5.4.3 Flood

The following section provides the hazard profile and vulnerability assessment for the flood hazard for the Livingston County Hazard Mitigation Plan (HMP).

5.4.3.1 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 United States. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states) (Federal Emergency Management Agency [FEMA] 2007). As defined in the New York State (NYS) HMP (NYS Division of Homeland Security and Emergency Services [DHSES] 2019), flooding is a general and temporary condition of partial or complete inundation of water on normally dry land caused by the following:

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

Many floods fall into three categories: riverine, coastal, and shallow (FEMA n.d.). Other types of floods may include ice-jam floods, alluvial fan floods, dam failure floods, and floods associated with local drainage or high groundwater. For the purpose of this HMP and as deemed appropriate by the Livingston County Steering Committee, riverine (inland), shallow, flash, ice jam, and dam and levee failure flooding are the main flood types of concern for the county. These types of floods are further discussed below.

Riverine Flooding

Riverine floods is the most common flood type. They occur when rivers overflow their banks in response to excessive precipitation levels and water runoff volumes within the watershed. Riverine floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon. Riverine flooding can occur seasonally or with heavy rains associated with storms (National Weather Service [NWS] n.d.).

Shallow Flooding

Shallow flooding described below is caused by local drainage issues and high groundwater levels. Locally, heavy precipitation may produce flooding in areas other than delineated floodplains or along recognizable channels. If local conditions cannot accommodate intense precipitation through a combination of infiltration and surface runoff, water may accumulate and cause flooding problems. During winter and spring, frozen ground

and snow accumulations may contribute to inadequate drainage and localized ponding. Flooding issues of this nature generally occur in areas with flat gradients and 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 2005).

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 2005).

Urban drainage flooding that is caused by heavy rainfall that overwhelms a developed area's stormwater infrastructure causing flooding is commonly referred to as urban flooding. Urban flooding can be worsened by aging and inadequate infrastructure, and over-development of land. The growing number of extreme rainfall events that produce intense precipitation are resulting in increased urban flooding (Center for Disaster Resilience 2016). While riverine and coastal flooding is mapped and studied by FEMA, urban flooding is not.

Flash Flooding

Flash floods are defined by NWS 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 riverbeds, 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." (NWS n.d.).

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 (National Oceanic and Atmospheric Administration [NOAA] n.d.). 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 (NWS n.d.).

There are two main types of ice jams: freeze-up and breakup. Freeze-up jams occur when floating ice may slow or stop because of a change in water slope as it reaches an obstruction to movement. Breakup jams occur during periods of thaw, generally in late winter and early spring. The ice cover breakup is usually when the ice jam acts as a dam on the river that results in flooding behind the dam until the ice melts or the jam weakens to the point that the ice releases and moves downstream (NWS n.d.).

Dam Failure Flooding

According to the U.S. Army Corps of Engineers (USACE) and the New York State Department of Environmental Conservation (NYSDEC), there are no levees in Livingston County; therefore, levee failure flooding will not be profiled.

Dam failure is defined in hydrologic terms, characterized by the sudden and uncontrolled release of impounded water (NWS n.d.) Dams are man-made structures built across a stream or river that impound water and reduce

the flow downstream. They are built for the purpose of 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 2014). Dams can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam (inadequate spillway capacity)
- Prolonged periods of rainfall and flooding
- Deliberate acts of sabotage (terrorism)
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate or negligent operation, maintenance and upkeep
- Failure of upstream dams on the same waterway
- Earthquake (liquefaction or landslides) (FEMA 2019)

Flood Control Measures

There are 77 dams located in Livingston County. The dams are used for fire protection, flood control, hydroelectricity, recreation, and water supply. The following provides descriptions of several dams in the County. Table 5.4.3-1 provides a description of the dams and flood control measures in the County as described in the Flood Insurance Study for the County.

