons requiring short-term shelter for each flood return period is provided in Table 6-9.

Table 6-9. HAZUS Flood Model: Shelter Requirements

Return Period	Persons Seeking Short-Term Shelter (and percentage of total County population)	Displaced Population (and percentage of total County population)
1% Annual Chance Flood Event	674 (1.39%)	6,826 (14.09%)
0.2% Annual Chance Flood Event	755 (1.56%)	8,364 (17.27%)

HAZUS estimates the direct economic losses for wastewater utilities to be $124.18 and $151.12 in millions of dollars for the 1% annual chance flood and 0.2% annual chance flood return periods, respectively. HAZUS estimates the direct economic losses for highway bridges to be $44,420 and $95,130 in thousands of dollars for the 1% annual chance and 0.2% annual chance flood return periods, respectively. The direct economic loss reports for transportation and utilities along with other HAZUS model output summary reports are provided in Appendix F.

6.1.7 Future Potential Impacts and Relation to Climate Change

Probability of Future Events

Based on the Tioga County CEPA Results, the National Risk Index, previous Presidential Disaster Declarations, Hazard Identification and Ranking, and Historical Hazard Occurrences, the County's overall vulnerability to a flood remains high. According to the NOAA National Climate Data Center (NCEI) and the CRREL database, Tioga County experienced 71 flood events between 1950 and 2022, including 37 floods, 29 flash floods, 5 ice jams, and no dam failures. The table below shows these statistics, as well as the annual average number of events and the probability of these individual flood hazards occurring in Tioga County in future years, if there are no other changes (NOAA National Centers for Environmental Information, 2023) (Ice Jam Engineering Research Group, 2023).

The probabilities are calculated using the formula P = e / (e + y - 1) *100% where P is the probability of one or more of a given type of event occurring in a given year (e.g. the probability that there would be at least one ice jam in 2022), e is the total number of events over a given number of years (e.g. 1950-2022), and y is the number of years (e.g. 72 years between 1950 and 2022). In these probability calculations, the simplifying assumption has been made that these events are independent of each other (i.e. that the events are not related to one another). This assumption could be incorrect if, for example, an ice jam occurred and then later caused a different flood event when it melted.

Table 6-10. Probability of Future Occurrence of Flooding Events Given No Other Changes

Hazard Type	Number of Occurrences between 1950 and 2022	Rate of Occurrence or Annual Number of Events (Average)	Recurrence Interval (in years) (# Years/Number of Events)	Probability of Event in Any Given Year (%)
Flash Flood	37	.513	1.945	34.3%
Riverine Flood	29	.402	2.482	29.0%
Dam Failure	0	0	0	0.0%
Ice Jams	5	.069	14.4	6.6%
ALL FLOODS	**71**	**.986**	**1.014**	**50.0%**

Note: Probability listed is based on 1950-2022 data only. The actual probability may differ; for example, the actual probability of dam failure is greater than 0%.

As mentioned, the table above displays the probability of future events if there are no other changes; it is solely based on historical probability. However, the County's future vulnerability to flooding can be impacted by several factors, including land use changes, population changes, mitigation actions, and climate change. For example, future developments may affect where flooding occurs. Development trends are described in Section 0 and a list of recent developments is contained in each jurisdictional annex (Appendix A). Increases in population may lead to additional development pressures in the floodplain (potentially increasing vulnerability), while decreases in population may lead to more vacant properties and less development pressure in the floodplain. Additionally, the County and its jurisdictions proposed numerous flood-related mitigation actions, such as upgrades to culverts, updates to municipal regulations that impact flooding, and nature-based flood mitigation solutions. Once implemented, these projects will reduce the County's overall vulnerability to flood damages. These actions are further described in the jurisdictional annexes (Appendix A). Climate change may also impact the County's vulnerability to flooding, as described below.

Relation to Climate Change

Climate change is expected to increase the future vulnerability of the County to flood events, by slightly increasing the severity and frequency of flooding, and flooding additional locations. Based on the U.S. Global Change Research Program's Climate Mapping For Resilience and Adaptation tool (U.S. Federal Government, 2022), it is predicted that Tioga County will experience slightly fewer wet days, but slightly more heavy precipitation events by mid-century. Specifically, the County may experience 3.3 to 4.2 fewer days per year with any precipitation by mid-century (2035-2064), compared with 1976-2005, according to mid-level projections. However, the County may experience 5.8 to 6.3 days per year that exceed 99th percentile precipitation by mid-century, compared to 4.5 days per year from 1976-2005, according to mid-level predictions. These days that exceed the 99th percentile precipitation will result in an increase in flooding. Locations of flood events would also expand when there are more severe floods; for instance, more locations in the 1% annual chance flood event area may experience flooding on a more regular basis, and areas that are nearby the 1% annual chance flood event area may also experience flooding. The types of flooding may not change significantly, except that the increase in average temperatures caused by climate change may lead to less ice buildup and less ice jam flooding.

More generally, with the anticipated increase in severe storms due to climate change, heavy precipitation and associated flash floods will likely become more common (Horton, 2014). The annual average amount of precipitation is projected increase, resulting in a rise in the frequency and severity of flash flooding events in New York State (Rosenzweig, 2011). Increased winter precipitation could lead to more winter floods, especially if the ground is frozen and less permeable. In addition, rising air and water temperatures would cause ice and snow to melt more rapidly, which could cause more frequent flooding during the winter and early spring months.

6.2 Drought

6.2.1 Description

A drought is defined as a prolonged period of limited precipitation affecting the supply and quality of water. Five types of droughts are recognized:

- Meteorological droughts are caused by a lack of precipitation that leads to dry conditions;
- Hydrological droughts are caused by changes in surface and groundwater supplies, and the effects of these events can persist for multiple years;
- Agricultural droughts relate to impacts to crops, forestry, and/or livestock caused by meteorological and hydrological droughts;
- Socioeconomic droughts reflect water shortages that adversely impact the population at both small and large scales; and
- Ecological droughts are deficits in water supplies that create multiple stresses across ecosystems (National Drought Mitigation Center, 2023).

The U.S. Drought Monitor classifies droughts in five different categories based on severity, ranging from abnormally dry (D0), to exceptional droughts (D4) (shown in Figure 6-5). Droughts are most commonly characterized using the Palmer Drought Severity Index (also provided in Figure 6-5).

Figure 6-5. Drought Classification

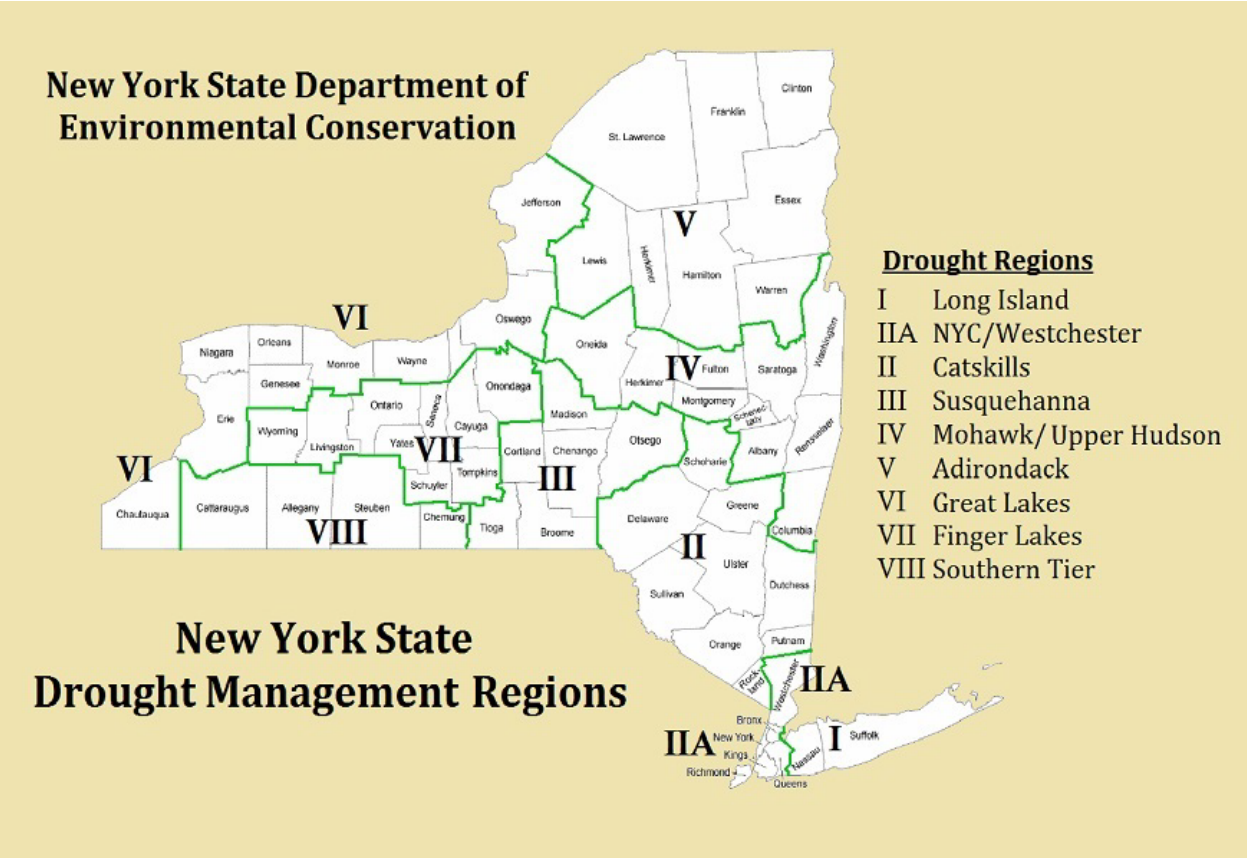
			Ranges				
Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: • short-term dryness slowing planting, growth of crops or pastures Coming out of drought: • some lingering water deficits • pastures or crops not fully recovered	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7	21 to 30
D1	Moderate Drought	• Some damage to crops, pastures • Streams, reservoirs, or wells low, some water shortages developing or imminent • Voluntary water-use restrictions requested	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20
D2	Severe Drought	• Crop or pasture losses likely • Water shortages common • Water restrictions imposed	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	• Major crop/pasture losses • Widespread water shortages or restrictions	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9	3 to 5
D4	Exceptional Drought	• Exceptional and widespread crop/pasture losses • Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0 to 2	0 to 2	-2.0 or less	0 to 2

6.2.2 Location

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. 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, 2023). Figure 6-6 shows the drought regions of New York State. Tioga County is located within the Susquehanna Drought Region (Region III).

Figure 6-6. NYS Drought Management Regions



6.2.3 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. The NYSDEC and the New York State Drought Management Task Force identify 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 (NYSDEC, 2023).

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).

6.2.4 Impacts and Vulnerability

According to the updated hazard analysis in Section 5.4, Tioga County is highly vulnerable to a drought based on this hazard's moderate impact (moderate potential for damage to property, crops, and/or people), infrequent occurrence, large extent (county-wide extent of impacts), and low level of preparedness. This assessment is backed by additional information in Section 6.2.

In Tioga County, droughts are more likely to adversely impact residents who rely on private wells for their drinking water, as well as agricultural properties. The rural portions of the County, particularly expansive agricultural areas and/or areas that lack access to public water, would be most susceptible to drought impacts. Farms that do not have local irrigation systems are more likely to experience negative effects from drought conditions. Municipalities in Tioga County that are partially or wholly supplied by public water systems are summarized in Section 7.3.2; overall, many residents rely on private drinking water sources.

The County's overall vulnerability to hazards in this Hazard Mitigation Plan Update is described in Section 8.

6.2.5 Historical Hazard Occurrences and Damage Estimates

Tioga County experienced no drought events between 2018 and 2022, according to the NOAA Storm Events Database (NOAA National Centers for Environmental Information, 2023). According to the FEMA National Risk Index's Expected Annual Loss ($) Data, droughts are expected to incur no annual losses, based on recent historical data (FEMA, 2023). However, as discussed in Section 6.2.6, there have been some drought events since 1950, and droughts could occur in the future and cause damages.

6.2.6 Future Potential Impacts and Relation to Climate Change

Probability of Future Events

Based on the Tioga County CEPA Results, the National Risk Index, previous Presidential Disaster Declarations, Hazard Identification and Ranking, and Historical Hazard Occurrences, the County's overall vulnerability to a drought remains moderate. According to the NOAA National Climate Data Center (NCEI) Tioga County experienced seven drought events between 1950 and 2022. The table below shows these statistics as well as the annual average number of

events and the percent chance of drought events occurring in Tioga County in future years (NOAA National Centers for Environmental Information, 2023).

The probabilities are calculated using the formula P = e / (e + y - 1) *100% where P is the probability of one or more of a given type of event occurring in a given year (e.g. the probability that there would be at least one drought in 2022), e is the total number of events over a given number of years (e.g. 1950-2022), and y is the number of years (e.g. 72 years between 1950 and 2022). In these probability calculations, the simplifying assumption has been made that these events are independent of each other (i.e. that the events are not related to one another). This assumption could be incorrect if, for example, two drought events occurred in a single summer but were caused by the same weather patterns (such as an El Niño year causing unusually high temperatures).

Table 6-2. Probability of Future Occurrence of Drought Events Given No Other Changes

Hazard Type	Number of Occurrences between 1950 and 2022	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/Number of Events)	Probability of Event in Any Given Year (%)
Drought	7	.097	10.28	9.0%

Note: Probability listed is based on 1950-2022 data only. The actual probability may differ.

As mentioned, the table above displays the probability of future events if there are no other changes; it is solely based on historical probability. However, the County's future vulnerability to drought events can be impacted by several factors, including land use changes, population changes, mitigation actions, and climate change. For example, a decrease in the amount of agricultural operations in a given area or less water-intensive operations may lead to fewer strains on the water system during times of drought. This could decrease the severity of a drought. A significant increase in population in a given area could put more strain on the water system, increasing the severity and frequency of droughts. The use of water-saving techniques, as is included in some jurisdictions' mitigation actions, could decrease the severity of a drought. Climate change may also impact droughts, as described below.

Relation to Climate Change

Climate change is expected to increase the future vulnerability of the County to drought events. Properties that rely on private wells (particularly those that are vulnerable to supply issues) and agricultural areas are particularly likely to be impacted by a drought in the future. The frequency of droughts in New York State, particularly short-duration events occurring in the late summer months, is expected to increase in the future due to projected temperature increases associated with climate change (Horton et al, 2014).

Specifically, based on the U.S. Global Change Research Program's Climate Mapping For Resilience and Adaptation tool, it is predicted that Tioga County will experience slightly more dry days (U.S. Federal Government, 2022). The county may experience 3.3 to 4.2 more days per year with no precipitation by mid-century (2035-2064), compared with 1976-2005, according to mid-level projections. Maximum consecutive dry days increase by 0.4 to 0.5 days per year for the same time period, based again on mid-level projections.

