5.4.4 Flood

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

5.4.4.1 Hazard Profile

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

Hazard Description

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

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

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

Riverine (Inland) and Flash Flooding

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

Flash floods are defined by the National Weather Service as "A flood caused by heavy or excessive rainfall in a short period of time, generally less than 6 hours. Flash floods are usually characterized by raging torrents after heavy rains that rip through river beds, urban streets, or mountain canyons sweeping everything before them. They can occur within minutes or a few hours of excessive rainfall. They can also occur even if no rain has fallen, for instance after a levee or dam has failed, or after a sudden release of water by a debris or ice jam." (National Weather Service [NWS], n.d.).

Stormwater Flooding

Stormwater flooding described below is due to local drainage issues and high groundwater levels. Locally, heavy precipitation may produce flooding in areas other than delineated floodplains or along recognizable channels. If local conditions cannot accommodate intense precipitation through a combination of infiltration and

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surface runoff, water may accumulate and cause flooding problems. During winter and spring, frozen ground and snow accumulations may contribute to inadequate drainage and localized ponding. Flooding issues of this nature generally occur in areas with flat gradients and generally increase with urbanization which speeds the accumulation of floodwaters because of impervious areas. Shallow street flooding can occur unless channels have been improved to account for increased flows (FEMA 1997).

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

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

Ice Jam Flooding

An ice jam occurs when pieces of floating ice are carried with a stream's current and accumulate behind any obstruction to the stream flow. Obstructions may include river bends, mouths of tributaries, points where the river slope decreases, as well as dams and bridges. The water held back by this obstruction can cause flooding upstream, and if the obstruction suddenly breaks, flash flooding can occur as well (NOAA 2013). The formation of ice jams depends on the weather and physical condition of the river and stream channels. They are most likely to occur where the channel slope naturally decreases, in culverts, and along shallows where channels may freeze solid. Ice jams and resulting floods can occur during at different times of the year: fall freeze-up from the formation of frazil ice; mid-winter periods when stream channels freeze solid, forming anchor ice; and spring breakup when rising water levels from snowmelt or rainfall break existing ice cover into pieces that accumulate at bridges or other types of obstructions (USACE 2002).

Ice Jams
At a Glance

- ✓ **Freeze-up jams occur when floating ice may slow or stop due to a change in water slope as it reaches an obstruction to movement.**
- ✓ **Breakup jams occur during periods of thaw, generally in late winter and early spring.**

Dam and Levee Failure Flooding

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

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

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

Flood Control Measures

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

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

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

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

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

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

Extent

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

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

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

- Moderate Flooding – some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding – extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations (NWS 2011).

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

- *Low Hazard (Class A)* is a dam located in an area where failure will damage nothing more than isolated buildings, undeveloped lands, or township or county roads and/or will cause no significant economic loss or serious environmental damage. Failure or mis-operation would result in no probable loss of human life. Losses are principally limited to the owner's property
- *Intermediate Hazard (Class B)* is a dam located in an area where failure may damage isolated homes, main highways, minor railroads, interrupt the use of relatively important public utilities, and/or will cause significant economic loss or serious environmental damage. Failure or mis-operation would result in no probable loss of human life, but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
- *High Hazard (Class C)* is a dam located in an area where failure may cause loss of human life, serious damage to homes, industrial or commercial buildings, important public utilities, main highways or railroads and/or will cause extensive economic loss. This is a downstream hazard classification for dams in which excessive economic loss (urban area including extensive community, industry, agriculture, or outstanding natural resources) would occur as a direct result of dam failure.
- *Negligible or No Hazard (Class D)* is (1) a dam that has been breached or removed, or has failed or otherwise no longer materially impounds waters, or (2) a dam that was planned but never constructed. Class "D" dams are considered to be defunct dams posing negligible or no hazard. The department may retain pertinent records regarding such dams.

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

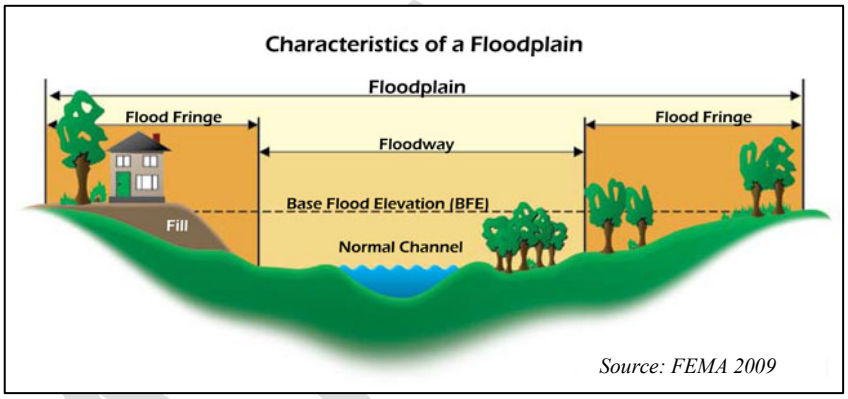
In addition, dam failures can significantly impact the operation and use of the reservoir/pool area, including consequences such as economic, environmental or social impacts of losing the source of drinking water or the recreational use of the pooled water.

The environmental impacts of a dam or levee failure can include significant water-quality and debris-disposal issues. Flood waters can back up sanitary sewer systems and inundate wastewater treatment plants,

causing raw sewage to contaminate residential and commercial buildings and the flooded waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals get added to flood waters. Hazardous materials may be released and distributed widely across the floodplain. Water supply and wastewater treatment facilities could be offline for weeks. After the flood waters subside, contaminated and flood-damaged building materials and contents must be properly disposed of. Contaminated sediment must be removed from buildings, yards, and properties. In addition, severe erosion is likely; such erosion can negatively impact local ecosystems.

Location

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



Floodplains

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

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

Flood Map Terms

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

Flood zones in Chenango County are depicted on the FEMA Flood Insurance Rate Map (FIRM). A digital version of the FIRM is illustrated in Figure 5.4.4-1 and the total land area in the floodplain, inclusive of waterbodies, is summarized in Table 5.4.4-1 Refer to Section 9 for a map of each jurisdiction depicting the floodplains. Flood hazard zones occur throughout Chenango County. Floodways and flood zones are most

prevalent along the Chenango River. The Digital Flood Insurance Rate Map (DFIRM) data provided by FEMA can be found online on the FEMA website and the Chenango County Planning & Development website (https://www.co.chenango.ny.us/planning/flood-information/). The DFIRMs for Chenango County show the following flood hazard areas:

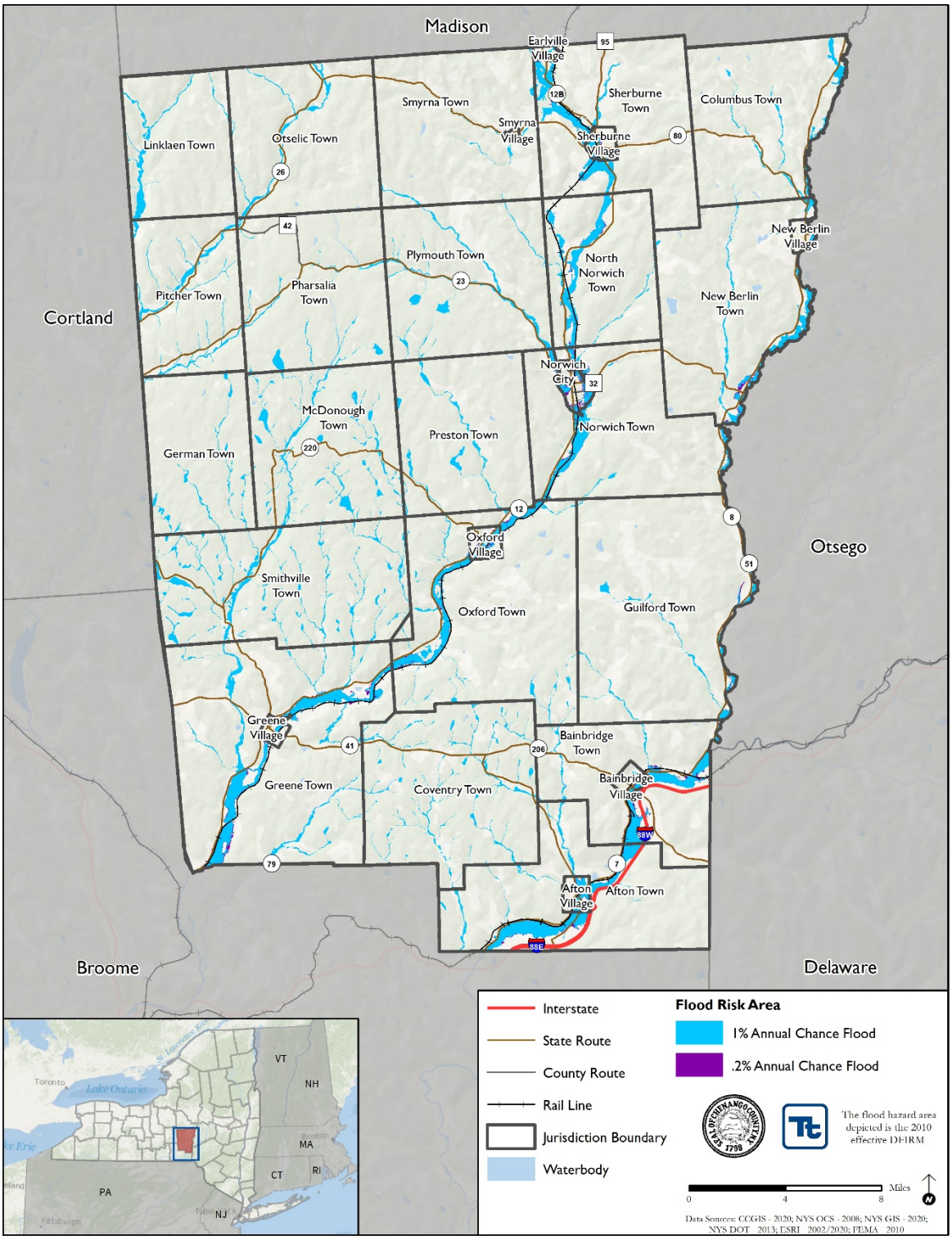
- 1-Percent Annual Chance Flood Hazard: Areas subject to inundation by the 1-percent-annual-chance flood event. This includes Zone A and Zone AE. Mandatory flood insurance requirements and floodplain management standards apply. Base flood elevations are provided in Zone AE. Zone A has no determined flood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