Table 5.4.3-1. Dams in Livingston County

Jurisdiction	Description
Village of Town of Avon	Mount Morris Dam – flood threats significantly reduced in the Village and Town; capacity of the reservoir, 337,400 acre-feet is ample to protect the basin below from all but very infrequent floods (FEMA 1978 and FEMA 1980).
Village of Caledonia	The village does not have any structures constructed specifically for flood control purposes but there is a concrete overflow dam built on Spring Creek. This dam has some regulatory effect on flooding in the village (FEMA 1980).
Town of Conesus	The elevation of Hemlock Lake is controlled by a gate valve structure and the elevation of Conesus Lake is controlled by an outlet control structure. Other flood control measures include cross culverts a various roadway locations, wing wall construction at roadways near Conesus Lake, and stone fill for bank protection at isolated locations (FEMA 1991).
Village of Danville	The Village of Dansville's flood protection measures include stone fill for bank protection has been placed at several isolated stream crossings. Also, a segment of Bradner Creek has been channelized with concrete side walls (FEMA 2010).
Town of Geneseo	The town has benefited from the construction of the Mount Morris Dam as it significantly reduced the threat of flood disaster (FEMA 1996).
Village of Geneseo	The construction of the Mount Morris Dam significantly reduced the village's threat of floods. A small portion of Jaycox Creek has been channelized (FEMA 1996).
Town of Groveland	The Town of Groveland's flood protection measures include the Mount Morris Dam holding back the water on the Genesee River, allowing Canaseraga Creek to drain faster than normal, affording a limited amount of flood relief into the Canaseraga Valley. New York State constructed a canal (State Canal) in the area to the west of Bradner Creek to improve local drainage. Another flood protection measure included a system of lateral ditches has been constructed throughout the village by local property owners in order to improve the drainage from their farmlands (FEMA 1991).
Town of Leicester	Mount Morris Dam reduced the threat of flood disaster (FEMA 1981).
Town of Livonia	Flood protection measures include the elevation of Hemlock Lake the is controlled by a gate valve structure. Other flood protection measures include cross culverts at various roadway locations, wing wall construction, stone fill for bank protection at isolated locations, and retention walls along various segments of the stream lengths (FEMA 1992).
Town of Mount Morris	The Town has greatly benefited from the construction of the Mount Morris Dam on the Genesee River. The dam has significantly reduced the threat of flood disaster. Other flood protection measures include cross

Jurisdiction	Description
	culverts a various roadway locations, wing wall construction, and stone fille for bank protection at isolated locations (FEMA 1978).
Village of Mount Morris	The Village of Mount Morris has benefited from the construction of the Mount Morris Dam as it reduced the threat of flood disaster. Other flood protection measures include the presence of a check dam that reduces the velocity of the flow approaching the Route 36 Bridge. A stone wall rising seven feet above the check dam extends about 200 feet upstream from the bridge along the east side of the river affording protection from flooding (FEMA 1978).
Town of North Dansville	Flood protection measures include lining the banks of Canaseraga Creek with stones and in some places, covered with cement. The bridge along Poags Hole Road over Canaseraga Creek was rebuilt with a sheet-pile wall that was constructed along the eastern bank for a distance of approximately 100 feet on each side of the bridge (FEMA 2010).
Town of Portage	The Town's flood protection measures are limited to clearing and dredging troublesome portions of the Genesee River and Keshequa Creek as needed (FEMA 1984).
Town of Sparta	The Town of Sparta's flood protection measures include the channelization of the Canaseraga Creek, which has helped somewhat confine the flow. However, modern day flood protection measures have been limited to ditching and clearing sections of the creek (FEMA 2010).
Town of West Sparta	Flood protection measures include ditching and clearing sections of Canaseraga Creek as necessary (FEMA 2010).
Town of York	The Town has benefitted from the construction of Mount Morris Dam. The dam significantly reduced the threat of flood disaster and flooding in the lower basin was not as severe in the upper basin (FEMA 1981).