Additionally, changes in precipitation may affect the groundwater supply. As mentioned above, climate change predictions indicate that Tioga County will experience slightly more heavy precipitation events, as well as more dry days. If all else is equal, then if the same volume of water falls as heavy precipitation events, rather than more frequent lighter precipitation events, more water will run off into streams and lakes. Consequently, less water will enter the ground and recharge the aquifers. This would lead to a reduced water supply that can be utilized during droughts (NYSDEC, 2023).

6.3 Severe Storm

6.3.1 Description

As described above, for the purpose of this HMP update, "Severe Storm" includes thunderstorms, lightning, hail, tornadoes, high winds, hurricanes, tropical storms, severe winter storms (such as heavy snowfall, blizzards, and ice storms), and any other storm event.

Thunderstorms

A thunderstorm is a local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder (National Weather Service, 2009). 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 to generate 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, large hail one inch (quarter size) in diameter or larger, or tornadoes.

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 US, 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, killing approximately 50 people and injuring hundreds each year.

Hailstorms

Hailstorms are often associated with severe thunderstorms. Hailstorms are characterized by balls or irregularly shaped lumps of ice greater than 0.75 inches in diameter that fall with rain. Peak periods for hailstorms are late spring and early summer, the time of year when the jet stream migrates northward across the US. Hailstorms can cause extensive crop damage, particularly to herbaceous and long-stemmed crops. Severe hailstorms can also cause damage to buildings, automobiles, and aircraft, but rarely cause fatalities or serious injury. Hailstorms are categorized on the TORRO Hailstorm Intensity Scale (TORRO, 2022), which is provided in Table 6-11.

Table 6-11. TORRO Hailstorm Intensity Scale

Intensity Category		Typical Hail Diameter (mm)	Probable Kinetic Energy, J-m2	Typical Damage Impacts
H0	Hard Hail	5	0-20	No Damage
H1	Potentially Damaging	5-15	>20	Slight general damage to plants, crops
H2	Significant	10-20	>100	Significant damage to fruit, crops, vegetation
H3	Severe	20-30	>300	Severe damage to fruit and crops. Damage to glass and plastic structures, paint, and wood scored
H4	Severe	25-40	>500	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-50	>800	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-60	-	Bodywork of grounded aircraft dented, brick walls pitted
H7	Destructive	50-75	-	Severe roof damage, risk of serious injuries
H8	Destructive	60-90	-	Severe damage to aircraft bodywork
H9	Super Hailstorms	75-100	-	Extensive structural damage. Risk of severe of even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100	-	Extensive structural damage. Risk of severe of even fatal injuries to persons caught in the open

Source: (TORRO, 2022)

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 leads to widespread power outages

and damaging residential and commercial structures throughout Tioga County. High winds are often associated with other severe weather events such as thunderstorms, tornadoes, hurricanes, and tropical storms.

Tornadoes

Tornadoes are one of 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) (National Weather Service, 2009).

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. A hurricane is a tropical storm that attains hurricane status when its wind speed reaches 74 or more miles an hour (National Weather Service, 2009).

Severe Winter Storms

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 are 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. For example, 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.

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 (National Snow and Ice Data Center, 2013).

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).

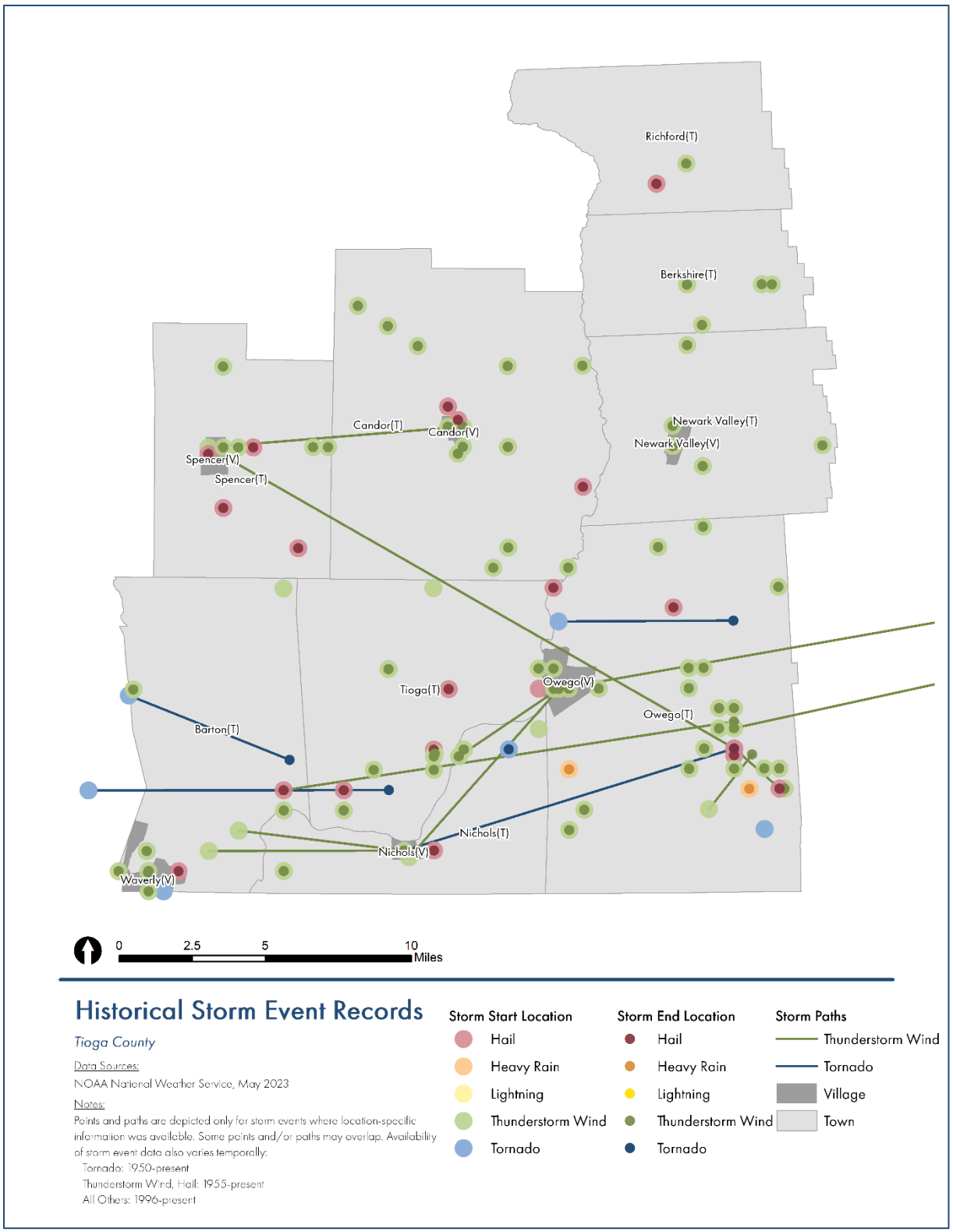
Ice Storms

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 (National Weather Service, 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 (National Weather Service, 2009).

6.3.2 Location

Figure 6-7 depicts the locations and types of severe storms in Tioga County. Additional information is included in each of the subsections below.

Figure 6-7. Historical Storm Event Records in Tioga County



Data Source: NOAA National Weather Service (May 2023)

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 US, 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).

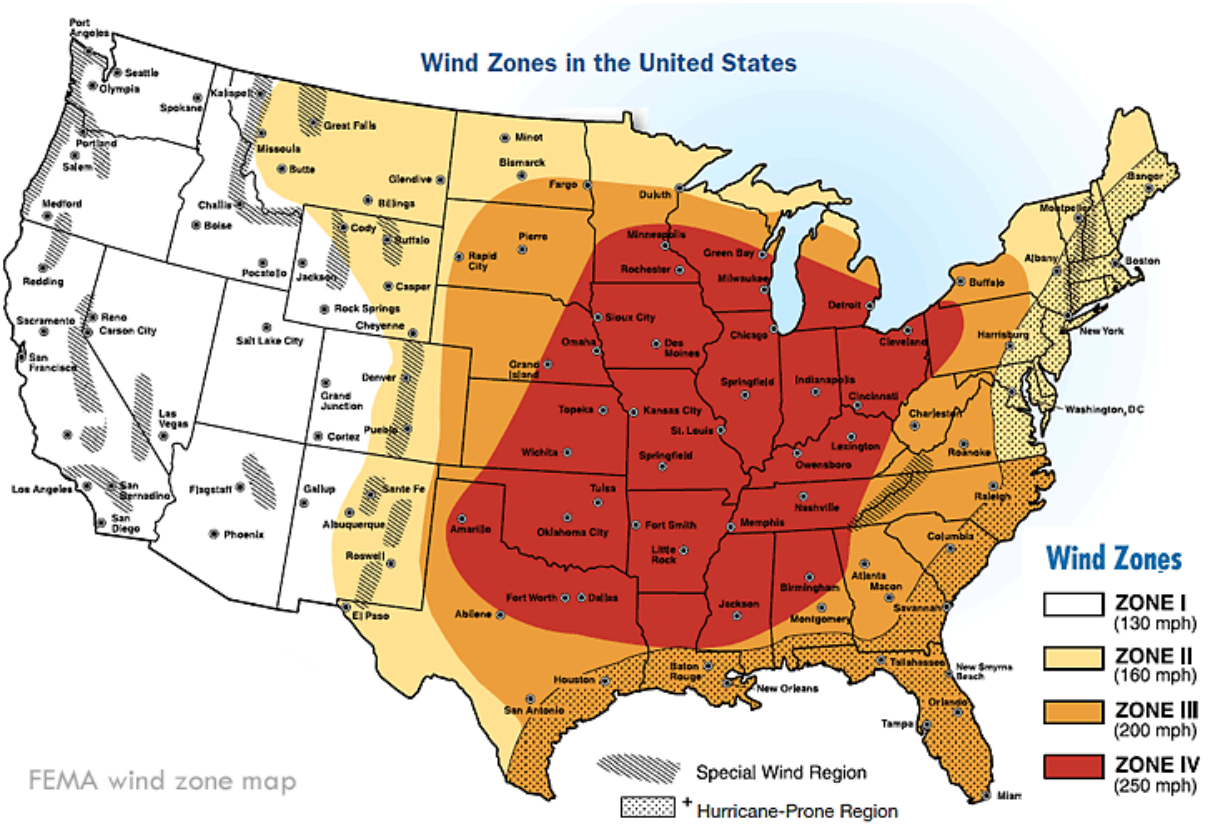
Hailstorms

Hailstorms are most frequent in the southern and central plains States in the US, where warm moist air off of the Gulf of Mexico and cold dry air from Canada collide, thereby spawning violent thunderstorms. This area of the US 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.

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. Figure 6-8 indicates how the frequency and strength of windstorms impact 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 6-8. FEMA Wind Zone Map of the United States



Data Source: (FEMA, 2014)

Tornadoes

Tornadoes have been documented in every state in the US and on every continent except Antarctica. Approximately 1,200 tornadoes occur in the US 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 (National Severe Storms Laboratory, 2013).

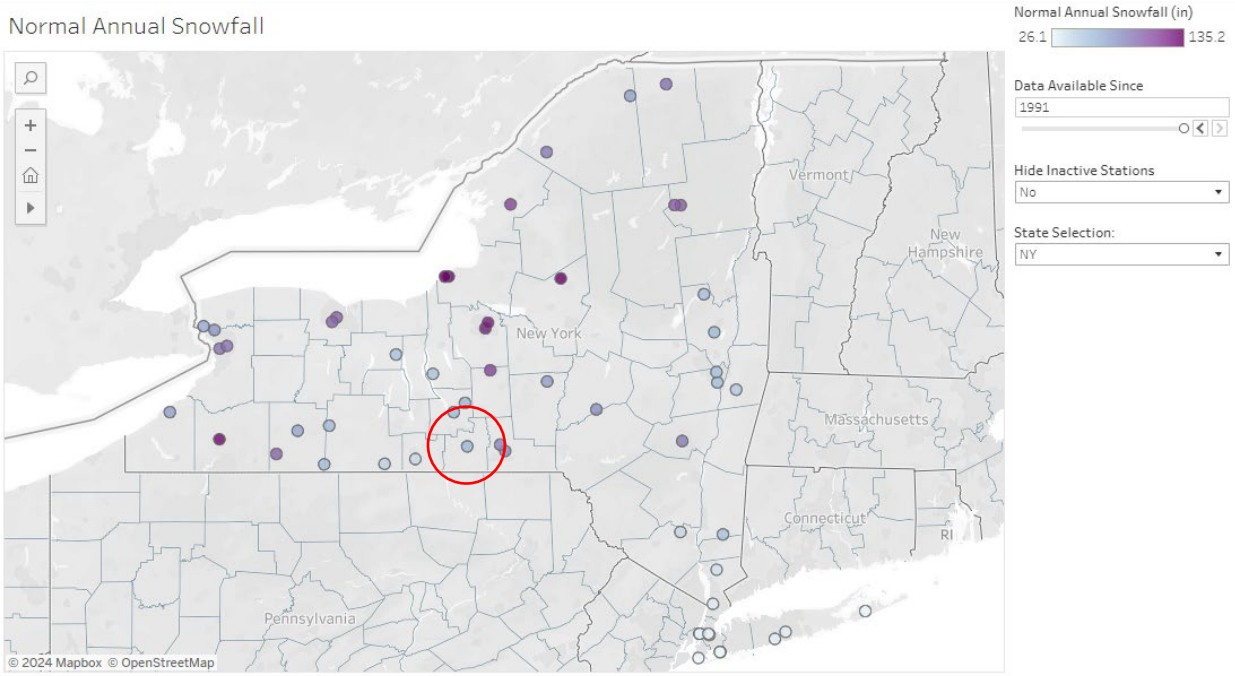
Tropical Storms/Hurricanes

Tropical storms and hurricanes can impact New York State from June to November, the official eastern US 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, as experienced during Hurricane Irene and Tropical Storm Lee in August and September 2011.

Severe Winter Storms

There is a wide variation in annual snowfall amounts across the different regions of the New York State. Based on a weather station in Candor, NY, Tioga County received an average of 64 inches of snow per year between 1991 and 2020, as shown in Figure 6-9.

Figure 6-9. Annual Average Snowfall in New York State, 1991-2020



Note: Tioga County is circled in red.
Source: Purdue University Midwestern Regional Climate Center Snowfall Climatology Toolbox

6.3.3 Extent

Specific details regarding the extent and frequency of each type of severe storm event considered are provided below.