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

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

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

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



Riverine/Flash Flooding/Stormwater Flooding

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

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

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

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

Flood Gages

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

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

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

Table 5.4.4-2. Stream Gage Statistics for Chenango County

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

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

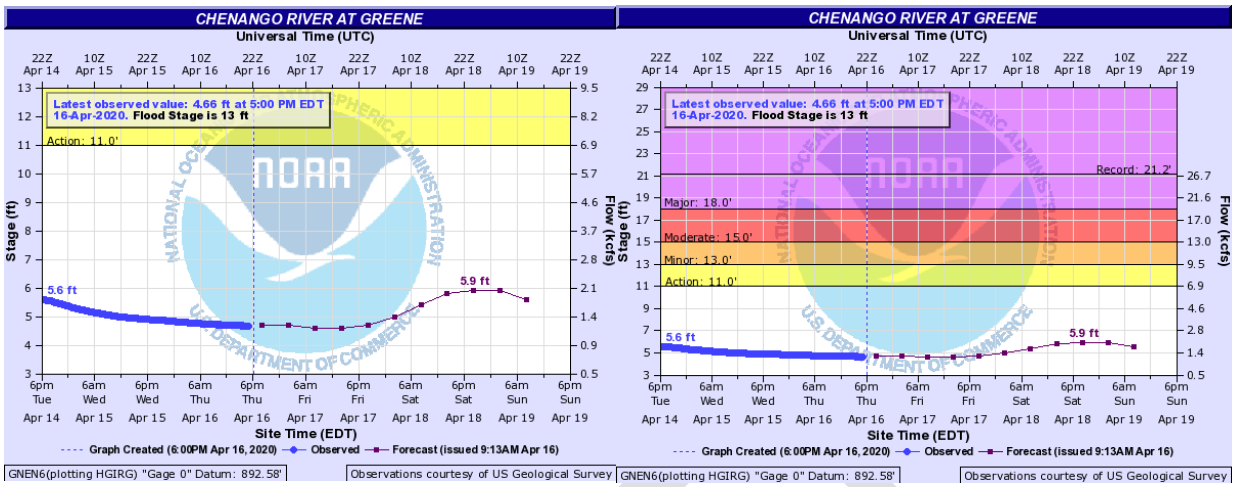
Water Level Data

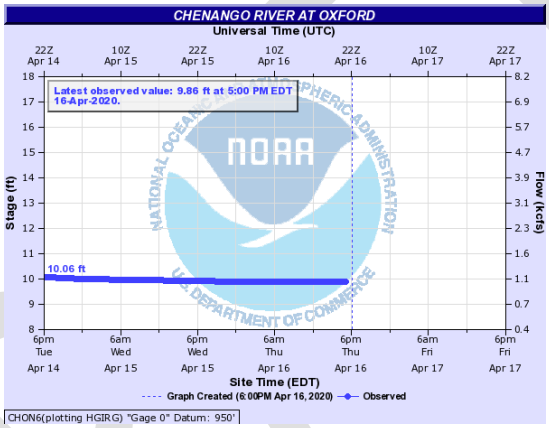
A hydrograph shows how a water level changes over time at a specific location to enable a review of historic water levels which are useful in floodplain management planning. In Chenango County, six of the seven gages provide the probabilistic and deterministic forecast for specific bodies of water. These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

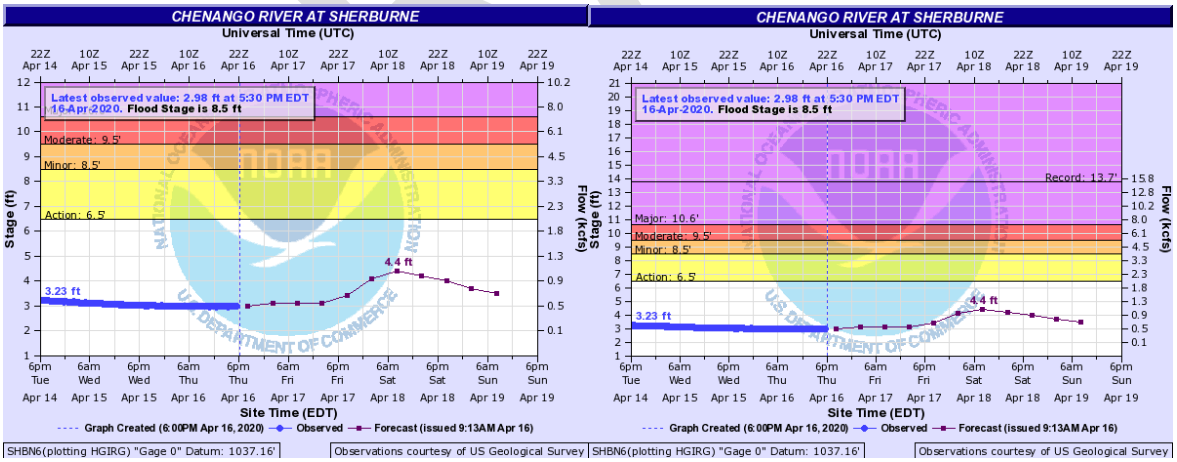
- Action Stage - the stage which; when reached by a rising stream, lake, or reservoir represents the level where the NWS or a partner/user needs to take some type of mitigation action in preparation for possible significant hydrologic activity.
- Minor Flooding - minimal or no property damage, but possibly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

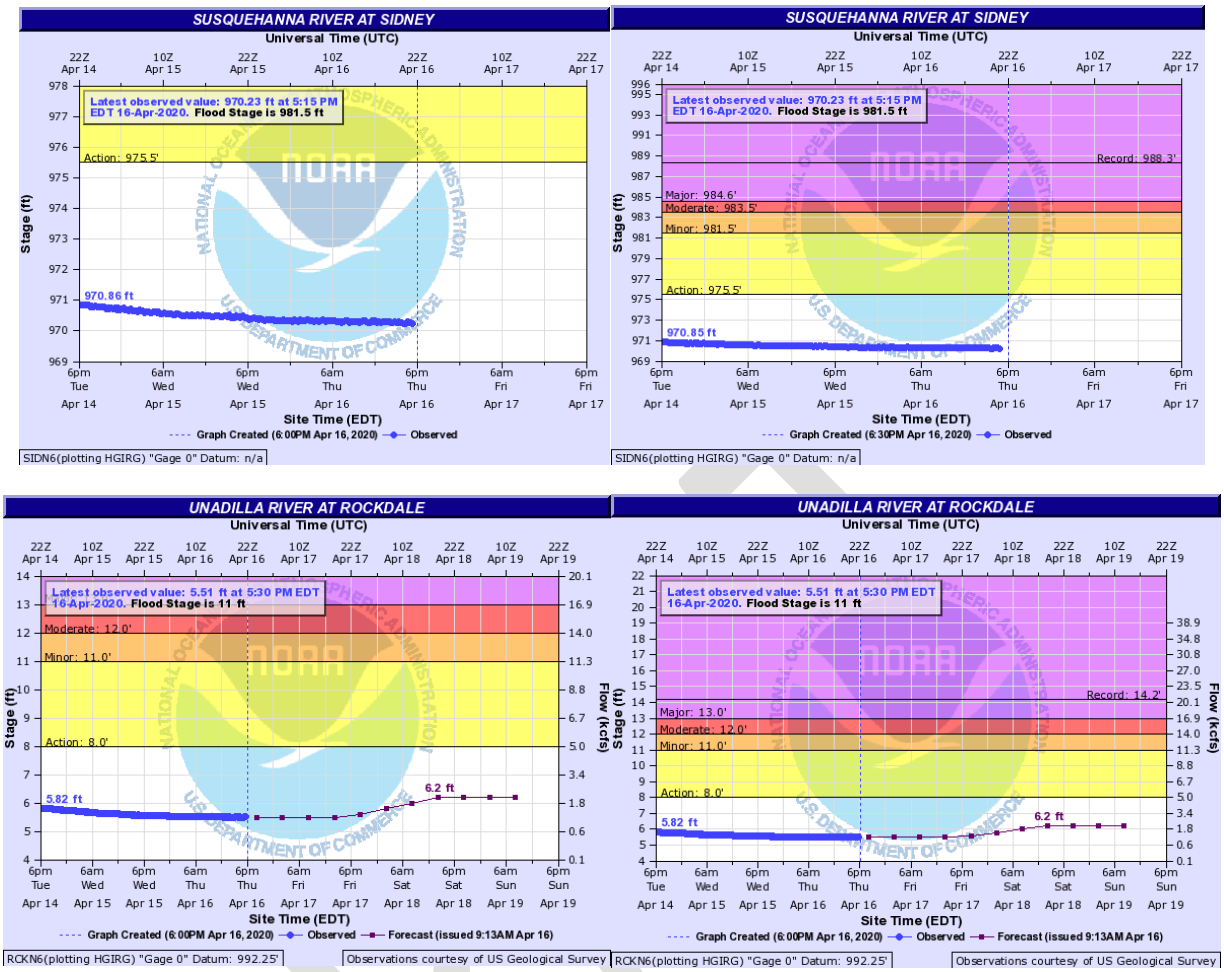
To illustrate the data available, screenshots of the gages are provided in Figure 5.4.4-2. Table 5.4.4-2 provides the action, minor, moderate, and major flood stages for each gage.