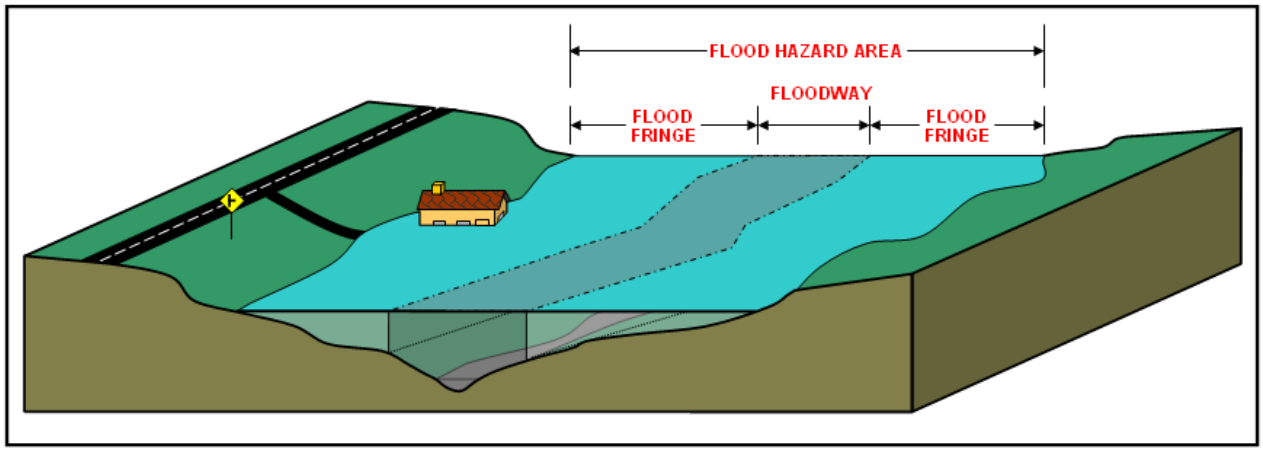
Location

Nearly all areas in the Livingston County could experience a flash flooding event. This depends on the intensity and duration of rainfall, the steepness of the watershed, the amount of impervious surfaces within the watershed, and vegetation. Flooding potential is influenced by climatology, meteorology, and topography (i.e., elevations, latitude, and water bodies and waterways). Flooding potential for each type of flooding that affects Livingston County is described in the subsections below.

Riverine, Shallow, and Flash Flooding

A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood. In Livingston County, floodplains line the rivers and streams of the county. The boundaries of the floodplains are altered as a result of changes in land use, the amount of impervious surface, placement of obstructing structures in floodways, changes in precipitation and runoff patterns, improvements in technology for measuring topographic features, and utilization of different hydrologic modeling techniques. Figure 5.4.3-1 depicts the flood hazard area, the flood fringe, and the floodway areas of a floodplain.

Figure 5.4.3-1. Floodplain



Source: New Jersey Department of Environmental Protection (NJDEP) n.d.

Most often floodplains are referred to as 100-year floodplains. A 100-year floodplain is not a flood that will occur once every 100 years; the designation indicates a flood that has a 1-percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. Because of this misleading term, FEMA has properly defined it as the 1-percent annual chance flood. Similarly, the 500-year floodplain will not occur every 500 years but is an event with a 0.2-percent chance of being equaled or exceeded each year. The "1-percent annual chance flood" is now the standard term used by most federal and state agencies and by the National Flood Insurance Program (NFIP) (FEMA 2018). The 1-percent annual chance floodplain establishes the area that has flood insurance and floodplain management requirements, and is also referenced as the regulatory floodplain.

Locations of flood zones in Livingston County as depicted in the FEMA Q3 data are illustrated in Figure 5.4.3-2 and the total land area in the floodplain, inclusive of waterbodies, is summarized in Table 5.4.3-2. Section 9, Jurisdictional Annexes, includes a map of each jurisdiction depicting the floodplains. As depicted in Figure 5.4.3-2, flood hazard zones occur to limited extents in smaller creeks within most Livingston municipalities. The Genesee and Canaseraga valleys that run through the county's central spine are comprised almost completely of lands in the 1 percent annual chance flood area.

The Livingston County Q3 Data from FEMA 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 flood boundary includes Zone AE and Zone A. Mandatory flood insurance requirements and floodplain management standards apply. The A Zones did not have determined flood depths provided in the Q3 data. As a result, the Q3 data boundaries were interpolated in ArcGIS to create a 3D water surface elevation and flood depth grid for the 1-percent annual chance flood event boundary.
- 0.2-Percent Annual Chance Flood Hazard: Area of minimal flood hazard, usually depicted on FEMA Flood Insurance Rate Maps (FIRM) as the 500-year flood level or Shaded X Zone.