Thunderstorms and Lightning

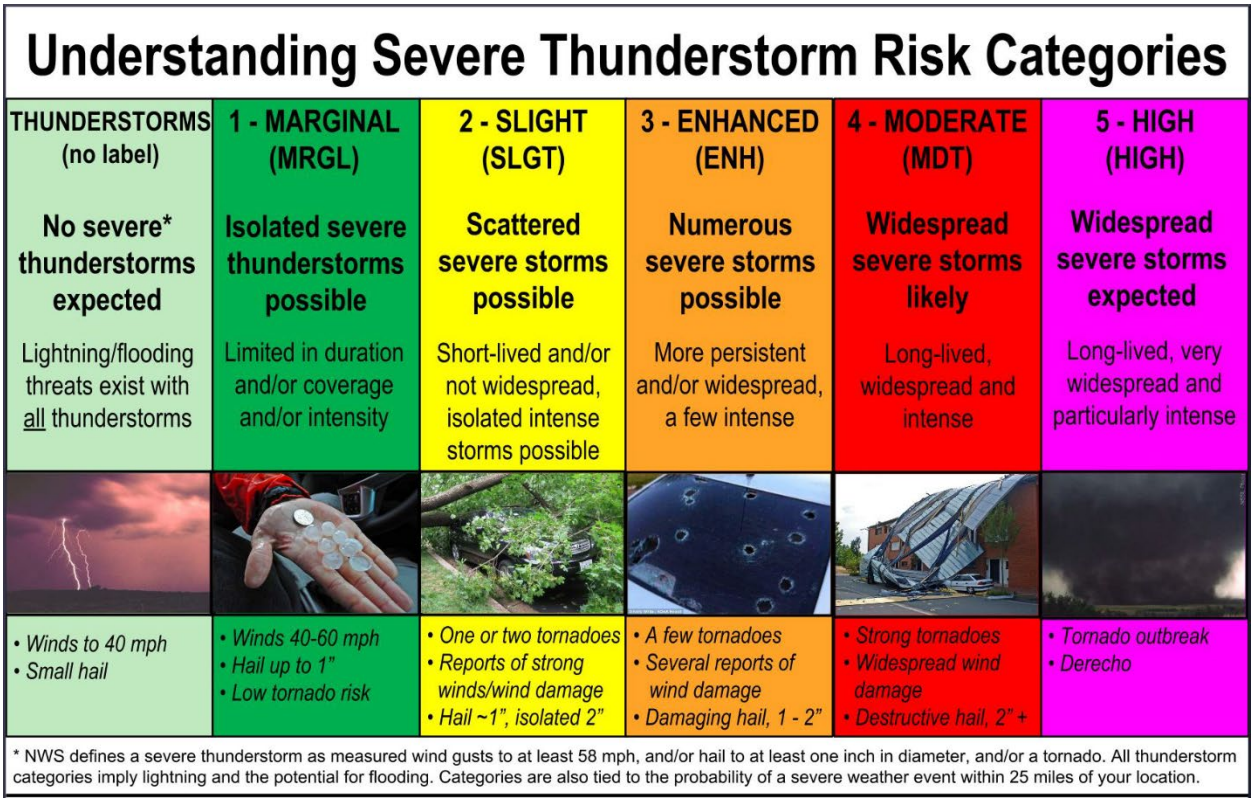
Severe thunderstorm watches and warnings are issued by the local NWS office and SPC. The NWS and SPC will update the watches and warnings and will notify the public when they are no longer in effect. Watches and warnings for tornadoes in New York State are as follows:

- 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 (National Weather Service, 2009) (National Weather Service, 2010).

- 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 canceled (National Weather Service, 2009) (National Weather Service, 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 (National Weather Service, 2010).

Figure 6-10. Severe Thunderstorm Risk Categories



Source: (NOAA SPC, 2017)

Hailstorms

The severity of hail is measured by duration, hail size, and geographic extent. All of these factors are directly related to thunderstorms, which create 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 6-12 shows the different sizes of hail and the comparison to real-world objects.

Table 6-12. Hail Size

Hail Diameter Size (Inches)	Description
1/4	Pea Size
1/2	Mothball, Peanut, USB Plug
3/4	Penny Size
7/8	Nickel Size
1	Quarter Size
1 1/4	Half Dollar Size
1 1/2	Ping Pong Ball Size
1 3/4	Golf Ball Size
2	Lime or Medium-Sized Hen Egg
2 1/2	Tennis Ball Size
2 3/4	Baseball Size
3	Large Apple
4	Softball
4 1/2	Grapefruit

Source: (National Weather Service, 2017)

High Winds

Table 6-13 provides the descriptions of winds used by the National Weather Service during wind-producing events.

Table 6-13. 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
Light or light and variable wind	5-15 or 10-20
None	0-5

Note: 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 are 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 for 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 when widespread damages are possible.
- Wind Advisories are issued when sustained winds of 30 to 39 mph are forecast for one hour or longer or for 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 6-11 illustrates the relationship between EF ratings, wind speed, and expected tornado damage.

Figure 6-11. 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: (National Weather Service, 2011)

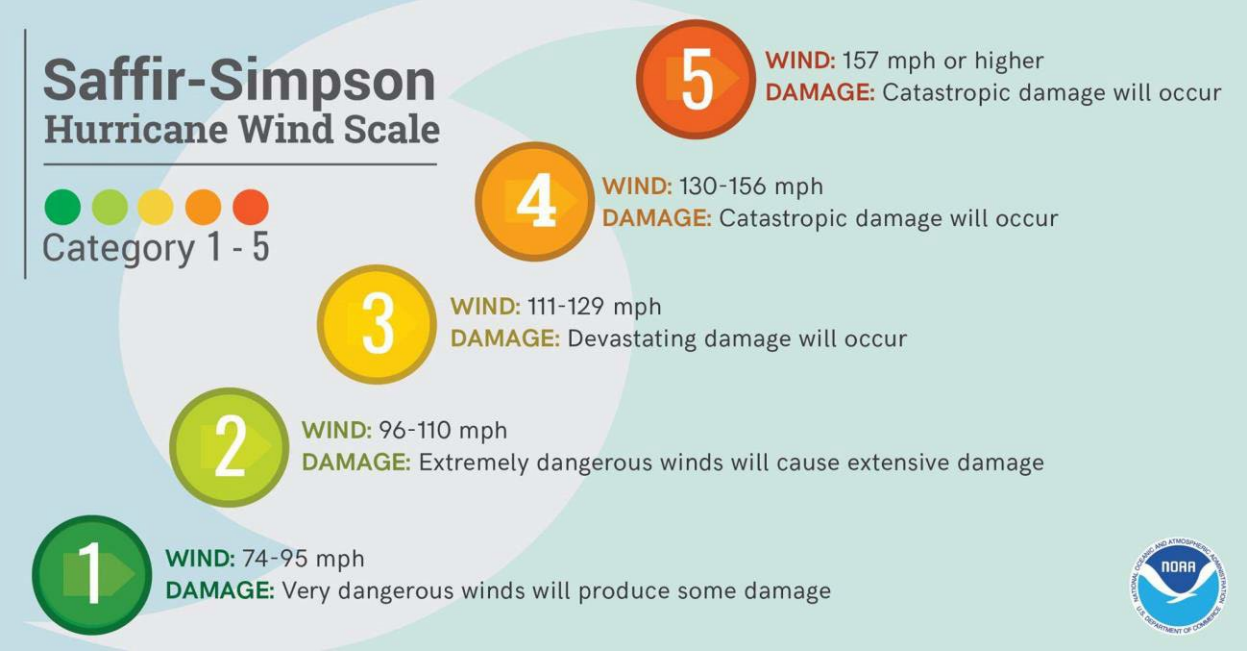
Tornado watches and warnings are issued by the local NWS office. A tornado watch is released when tornadoes are possible in an area. A tornado warning means a tornado has been sighted or indicated by weather radar (National Weather Service, 2018). The current

average lead time for tornado warnings is 13 minutes. Occasionally, tornadoes develop so rapidly, that little, if any, advance warning is possible (NOAA, 2011).

Tropical Storms/Hurricanes

The extent of a hurricane is categorized following 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 (National Weather Service, 2019). Figure 6-12 presents this scale, which is used to estimate the potential property damage and flooding expected when a hurricane makes landfall.

Figure 6-12. The Saffir-Simpson Scale



Source: (NOAA, n.d.)

Severe Winter Storms

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 National Centers for Environmental Information, 2023). Table 6-14 presents the five RSI ranking categories.

Table 6-14. 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+

Note: RSI = Regional Snowfall Index. Source: (NOAA National Centers for Environmental Information, 2022)

Table 6-15. Sperry-Piltz Ice Accumulation Index

Ice Damage Index	Damage and Impact Descriptions
0	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	Some isolated or localized utility interruptions are possible, typically lasting only a few hours each. Roads and bridges may become slick and hazardous
2	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulations.
3	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1-5 days.
4	Prolonged and widespread utility interruptions with extensive damage to main distribution feeder lines and some high voltage transmission lines/structures. Outages lasting 5-10 days.
5	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.

The NWS forecasted ice thickness for ice storms refers to accumulation on a horizontal flat surface. This value must be converted to mean radial ice accumulation to be more applicable to ice loads that could form on tree branches or utility lines. Mean radial ice accumulation is equivalent to the horizontal flat surface multiplied by 0.4. The design loading for overhead utility lines is calculated based on the National Electrical Safety Code Loading Districts (NYS is located in the heavy loading district, equating to ½" of ice) multiplied by a standard construction

grade value (NARUC, 2018). Ice storms can cause damage to trees and overhead utilities, reduced road safety, and power outages in Tioga County.

6.3.4 Impacts and Vulnerability

According to the updated hazard analysis in Section 5.4, Tioga County is highly vulnerable to severe storms based on severe storms' moderate impact (moderate potential for damage to property, crops, and/or people), regular occurrence, large extent (county-wide extent of impacts), and moderate level of preparedness. This assessment is backed by additional information in Section 6.3.

Impacts to the County from severe storm events include fallen trees from severe winds, which can damage overhead utility lines, resulting in power outages. These events are likely to result in damages to private and public infrastructure and property. In addition, during severe winter storm events, roadway safety is a primary concern and impacts the safety of residents and operation of critical facilities. Damages to the County's critical infrastructure or primary transportation routes would be most impactful to residents. Storm damages can have a particular impact on the more populated portions of the County, such as many of the hamlets and Villages within the County, as well as residents in more remote areas who may experience long power outages and longer wait times for snow removal, among other impacts. Municipal jurisdictions within Tioga County complete tree maintenance within each jurisdiction's road right of ways to minimize potential damages to overhead utility lines. Private utility right-of-ways are generally maintained by individual utility companies.

The County's overall vulnerability to hazards in this Hazard Mitigation Plan Update is described in Section 8.

6.3.5 Historical Hazard Occurrences and Damage Estimates

Table 6-16 shows the severe storm events that the County has experienced between 2018 and 2022, and their estimated damages. Two severe storm events in that time period were given federal disaster declarations, as shown in Section 5.2.3.

Table 6-16. Severe Storm Event Records, 2018-2022

Location	Event Type	Date	Magnitude	Estimated Property Damage	Estimated Crop Damage
Owego	Thunderstorm Wind	2/7/2018	50	$25,000	$0
Spencer	Thunderstorm Wind	5/28/2018	50	$5,000	$0
West Newark	Thunderstorm Wind	5/28/2018	50	$10,000	$0
West Newark	Thunderstorm Wind	6/13/2018	50	$10,000	$0
Candor	Thunderstorm Wind	6/13/2018	50	$10,000	$0
Catatonk	Thunderstorm Wind	6/18/2018	50	$10,000	$0
Flemingville	Thunderstorm Wind	7/2/2018	50	$10,000	$0
East Berkshire	Thunderstorm Wind	7/2/2018	50	$5,000	$0
North Spencer	Thunderstorm Wind	7/2/2018	55	$20,000	$0
Smithboro	Thunderstorm Wind	7/2/2018	50	$20,000	$0
Owego	Thunderstorm Wind	6/29/2019	50	$5,000	$0

Location	Event Type	Date	Magnitude	Estimated Property Damage	Estimated Crop Damage
Apalachin	Thunderstorm Wind	6/29/2019	50	$10,000	$0
Waits	Thunderstorm Wind	7/30/2019	50	$10,000	$0
Spencer	Thunderstorm Wind	8/8/2019	50	$5,000	$0
West Newark	Thunderstorm Wind	8/8/2019	50	$5,000	$0
Litchfield	Thunderstorm Wind	8/15/2019	50	$5,000	$0
Spencer	Hail	8/18/2019	1	N/A	$0
Spencer	Thunderstorm Wind	8/18/2019	50	$10,000	$0
West Candor	Thunderstorm Wind	8/18/2019	50	$10,000	$0
Candor	Thunderstorm Wind	8/18/2019	50	$15,000	$0
Candor	Hail	8/18/2019	1	N/A	$0
West Newark	Thunderstorm Wind	8/18/2019	50	$10,000	$0
Campville	Thunderstorm Wind	10/31/2019	50	$10,000	$0
Nichols	Thunderstorm Wind	3/20/2020	50	$5,000	$0
Campville	Thunderstorm Wind	4/13/2020	50	$5,000	$0
Waits	Thunderstorm Wind	5/29/2020	50	$10,000	$0
Owego	Thunderstorm Wind	7/23/2020	50	$5,000	$0
West Newark	Thunderstorm Wind	7/23/2020	50	$5,000	$0
Apalachin	Thunderstorm Wind	7/23/2020	50	$5,000	$0
Campville	Thunderstorm Wind	7/23/2020	50	$5,000	$0
Candor	Thunderstorm Wind	8/23/2020	50	$10,000	$0
Gaskill	Thunderstorm Wind	8/24/2020	50	$10,000	$0
Campville	Thunderstorm Wind	8/24/2020	50	$10,000	$0
Willseyville	Thunderstorm Wind	8/27/2020	50	$10,000	$0
Owego	Thunderstorm Wind	8/27/2020	50	$5,000	$0
Gaskill	Thunderstorm Wind	10/7/2020	50	$5,000	$0
Richford	Thunderstorm Wind	6/30/2021	50	$3,000	$0
Berkshire	Thunderstorm Wind	7/6/2021	50	$2,000	$0
Candor	Thunderstorm Wind	7/6/2021	50	$10,000	$0
Jenksville	Thunderstorm Wind	7/6/2021	50	$2,000	$0
South Apalachin	Thunderstorm Wind	7/7/2021	70	$70,000	$0
Owego	Thunderstorm Wind	7/7/2021	50	$4,500	$0
Crestview Hgts	Thunderstorm Wind	7/7/2021	50	$7,000	$0
Tioga Terrace	Thunderstorm Wind	7/7/2021	50	$1,000	$0
Barton	Thunderstorm Wind	7/13/2021	50	$5,000	$0
Smithboro	Thunderstorm Wind	7/13/2021	50	$2,000	$0
Straits Corners	Thunderstorm Wind	7/13/2021	50	$5,000	$0
Owego	Thunderstorm Wind	7/13/2021	50	$3,400	$0
West Newark	Thunderstorm Wind	7/13/2021	50	$2,000	$0
Apalachin	Thunderstorm Wind	7/20/2021	50	$2,000	$0
Campville	Thunderstorm Wind	3/7/2022	50	$1,000	$0
Litchfield	Thunderstorm Wind	8/4/2022	50	$1,000	$0
Tioga Center	Thunderstorm Wind	8/4/2022	50	$3,000	
Tioga Center	Thunderstorm Wind	8/4/2022	50	$5,000	
Lounsberry	Thunderstorm Wind	8/4/2022	50	$3,000	
Owego	Thunderstorm Wind	8/4/2022	50	$5,000	

Source: (NOAA National Centers for Environmental Information, 2023).