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









Source: NOAA 2020

Ice Jam Flooding

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

Dam Failure

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

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

Levee Failure

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

Previous Occurrences and Losses

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

Table 5.4.4-3. Flood Events 2015 – 2020

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

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

FEMA Disaster Declarations

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

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

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

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

Source: FEMA 2020

USDA Declarations

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

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

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

Previous Events

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

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

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

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

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

Climate Change Projections

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

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

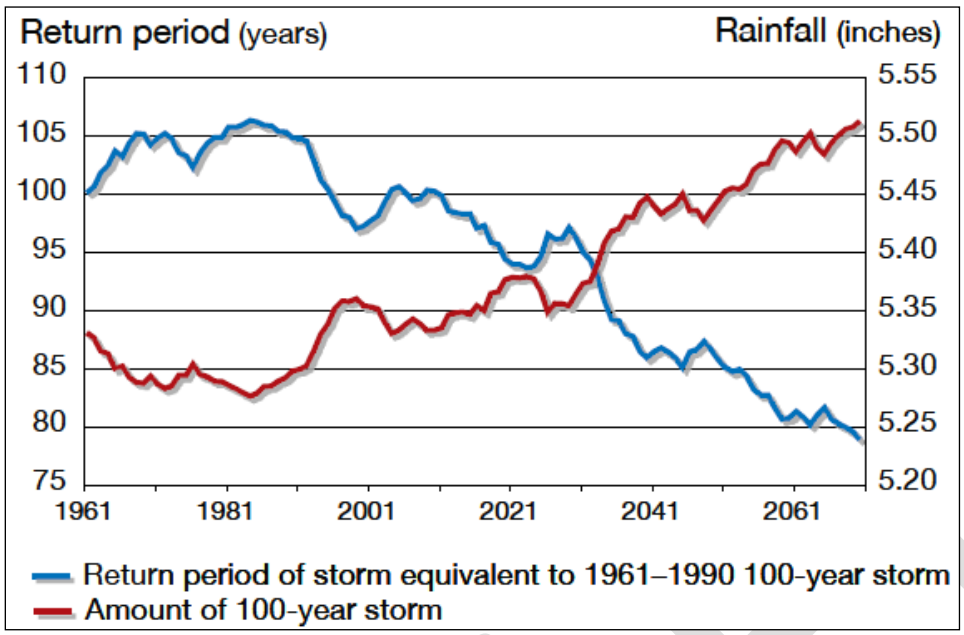
Winter	Spring	Summer	Fall
+5 to +15	0 to +15	-10 to +10	-5 to +10

Source:NYSERDA 2011

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

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

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



Source:NYSERDA 2011

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

Probability of Future Occurrences

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

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

Dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes, landslides, and excessive rainfall and snowmelt. However, the risk of such an event increases for each dam as the dam's age increases and/or frequency of maintenance decreases. Chenango County has not experienced recent dam failures, but the potential for dam failures may increase.

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

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

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

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

Climate change is expected to increase the severity and frequency of heavy rain events in Chenango County. This will likely lead to an increase in flooding events, dam failure events, and levee failure events. In Section 5.3, the identified hazards of concern for Chenango County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Committee, the probability of occurrence for flood in the County is considered 'frequent' (100% annual probability; a hazard event may occur multiple times per year).

5.4.4.2 Vulnerability Assessment

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

Impact on Life, Health and Safety

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

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

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

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

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

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

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

As with other hazards, research has shown that some populations, while they may not have more hazard exposure, may experience exacerbated impacts and prolonged recovery if/when impacted. This is due to many factors including their physical and financial ability to react or respond during a hazard. Of the population exposed, the most vulnerable include the economically disadvantaged and the population over age 65.

Economically disadvantaged populations may be more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on net economic impacts on their families. The population over age 65 is also more vulnerable because they are more likely to seek or need medical attention that may not be available due to isolation during a flood event, and they may have more difficulty evacuating. Within Chenango County, there are approximately 9,539 people over the age of 65 and 6,826 people below the poverty level (American Community Survey 2018).

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

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

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

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

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

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

Total number of injuries and casualties resulting from typical riverine and tidal flooding are generally limited based on advance weather forecasting, blockades, and warnings. Injuries and deaths generally are not anticipated if proper warning and precautions occur. In contrast, warning time for flash flooding is limited. These events are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event are highly vulnerable to this hazard.

Cascading impacts of flooding and dam failure inundation may also include exposure to pathogens such as mold. After flood events, excess moisture and standing water contribute to the growth of mold in buildings. Mold may present a health risk to building occupants, especially those with already compromised immune systems such as infants, children, the elderly and pregnant women. The degree of impact will vary and is not strictly measurable. Mold spores can grow in as short a period as 24-48 hours in wet and damaged areas of buildings that have not been properly cleaned. Very small mold spores can easily be inhaled, creating the potential for allergic reactions, asthma episodes, and other respiratory problems. Buildings should be properly cleaned and dried out to safely prevent mold growth (CDC 2015).

Molds and mildews are not the only public health risk associated with flooding. Floodwaters can be contaminated by pollutants such as sewage, human and animal feces, pesticides, fertilizers, oil, asbestos, and rusting building materials. Common public health risks associated with flood events also include:

- Unsafe food
- Contaminated drinking and washing water and poor sanitation
- Mosquitos and animals
- Carbon monoxide poisoning
- Secondary hazards associated with re-entering/cleaning flooded structures
- Mental stress and fatigue

Other impacts include the impact the operation and use of the reservoir/pool area, including consequences such as economic, environmental or social impacts of losing the source of drinking water or the recreational use of the pooled water.

Current loss estimation models such as HAZUS v4.2 are not equipped to measure public health impacts. The best level of mitigation for these impacts is to be aware that they can occur, educate the public on prevention, and be prepared to deal with these vulnerabilities in responding to flood events.

Impact on General Building Stock

Exposure to the flood hazard includes those buildings located in the flood zone or those that are built downstream in other flood inundation areas such as dam failure inundation areas. Potential damage is the modeled loss that could occur to the exposed inventory measured by the structural and content replacement cost value. For dam failures, vulnerable properties are those located closest to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are where

the dam waters would collect. Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues. This includes all roads, railroads and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

There are an estimated 1,928 buildings located in the 1-percent annual chance flood event hazard area with a value of approximately $1.5 billion of building and contents (based on replacement cost value). This represents approximately 6.7-percent of the County's total general building stock inventory replacement cost value (approximately $23 billion). The City of Norwich has the greatest percentage of its buildings located in the 1-percent annual chance flood hazard area; 26.1-percent or 653 buildings of its total building stock. Refer to Table 5.4.4-11 for a summary of 1-percent and 0.2-percent flood inundation area exposure results by jurisdiction. Table 5.4.4-12 and Table 5.4.4-13 break down the 1-percent and 0.2-percent annual chance flood event exposure results for residential structures and commercial structures, respectively.

Furthermore, HAZUS v4.2 estimates approximately $385 million in building and content damage as a result of the 1-percent annual chance flood event (or 1.7-percent of the total building stock replacement cost value). Of the $385 million in potential loss, approximately $179 million losses are estimated to occur to residential structures. Refer to Table 5.4.4-14 for the potential losses from the 1-percent annual chance flood event for all occupancies estimated by jurisdiction. Table 5.4.4-15 and Table 5.4.4-16 summarize HAZUS v4.2 estimated damages for residential and commercial occupancy classes, respectively.