The total land area located in the 1-percent annual chance flood zones was calculated using Q3 flood hazard data generated in the 1970s and 1980s for the county, as presented in Table 5.4.3-2. Section 9, Jurisdictional Annexes, contains information regarding specific areas of flooding for each participating municipality in Livingston County.

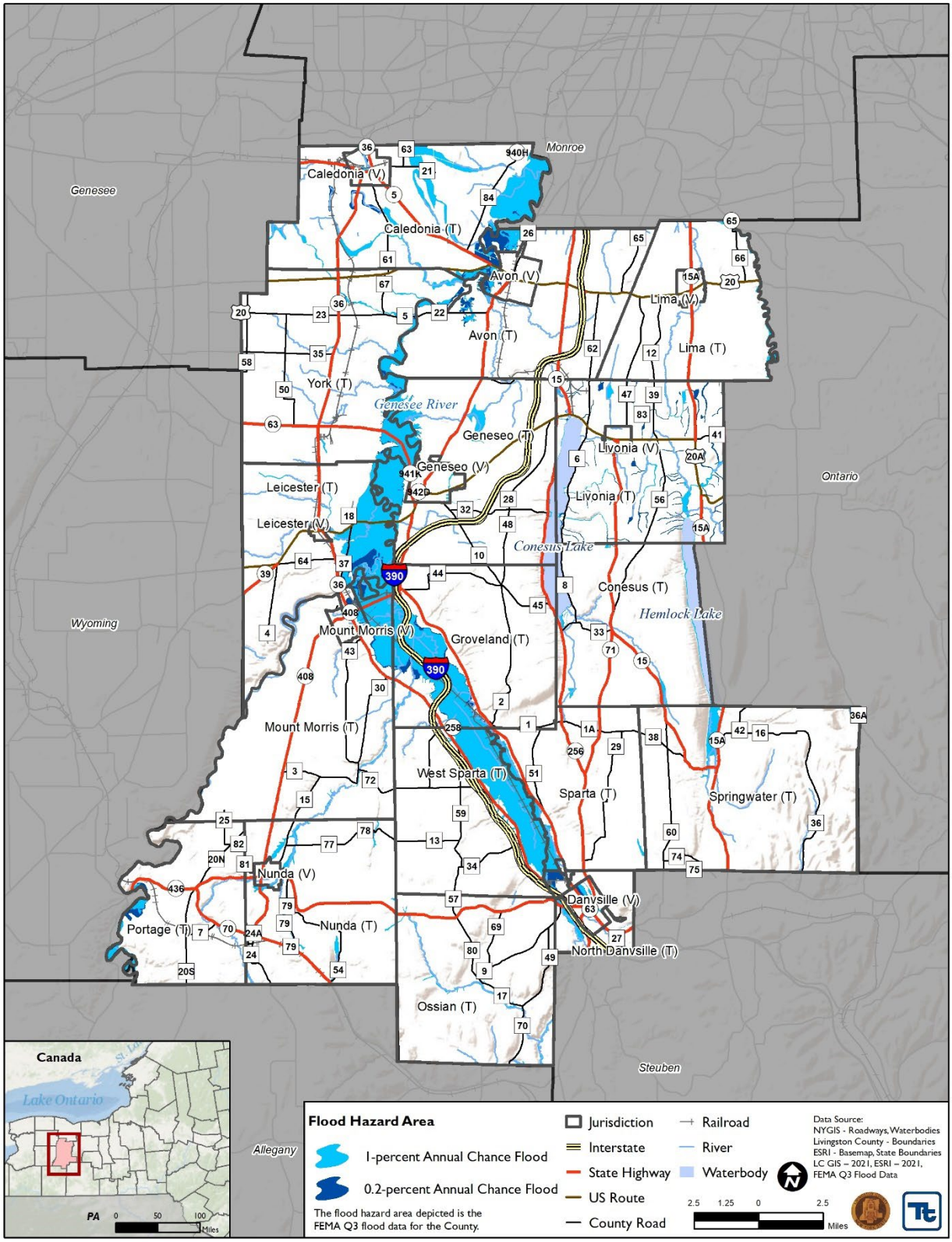
Table 5.4.3-2 Total Land Area in the 1-Percent and 0.2-Percent Annual Chance Flood Zones (Acres)