According to the FEMA National Risk Index's Expected Annual Loss ($) Data, severe storm events are expected to cause $1,519,546 in annual losses (FEMA, 2023). These statistics are displayed in Table 6-17, and include hail, hurricane, lightning, strong wind, tornado, and winter weather.

Table 6-17. Expected Annual Losses from Severe Storm Events

Event	Expected Annual Loss (Approximate)
Hail	$45,746
Hurricane	$420,765
Lightning	$48,449
Strong Wind	$171,815
Tornado	$829,620
Winter Weather	$3,151
TOTAL	$1,519,546

Source: (FEMA, 2023)

6.3.6 Future Potential Impacts and Relation to Climate Change

Probability of Future Events

Based on the Tioga County CEPA Results, the National Risk Index, previous Presidential Disaster Declarations, Hazard Identification and Ranking, and Historical Hazard Occurrences, the County's overall vulnerability to a flood remains moderate. According to the NOAA National Climate Data Center (NCEI), Tioga County experienced 284 severe storm events between 1950 and 2022. 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 National Centers for Environmental Information, 2023).

The probabilities are calculated using the formula P = e / (e + y - 1) *100% where P is the probability of one or more of a given type of event occurring in a given year (e.g. the probability that there would be at least one hail event in 2022), e is the total number of events over a given number of years (e.g. 1950-2022), and y is the number of years (e.g. 72 years between 1950 and 2022). In these probability calculations, the simplifying assumption has been made that these events are independent of each other (i.e. that the events are not related to one another). This assumption could be incorrect if, for example, a single event was counted as both a hail event and a strong wind event.

Table 6-2. Probability of Future Occurrence of Severe Storm Events Given No Other Changes

Hazard Type	Number of Occurrences between 1950 and 2022	Rate of Occurrence or Annual Number of Events (Average)	Recurrence Interval (in years) (# Years/ Number of Events)	Probability of Event in Any Given Year (%)
Lightning	2	.02	36	2.7%
Hail	45	.62	1.6	38.8%
Tornado	7	.097	10.28	9.0%
High Winds	8	.11	9	10.1%
Strong Wind	2	.02	36	2.7%

Hazard Type	Number of Occurrences between 1950 and 2022	Rate of Occurrence or Annual Number of Events (Average)	Recurrence Interval (in years) (# Years/ Number of Events)	Probability of Event in Any Given Year (%)
Thunderstorm Wind	135	1.875	.52	65.5%
Hurricane	0	0	0	0.0%
Tropical Storm	2	.02	36	2.7%
Tropical Depression	2	.02	36	2.7%
Heavy Rain	3	.041	24	4.1%
Severe Winter Storm	78	1.08	.92	52.3%
All Severe Storm Events	**284**	**3.944**	**.253**	**80.0%**

Note: Probability listed is based on 1950-2022 data only. The actual probability may differ; for example, a hurricane has a greater than 0% probability, because there is some chance that it will occur in the future even if it has not occurred between 1950 and 2022.

As mentioned, the table above displays the probability of future events if there are no other changes; it is solely based on historical probability. However, the County's future vulnerability to severe storm events can be impacted by several factors, including land use changes, mitigation actions, and climate change. For example, an increase in tree cover in a given area may decrease the severity of winds in that area; however, tree cover near a building may lead to an increased risk of branches or trees falling on that building. Tree cover may be impacted by changes in population and development, as well as mitigation actions such as tree plantings. Climate change may also impact severe storms, as described below.

Relation to Climate Change

Climate change is expected to change the types of severe storm events that the County is vulnerable to, likely making the County more vulnerable to severe thunderstorm, windstorm, and hail events and less vulnerable to heavy snow, ice storms, winter storms, and winter weather.

The County's overall vulnerability to severe thunderstorm, windstorm, and hail events remains high. New York State Energy and Research Development Authority's (NYSERDA) ClimAID report states that temperatures will continue to rise over the next several decades (Rosenzweig, 2011). U.S. Global Change Research Program's Climate Mapping for Resilience and Adaptation tool shows similar results, with annual maximum temperature averages increasing. The County may experience 4.9°F to 6.6°F higher annual maximum temperature averages by mid-century (2035-2064), compared with 1976-2005, according to mid-level projections (U.S. Federal Government, 2022). As a result, weather patterns are projected to increase in severity. Higher temperatures allow storm clouds to hold more vapor, which in turn produces more intense precipitation during storm events. Due to projected increases in precipitation and increases in yearly average temperatures, severe storm events are anticipated to increase in frequency and intensity.

The County's overall vulnerability to heavy snow, ice storms, winter storms, and winter weather may decrease. Based on the U.S. Global Change Research Program's Climate Mapping for Resilience and Adaptation tool, the County may experience 18 to 22 fewer days with a maximum temperature of 32°F by mid-century (2035-2064), compared to modeled history (1976-2005) (U.S. Federal Government, 2022).

6.4 Extreme Temperatures

6.4.1 Description

Extreme temperature events are defined as extended periods of excessive cold or hot weather with a serious impact on human and/or animal populations. In extreme heat and high humidity, evaporation is slowed and the body must work harder to maintain a normal temperature. People exposed to extreme heat exposure may develop symptoms that include, sunburn, dehydration, heat exhaustion, or heat stroke. In extreme cold conditions, people can experience wind chill, frostbite, or hypothermia. Exposure to extreme temperatures for prolonged periods of time can result in death.

6.4.2 Location

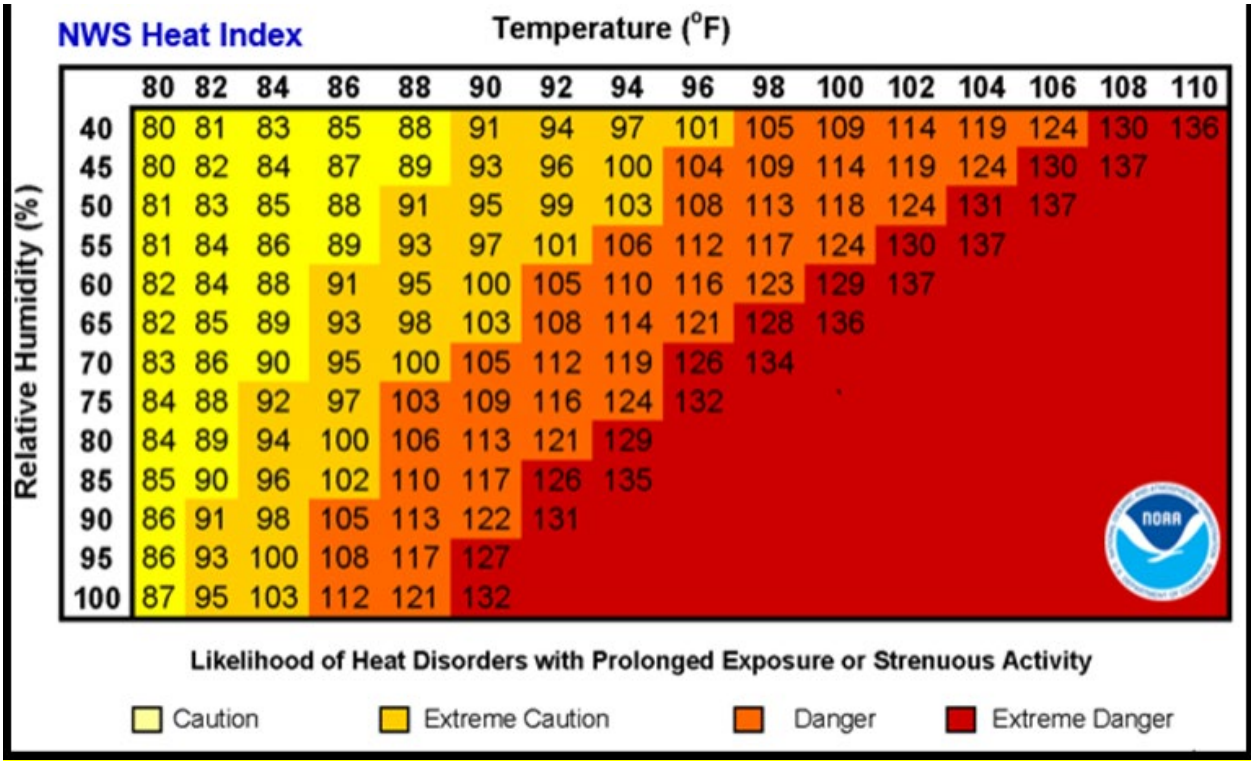
Extreme temperatures may occur anywhere within the county. However, the amount of pavement, tree cover, and elevation are all factors that affect where extreme temperatures occur within the County. For example, areas with more pavement, less tree cover, and lower elevation experience increased temperatures in the summer, whereas areas of higher elevation experience colder winter days.

6.4.3 Extent

The NWS Heat Index, a function of temperature and relative humidity, is used to predict the likelihood that someone could develop heat disorders. The NWS Wind Chill Index is a function of temperature and wind velocity. The NWS Heat and Wind Chill Indices are included in Figure 6-13 and Figure 6-14.

According to the National Centers for Environmental Information's (NCEI) Climate at a Glance Time Series, from 1895 to 2022 in Tioga County, July 1955 had the highest monthly maximum temperature (87.3°F), while February 1934 had the lowest monthly minimum temperature (-1.6°F) (NOAA National Centers for Environmental Information, 2023).

Figure 6-13. NWS Heat Index



NWS Heat Index

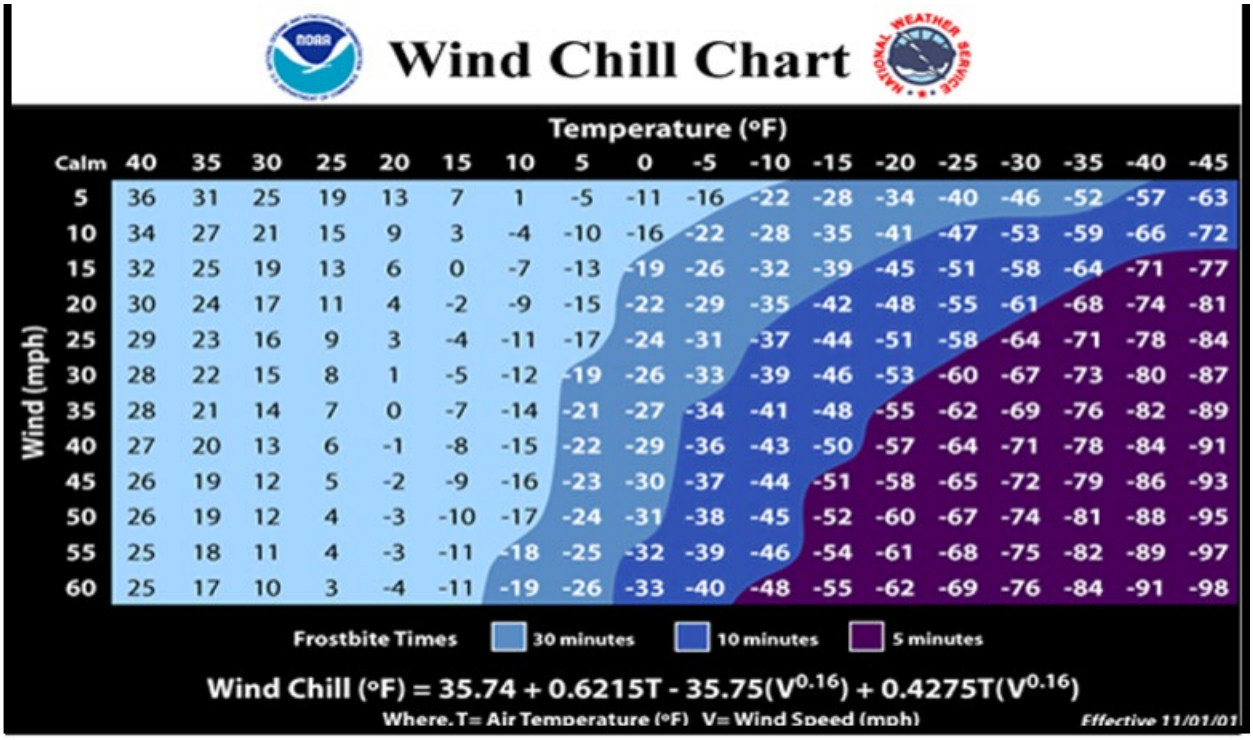
Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Figure 6-14. NWS Wind Chill Chart



Wind Chill Chart

Temperature (°F)

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

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

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

Effective 11/01/01

6.4.4 Impacts and Vulnerability

According to the updated hazard analysis in Section 5.4, the County is moderately vulnerable to extreme temperature events based on this hazard's minor impact (minor potential for damage to property, crops, and/or people), infrequent occurrence, large extent (county-wide extent of impacts), and moderate level of preparedness. This assessment is backed by additional information in Section 6.4.

Extreme temperature events tend to have greater impacts on vulnerable populations, including older adults (over 65 years), young children (under 5 years), people with health problems, or people who cannot afford to sufficiently heat or cool their homes. Approximately 5.1% of the population in Tioga County is under 5 years old, and 20.2% of the population is 65 years old and above. These statistics mean that around 25% of the population is at higher risk for greater impacts to extreme temperatures based on age. Additionally, 9.9% of the families within the County are below the poverty level (including 15.6% of children under age 5), and 15.3% of the County's population has a disability (including 32.8% of residents age 65+) (Tioga County, 2022). Extreme temperatures principally affect the health and safety of the human population, although they can also impact livestock and crops, and may also cause damage to infrastructure and property.

Extreme heat events are often more impactful than extreme cold events. In general, buildings are constructed to retain heat. Heat waves leave vulnerable populations at risk. There are multiple cooling center locations established throughout the County. The County recommends that residents utilize facilities such as libraries, public pools, grocery stores, and shopping centers to seek relief from extreme heat.

The County's overall vulnerability to hazards in this Hazard Mitigation Plan Update is described in Section 8.

6.4.5 Historical Hazard Occurrences and Damage Estimates

Table 6-18 shows the extreme temperature events that the County has experienced between 2018 and 2022, and their estimated damages.

Table 6-18. Extreme Temperature Event Records, 2018-2022

Location	Event Type	Date	Magnitude	Estimated Property Damage	Estimated Crop Damage
Tioga County	Extreme Cold	1/22/2022	N/A	$0	$0

Source: (NOAA National Centers for Environmental Information, 2023).

According to the FEMA National Risk Index's Expected Annual Loss ($) Data, extreme heat events are expected to cause $29,224.64 in annual total losses, and cold waves are expected to cause $232,745 annual total losses (FEMA NRI, 2023). Cold waves, as defined by FEMA's National Risk Index, are considered "a rapid fall in temperature within 24 hours and extreme low temperatures for an extended period" (FEMA, 2023). This differs slightly from the National Oceanic and Atmospheric Administration's definition of extreme cold, which is identified as "A period of extremely low temperatures or wind chill temperatures reaching or exceeding

locally/regionally defined warning criteria (typical value around -35° F or colder)" (NOAA National Centers for Environmental Information, 2023). There were no listed extreme heat events in Tioga County between 2018-2022.