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Table 5.4.4-11 Estimated General Building Stock Exposure to the 1-Percent and 0.2-Percent Annual Chance Flood Events

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value	Total (All Occupancies)							
			1-Percent Annual Chance Flood Event				0.2-Percent Annual Chance Flood Event			
			Number of Buildings	Percent Total	Replacement Cost Value	Percent Total	Number of Buildings	Percent Total	Replacement Cost Value	Percent Total
Afton (T)	1,609	$864,699,700	119	7.4%	$36,115,005	4.2%	150	9.3%	$49,701,664	5.7%
Afton (V)	531	$1,019,188,804	38	7.2%	$20,955,341	2.1%	44	8.3%	$22,821,040	2.2%
Bainbridge (T)	1,493	$915,529,770	118	7.9%	$115,049,176	12.6%	160	10.7%	$141,140,585	15.4%
Bainbridge (V)	697	$584,957,184	97	13.9%	$79,389,837	13.6%	119	17.1%	$89,401,285	15.3%
Columbus (T)	748	$862,354,994	5	0.7%	$4,176,818	0.5%	5	0.7%	$4,176,818	0.5%
Coventry (T)	1,255	$703,237,371	8	0.6%	$4,328,203	0.6%	8	0.6%	$4,328,203	0.6%
Earlville (V)	155	$87,153,360	1	0.6%	$525,506	0.6%	1	0.6%	$525,506	0.6%
German (T)	395	$203,106,925	1	0.3%	$1,028,728	0.5%	1	0.3%	$1,028,728	0.5%
Greene (T)	2,711	$1,319,736,091	68	2.5%	$22,776,664	1.7%	95	3.5%	$39,433,051	3.0%
Greene (V)	700	$686,754,321	119	17%	$60,392,164	8.8%	144	20.6%	$83,227,435	12.1%
Guilford (T)	1,963	$1,010,987,220	68	3.5%	$22,702,682	2.2%	77	3.9%	$25,952,697	2.6%
Lincklaen (T)	398	$229,671,722	9	2.3%	$12,120,294	5.3%	9	2.3%	$12,120,294	5.3%
McDonough (T)	807	$339,089,552	10	1.2%	$3,219,651	0.9%	10	1.2%	$3,219,651	0.9%
New Berlin (T)	1,225	$778,713,525	25	2%	$9,426,480	1.2%	34	2.8%	$11,968,060	1.5%
New Berlin (V)	411	$432,605,770	38	9.2%	$15,886,500	3.7%	43	10.5%	$16,937,996	3.9%
North Norwich (T)	1,121	$823,054,726	32	2.9%	$19,174,444	2.3%	41	3.7%	$24,315,645	3.0%
Norwich (C)	2,503	$3,140,959,099	653	26.1%	$396,912,362	12.6%	919	36.7%	$580,974,687	18.5%
Norwich (T)	2,013	$2,080,430,801	42	2.1%	$169,089,308	8.1%	70	3.5%	$208,641,337	10.0%
Otselic (T)	741	$461,373,250	32	4.3%	$39,724,613	8.6%	32	4.3%	$39,724,613	8.6%
Oxford (T)	1,731	$958,330,880	45	2.6%	$23,830,203	2.5%	48	2.8%	$25,493,317	2.7%
Oxford (V)	648	$679,367,779	132	20.4%	$220,600,502	32.5%	191	29.5%	$271,465,414	40.0%
Pharsalia (T)	583	$389,863,952	2	0.3%	$565,766	0.1%	2	0.3%	$565,766	0.1%
Pitcher (T)	609	$315,344,531	11	1.8%	$2,884,347	0.9%	11	1.8%	$2,884,347	0.9%
Plymouth (T)	1,244	$510,829,645	43	3.5%	$24,684,346	4.8%	43	3.5%	$24,684,346	4.8%
Preston (T)	782	$348,948,426	5	0.6%	$852,422	0.2%	5	0.6%	$852,422	0.2%
Sherburne (T)	1,463	$1,113,221,738	95	6.5%	$83,328,426	7.5%	105	7.2%	$89,795,960	8.1%
Sherburne (V)	611	$768,785,678	84	13.7%	$111,758,641	14.5%	116	19%	$175,470,530	22.8%
Smithville (T)	1,032	$690,983,617	19	1.8%	$15,126,536	2.2%	19	1.8%	$15,126,536	2.2%
Smyrna (T)	842	$519,858,907	8	1%	$2,298,338	0.4%	11	1.3%	$3,058,326	0.6%
Smyrna (V)	99	$161,456,951	1	1%	$19,452,136	12.0%	1	1.0%	$19,452,136	12.0%
Chenango County (Total)	**31,120**	**$23,000,596,289**	**1,928**	**6.2%**	**$1,538,375,439**	**6.7%**	**2,514**	**8.1%**	**$1,988,488,395**	**8.6%**

Sources: FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

Table 5.4.4-12 Estimated General Building Stock Exposure to the 1-percent and 0.2- Percent Annual Chance Flood Events – Residential Occupancy Class

Jurisdiction	Total Number of Buildings (Residential Structures Only)	Total Replacement Cost Value (Residential Structures Only)	Residential							
			1-Percent Annual Chance Flood Event				0.2-Percent Annual Chance Flood Event			
			Number of Buildings	Percent Total	Replacement Cost Value	Percent Total	Number of Buildings	Percent Total	Replacement Cost Value	Percent Total
Afton (T)	1,331	$532,628,331	116	8.7%	$34,101,102	6.4%	147	11.0%	$47,687,761	9.0%
Afton (V)	467	$252,492,985	35	7.5%	$18,819,483	7.5%	40	8.6%	$20,163,450	8.0%
Bainbridge (T)	1,160	$455,185,271	84	7.2%	$40,820,548	9.0%	114	9.8%	$56,742,216	12.5%
Bainbridge (V)	611	$263,652,093	83	13.6%	$52,086,574	19.8%	102	16.7%	$59,997,722	22.8%
Columbus (T)	446	$168,681,001	2	0.4%	$903,873	0.5%	2	0.4%	$903,873	0.5%
Coventry (T)	875	$314,112,125	6	0.7%	$2,996,294	1.0%	6	0.7%	$2,996,294	1.0%
Earlville (V)	137	$55,895,731	1	0.7%	$525,506	0.9%	1	0.7%	$525,506	0.9%
German (T)	350	$162,861,915	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Greene (T)	2,498	$947,905,937	61	2.4%	$18,848,201	2.0%	83	3.3%	$29,625,955	3.1%
Greene (V)	587	$292,279,720	96	16.4%	$38,166,741	13.1%	118	20.1%	$47,088,178	16.1%
Guilford (T)	1,719	$638,935,588	65	3.8%	$21,352,916	3.3%	74	4.3%	$24,602,931	3.9%
Lincklaen (T)	332	$143,981,313	4	1.2%	$1,442,726	1.0%	4	1.2%	$1,442,726	1.0%
McDonough (T)	674	$221,651,844	7	1.0%	$2,058,704	0.9%	7	1.0%	$2,058,704	0.9%
New Berlin (T)	1,017	$421,229,852	22	2.2%	$7,370,621	1.7%	31	3.0%	$9,912,201	2.4%
New Berlin (V)	350	$175,364,889	31	8.9%	$9,991,156	5.7%	34	9.7%	$10,175,717	5.8%
North Norwich (T)	949	$354,209,855	25	2.6%	$6,898,859	1.9%	31	3.3%	$10,442,922	2.9%
Norwich (C)	2,258	$1,220,883,174	604	26.7%	$253,362,615	20.8%	851	37.7%	$360,445,191	29.5%
Norwich (T)	1,638	$674,132,460	14	0.9%	$8,356,269	1.2%	24	1.5%	$13,808,571	2.0%
Otselic (T)	587	$222,023,439	24	4.1%	$9,108,012	4.1%	24	4.1%	$9,108,012	4.1%
Oxford (T)	1,432	$550,797,506	36	2.5%	$9,598,473	1.7%	39	2.7%	$11,261,587	2.0%
Oxford (V)	579	$284,337,570	102	17.6%	$72,886,556	25.6%	150	25.9%	$101,140,088	35.6%
Pharsalia (T)	446	$177,916,135	2	0.4%	$565,766	0.3%	2	0.4%	$565,766	0.3%
Pitcher (T)	526	$198,731,400	11	2.1%	$2,884,347	1.5%	11	2.1%	$2,884,347	1.5%
Plymouth (T)	1,140	$401,094,276	40	3.5%	$14,470,454	3.6%	40	3.5%	$14,470,454	3.6%
Preston (T)	705	$268,708,818	5	0.7%	$852,422	0.3%	5	0.7%	$852,422	0.3%
Sherburne (T)	1,194	$428,762,759	73	6.1%	$16,536,856	3.9%	81	6.8%	$19,909,413	4.6%
Sherburne (V)	489	$322,999,342	55	11.2%	$33,260,343	10.3%	79	16.2%	$56,658,156	17.5%
Smithville (T)	844	$307,073,880	12	1.4%	$7,824,195	2.5%	12	1.4%	$7,824,195	2.5%
Smyrna (T)	577	$202,741,399	8	1.4%	$2,298,338	1.1%	10	1.7%	$2,570,742	1.3%
Smyrna (V)	75	$32,182,528	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Chenango County (Total)	**25,993**	**$10,693,453,136**	**1,624**	**6.2%**	**$688,387,949**	**6.4%**	**2,122**	**8.2%**	**$925,865,101**	**8.7%**