Jurisdiction	Total Acres	Acres Located in 1-Percent Annual Chance Flood Event	Percent of Total	Acres Located in 0.2-Percent Annual Chance Flood Event	Percent of Total
Avon (T)	24,401	846	3.5%	1,391	5.7%
Avon (V)	2,010	107	5.3%	186	9.3%
Caledonia (T)	26,919	4,295	16.0%	4,945	18.4%
Caledonia (V)	1,338	57	4.3%	121	9.0%
Conesus (T)	22,965	2,173	9.5%	2,180	9.5%
Dansville (V)	1,669	161	9.6%	294	17.6%
Geneseo (T)	27,056	3,328	12.3%	3,384	12.5%
Geneseo (V)	1,825	45	2.5%	49	2.7%
Groveland (T)	25,514	4,880	19.1%	5,320	20.9%
Leicester (T)	21,590	3,698	17.1%	4,105	19.0%
Leicester (V)	232	12	5.2%	12	5.2%
Lima (T)	19,592	354	1.8%	354	1.8%
Lima (V)	865	22	2.5%	22	2.5%

Jurisdiction	Total Acres	Acres Located in 1-Percent Annual Chance Flood Event	Percent of Total	Acres Located in 0.2-Percent Annual Chance Flood Event	Percent of Total
Livonia (T)	25,623	2,590	10.1%	3,648	14.2%
Livonia (V)	649	35	5.4%	35	5.4%
Mount Morris (T)	30,746	2,125	6.9%	2,270	7.4%
Mount Morris (V)	1,311	162	12.4%	273	20.8%
North Dansville (T)	4,709	360	7.6%	558	11.8%
Nunda (T)	23,138	716	3.1%	716	3.1%
Nunda (V)	624	101	16.2%	101	16.2%
Ossian (T)	25,438	436	1.7%	436	1.7%
Portage (T)	16,992	544	3.2%	695	4.1%
Sparta (T)	17,699	934	5.3%	938	5.3%
Springwater (T)	34,038	556	1.6%	556	1.6%
West Sparta (T)	21,393	4,284	20.0%	4,326	20.2%
York (T)	31,383	2,480	7.9%	2,655	8.5%
Livingston County (Total)	**409,718**	**35,300**	**8.6%**	**39,568**	**9.7%**

Source: Livingston County GIS 2021; Livingston County Q3 Data from FEMA 1970/1980s; NLCD/USGS 2016
Notes: The area presented includes the area of inland waterways. % - Percent; T - Town; V - Village

Figure 5.4.3-2. FEMA Flood Hazard Areas in Livingston County



Livingston County is covered by several watershed. The largest feed into the Genesee River watershed which encompasses the large Canaseraga Creek drainage. The Genesee River Watershed (New York State Drainage Basin Number 1) is composed of the Genesee River and its tributary creeks including Oatka Creek, Black Creek, Honeoye Creek, Conesus Creek, and Canaseraga Creek. (NYSDEC 2012).

Other notable watersheds include Beard's Creek, Conesus Lake and Honeoye Creek (NYSDEC n.d.). A complete countywide watershed map is posted within the County Profile (Section 4) in Figure 4-3.

Flooding Issues

Damaging floods in the Genesee River Basin have occurred in all months of the year except August. Summer floods are, in general, localized in a portion of the watershed and are usually the result of convectively unstable air conditions. Winter and spring floods are usually the result of frontal precipitation on saturated or frozen ground or on melting snow cover, although floods have occurred from melting snow cover alone. Large magnitude floods have occurred in the basin eight times during the 50-year period from 1917 to 1967, causing extensive damage to businesses, utilities, transportation, and homes. These floods occurred in 1927, 1935, 1942, 1950 (two floods), 1956, 1960, and 1961

A severe flood, resulting from Tropical Storm Agnes during June 1972, subjected the Genesee River Basin to approximately $50 million worth of damages. The magnitude of this flood in the lower basin ranged from a 10-year storm at Rochester to a 60-year storm at the Jones Bridge gage; in the upper basin, the flood's magnitude ranged from a 35-year storm at Shongo to a 285-year storm at Portageville. Although the amount of rainfall was not officially recorded in the Town of Geneseo, it can be approximated via the inspection of the isohyetal map for the storm and the comparison of recorded data at official rainfall stations in the basin. The total rainfall is estimated to have ranged from 4.5 to 5.7 inches within the town, with a maximum daily amount of 2.4 to 3.0 inches (Reference 8).