6.4.6 Future Potential Impacts and Relation to Climate Change

Probability of Future Events

Based on the Tioga County CEPA Results, the National Risk Index, previous Presidential Disaster Declarations, Hazard Identification and Ranking, and Historical Hazard Occurrences, the County's overall vulnerability to an extreme temperature event is moderate. According to the NOAA National Climate Data Center (NCEI) Tioga County experienced seven extreme temperature events between 1950 and 2022. The table below shows these statistics, as well as the annual average number of events and the percent chance of these individual extreme temperature hazards occurring in Tioga County in future years (NOAA National Centers for Environmental Information, 2023).

In the table below, cold events are defined as a period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory (typical value is -18°F or colder) conditions, and extreme cold events are defined as a period of extreme low temperatures or wind chill temperatures reaching or exceedingly locally/regionally defined warning criteria (typically around -35 °F or colder). Heat events are defined as a period of heat resulting from the combination of high temperatures (above normal) and relative humidity, and excessive heat events are defined as a combination of high temperatures (well above normal) and high humidity. Both heat and excessive heat events are reported in Storm Data whenever heat index values meet or exceed locally/regionally established warning thresholds (NOAA, 2021).

The probabilities are calculated using the formula P = e / (e + y - 1) *100% where P is the probability of one or more of a given type of event occurring in a given year (e.g. the probability that there would be at least one hail event in 2022), e is the total number of events over a given number of years (e.g. 1950-2022), and y is the number of years (e.g. 72 years between 1950 and 2022). In these probability calculations, the simplifying assumption has been made that these events are independent of each other – i.e. that the events are not related to one another. This assumption could be incorrect if, for example, a heat event occurred and then an excessive heat event occurred shortly afterward, but they were both caused by the same warm spell.

Table 6-2. Probability of Future Occurrence of Extreme Temperature Events Given No Other Changes

Hazard Type	Number of Occurrences between 1950 and 2022	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/ Number of Events)	Probability of Event in Any Given Year (%)
Heat	3	.041	24	4.1%
Cold	6	.083	12	7.8%
Excessive Heat	1	.013	72	1.4%

Hazard Type	Number of Occurrences between 1950 and 2022	Rate of Occurrence or Annual Number of Events (average)	Recurrence Interval (in years) (# Years/ Number of Events)	Probability of Event in Any Given Year (%)
Extreme Cold	3	.041	24	4.1%
All Extreme Temperature Events	**13**	**.180**	**5.53**	**15.47%**

Note: Probability listed is based on 1950-2022 data only. The actual probability may differ.

As mentioned, the table above displays the probability of future events if there are no other changes; it is solely based on historical probability. However, the County's future vulnerability to extreme temperature events can be impacted by several factors, including land use changes, population changes, mitigation actions, and climate change. For example, if additional development (e.g. from increases in population) leads to areas with more pavement, those areas may see an increase in extreme heat events. Areas that experience an increase in tree cover (e.g. from changing land uses) may see a decrease in extreme heat events. Mitigation actions can also reduce the vulnerability of the County to extreme cold or extreme heat events; for example, creating warming or cooling centers, publicizing them, and offering transportation could reduce the health and safety impacts that many people feel from extreme heat and extreme cold events. Climate change is also expected to impact the frequency and severity of extreme temperature events, as described below.

Relation to Climate Change

Climate change is expected to increase the future vulnerability of the County to extreme heat events and decrease its vulnerability to extreme cold events. Based on the U.S. Global Change Research Program's Climate Mapping For Resilience and Adaptation tool, it is predicted that Tioga County will experience more extreme heat (U.S. Federal Government, 2022). The county may experience 18 to 24 days per year above 90 degrees Fahrenheit by mid-century (2035-2064), compared with 4 days per year in modeled history (1976-2005), according to mid-level projections. Additionally, it is predicted that Tioga County will experience fewer cold days. The County may experience 26 to 30 days per year with a maximum temperature below 32 degrees Fahrenheit by mid-century (2035-2064), compared with 48 days per year in modeled history (1976-2005), according to mid-level projections.

Going forward, increased use of air conditioning associated with the rise in extreme heat events will increase demands on local power grids, which should be taken into consideration by municipalities as well as utility providers regarding future planning efforts.

7 ASSETS

7.1 People

People are Tioga County's most important asset. Demographic characteristics of Tioga County – including vulnerable populations and steps taken to consider such populations – are described in Section 2, the Community Engagement Plan (Appendix C), and in each jurisdictional annex (Appendix A).

7.2 Economic Assets

The County's economy includes agriculture, retail trade, tourism, industry, manufacturing, and educational services. These assets are described in more detail in Section 2.3.3.

7.3 Key Infrastructure

7.3.1 Transportation

Roadways

The roadway network in Tioga County provides residents and workers with a range of options for getting throughout the county and the surrounding area. The County does not have any US or Interstate highways. Nearly 30 County Routes and more than 10 State Routes serve as transportation routes throughout the County. State Routes 34, 38, 79, 86, 96, 220, 282, 434, 17C, 38, 96, and W Main Street are only a few of the routes.

Public Transportation

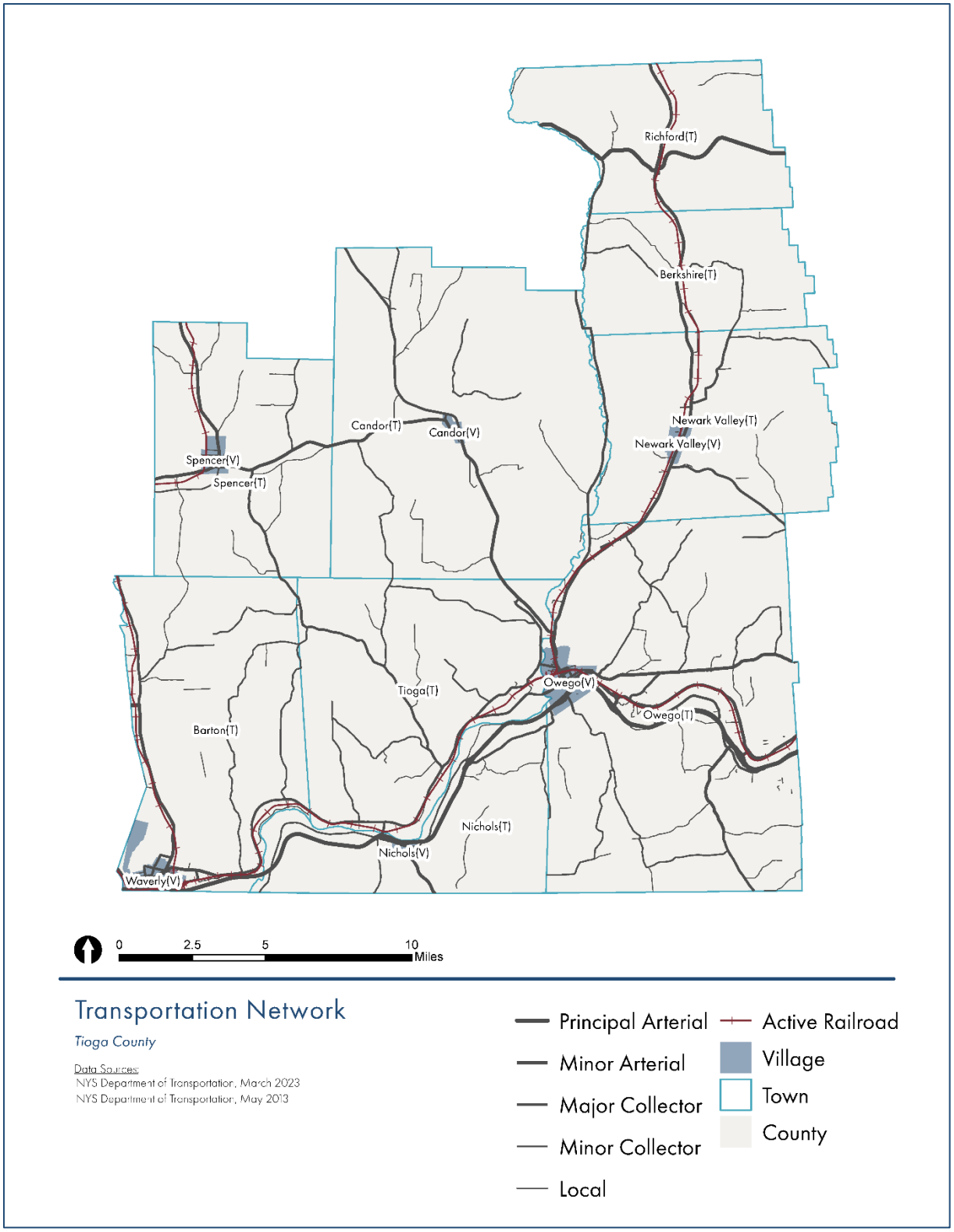
There are a few alternatives accessible to Tioga County residents for taking public transportation. Between Elmira and Owego, the C TRAN serves the counties of Chemung and Tioga, while Coach USA/Shortline has bus stops in both Owego and Waverly and offers transportation to areas outside the county. Also, Tioga County Public Transit (T-Tran) provides a fixed route and paratransit service to all of Tioga County, with commuter service to Ithaca, Dryden, Binghamton, Elmira, and Corning.

The County offers a variety of specialized transportation services. In Tioga County, organizations – including Northern Tioga Neighbors Network, Senior Information and Referral Service, Community Care Network of Nichols, Tioga Opportunities, Inc., and RSVP – all offer transportation services to seniors and others with special needs for residents of Tioga County, on-demand Paratransit and Medivan services are provided by Empire Transport, Endicott-Union Inc., Greater Valley EMS/W/C, and HTM MedTrans. Several taxi companies and ride-sharing services, such as Ride Share - NYS11, Southern Tier Ride Share, Finger Lakes Ride Share, Uber, and Lyft, are also available to residents as individual transportation options.

Railroad Facilities

Tioga County's rail networks are only used for freight transportation. Both the Town of Spencer and the Town of Richford have freight lines that go from north to south through the Village of Owego. From the Village of Owego, rail lines extend east to west into the counties of Broome and Chemung. Although Norfolk Southern Railway generally owns and operates rail lines, Tioga Industrial Development Agency also owns and manages a line that extends from the Village of Owego northward into Cortland County.

Figure 7-1. Transportation Networks in Tioga County



Data Sources: NYS Department of Transportation (March 2023 and May 2013)

7.3.2 Utilities

Utilities, such as water and sewer systems, electricity and natural gas, telecommunications, and internet, can play an important role in mitigating risk to natural hazards while also serving as essential infrastructure during a hazard event. Many utilities within Tioga County are operated by private utility companies, however, several are operated by the municipalities, as indicated in Table 7-1.

Table 7-1. Municipal Utilities in Tioga County

Entity/Area Served	Municipal Utility(ies)
Town of Barton	Water (groundwater drawn from one well) and sewer
Town of Owego	Water and sewer
Town of Nichols	Water and sewer (utilized by larger development (four industrial clients))
Village of Candor	Water
Village of Newark Valley	Water *Note: Recycling for Village is handled through contract (Casella), but the Village is given a rate for residents*
Village of Owego	Sewer
Village of Waverly	Water (aquifer source) and sewer

Note: Veolia provides direct water service to approx. 5,500 people in the Villages of Owego and Nichols, and limited sections of the Towns of Owego, Nichols, and Tioga

7.3.3 Critical Facilities

Infrastructure and critical facilities are those that are crucial to the health and welfare of the population. These take on a greater significance after any hazard event. These critical facilities include community lifelines, such as fire departments, EMS services, police stations, water and wastewater services, medical facilities, and highway garages. They also include facilities such as Town and Village halls, schools, and senior centers. Included as well are Tier II facilities and railroads, which store or transport substantial quantities of hazardous materials, having the potential to harm public health and welfare in the case of a crisis.

A list of the County's critical facilities was compiled based on the 2018 HMP, recommendations from the Core Planning Group, and recommendations from the County Legislature. Additionally, each jurisdiction provided information about critical facilities within that particular jurisdiction, as well as their vulnerabilities and protection to 1% and 0.2% annual chance flood events, as detailed in each jurisdictional annex (Appendix A). The list of critical facilities for each jurisdiction was adapted from the 2018 HMP. Then, certain key facilities were added – such as Town/Village halls, highway garages, water and wastewater facilities, schools, fire departments, EMS facilities, and facilities that house vulnerable populations – depending what was present in each jurisdiction. This list was further refined based on jurisdictional input. Jurisdictions ultimately decided what they considered to be critical facilities.

A list of critical facilities is included in each jurisdictional annex, including the County's annex (Appendix A).

7.3.4 Emergency Shelters

Emergency shelters are another type of asset. Emergency shelters are established in partnership with the Red Cross. While a formal list of emergency shelters is not included as part of this plan, many jurisdictions took sheltering capacity into account while identifying critical facilities. Jurisdictions also took into consideration capacity for warming and cooling centers. An existing map of cooling centers in the County can be found here: https://apps.health.ny.gov/statistics/environmental/public_health_tracking/tracker/#/CCMap.

7.3.5 Social Infrastructure

While not controlled by the County, there other types of infrastructure that provided needed services, especially to vulnerable populations. Food pantries are one example. According to the Tioga County Department of Public Health and the Tioga County Resource Guide, there are approximately 15 food pantries in the County (Tioga County Public Health) (Tioga County Public Health, 2021). The Food Bank of the Southern Tier distributes food to partner agencies across seven counties including Tioga County; in 2022 they distributed 11,107,681 meals across all seven counties (Food Bank of the Southern Tier, 2022). In addition, nonprofits such as Tioga Opportunities, and agencies such as the Department of Social Services provide needed services to vulnerable populations.

7.3.6 Additional Infrastructure

While they may be considered assets, high hazard potential dams and dams outside Tioga County pose threats to the County. These are described in Section 6.1.1. Additionally, recent and proposed developments are described in Section 0 and in the jurisdictional annexes.

7.4 Historic and Cultural Resources

Many of the municipalities identified historic and cultural resources – such as sites on the National Register of Historic Places and libraries – as important assets that they would like protected against natural hazard events, even though not considered critical facilities. The Owego Central Historic District, which is located in a floodplain, is an example of on such asset that has been identified for its importance to Tioga County. Specific historic and cultural resources identified by the municipalities are described in the jurisdictional annexes (Appendix A).

7.5 Natural Environment

Water resources are described in Section 2.1.3. The river basins that intersect Tioga County – and the associated ponds, lakes, creeks, rivers, and aquifers – provide a significant asset to the County in the form of drinking water, recreation, and other uses. Some of these water resources have measures to protect them, such as wellhead protection areas, as described in Section 4.3 and in each jurisdictional annex. The County also has numerous parks and natural areas that increase the value of life in the County.