Sources: FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

Table 5.4.4-13 Estimated General Building Stock Exposure to the 1-percent and 0.2- Percent Annual Chance Flood Events – Commercial Occupancy Class

Jurisdiction	Total Number of Buildings (Commercial Buildings Only)	Total Replacement Cost Value (Commercial Buildings Only)	Commercial							
			1-Percent Annual Chance Flood Event				0.2-Percent Annual Chance Flood Event			
			Number of Buildings	Percent Total	Replacement Cost Value	Percent Total	Number of Buildings	Percent Total	Replacement Cost Value	Percent Total
Afton (T)	178	$224,686,376	1	0.6%	$516,365	0.2%	1	0.6%	$516,365	0.2%
Afton (V)	46	$626,789,923	3	6.5%	$2,135,857	0.3%	3	6.5%	$2,135,857	0.3%
Bainbridge (T)	278	$382,755,751	31	11.2%	$72,270,317	18.9%	39	14.0%	$80,124,760	20.9%
Bainbridge (V)	70	$227,455,479	14	20.0%	$27,303,263	12.0%	16	22.9%	$29,143,893	12.8%
Columbus (T)	228	$307,604,344	3	1.3%	$3,272,945	1.1%	3	1.3%	$3,272,945	1.1%
Coventry (T)	294	$291,804,567	2	0.7%	$1,331,910	0.5%	2	0.7%	$1,331,910	0.5%
Earlville (V)	15	$24,418,874	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
German (T)	3	$1,570,759	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Greene (T)	87	$134,744,128	5	5.7%	$3,136,487	2.3%	9	10.3%	$8,804,115	6.5%
Greene (V)	77	$193,731,718	17	22.1%	$18,312,270	9.5%	19	24.7%	$20,509,784	10.6%
Guilford (T)	70	$110,600,841	3	4.3%	$1,349,766	1.2%	3	4.3%	$1,349,766	1.2%
Lincklaen (T)	3	$4,739,651	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
McDonough (T)	91	$87,272,473	3	3.3%	$1,160,947	1.3%	3	3.3%	$1,160,947	1.3%
New Berlin (T)	49	$52,373,678	1	2.0%	$915,408	1.7%	1	2.0%	$915,408	1.7%
New Berlin (V)	43	$193,638,738	6	14.0%	$5,118,630	2.6%	8	18.6%	$5,985,565	3.1%
North Norwich (T)	55	$115,449,824	5	9.1%	$10,525,498	9.1%	5	9.1%	$10,525,498	9.1%
Norwich (C)	192	$1,532,435,436	39	20.3%	$105,918,322	6.9%	54	28.1%	$178,710,040	11.7%
Norwich (T)	178	$929,743,052	9	5.1%	$49,967,180	5.4%	12	6.7%	$59,647,276	6.4%
Otselic (T)	36	$54,493,865	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Oxford (T)	21	$27,632,031	2	9.5%	$2,713,529	9.8%	2	9.5%	$2,713,529	9.8%
Oxford (V)	45	$284,832,722	21	46.7%	$122,431,682	43.0%	32	71.1%	$145,043,062	50.9%
Pharsalia (T)	12	$19,289,849	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Pitcher (T)	8	$12,758,503	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Plymouth (T)	18	$19,198,236	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%

Jurisdiction	Total Number of Buildings (Commercial Buildings Only)	Total Replacement Cost Value (Commercial Buildings Only)	Commercial							
			1-Percent Annual Chance Flood Event				0.2-Percent Annual Chance Flood Event			
			Number of Buildings	Percent Total	Replacement Cost Value	Percent Total	Number of Buildings	Percent Total	Replacement Cost Value	Percent Total
Preston (T)	3	$2,898,859	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Sherburne (T)	61	$184,539,835	20	32.8%	$59,702,820	32.4%	22	36.1%	$62,797,797	34.0%
Sherburne (V)	93	$227,814,037	22	23.7%	$26,685,148	11.7%	30	32.3%	$66,999,225	29.4%
Smithville (T)	21	$133,179,524	3	14.3%	$5,076,110	3.8%	3	14.3%	$5,076,110	3.8%
Smyrna (T)	181	$188,213,419	0	0.0%	$0	0.0%	1	0.6%	$487,584	0.3%
Smyrna (V)	22	$125,807,922	1	4.5%	$19,452,136	15.5%	1	4.5%	$19,452,136	15.5%
Chenango County (Total)	**2,478**	**$6,722,474,412**	**211**	**8.5%**	**$539,296,592**	**8.0%**	**269**	**10.9%**	**$706,703,572**	**10.5%**

Sources: FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

Table 5.4.4-14 Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event – All Occupancies

Jurisdiction	Total Replacement Cost Value	All Occupancies 1-Percent Annual Chance Flood Event	
		Estimated Loss (Replacement Cost Value)	Percent of Total
Afton (T)	$864,699,700	$16,728,823	1.9%
Afton (V)	$1,019,188,804	$7,283,070	0.7%
Bainbridge (T)	$915,529,770	$39,591,578	4.3%
Bainbridge (V)	$584,957,184	$15,550,178	2.7%
Columbus (T)	$862,354,994	$261,321	0.0%
Coventry (T)	$703,237,371	$639,826	0.1%
Earlville (V)	$87,153,360	$348,585	0.4%
German (T)	$203,106,925	$180,027	0.1%
Greene (T)	$1,319,736,091	$4,611,254	0.3%
Greene (V)	$686,754,321	$18,971,354	2.8%
Guilford (T)	$1,010,987,220	$9,555,786	0.9%
Lincklaen (T)	$229,671,722	$630,536	0.3%
McDonough (T)	$339,089,552	$328,655	0.1%
New Berlin (T)	$778,713,525	$3,960,227	0.5%
New Berlin (V)	$432,605,770	$1,208,909	0.3%
North Norwich (T)	$823,054,726	$2,828,359	0.3%
Norwich (C)	$3,140,959,099	$129,372,486	4.1%
Norwich (T)	$2,080,430,801	$15,517,187	0.7%
Otselic (T)	$461,373,250	$8,759,377	1.9%

Jurisdiction	Total Replacement Cost Value	All Occupancies 1-Percent Annual Chance Flood Event Estimated Loss (Replacement Cost Value)	Percent of Total
Oxford (T)	$958,330,880	$3,782,665	0.4%
Oxford (V)	$679,367,779	$21,954,398	3.2%
Pharsalia (T)	$389,863,952	$134,561	0.0%
Pitcher (T)	$315,344,531	$1,423,402	0.5%
Plymouth (T)	$510,829,645	$10,976,663	2.1%
Preston (T)	$348,948,426	$679,118	0.2%
Sherburne (T)	$1,113,221,738	$24,178,183	2.2%
Sherburne (V)	$768,785,678	$35,399,596	4.6%
Smithville (T)	$690,983,617	$1,164,912	0.2%
Smyrna (T)	$519,858,907	$3,496,830	0.7%
Smyrna (V)	$161,456,951	$5,543,859	3.4%
Chenango County (Total)	**$23,000,596,289**	**$385,061,727**	**1.7%**

Sources: HAZUSv4.2; FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

Table 5.4.4-15 Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event – Residential Occupancy Class

Jurisdiction	Total Replacement Cost Value (Residential Only)	Residential Losses Only 1-Percent Annual Chance Flood Event Estimated Loss (Replacement Cost Value)	Percent of Total
Afton (T)	$532,628,331	$16,099,857	3.0%
Afton (V)	$252,492,985	$6,599,815	2.6%
Bainbridge (T)	$455,185,271	$7,234,091	1.6%
Bainbridge (V)	$263,652,093	$11,186,779	4.2%
Columbus (T)	$168,681,001	$261,321	0.2%
Coventry (T)	$314,112,125	$497,963	0.2%
Earlville (V)	$55,895,731	$348,585	0.6%
German (T)	$162,861,915	$0	0.0%
Greene (T)	$947,905,937	$3,779,620	0.4%
Greene (V)	$292,279,720	$11,322,321	3.9%
Guilford (T)	$638,935,588	$8,995,638	1.4%
Lincklaen (T)	$143,981,313	$181,258	0.1%
McDonough (T)	$221,651,844	$232,573	0.1%
New Berlin (T)	$421,229,852	$3,479,638	0.8%
New Berlin (V)	$175,364,889	$1,045,781	0.6%
North Norwich (T)	$354,209,855	$2,241,633	0.6%