Tropical Storm Agnes produced the flood of record in the area. At the Jones Bridge gage, the maximum recorded discharge of the Genesee River was 17,500 cubic feet per second (cfs). Within the boundary limits of the Town of Geneseo, the water-surface elevation of the river rose from 26 to 32 feet above its channel bottom. The agricultural sector suffered the heaviest damages. Damages in the vicinity of Conesus Lake, estimated at $285,000, were spread among several communities, and involved mainly residential properties. The June 1972 flood resulted in record high lake stages on Conesus Lake of 822.5 feet (Reference 8). The calculated 100-year flood elevation without the Conesus Lake Flood Control Project was 822.9 feet. The 100-year water-surface elevation with the project is 821 feet.

Ice Jam Flooding

According to the USACE Ice Jam Database, 39 ice jams have occurred in Livingston County. A majority of them occurring along the Genesee River with several along Canaseraga Creek.

Dam Failure

There are 77 dams in Livingston County. Of the 77 dams, only two are classified as high hazard dams. Section 4, County Profile, includes a map of dam locations by hazard classification in Livingston County.

Stream Gages

The National Weather Service (NWS) Advanced Hydrologic Prediction Service (AHPS) operates and/or monitors over 9,800 river and stream gages across the country, 677 of them in New York State, and seven within Livingston County (shown in Table 5.4.3-3 and Figure 5.4.3-3). The data is collected by automatic recorders and manual field measurements at the gage locations. The flood stage is identified at each gage. Livingston

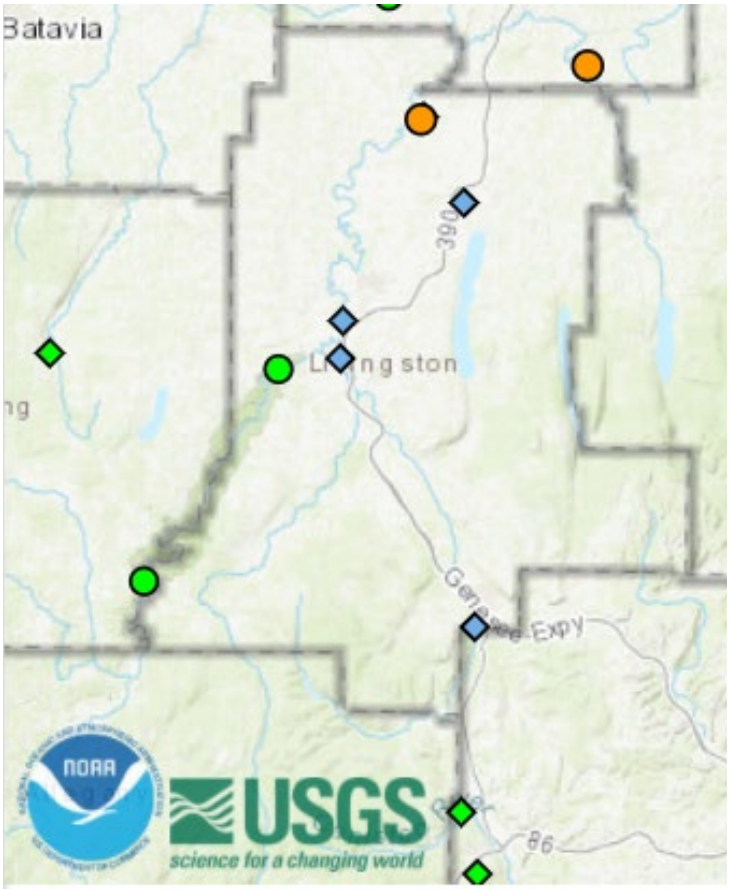
County and its municipalities rely on these gages to determine the height of the rivers during heavy rain events and to determine whether or not residents need to evacuate.