7.6 Additional Assets

Additional Jurisdiction/Public Identified Vulnerabilities are included in the jurisdictional annexes (Appendix A). These include essential businesses, large employment centers, senior living facilities, historic and cultural resources, natural resources, and other assets that are deemed important to be protected from natural hazards, but not classified as critical facilities. Each jurisdiction ultimately decided what assets were important enough to include in their lists of additional assets and vulnerabilities.

8 IMPACTS AND OVERALL HAZARD VULNERABILITY

8.1 Background

Tioga County's vulnerability to each hazard (flood, drought, severe storm, and extreme temperatures) is detailed in Section 6. This section contains information about the County's vulnerability to these hazards overall. Vulnerability of each jurisdiction to each hazard profiled is described in the jurisdictional annexes (Appendix A). Additional vulnerabilities of interest may include critical facilities (described in each jurisdictional annex), and potential damages (described in Section 6 for each hazard profiled).

Table 8-1 is a tool for understanding the vulnerability of different community assets to events of varying magnitudes. Vulnerability is an expression of the capacity of an asset to return to service after a disaster event, taking into account its material strength relative to the hazard as well as its recovery capacity. For example, if an asset quickly recovers without external assistance, it has a low vulnerability. In general, an asset may be considered vulnerable to a particular hazard if that hazard would cause moderate to major disruptions to the asset. However, criteria and methodology used to evaluate and develop a score for vulnerability vary among communities due to the diversity of populations, assets, and issues. Local knowledge of how community assets have been affected in the past may help to estimate future effects.

Table 8-1. Assessing Community Asset Vulnerability

Impact	Insignificant	Minor	Moderate	Significant	Major
Economic Assets	Limited interruption in service or short term reduced service	Service loss for up to 1 week or longer term reduced service	Service loss for more than 1 week up to 1 month or longer term reduced service	Service loss for more than 1 month or permanent reduced capacity	Permanent loss of service of the economic asset
Health and Social Services Assets	Limited interruption in service or short term reduced service; Services under more than usual stress but manageable	Service loss for up to 1 week or longer term reduced service; Services under more than usual stress on several fronts	Service loss for more than 1 week up to 1 month or longer term reduced service; Services under severe pressure	Service loss for more than 1 month or permanent reduced capacity	Permanent loss of service or any one of the essential services listed

Impact	Insignificant	Minor	Moderate	Significant	Major
Housing Assets	Limited inconvenience	Out of use for up to 1 week	Out of use for more than 1 week up to 1 month	Out of use for up to months or permanent loss of 15% or less of housing in a group asset	Out of use for more than 6 months or permanent loss of more than 15% of housing in a group asset
Infrastructure Systems Assets	Limited interruption in service or short term reduced service	Service loss for up to 1 week up to 1 month or longer term reduced service	Service loss for more than 1 week up to 1 month or longer term reduced service	Service loss for more than 1 month or permanent reduced capacity	Permanent loss of service of any one of the facilities listed
Natural and Cultural Resources Assets	Limited interruption in service or short term reduced service or limited loss of access, habitat, or use	Service Loss for up to 1 week or longer term reduced service; Minimal natural habitat impacts, temporary loss of public access, temporary loss of open space/tourism assets	Service loss for more than 1 week up to 1 month or moderate impacts on natural habitats, sustained loss of public access, long term loss of private open space	Service loss greater than 1 month or permanently diminished capacity of natural resource; substantial damages of important natural habitats	Permanent loss of service of the cultural asset or complete loss of important natural habitats
Assets Providing Services for Socially Vulnerable Populations	Limited Service Interruption	Service interruption for up to 1 week	Service interruption of more than 1 week up to 1 month	Permanent service interruption of more than 1 and less than 6 months	Service interruption of 6 or more months

When assessing vulnerabilities to flood, drought, severe storm, and extreme temperatures, jurisdictions took into account the vulnerability of assets to each of these hazards. The results are detailed in Table 4-2 of each jurisdictional annex.

8.2 Vulnerability Summary

8.2.1 Summary of Vulnerability and Impacts

As addressed in Sections 5 and 6, Tioga County is highly vulnerable to floods, highly vulnerable to drought, highly vulnerable to severe storms, and moderately vulnerable to extreme temperatures. In the future, the County's level of vulnerability to each of these hazards may be affected by climate change, land use, and population changes, as described in Section 6.

Climate change is expected to increase the County's future vulnerability to flood events, change the types of severe storm events that the County is vulnerable to, increase the County's future vulnerability to drought events, and increase the County's future vulnerability to extreme heat events while decreasing its vulnerability to extreme cold events.

The current level of vulnerability to each hazard varies depending on the jurisdiction, and is further addressed in Section 6 of each jurisdictional annex (Appendix A). Each jurisdiction's ranking of vulnerability to each hazard is detailed in Table 8-2.

Table 8-2. Vulnerability of Jurisdictions to Hazards Profiled (Self-Described)

Jurisdiction	Flood	Drought	Severe Storm	Extreme Temperatures
Barton, Town of	Moderate	Moderate	High	Moderate
Berkshire, Town of	High	Moderate	High	Moderate
Candor, Town of	High	Moderate	Moderate	Moderate
Candor, Village of	Moderate	Low	Moderate	Moderate
Newark Valley, Town of	High	High	High	Moderate
Newark Valley, Village of	Moderate	Low	Moderate	Moderate
Nichols, Town of	Moderate	Moderate	Moderate	Moderate
Nichols, Village of	High	Moderate	High	High
Owego, Town of	High	Moderate	High	Moderate
Owego, Village of	High	Moderate	High	High
Richford, Town of	High	Moderate	High	Moderate
Spencer, Town of	High	Moderate	High	Moderate
Spencer, Village of	Moderate	Moderate	Moderate	Moderate
Tioga, Town of	High	Moderate	High	Moderate
Waverly, Village of	Moderate	Moderate	High	Moderate
Tioga County Overall	**High**	**High**	**High**	**Moderate**

Impacts of these hazards on the County are described in Sections 6, 7, and 8. Key impacts of flooding on the County include damages to homes, businesses, and possessions; utility disruptions; transportation hazards and delays; losses in income; debris; relocation; and displacement. Key impacts of drought on the County include a lesser quality and quantity of drinking water, disruptions to farming, and lost time and resources from disruptions to the water supply. Key impacts of severe storms on the County include power outages, damages to infrastructure and property, transportation delays and safety hazards, and lost time and income. Key impacts of extreme temperatures on the County include health effects for vulnerable populations (such as older adults, young children, people with health problems, and low-income residents) and an increase in EMS calls during extreme heat events.

8.2.2 County Priorities

Taking into account the identified natural hazards, potential impacts, assets, and vulnerabilities identified above, the County has identified the following as priority areas and key vulnerabilities that it would like to address:

- Mobile home parks within the County, which often house lower income communities with limited capacity to relocate, are often located within a floodplain. This combination of demographic and geographic characteristics increases the vulnerability of these neighborhoods.
- There has been some increase in EMS calls during extreme heat events.
- The elderly population is vulnerable to natural hazards, and are located throughout the County.
- There is a lack of public transportation to move individuals to emergency shelters, and the assistance of schools is often needed. However, transportation using school buses is dependent on availability.

The County has not identified any changes in priorities since the 2018 HMP Update.

8.2.3 Municipal Priorities

Key vulnerabilities and priorities for each jurisdiction are identified in Section 6 of each jurisdictional annex (Appendix A). Common themes among jurisdictions include the following:

- Many jurisdictions wanted strategies for implementing and maintaining the actions included in the HMP. Additionally, many jurisdictions and the stakeholders were concerned about obtaining adequate funding to help reduce the impact of hazards on the populations they serve.
- Many areas are susceptible to flooding, which causes road damages and property damages.
- Many culverts are undersized, plugging, and/or do not adequately deal with flooding.
- Tree debris (for example, from dead and dying ash trees) can cause power outages, block roads, and fill streams, increasing the severity of severe storms and flooding. Severe storms can cause downed trees and fallen branches.
- Creeks and streams often have limited space for high levels of water to go (for instance if they have high amounts of gravel), and can cause flooding and infrastructure/property damage.
- Dams outside of Tioga County pose a flood concern. For example, if the East Sidney Dam in Delaware County were breached, it would likely flood Tioga County in a matter of hours. The County has an existing action to establish a stream gauge system to provide early alert of flooding, and has added the East Sidney Dam to this action.
- Debris creation during flooding was listed as a concern during many jurisdictional interviews and by stakeholders in the emergency services field. Many items can become sources of pollution during a flood and even can be dangerous if large items start to float.
- The hazards in this HMP, can impact vulnerable populations, including older adults, people without vehicles, homeless populations, and people with disabilities.
- Some jurisdictions were interested in creating intermunicipal agreements to help with hazard preparedness and response, such as agreements for snow removal.

Many jurisdictions did not identify changes in priorities since the last HMP Update. Some of these themes may primarily relate to preparedness and response rather than mitigation, and therefore are not addressed in this Hazard Mitigation Plan.

8.2.4 Public Priorities

Public feedback about hazard mitigation is summarized in Section 3.4, and more information is provided in Appendix A. Common themes identified by the public include the following:

- Communication before and during hazard events could be improved, and could include multiple methods of communication. Many residents would like a better understanding of what to do, where to go, who to contact, how to get transportation during an emergency, and requested to be informed on the action plan before an emergency.
- Clearing soot and debris out of rivers and creeks was mentioned by several survey respondents.
- There is a general concern among residents about vulnerable populations such as older adults, people with disabilities, and lower income residents.
- Some vulnerable populations themselves expressed concern about having food, water, and access to medical care during emergencies.
- Infrastructure investment and maintenance was a priority for many, including roads, water and sewer systems, and electrical infrastructure, all of which can be damaged by storms and flooding in particular.
- Many residents had specific locations that they would like to see better maintained in the face of flooding and storms.
- Many residents have had their home or business damaged by a storm, have had their home or business flooded, and/or have been concerned about how to get water for their home, business, or farm.

Some of these themes primarily relate to preparedness and response rather than mitigation, and therefore are not addressed in this Hazard Mitigation Plan.

9 MITIGATION STRATEGY

9.1 Mission, Goals, and Objectives

9.1.1 Mission

The mission statement for the HMP update is:

The Hazard Mitigation Plan for Tioga County forms the foundation of the County's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repetitive damage.

9.1.2 Goals

Tioga County developed mitigation planning goals based on the risk assessment results, general vulnerabilities, and overall capabilities of the County and jurisdictions. These goals are intended to address the County's vulnerabilities to flood, drought, severe storm, and extreme temperatures, while providing additional benefits to the County such as protecting natural resources. Goals are broad, long-term policy and vision statements that explain what the mitigation strategy aims to achieve. They are visions for reducing or avoiding losses from the identified hazards (FEMA, 2023).

The goals and objectives identified by this process represent what the participants were hoping to achieve through the implementation of this HMP. They were created in consultation with stakeholders at the County Roundtable (see Section 3). Specific mitigation strategies were identified that support the goals and objectives of this plan. These strategies were adjusted based on hazard research, input from Tioga County and jurisdiction representatives, and comments received during the public and stakeholder review process.

The goals for the 2024 Tioga County HMP Update are as follows:

1. Goal 1: Protect Life and Property
2. Goal 2: Increase Public Awareness and Preparedness/Understanding of Natural Hazards and their Risks
3. Goal 3: Reduce Hazard Impact on the Economy (throughout the County)
4. Goal 4: Protect Open Space, Agricultural Land, the Environment, and Natural Resources
5. Goal 5: Promote and Support Partnerships
6. Goal 6: Enhance Emergency Management Preparedness, Response, and Recovery

9.1.3 Objectives

As part of the HMP update process, the County reviewed and updated their objectives from the 2018 HMP. The objectives further describe the specific strategies or implementation steps associated with their HMP goals. Unlike goals, objectives are specific and measurable (FEMA, 2017). The objectives were based on grouping common mitigation strategy themes that were identified by the County and jurisdictions. Table 9-1 notes the objectives for the Tioga County

2024 HMP Update. While each objective corresponds with one goal in particular, many objectives may apply to multiple goals.

Table 9-1. Goals and Objectives for the 2024 HMP Update

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.
	Objective 1-12: Address risks posed by high hazard potential dams (HHPDs).
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 Land, the Environment and Natural Resources	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.
	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 5-2: 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.

9.2 Status of 2018 Actions

The County has implemented many actions that were identified in their 2018 HMP. Details regarding the status of the County's mitigation actions from their 2018 HMP are listed in the County's jurisdictional annex (Appendix A). 18 of the County's 2018 mitigation actions were re-included in the 2024 HMP Update because they are either incomplete or on-going. The status of mitigation actions identified by individual jurisdictions in the County's 2018 HMP are summarized in each jurisdictional annex (Appendix A).

9.3 New Mitigation Actions

9.3.1 Range of Mitigation Actions Considered

County Actions Considered

In addition to actions carried over from the 2018 HMP, the County considered a comprehensive range of new mitigation actions through multiple meetings and iterations of the list of actions. First, a County Roundtable Meeting was held in April 2023, as described in Section 3, and included a brainstorming session for mitigation actions among other agenda items. This list was then added to and refined by the Core Planning Group. In July of 2023, a meeting with the Core Planning Group was held in which the group discussed in more detail the County's priorities, vulnerable communities, assets and vulnerabilities, and 2018 mitigations, among other topics as described in the County's annex (Appendix A). This included consideration to the ways that the County could expand and improve their identified capabilities to achieve mitigation. In the latter part of this meeting, new mitigation actions were brainstormed. Mitigation action ideas that had full support were included, while action ideas that were not clearly feasible or did not clearly meet the County's priorities were left for discussion at future meetings. Additional actions and ideas were suggested during a meeting with the Tioga County Local Emergency Planning Committee in September 2023, interviews with departments that serve vulnerable communities, and during the Public Information Meeting #1 and Jurisdictional Team Meeting #2 in October 2023. Mitigation actions suggested at these meetings were further vetted, refined, and revised in discussions with the Core Planning Group, based on the County's priorities, the feasibility of the actions, the extent to which these actions met the requirements of the Hazard Mitigation Plan, and other factors.

More details on these meetings can be found in Section 3 and in the meeting notes in Appendix D and Appendix E. These appendices also contain more details on the mitigation actions that were proposed in these meetings.

County Critical Facilities Actions

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, and discretion must be recognized. Further, it must be recognized that the County has limited authority over privately-owned critical facility owners regarding mitigation at any level of protection.

Municipal Actions Considered

Individual jurisdictions brainstormed actions based on the capabilities, hazard identification, impacts, and vulnerabilities described in their jurisdictional annexes. This included consideration to the ways that each jurisdiction could expand and improve their identified capabilities to achieve mitigation, as described in the jurisdictional annexes. Then, a more comprehensive range of actions were evaluated as described below. Finally, actions that tied in most closely with the vulnerabilities identified by each jurisdiction were selected for inclusion in the plan.