Jurisdiction	Total Replacement Cost Value (Residential Only)	Residential Losses Only 1-Percent Annual Chance Flood Event	
		Estimated Loss (Replacement Cost Value)	Percent of Total
Norwich (C)	$1,220,883,174	$63,847,699	5.2%
Norwich (T)	$674,132,460	$2,837,720	0.4%
Otselic (T)	$222,023,439	$1,027,334	0.5%
Oxford (T)	$550,797,506	$2,602,594	0.5%
Oxford (V)	$284,337,570	$8,881,861	3.1%
Pharsalia (T)	$177,916,135	$134,561	0.1%
Pitcher (T)	$198,731,400	$966,583	0.5%
Plymouth (T)	$401,094,276	$5,357,472	1.3%
Preston (T)	$268,708,818	$679,118	0.3%
Sherburne (T)	$428,762,759	$6,950,595	1.6%
Sherburne (V)	$322,999,342	$10,286,353	3.2%
Smithville (T)	$307,073,880	$441,334	0.1%
Smyrna (T)	$202,741,399	$1,662,173	0.8%
Smyrna (V)	$32,182,528	$0	0.0%
Chenango County (Total)	**$10,693,453,136**	**$179,182,270**	**1.7%**

Sources: HAZUSv4.2; FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

Table 5.4.4-16 Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event – Commercial Occupancy Class

Jurisdiction	Total Replacement Cost Value (Commercial Only)	Commercial Losses Only 1-Percent Annual Chance Flood Event	
		Estimated Loss (Replacement Cost Value)	Percent of Total
Afton (T)	$224,686,376	$0	0.0%
Afton (V)	$626,789,923	$683,255	0.1%
Bainbridge (T)	$382,755,751	$31,092,865	8.1%
Bainbridge (V)	$227,455,479	$4,363,400	1.9%
Columbus (T)	$307,604,344	$0	0.0%
Coventry (T)	$291,804,567	$141,863	<0.1%
Earlville (V)	$24,418,874	$0	0.0%
German (T)	$1,570,759	$0	0.0%
Greene (T)	$134,744,128	$566,828	0.4%

Jurisdiction	Total Replacement Cost Value (Commercial Only)	Commercial Losses Only 1-Percent Annual Chance Flood Event	
		Estimated Loss (Replacement Cost Value)	Percent of Total
Greene (V)	$193,731,718	$4,726,227	2.4%
Guilford (T)	$110,600,841	$560,148	0.5%
Lincklaen (T)	$4,739,651	$0	0.0%
McDonough (T)	$87,272,473	$96,082	0.1%
New Berlin (T)	$52,373,678	$480,589	0.9%
New Berlin (V)	$193,638,738	$163,128	0.1%
North Norwich (T)	$115,449,824	$586,726	0.5%
Norwich (C)	$1,532,435,436	$45,571,593	3.0%
Norwich (T)	$929,743,052	$4,928,986	0.5%
Otselic (T)	$54,493,865	$0	0.0%
Oxford (T)	$27,632,031	$188,864	0.7%
Oxford (V)	$284,832,722	$9,756,452	3.4%
Pharsalia (T)	$19,289,849	$0	0.0%
Pitcher (T)	$12,758,503	$0	0.0%
Plymouth (T)	$19,198,236	$0	0.0%
Preston (T)	$2,898,859	$0	0.0%
Sherburne (T)	$184,539,835	$15,807,248	8.6%
Sherburne (V)	$227,814,037	$6,466,322	2.8%
Smithville (T)	$133,179,524	$704,962	0.5%
Smyrna (T)	$188,213,419	$255,982	0.1%
Smyrna (V)	$125,807,922	$5,543,859	4.4%
Chenango County (Total)	**$6,722,474,412**	**$132,685,377**	**2.0%**

Sources: HAZUSv4.2; FEMA 2010, Chenango County GIS 2020; RS Means 2019
Note: T = Town; V = Village; C= City

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NFIP Statistics

FEMA Region 2 provided a list of NFIP policies, past claims, and repetitive loss properties (RL) in Chenango County. According to FEMA, a RL property is a NFIP-insured structure that has had at least two paid flood losses of more than $1,000 in any 10-year period since 1978. A SRL property is a NFIP-insured structure that has had four or more separate claim payments made under a standard flood insurance policy, with the amount of each claim exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or at least two separate claims payments made under a standard flood insurance policy with the cumulative amount of such claim payments exceed the fair market value of the insured building on the day before each loss (FEMA 2018). Table 5.4.4-17 shows that there are more NFIP claims than policies in Chenango County reported. This is likely because multiple repetitive loss properties submitted more than one flood loss claim under their NFIP policy. Note that specific locations of repetitive loss properties were not made available for this Plan. Table 5.4.4-18 and Table 5.4.4-19 summarizes the NFIP RL properties, by occupancy class, in Chenango County.

Table 5.4.4-17 Repetitive Loss Properties and NFIP Data for Chenango County

Municipality	Number of Policies	Number of Claims	Total Paid Claims	Number of Repetitive Loss Properties	Number of Severe Repetitive Loss Properties	Number of Policies in the 1-Percent Annual Chance Flood Event Area
Afton (T)	11	30	$660,958	4	0	4
Afton (V)	11	27	$554,018	5	0	3
Bainbridge (T)	21	39	$686,418	6	1	6
Bainbridge (V)	28	35	$679,420	9	0	8
Columbus (T)	0	1	$0	0	0	0
Coventry (T)	5	5	$34,641	1	0	0
Earlville (V)	0	0	$0	0	0	0
German (T)	1	0	$0	0	0	0
Greene (T)	17	45	$1,165,126	5	1	4
Greene (V)	62	77	$2,515,997	17	2	19
Guilford (T)	9	16	$171,966	1	0	1
Linklaen (T)	0	0	$0	0	0	0
McDonough (T)	3	0	$0	0	0	0
New Berlin (T)	6	5	$43,606	1	0	0
New Berlin (V)	2	4	$31,600	0	0	0
North Norwich (T)	7	3	$40,347	0	0	0
Norwich (C)	193	201	$1,411,677	16	1	15
Norwich (T)	11	23	$1,709,721	1	1	1
Otselic (T)	2	3	$10,535	0	0	0
Oxford (T)	46	53	$594,997	3	0	0
Oxford (V)	7	10	$68,761	7	0	6
Pharsalia (T)	1	0	$0	0	0	0
Pitcher (T)	0	0	$0	0	0	0
Plymouth (T)	7	3	$33,805	0	0	0
Preston (T)	1	1	$75,000	0	0	0
Sherburne (T)	14	18	$183,084	4	0	1
Sherburne (V)	25	11	$332,636	1	0	1
Smithville (T)	2	0	$0	0	0	0
Smyrna (T)	5	3	$55,523	1	0	0
Smyrna (V)	0	0	$0	0	0	0
Chenango County	**497**	**613**	**$11,059,837**	**82**	**6**	**69**

Source: FEMA Region 2, 2020
Note: NFIP = National Flood Insurance Program, V = Village, T = Town; C= City

Table 5.4.4-18 Occupancy Class of Repetitive Loss Structures in Chenango County

Occupancy Class	Total Number of Repetitive Loss Properties	Total Number of Severe Repetitive Loss Properties	Total (Repetitive Loss + Severe Repetitive Loss)
Single Family	64	4	68
Assumed Condo	0	2	2
2-4 Family	9	0	9
Other Residential	2	0	2
Non-Residential	7	0	7
Total	**82**	**6**	**88**

Source: FEMA Region 2, 2020
Note: NFIP = National Flood Insurance Program, V = Village, T = Town; C= City

Table 5.4.4-19 Occupancy Class of Repetitive Loss Structures in Chenango County, by Municipality

	Repetitive Loss Properties					Severe Repetitive Loss Properties				
Municipality	2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family
Afton (T)	1	0	0	0	3	0	0	0	0	0
Afton (V)	0	0	0	1	4	0	0	0	0	0
Bainbridge (T)	0	0	2	0	4	0	1	0	0	0
Bainbridge (V)	0	0	1	0	8	0	0	0	0	0
Columbus (T)	0	0	0	0	0	0	0	0	0	0
Coventry (T)	0	0	0	0	1	0	0	0	0	0
Earlville (V)	0	0	0	0	0	0	0	0	0	0
German (T)	0	0	0	0	0	0	0	0	0	0
Greene (T)	0	0	0	0	5	0	1	0	0	0
Greene (V)	2	0	1	0	14	0	0	0	0	2
Guilford (T)	0	0	0	0	1	0	0	0	0	0
Linklaen (T)	0	0	0	0	0	0	0	0	0	0
McDonough (T)	0	0	0	0	0	0	0	0	0	0
New Berlin (T)	0	0	0	0	1	0	0	0	0	0
New Berlin (V)	0	0	0	0	0	0	0	0	0	0
North Norwich (T)	0	0	0	0	0	0	0	0	0	0
Norwich (C)	5	0	1	0	10	0	0	0	0	1
Norwich (T)	0	0	1	0	0	0	0	0	0	1
Otselic (T)	0	0	0	0	0	0	0	0	0	0
Oxford (T)	0	0	0	0	3	0	0	0	0	0
Oxford (V)	0	0	1	0	6	0	0	0	0	0
Pharsalia (T)	0	0	0	0	0	0	0	0	0	0
Pitcher (T)	0	0	0	0	0	0	0	0	0	0
Plymouth (T)	0	0	0	0	0	0	0	0	0	0
Preston (T)	0	0	0	0	0	0	0	0	0	0
Sherburne (T)	1	0	0	1	2	0	0	0	0	0
Sherburne (V)	0	0	0	0	1	0	0	0	0	0

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties				
	2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non-Residential	Other Residential	Single Family
Smithville (T)	0	0	0	0	0	0	0	0	0	0
Smyrna (T)	0	0	0	0	1	0	0	0	0	0
Smyrna (V)	0	0	0	0	0	0	0	0	0	0
Chenango County	**9**	**0**	**7**	**2**	**64**	**0**	**2**	**0**	**0**	**4**

Source: FEMA Region 2, 2020
Note: NFIP = National Flood Insurance Program, V = Village, T = Town; C= City

Impact on Land Uses

An exposure analysis was completed to determine the acres of developed residential land and developed non-residential land use types located in the 1-percent and 0.2-percent flood hazard area. To estimate exposure for developed residential and non-residential land use types to the 1-percent and 0.2-percent flood hazard area, the floodplain boundary was overlaid upon land use data. Refer to Table 5.4.4-20 for a complete summary of this analysis.