To develop a comprehensive range of actions for jurisdictional consideration, the project team used FEMA's Mitigation Ideas guide (FEMA, 2013), past experience, and feedback that had been attained from jurisdictions up to that point. From this knowledge, the project team created the following list of example actions to suggest to jurisdictions. Actions that could fit with a particular jurisdiction's context and challenges were suggested to that jurisdiction for consideration. If included as new mitigation actions, the example actions were expanded upon and tailored based on the jurisdiction's unique context, challenges, and opportunities.

Table 9-2. Example Mitigation Actions Considered

Action Name	Description
Critical Facilities Assessment and Upgrades	Complete an assessment of each of the jurisdiction's critical facilities to determine their level of protection against a 0.2% flood event (or previous worst case flood). When feasible, implement infrastructural upgrades to ensure these critical facilities will remain operable in the case of a 0.2% flood event (or previous worst case flood).
Review and Update Municipal Regulations	Review municipal laws and ordinances and update as necessary to incorporate hazard mitigation. This may include review of the zoning code, development regulations, subdivision regulations, building codes, and other regulations to ensure that new and existing developments are protected against a 500-year flood event and against other hazards.
Inspection/Right-sizing of Culverts	Assess the condition, size, and effectiveness of culverts within the jurisdiction. Create a list of culverts that need attention, and work with the County SWCD to replace with new right-sized piping, where deemed necessary.
Hazardous Tree Inspection and Management	Incorporate the regular inspection and management of hazardous trees into the Town's existing procedures for drainage system and infrastructure maintenance.
Drought Mitigation & Emergency Plan for Local Agricultural Operations	Develop and implement a Drought Mitigation & Emergency Plan that establishes an outreach campaign to raise awareness of strategies and resources for reducing agricultural operations' risk to drought (e.g. planting cover crops, reducing tillage, harvesting rainwater, etc.).
Outreach Regarding Buyouts	Conduct outreach to property owners regarding buyouts.

Action Name	Description
Farmer Outreach Campaign for Flood Mitigation Measures	Implement an outreach campaign to farmers to encourage the installation of stormwater retention ponds, wetlands, and riparian forest buffers to limit flooding within the watershed.
Tree Planting Program	Work with the SWCD to implement and promote a tree planting program through the SWCD's Tree and Shrub Sale.
Backup Generators	Ensure that critical facilities that require emergency power sources are equipped with backup generators.
Resident Contact List	Gather a list of residents who would like to be contacted during storms, floods, and hot/cold days, to check on their well-being.
Drought Emergency Plan	Create a Drought Emergency Plan to identify actions that can be taken in the case of drought.
Assessment and Upgrades of Water Delivery Systems	Assess water delivery systems for any existing breaks and leaks. If necessary, upgrade water delivery systems or develop new systems to eliminate breaks and leaks.
Stormwater Drainage Study	Complete a stormwater drainage study for known problem areas
Water Supply Monitoring	Improve water supply monitoring in the jurisdiction.
Debris Reduction Program	Incentivize the removal of large debris items and educate residents on junk removal.
Basement Flood Mitigation Program	Conduct outreach to homeowners regarding measures they can take to mitigate flood risk on their property.

To provide another resource for brainstorming new mitigation actions, each jurisdiction was given the opportunity to attend a Jurisdictional Team Meeting on October 5, 2023 to hear about actions that other jurisdictions in the County had identified, as well as some suggestions from the project team. Actions presented included:

Flood

A. Critical Facilities Assessment and Upgrades
B. Inspection/Resizing of Culverts
C. Infrastructure Assessment and Repairs/Replacements
D. Watershed Assessments for Flood Mitigation
E. Basement Flood Mitigation Program
F. Bulk Waste Reduction Program
G. Farmer Outreach Campaign for Flood Mitigation Measures
H. Plan for Vacant Properties
I. Erosion Management Plan
J. Community Rating System Participation
K. Flood Mitigation Parcel Inventory
L. Review and Update Municipal Regulations
M. Nature-Based Flood Mitigation Solutions
N. Evacuation Strategy
O. Tree Planting Program

Severe Storm

A. Hazardous Tree Inspection and Management
B. Backup Generators for Critical Facilities
C. Assess Relocation and Replacement of Town Hall and Highway Barn
D. Solar Panels for Backup Power Generation
E. Update Site Design Review Standards

Drought

A. Drought Mitigation & Emergency Plan
B. Backup Water Supply
C. Inter-district Water Coordination
D. Drought Education and Outreach
E. Drought Monitoring Plan
F. Assessment and Upgrades of Water Delivery Systems

Extreme Temperatures

A. Cooling and Warming Centers
B. Tree Planting Program
C. Assess Relocation of Highway Garage
D. Review and Update Municipal Regulations
E. Encouraging Tree Plantings and Green Roofs in Building Codes To Mitigate Extreme Heat
F. Buddy Cards
G. Funding for A/C Units

Following the Jurisdictional Team Meeting on October 5, 2023, each municipality was sent a comprehensive spreadsheet of draft mitigation actions developed by each jurisdiction. Based on the comprehensive range of actions identified through these processes, and the prioritization strategies identified in Section 9.3.3 (including a cost-benefit review), jurisdictions were given the opportunity to review the list of mitigation actions and determine which ones to keep, revise, discard, or add.

Municipal Critical Facilities Actions

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 municipalities have limited authority over privately-owned critical facility owners regarding mitigation at any level of protection.

Local municipalities must also assess their critical facilities within their jurisdictions and the vulnerabilities of these facilities. Municipalities may choose to upgrade these facilities as needed, pending feasibility and the availability of funding.

9.3.2 Proposed Mitigation Actions for HMP Update

The proposed new mitigation actions for the County and each municipality are listed in the jurisdictional annexes (Appendix A).

9.3.3 Mitigation Action Prioritization

Both County and municipal mitigation actions were prioritized using a tool adapted from the US Climate Resilience Toolkit's Steps to Resilience Framework, found at https://toolkit.climate.gov/image/1694. The criteria for analysis included: Ability to Increase Resilience, Economic Feasibility, Low Environmental Impact, and Ability to Implement.

Table 9-3 illustrates the process used to prioritize actions in the mitigation strategy. This process was followed for each action in each jurisdiction, in order to assign a priority to each action. After each action was assigned a priority, jurisdictions were given the opportunity to review the priorities listed and adjust them if desired.

Table 9-3. New Mitigation Action Prioritization Process

Mitigation Action ID	Mitigation Action Name	Ability to Increase Resilience	Economic Feasibility	Low Environmental Impact	Ability to Implement	Total Score	Priority
F1	Basement Flood Mitigation Program	2	2	3	3	10	High

Note: Feasibility/effectiveness is rated as follows: 1 = Poor, 2 = Moderate, 3 = Good. Priority is determined as follows based on total score: 4-6 = Low, 7-9 = Medium, 10-12 = High.

This analysis constitutes a benefit-cost review, as Ability to Increase Resilience, Low Environmental Impact, and Ability to Implement were considered benefits of the actions, while Economic Feasibility took into account the costs of the actions. Additionally, for each new mitigation action, a narrative form of estimated benefits and a more detailed measure of the cost was included. The estimated benefits took into account factors such as structures and infrastructure protected by the action, people protected from injury and loss of life, ecosystem benefits, and quality of life benefits. The costs of each action were estimated using three categories: Low: <$10,000, Medium: $10,000-$100,000, and High: >$100,000. Jurisdictions assessed whether the costs are reasonable compared to the proposed benefits and excluded actions if the costs did not seem reasonable.

For proposed County mitigation actions, in addition to utilizing the prioritization methodology outlined above, a survey was distributed to County departments inviting them to rank the proposed actions based on their perceived order of importance. This provided another level of insight into which of the County's proposed mitigation actions may be beneficial address in the near-term, based on support from various County departments.

9.4 Implementation Strategy

Each jurisdiction's new mitigation actions will be implemented and administered in accordance with the Mitigation Action – Review spreadsheet (Appendix I). This includes information about the office, department, or agency responsible for implementing and administering each of the identified mitigation actions. It also includes potential funding sources and the expected time frame for completion upon project initiation. Additional potential funding sources are listed in Section 9.5 as a reference to the County and individual municipalities.

Carryover actions from the 2018 Hazard Mitigation Plan Update will be implemented in accordance with each jurisdiction's Status of 2018 Actions table as detailed in each jurisdictional annex.

Additionally, Tioga County will provide opportunities for discussion of the mitigation actions identified in this HMP at quarterly jurisdictional team meetings. These will provide an opportunity for jurisdictions to network with each other about ways to fund and implement the actions in this HMP, including both new actions and actions carried over from the 2018 Hazard Mitigation Plan Update.

9.5 Potential Funding Sources

The Disaster Mitigation Act of 2000 requires that state, local, tribal, and territorial governments prepare natural hazard mitigation plans as a condition of future funding. With a FEMA approved Hazard Mitigation Plan, communities will be eligible to apply for funding through FEMA Hazard Mitigation Assistance and Resilience Grant programs, identified below.

9.5.1 FEMA Hazard Mitigation Assistance and Resilience Grant Programs

A list of some key Hazard Mitigation Assistance and Resilience Grant Programs established by FEMA is included below.

- Building Resilient Infrastructure and Communities (BRIC) Program – supports a broad array of hazard mitigation projects to reduce risks from disasters and natural hazards. Examples of project types include construction projects, plan creation and updates, project scoping, education and awareness, gathering feedback from community members, management costs, and many more.
- Flood Mitigation Assistance (FMA) Program – provides funding to reduce or eliminate the risk of repetitive flood damage to buildings insured under the National Flood Insurance Program (NFIP).
- Hazard Mitigation Grant Program (HMGP) – provides funding to communities to rebuild in a way that reduces, or mitigates, future natural disaster losses in their communities. Supports a broad array of hazard mitigation projects.

- Hazard Mitigation Grant Program Post Fire (HMGP Post Fire) – provides funding to help communities implement hazard mitigation measures focused on reducing the risk of harm from wildfire.

Additional FEMA HMA programs include the Pre-Disaster Mitigation Program (PDM), which was largely replaced by BRIC, and Safeguarding Tomorrow Revolving Loan Fund Program, which is administered through individual states. For a summary of eligibility activities by program type for HMGP, HMGP Post Fire, BRIC, and FMA, see page 72 of the Hazard Mitigation Assistance Program and Policy Guide: https://www.fema.gov/sites/default/files/documents/fema_hma-program-policy-guide_032023.pdf (FEMA, 2023).

In addition, several other funding sources may potentially be utilized for mitigation actions in this plan, in addition to municipal and county budgets. Other possible funding sources are outlined below. This is not an exhaustive list but is a starting place for sources that may fit the mitigation actions identified in the plan. These funding sources will not be appropriate for all the mitigation actions identified. For each mitigation action, municipalities should select potential sources from this list, visit the associated website and/or other materials to determine suitability, and look for additional sources if desired. Additional lists of funding sources are identified below.

9.5.2 Additional Federal Resources

A list of some key additional federal resources is included below. For additional resources, see FEMA's Mitigation Resource Guide: https://www.fema.gov/sites/default/files/documents/fema_mitigation-resource-guide.pdf

- FEMA Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program – provides grants for the rehabilitation of eligible high hazard potential dams, in the form of technical, planning, design, and construction assistance. High Hazard Potential Dams are classified in the National Inventory of Dams, and refer to any dam whose failure or mis-operation will cause loss of human life and significant property destruction.
- FEMA Fire Management Assistance Grant – provides funding for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands that threaten to cause a major disaster.
- FEMA Emergency Management Performance Grant (EMPG) – provides federal funds to states to assist state, local, territorial, and tribal governments in preparing for all hazards.
- EPA Environmental Justice Small Grants (EJSG) – awards grants that support community-driven projects designed to engage, educate, and empower communities to better understand local environmental and public health issues and develop strategies for addressing those issues, building consensus in the community, and setting community priorities. The grants can be used for education and outreach about hazard mitigation efforts.
- USDA/NRCS Emergency Watershed Protection Program – offers technical and financial assistance to help local communities mitigate imminent hazards to life and property

caused by floods, fires, windstorms, and other natural occurrences that impair a watershed. Example activities include removing debris from stream channels, road culverts, and bridges; reshaping and protecting eroded streambanks; correcting damaged or destroyed drainage facilities; establishing vegetative cover on critically eroding lands; repairing levees and structures; repairing conservation practices; and purchasing floodplain easements.

- USDA Housing Preservation Grant Program – provides grants to sponsoring organizations for the repair or rehabilitation of low-income and very low-income housing.
- USDA Rural Development Water and Environmental Programs (WEP) – provide technical assistance, loans, grants, and loan guarantees for drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas and cities and towns of 10,000 or less. Often, these projects meet flood mitigation goals.
- USDA Rural Development Community Facilities Loan/Grant Program – Funding to develop essential community facilities in rural areas
- USDA Rural Development Water & Waste Disposal Loan/Grant Program – Funding for drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and stormwater drainage in eligible rural areas.
- Economic Development Administration Disaster Recovery – facilitates the delivery of federal economic development assistance to support long-term community economic recovery planning and project implementation, redevelopment and resiliency. Examples include updating critical water infrastructure needed to protect local businesses from flooding.
- USACE Continuing Authorities Program* – technical assistance that allows the USACE to plan, design, and implement certain types of water resources projects, such as streambank and shoreline protection, hurricane and storm damage reduction projects, and flood damage reduction projects.
- USACE Floodplain Management Services (FPMS) Program* – range of technical services and planning guidance needed to support effective floodplain management.
- USACE Small Flood Control* – technical assistance to plan, design and construct certain small flood control projects that have not already been specifically authorized by Congress. Both structural (levees, channels, or dams, for instance) and nonstructural (floodproofing or evacuation, for example) solutions are considered.
- EPA Smart Growth Support – grant funding and technical assistance to help local governments make their communities more attractive, economically stronger, socially diverse, and more resilient to climate change.
- EPA Clean Water State Revolving Fund (CWSRF) – provides a permanent source of low-cost financing for a wide range of water quality infrastructure projects.
- EPA Greening America's Communities* – helps cities and towns develop an implementable vision of environmentally friendly neighborhoods that incorporate innovative green infrastructure, hazard mitigation, and other sustainable/resilient design strategies.

- NRCS Watershed and Flood Prevention Operations (WFPO) Program – helps governments protect and restore watersheds. This includes watershed projects for the purpose of flood prevention and other goals. Funding supports watershed projects ≤ 250,000 acres. Agricultural benefits, including rural communities, must be ≥ 20% of the total benefits for the project. Projects must have a local sponsor.
- NRCS Watershed Rehabilitation Program (REHAB) – helps project sponsors rehabilitate aging dams that are reaching the end of their design life and/or no longer meet federal or state safety criteria or performance standards. Since 1948, NRCS has assisted local sponsors in constructing over 11,850 dams.

** Denotes a technical assistance program rather than straight funding.*

9.5.3 New York State Funding Resources

A list of some key funding resources administered by New York State is included below. There may be additional resources not on this list that jurisdictions may wish to pursue.

- CDBG Public Infrastructure and Community Planning – Eligible projects for NYS CDBG Public Infrastructure may include the repair or replacement of existing systems, construction of new systems, or expansion of existing systems into areas previously unserved. Funding categories include Public Infrastructure, Public Facilities, and Community Planning. This includes CDBG-MIT for declared disaster areas.
- DEC Water Quality Improvement Project (WQIP) Program – There are eight project types under the WQIP Program. These include Wastewater Treatment Improvement, Non-Agricultural Nonpoint Source Abatement and Control, Vacuum Trucks in Municipal Separate Storm Sewer System (MS4) Areas, Land Acquisition for Source Water Protection, Salt Storage, Dam Safety Repair/Rehabilitation, Aquatic Connectivity Restoration, and Marine District Habitat Restoration. See the project website for funding/match/eligibility/and attachment requirements.
- NYS EFC Water Infrastructure Improvements Grant (WIIA) - projects include water quality infrastructure projects at municipally-owned sewage treatment works OR municipally-owned public water systems for construction, replacement or repair of infrastructure; or compliance with environmental and public health laws and regulations related to water quality.
- NYS EFC Wastewater Infrastructure Engineering Planning Grant (EPG) - planning activities to determine the scope of water quality issues, evaluation of alternatives, and the recommendation of a capital improvement project. In addition, the costs to conduct an environmental review for the recommended alternative are eligible. Design and construction costs are not eligible. Requires a 20% local match.
- NYS EFC Green Innovation Grant Program – funds projects that improve water quality and mitigate the effects of climate change through the implementation of one or more of the following green practices: Green Stormwater Infrastructure, Energy Efficiency, Water Efficiency and Environmental Innovation. See website for details of funding/matching/requirements for each category.

- NYS Hazard Mitigation Revolving Loan Fund (NYS HM RLF) – provide hazard mitigation assistance for local governments to reduce risks from natural hazards and disasters. Priorities for the first year of the program include disadvantaged, underserved, and socially vulnerable areas; cost-share for existing hazard mitigation projects; flood risk reduction; social stabilization; infrastructure retrofit; generators; and projects that are not eligible under other HMA grants due to not passing a benefit cost analysis.
- DOS Smart Growth Comprehensive Planning Grant Program – This program advances the preparation of municipal comprehensive plans, new or updated zoning regulations, or area plans (e.g. transit-oriented development plans or downtown/hamlet area plans) that support smart growth principles. Smart growth principles include development in areas with adequate infrastructure, protection of historic and natural resources, planning for equity, development of clean energy, and more.
- NYS Climate Smart Communities Program – helps local governments take action to reduce greenhouse gas emissions and adapt to a changing climate. Includes funding for various actions incorporating mitigation and climate resiliency into existing local policies, comprehensive planning with sustainability elements, certain transportation infrastructure upgrades, creating a heat emergency plan, and more. The list of actions eligible for competitive funding can be found at https://climatesmart.ny.gov/actions-certification/actions/
- Resilient NY Program – One of the Tioga watersheds, the Rock Creek Watershed, is part of the Resilient NY program. According to the NYS Department of Environmental Conservation, "The Resilient NY program will develop state-of-the-art studies to reduce flooding and ice jam formations, and improve riparian ecology on 48 high-priority flood-prone watersheds throughout New York State" (https://www.dec.ny.gov/lands/121102.html). This may be a source of funding for municipalities within the Rock Creek Watershed.
- DASNY State and Municipal Facilities Program – Funding for projects that support community and economic development
- NYSDEC Urban and Community Forestry Grants – Funding for improving urban and community forest health and increasing the sustainability of forestry programs. Eligible projects include: tree inventories, management plans, tree planting, maintenance, and education programming.
- NYSDOT Bridge NY – Funding for bridge/culvert rehabilitation or replacement
- NYSDOT Consolidated Local Street and Highway Improvement Program (CHIPS) – Funding for municipalities to support the construction and repair of highways, bridges, highway-railroad crossings, and other facilities that are not on the State highway system.
- NYSEFC Clean Water State Revolving Fund – provides interest-free or low-interest rate financing for wastewater and sewer infrastructure projects to municipalities throughout New York State. Eligible projects include: construction or restoration of sewers and wastewater treatment facilities, stormwater management, landfill closures, and habitat restoration and protection projects.

- NYSEFC Drinking Water State Revolving Fund – Financing for drinking water projects. Eligible project include: treatment plants, distribution mains, and storage facilities.
- NYSOCR Community Development Block Grant (CDBG) Program – Financial assistance to eligible cities, towns, and villages with populations under 50,000 and counties with an area population under 200,000 to develop viable communities by providing affordable housing and suitable living environments, as well as expanding economic opportunities, principally for persons of low and moderate income.

10 PLAN MAINTENANCE

10.1 Background

As outlined by FEMA, the Hazard Mitigation Plan will need to change to stay up to date as conditions change, new details become available, or actions progress over time. Key components of the plan maintenance process include:

- Monitoring: Tracking implementation of the plan over time.
- Evaluating: Assessing how well the plan meets its stated purpose and goals.
- Updating: Reviewing and revising the plan at least once every 5 years (FEMA, 2023).

10.2 Plan Monitoring, Evaluation, and Updates

The County staff in the Core Planning Group will integrate discussion and networking opportunities about mitigation actions into the quarterly jurisdictional team meetings. At these meetings, jurisdictions will discuss the implementation of the mitigation plan (including the progress/status of the mitigation actions identified within the Mitigation Strategy), evaluate the effectiveness of the plan, and identify any necessary updates. Additionally, as necessary the County may hold periodic meetings (such as on an annual basis) that delve more in depth into the monitoring, evaluation, and updates to the plan. These periodic meetings may be an opportunity to discuss the implementation of County-specific mitigation actions internally among County officials, as well as the implementation of jurisdictional mitigation actions as necessary.

The primary contacts for each jurisdiction, as indicated in each jurisdictional annex, will be invited to attend the quarterly jurisdictional meetings, as well as annual meetings if the County holds them. It is recognized that with increased growth and the passing of time, there may be changes in County and jurisdiction representatives. Any representative changes will be indicated when the plan is revised.

The Core Planning Group may also meet to evaluate and revise the County's mitigation plan following a major disaster event. This would allow Core Planning Group members to determine if the actions recommended in the plan are appropriate and effective, and to see if any changes are necessary based on the pattern of disaster damages. The Director of the County's Office of Emergency Services is responsible for approving all proposed additions and updates to the plan. The County will keep careful track of any updates that occur to the plan, in order to incorporate them into the 5-year plan updates discussed in Section 10.2.2.

Prior to the quarterly meetings (and annual HMP review meeting if desired), a reminder will be distributed to the primary contacts for each jurisdiction, to address monitoring, evaluation, and updates for each jurisdiction. Representatives will be encouraged to think about topics such as how risks and hazards have changed within their jurisdiction or at the County level, whether the goals, objectives, and actions identified in the plan are effective at addressing the current concerns of their jurisdiction and the County, whether the status of any proposed mitigation actions have changed, and whether additional actions should be included or certain actions

should be excluded. The County may choose to focus on a different topic area for each meeting. The implementation of proposed mitigation actions is important to review in order to determine whether the plan is being executed correctly and to the optimal extent (plan effectiveness). Items that should be reviewed for each mitigation action include the current status of the action, the ultimate cost of the action, the success (if completed action), and the funding sources used for the action.

During the annual plan review meeting, and/or periodically during jurisdictional meetings, the County and each jurisdiction will provide an update to the group of their review of the plan and the implementation details for the proposed mitigation actions that apply to their jurisdiction. Meeting notes will be documented at each meeting, which will include specific details associated with any proposed changes to the plan. During re-approval years (every five years), the revised plan will be submitted to FEMA for re-approval in accordance with the five-year review schedule dictated in the Disaster Mitigation Act of 2000 (DMA 2000), as detailed in Section 10.2.2.

10.2.1 Plan Evaluation

As discussed above, plan evaluation will be included as part of the quarterly jurisdictional meetings and/or annual meetings. While monitoring should happen on a regular basis (e.g. at quarterly meetings), plan evaluation may happen less frequently (e.g. once per year). Staff members from the Core Planning Group will be responsible for facilitating discussions of plan effectiveness and documenting the results.

Criteria for evaluating the effectiveness of the plan may include:

- Where are you in terms of reaching your mitigation goals?
- Are the goals and objectives of the plan still relevant?
- Has the level of risk or impacts changed since the last update?
- What is the status of your previous mitigation plan? When does the plan expire? Did your jurisdiction adopt the plan?
- Are there enough resources (funds, people, or programs) to carry out the plan?
- What outcomes can you reference to show progress? Were any of them different from what you expected?

These criteria are subject to modification, for example, if the Core Planning Group or jurisdictions feel that these criteria should be changed as more insights are gained during plan evaluation.

10.2.2 5-Year Updates

In addition to the potential updates that may occur within the 5 year period, as discussed above, the County will update the Hazard Mitigation plan at least once every 5 years in accordance with FEMA guidelines. These plan updates will follow the entire planning process, as outlined by FEMA (FEMA, 2023):

- Convene a planning team and complete stakeholder and public outreach.

- Identify new plans, studies, reports and technical information that pertain to the County's vulnerabilities.
- Validate or update the hazard list.
- Update hazard profiles to include events that occurred since the last plan.
- Validate or update community capabilities.
- Validate or update community assets.
- Update the risk assessment based on the above.
- Update the mitigation strategy based on the new risk assessment.
- Address changes in development and changes in priorities.
- Document and describe the plan update process.

The proposed HMP 5-year review schedule will be completed as follows:

- County staff in the Core Planning Group will meet with jurisdiction representatives regularly within the 5-year period, as discussed above in Section 10.1. Meeting discussions will be documented, including proposed changes to the plan. An annual update checklist is provided in Appendix G, which will be referenced during these meetings. All discussion and proposed changes will be kept in Appendix G.
- The Core Planning Group will meet approximately 18 months prior to the plan's expiration date to begin the process of updating and revising all elements of the plan. Discussion items may include creating a schedule of updates, identifying who will conduct the updates (whether completing them internally or hiring a contractor), and pursuing funding sources as necessary. Additionally, the Core Planning Group may discuss how to incorporate any feedback and updates that have arisen within the last 5 years, as discussed above in Section 10.1.
- Over those 18 months, the Core Planning Group will work to update the plan as outlined above and produce a final revised document.
- This updated plan will be presented to the boards of each participating jurisdiction in order for each jurisdiction to formally concur with and adopt the proposed changes.
- Once all participating jurisdictions have re-adopted the HMP, the revised plan will be submitted to FEMA for re-approval.

Questions to consider during the update period may include:

- How has the planning area changed since the last update, including assets?
- What worked well for the planning process last time?
- What might need to change?
- Are there other stakeholders or members of the public you can engage?
- What new data would be most helpful to inform the plan update?
- Have there been any recent major disaster events? (FEMA, 2023)

10.3 Incorporation into Planning Mechanisms

Currently, Tioga County takes steps to ensure that Hazard Mitigation Planning is incorporated into planning mechanisms. If a municipality is updating its comprehensive plan, the Tioga County Office of Economic Development & Planning ensures that the municipality refers to the HMP. Additionally, development proposals that are located within the floodplain must be reviewed by the Code Enforcement Officer.

In the future, elements of the HMP will be considered as the County and municipalities undertake future development and comprehensive planning efforts. The approved HMP will also serve as an important resource for developing and/or updating emergency operations plans and procedures throughout Tioga County. The County's HMP update will be incorporated into and referenced by future updates of existing plans, policies, ordinances, and programs listed in Section 3 of the County's annex and each municipality's annex (Appendix A). It may also be used for creating new regulations as applicable. County efforts may include adding hazard mitigation as an agenda item at County meetings where laws are being developed or updated, including hazard mitigation considerations in any templates used to make new laws, making local officials aware of the need to consider hazard mitigation in any plan updates, or other initiatives. All of these actions will help expand and improve upon these existing capabilities so that they reduce risk and better support hazard mitigation.

Table 10-1 summarizes methods for incorporating the HMP update into the existing and future planning mechanisms and opportunities at the County and municipal levels. Additional detail is given in Section 3 of each jurisdiction's annex, which lists individual jurisdiction's existing capabilities related to hazard mitigation, opportunities to integrate the mitigation plan into other planning mechanisms for each jurisdiction, the process that will be followed to do so, and opportunities for each jurisdiction to expand and improve the identified capabilities to achieve mitigation.

Table 10-1. Planning Mechanism Incorporation

Mechanism	How Plan Will be Incorporated
Emergency Planning	Hazard risk assessment and vulnerability data included in the mitigation plan will be reviewed during emergency planning.
Annual Budget	Mitigation actions will be considered when setting the annual budgets for the County, Soil & Water Conservation District, and all participating jurisdictions.
Plans and Programs	Hazard Mitigation Plan information will be considered by each participating jurisdiction during program and protection updates and revisions. Programs and plans will be compared to the Hazard Mitigation Plan to ensure that goals and objectives are consistent among all documents.
Grant Applications and other Funding Opportunities	Data and maps from the HMP will be used as supporting documentation in grant applications. Mitigation actions included in the Plan will be heavily considered during application submission and fund allocation.
Economic Development	Hazard vulnerability information will be reviewed and utilized during the siting of local development efforts within participating jurisdictions.
Capital Improvement Planning	Current and future projects will be reviewed for hazard vulnerability. Hazard resistant construction standards will be incorporated into the design and location of potential projects, as appropriate.

10.4 Public Involvement

The Core Planning Group will keep the public informed about hazard mitigation planning efforts, actions, and projects that occur within the County. To accomplish this goal, and in addition to the public involvement already incorporated into the completion and review of the HMP Update (as described in Section 3 and the Community Engagement Plan in Appendix C), the following opportunities for public involvement in this ongoing process will be made available:

- A link to the updated HMP will be provided on Tioga County's website;
- Public announcements of and invitations to a selection of the quarterly jurisdictional meetings and 5-year mitigation plan update events; and
- Completion of public outreach and mitigation education events or other activities throughout the County, especially in more vulnerable areas.

Public outreach efforts will be documented in future plan updates through the inclusion of samples, copies of notices, flyers, web announcements, and/or meeting minutes. If public response is lacking during subsequent update processes, additional public outreach methods will be considered and implemented. Coordination efforts between the Tioga County Office of Emergency Services and jurisdiction representatives will continue to keep the plan current and useful. Public outreach options that may be implemented to increase participation include:

- Distribute targeted questionnaires to local municipal, community, and non-profit groups to solicit public feedback;
- Organize topic-specific meetings with key individuals and experts to discuss particular concerns and brainstorm solutions; and
- Hold educational programs during various community events to disseminate information and engage the public in discussions on mitigation planning and preparedness.

Each participating jurisdiction's plans to continue to seek future public participation after the plan has been approved are listed in Section 8 of each jurisdictional annex.

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