Table 5.4.4-20 Developed Residential and Non-Residential Land Use Exposed to 1-Percent and 0.2-Percent Annual Chance Flood Event Hazard Areas

Land Use Type	Total Acres for County	1-Percent Annual Chance Event		0.2-Percent Annual Chance Event	
		Acres	Percent of Total	Acres	Percent of Total
Residential Land	5,173	632	12.2%	816	15.8%
Non-Residential Land	565,951	27,820	4.9%	28,684	5.1%
Natural Land	387,797	14,605	3.8%	14,832	3.8%
Total County Land	**571,124**	**28,452**	**5.0%**	**29,500**	**5.2%**

Sources: FEMA 2010, Chenango County GIS 2020; NLCD 2016
Notes: Land use areas do not include areas of water. Non-residential area = Agriculture, Barren, Developed – Open Space, Forest, Wetlands; This analysis does not incorporate areas delineated as water. Residential area = Developed – low intensity, Developed – medium intensity, and Developed – high intensity. Natural Land = Wetlands, Forest

Impact on Critical Facilities

It is important to determine the critical facilities and infrastructure that may be at risk to flooding, and who may be impacted should damage occur. Critical services during and after a flood event may not be available if critical facilities are directly damaged or transportation routes to access these critical facilities are impacted. Roads that are blocked or damaged can isolate residents and can prevent access throughout the planning area to many service providers needing to reach vulnerable populations or to make repairs.

Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues and significant disruption to travel, including all roads, railroads and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines in the inundation zone could also be vulnerable. If phone lines were lost, significant communication issues may occur in the planning area due to limited cell phone reception in many areas. In addition, emergency response would be hindered due to the loss of transportation routes as well as some protective-function facilities located in the

inundation zone. Recovery time to restore many critical functions after an event may be lengthy, as wastewater, potable water, and other community facilities are located in the dam inundation zone.

Major roadways that may be impacted by the 1-percent annual chance flood event include Interstate 88-W and 88-E, State Roads NY-12, NY-12B, NY-206, NY-220, NY-23, NY-26, NY-41, NY-51, NY-8, NY-80 and various county roads. Approximately 3.7- percent of all roadways are located within the 1-percent annual chance flood event boundary. Table 5.4.4-21 summarizes the road types and mileage located within the 1-percent annual chance flood event boundary. Overall, over 145 miles of roadway would be impacted by the 1-percent annual chance flood in which the majority of roads are local (129 miles). Bridges washed out or blocked by floods or debris also can cause isolation. Water and sewer systems can be flooded or backed up, causing health problems. Floodwaters can get into drinking water supplies, causing contamination. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers, and streams.

Table 5.4.4-21 Road Miles Located in the 1-Percent Annual Chance Flood Hazard Area

Road Type	Total Miles for County	1-Percent Annual Chance Event	
		Miles	Percent of Total
Local and Private Roads	3,701	129	3.5%
County Roads	6	0.5	8.1%
State Routes	235	15	6.3%
Interstate	29	1	4.5%
Chenango County (Total)	**3,970**	**145**	**3.7%**

Sources: FEMA, 2010; Chenango County GIS, 2020; New York State GIS, 2020

Critical facility exposure to the 1-percent and 0.2-percent annual chance flood hazard event boundary was examined. In addition, HAZUS v4.2 was used to estimate the flood loss potential to critical facilities located in the FEMA mapped floodplains. Table 5.4.4-22 summarizes the number of critical facilities exposed to the 1-percent and 0.2-percent flood inundation areas by jurisdiction. Table 5.4.4-23 and Table 5.4.4-24 summarizes the distribution of critical facilities in the 1-percent and 0.2-percent annual chance flood event boundary. Of the 48 critical facilities located in the 1-percent annual chance flood event boundary, 45 are considered lifelines for the County (Table 5.4.4-22). Refer to Section 4 (County Profile) for more information about the critical facilities and lifelines in Chenango County.

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Table 5.4.4-22 Number of Critical and Lifeline Facilities Located in the 1-Percent and 0.2-Percent Annual Chance Flood Hazard Area

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Exposed to the 1-Percent Annual Chance Flood Event				Number of Critical Facilities and Lifeline Facilities Exposed to the 0.2-Percent Annual Chance Flood Event			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines	Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Afton (T)	10	10	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Afton (V)	16	16	4	25.0%	4	25.0%	4	25.0%	4	25.0%
Bainbridge (T)	8	8	4	50.0%	4	50.0%	4	50.0%	4	50.0%
Bainbridge (V)	23	22	5	21.7%	5	22.7%	5	21.7%	5	21.7%
Columbus (T)	7	6	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Coventry (T)	20	20	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Earlville (V)	4	4	0	0.0%	0	0.0%	0	0.0%	0	0.0%
German (T)	5	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Greene (T)	14	14	0	0.0%	0	0.0%	2	14.3%	2	14.3%
Greene (V)	25	24	3	12.0%	3	12.5%	4	16.0%	4	16.0%
Guilford (T)	16	16	1	6.3%	1	6.3%	1	6.3%	1	6.3%
Lincklaen (T)	1	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
McDonough (T)	13	13	1	7.7%	1	7.7%	1	7.7%	1	7.7%
New Berlin (T)	15	15	1	6.7%	1	6.7%	2	13.3%	2	13.3%
New Berlin (V)	24	23	2	8.3%	2	8.7%	3	12.5%	3	12.5%
North Norwich (T)	10	10	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Norwich (C)	55	50	7	12.7%	6	12.0%	12	21.8%	11	20.0%
Norwich (T)	39	38	4	10.3%	4	10.5%	5	12.8%	5	12.8%
Otselic (T)	14	13	1	7.1%	0	0.0%	1	7.1%	0	0.0%
Oxford (T)	15	14	1	6.7%	0	0.0%	1	6.7%	0	0.0%
Oxford (V)	25	25	7	28.0%	7	28.0%	14	56.0%	14	56.0%
Pharsalia (T)	5	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Pitcher (T)	1	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Plymouth (T)	23	23	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Preston (T)	17	17	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Sherburne (T)	16	16	6	37.5%	6	37.5%	6	37.5%	6	37.5%
Sherburne (V)	23	23	1	4.3%	1	4.3%	7	30.4%	7	30.4%
Smithville (T)	28	28	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Smyrna (T)	102	102	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Smyrna (V)	5	5	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Chenango County (Total)	**579**	**567**	**48**	**8.3%**	**45**	**7.9%**	**72**	**12.4%**	**69**	**11.9%**

Sources: FEMA 2010, Chenango County GIS 2020
Notes: T= Town; V= Village; City = City

Table 5.4.4-23 Distribution of Critical Facilities in the 1-Percent Annual Chance Flood Event Floodplain by Type and Jurisdiction

Jurisdiction	Facility Types																	
	County Building	Dam	Electrical Substation	Gas Station/Convenience Store	Hazmat	Heating Fuel	Kerosene	Levee	Major Employer	Municipal Hall	Police Station	Potable Water Well	Reservoir	Senior Center	Supermarket	Water Booster Substation	Water Tank	Water Treatment Facility
Afton (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Afton (V)	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	1
Bainbridge (T)	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Bainbridge (V)	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
Columbus (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coventry (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Earlville (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
German (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene (V)	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1
Guilford (T)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Lincklaen (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
McDonough (T)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Berlin (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
New Berlin (V)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
North Norwich (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norwich (C)	1	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	1	1
Norwich (T)	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	0	0
Otselic (T)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Oxford (T)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Oxford (V)	0	0	0	1	0	0	0	1	0	2	1	1	0	0	0	0	0	1
Pharsalia (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pitcher (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plymouth (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Preston (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sherburne (T)	0	0	0	0	0	1	0	0	0	0	0	5	0	0	0	0	0	0
Sherburne (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Smithville (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smyrna (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smyrna (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chenango County (Total)	**1**	**1**	**2**	**3**	**1**	**1**	**1**	**2**	**5**	**2**	**1**	**14**	**1**	**1**	**2**	**1**	**2**	**7**

Sources: FEMA 2010, Chenango County GIS 2020
Notes: T= Town; V= Village; City = City

Table 5.4.4-24 Distribution of Critical Facilities in the 0.2-Percent Annual Chance Flood Event Floodplain by Type and Jurisdiction

Jurisdiction	Facility Types																					
	Convenience Store	County Building	Dam	Electrical Substation	Fire/EMS	Gas Station/Convenience Store	Hazmat	Heating Fuel	Kerosene	Levee	Major Employer	Medical Facility	Municipal Hall	Police Station	Potable Water Well	Public Health Department	Reservoir	Senior Center	Supermarket	Water Booster Substation	Water Tank	Water Treatment Facility
Afton (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Afton (V)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1
Bainbridge (T)	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Bainbridge (V)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Columbus (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coventry (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Earlville (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
German (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene (T)	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene (V)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	1
Guilford (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Lincklaen (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
McDonough (T)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Berlin (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
New Berlin (V)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
North Norwich (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norwich (C)	0	2	0	0	0	0	0	0	0	1	5	0	0	0	0	1	0	1	0	0	1	1
Norwich (T)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	1	1	0	0
Otselic (T)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Oxford (T)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Oxford (V)	1	0	0	0	0	2	0	1	0	1	0	1	2	1	3	0	0	0	0	0	0	2
Pharsalia (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pitcher (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plymouth (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Preston (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sherburne (T)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	0	0	0	0	0	0	0
Sherburne (V)	1	0	0	0	0	0	2	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0
Smithville (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smyrna (T)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smyrna (V)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chenango County (Total)	**3**	**2**	**1**	**3**	**1**	**4**	**4**	**3**	**1**	**2**	**7**	**1**	**3**	**2**	**16**	**1**	**1**	**3**	**2**	**1**	**2**	**9**

Sources: FEMA 2010, Chenango County GIS 2020
Notes: T= Town; V= Village; City = City

Impact on the Economy

Flood and dam failure events can significantly impact the local and regional economy. This includes but is not limited to general building stock damages and associated tax loss, impacts to utilities and infrastructure, business interruption, and impacts on tourism. In areas that are directly flooded, renovations of commercial and industrial buildings may be necessary, disrupting associated services. Similar to flooding, losses include, but are not limited to, damages to buildings and infrastructure, agricultural losses, business interruption and impacts on tax base. Flooding as a result of dam failure or levee failure can cause extensive damage to public utilities and disruptions in delivery of services. Loss of power and communications may occur and drinking water and wastewater treatment facilities may be temporarily out of operation. Refer to the 'Impact on Buildings' subsection earlier which discusses direct impacts to buildings in Chenango County.

Debris management may also be a large expense after a flood event. HAZUS v4.2 estimates the amount of structural debris generated during a flood event. The model breaks down debris into three categories: (1) finishes (dry wall, insulation, etc.); (2) structural (wood, brick, etc.); and (3) foundations (concrete slab and block, rebar, etc.). These distinctions are necessary because of the different types of equipment needed to handle debris. Table 5.4.4-25 summarizes the HAZUS v4.2 countywide debris estimates for the 1-percent annual chance flood event. This table only estimates structural debris generated by flooding and does not include non-structural debris or additional potential damage and debris possibly generated by wind that may be associated with a flood event or storm that causes flooding. Overall, HAZUS v4.2 estimates that there will be 70,392 tons of debris generated during the 1-percent annual chance flood event in Chenango County.

Table 5.4.4-25 Estimated Debris Generated from the 1-Percent Annual Chance Flood Event

Jurisdiction	1-Percent Annual Chance Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Afton (T)	3,118	1,013	1,168	938
Afton (V)	1,608	686	544	378
Bainbridge (T)	9,334	1,952	4,022	3,360
Bainbridge (V)	4,988	1,142	2,097	1,749
Columbus (T)	607	164	237	206
Coventry (T)	79	43	17	19
Earlville (V)	109	47	36	27
German (T)	4	3	0	1
Greene (T)	3,090	1,143	1,085	862
Greene (V)	2,631	879	930	822
Guilford (T)	3,484	626	1,591	1,268
Lincklaen (T)	121	112	3	6
McDonough (T)	265	92	89	84
New Berlin (T)	1,747	493	692	561
New Berlin (V)	437	236	109	93
North Norwich (T)	2,371	544	1,013	814
Norwich (C)	17,124	5,666	6,143	5,314
Norwich (T)	4,749	1,018	2,088	1,643
Otselic (T)	313	173	72	69
Oxford (T)	961	402	307	252
Oxford (V)	2,855	1,696	687	472
Pharsalia (T)	13	9	3	2
Pitcher (T)	478	247	131	100
Plymouth (T)	1,148	340	444	364
Preston (T)	26	14	6	6
Sherburne (T)	4,222	898	1,813	1,510
Sherburne (V)	3,734	1,651	1,143	941
Smithville (T)	194	120	34	40
Smyrna (T)	258	78	98	81
Smyrna (V)	324	111	117	96
Chenango County (Total)	**70,392**	**21,597**	**26,717**	**22,078**

Sources: HAZUSv4.2

Notes: T= Town; V= Village, C= City

Impact on the Environment

As Chenango County and its jurisdictions evolve with changes in population and density, flood events may increase in frequency and/or severity as land use changes, more structures are built, and impervious surfaces expand. Furthermore, flood extents for the 1-percent annual chance flood event will continue to evolve alongside natural occurrences such as climate change and/or severe weather events. These flood events will inevitably impact Chenango County's natural and local environment.

Furthermore, the environmental impacts of a dam failure can include significant water-quality and debris-disposal issues. Flood waters can back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate residential and commercial buildings and the flooded waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals get added to flood waters. Hazardous materials may be released and distributed widely across the floodplain. Water supply and wastewater treatment facilities could be offline for weeks. After the flood waters subside, contaminated and flood-damaged building materials and contents must be properly disposed of. Contaminated sediment must be removed from buildings, yards, and properties. In addition, severe erosion is likely; such erosion can negatively impact local ecosystems.

Overall, the acreage of natural land makes up 67.9-percent of the County's total land area (NLCD 2016). Natural land areas from the 2016 land use type dataset includes areas of forested land, and wetlands. Severe flooding will not only influence the habitat of these natural land areas, it can be disruptive to species that reside in these natural habitats. Overall, 3.77-percent and 3.8-percent of the natural land area in the County is exposed to the 1-percent and 0.2-percent annual chance flood event boundary, respectively.

Cascading Impacts on Other Hazards

Flood events can exacerbate the impacts of disease outbreaks and harmful algal blooms. Flooding of lawns and agricultural areas can flow into bays, rivers, and waterbodies and is linked to "overfeeding" harmful algal blooms with nutrients such as phosphorus and nitrogen (NOAA 2020). Flooding could increase the risk of transmitting water-borne and vector diseases by contaminating drinking water facilities (WHO 2020). See Sections 5.4.5 and 5.4.1 for more information on the harmful algal bloom and disease outbreak hazards of concern, respectively.

Future Changes that May Impact Vulnerability

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

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

Projected Development

As discussed in Section 4, areas targeted for future growth and development have been identified across the County. Any areas of growth located in the flood inundation areas could be potentially impacted by flooding. It is recommended that the County and municipal partners implement design strategies that mitigate against the risk of flooding. Refer to the maps in the jurisdictional annexes (Section 9) to view the new development locations throughout the County and their proximity to the 1-percent annual chance flood hazard event boundary.

Projected Changes in Population

According to the U.S. Census Bureau, the population in Chenango County has decreased by approximately 4.2-percent between 2010 and 2018 (US Census Bureau 2020). Estimated population projections provided by the 2017 Cornell Program on Applied Demographics indicates that the County's population will continue to decrease into 2040, decreasing the total population to approximately 41,123 persons (Cornell Program on Applied Demographics 2017). Even though the population will decrease, there are possibilities that people will move to locations that are more susceptible than others to flooding. This includes areas that are directly impacted by flood events and those that are indirectly impacted (i.e., isolated neighborhoods, flood-prone roadways, etc.). Refer to Section 4 (County Profile) for additional discussion on population trends.

Climate Change

As discussed earlier, annual precipitation amounts in the region are projected to increase, primarily in the form of heavy rainfalls, which have the potential to increase the risk to flash flooding and riverine flooding, and flood critical transportation corridors and infrastructure (NYSERDA 2014). Increases in precipitation may alter and expand the floodplain boundaries and runoff patterns, resulting in the exposure of populations, buildings, and critical facilities and infrastructure that were previously outside the floodplain. This increase in exposure would result in an increased risk to life and health, an increase in structural losses, a diversion of additional resources to response and recovery efforts, and an increase in business closures affected by future flooding events due to loss of service or access.

Change of Vulnerability Since the 2015 HMP

Since the 2015 analysis, population statistics have been updated using the 5-Year 2014-2018 American Community Survey Population Estimates. The general building stock was also updated using RS Means 2019 building valuations that estimated replacement cost value for each building in the inventory, updated building footprints and critical facilities were provided and reviewed by Chenango County. The updated building stock inventory and flood data was imported into HAZUS v4.2 to complete a riverine analysis for the 1-percent annual chance flood event.

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

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