Table 5.4.3-3. USGS Gages Located in Livingston County

Gage Site Number	Site Name	Action Stage (feet)	Minor Flood Stage (feet)	Moderate Flood Stage (feet)	Major Flood Stage (feet)	Record Flood
AVON6	Genesee River at Avon	30	33	37	40	40.67 feet on June 25, 1972
DSVN6	Canaseraga Creek at Dansville	Not Available	Not Available	Not Available	Not Available	Not Available
JONN6	Genesee River at Jones Bridge	Not Available	Not Available	Not Available	Not Available	Not Available
LLLN6	Conesus Creek near Lakeville	Not Available	Not Available	Not Available	Not Available	Not Available
MMDN6	Genesee River at Mount Morris Dam	720	760	760	760	755.00 feet on June 23, 1972
PRTN6	Genesee River at Portageville	17	19	25	29	35.25 feet on June 23, 1972
SHKN6	Canaseraga Creek at Shakers Crossing	Not Available	Not Available	Not Available	Not Available	Not Available

Source: NWS 2021

Figure 5.4.3-3. USGS Gage Locations in Livingston County



Source: NWS 2021

Extent

Riverine Flooding

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

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

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

Dam Failure Flooding

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

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

Previous Occurrences and Losses

Table 5.4.3-4 documents historical flood events from 1950 to December 2020 in Livingston County based on data collected from the NCEI, National Performance of Dams Program (NPDP), and Cold Regions Research and Engineering Laboratory (CRREL) databases.

Table 5.4.3-4. Flood Events 1950-2021

Hazard Type	Number of Occurrences Between 1950 and 2021	Total Fatalities	Total Injuries	Total Property Damage ($)	Total Crop Damage ($)
Flash Flood	32	0	0	$11.7 million	$100,000
Flood	12	0	0	$834, 000	$0
Dam Failure	0	-	-	-	-
Ice Jam	39	-	-	-	-
Total	**83**	**0**	**0**	**$12.6 million**	**$100,000**

Source: NOAA-NCEI 2021; CRREL 2021
Note: Ice jam data from CRREL and Dam Failure data from National Performance of Dams Program (NPDP) do include information regarding fatalities, injuries, property damage, or crop damage.

According to the New York State Hazard Mitigation Plan, between 1954 and 2021, FEMA included New York State in 51 flood-related major disaster (DR) or emergency (EM) declarations (FEMA 2021). Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. Livingston County was included in two of these flood-related declarations, as listed on Table 5.4.3-5.

Table 5.4.3-5. FEMA DR and EM Declarations for Flood Events in Livingston County, 1954 to 2021

Date(s) of Event	FEMA Declaration Number	Declaration Date	Event Type
April 26 – May 8, 2011	DR-1993	June 10, 2011	Showers and thunderstorms accompanied the passage of a cold front across the region. The thunderstorms winds downed trees and power lines. Several hundred customers were without power. In Dansville, the thunderstorm winds blew off a portion of the roof of Dansville High School.
May 15-16, 2014	DR-4180	July 8, 2014	The storms brought heavy rains and flooding to much of the area. In Livingston County, a barn was blown down on Dutch Street in Mount Morris. Utility poles were down in Leicester, and the grandstands at Edinburgh Community High School were bent in two and dragged. In Geneseo, trees were down. Heavy rains left some rural roads covered in mud and washouts on others. Bridges were threatened by rising water and debris. Docks were underwater at Conesus Lake. Overall, the storms caused over $28 million in damage within the impacted counties of New York State.

Source: FEMA 2021

The Secretary of Agriculture from the U.S. Department of Agriculture (USDA) is authorized to designate counties as disaster areas to make emergency loans available to producers suffering losses in those counties and in counties that are contiguous to a designated county. Two USDA agricultural disasters attributed to flooding occurred in Livingston County from 2015 through 2020, as listed below:

- S4265 – 2017 Excessing rain
- S4274 – 2017 Flooding

For this update, flood events were summarized from 2015 to 2021. Known flood events, including FEMA disaster declarations, which have impacted Livingston County between 2015 and 2021 are identified in Table 5.4.3-6. Events prior to 2015 are listed in Appendix E. Not all events that have occurred in Livingston County are included because of the extent of documentation and the fact that not all sources may have been identified or researched. Loss and impact information could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP Update. Section 9 provides detailed information regarding flood impacts to each municipality.

Table 5.4.3-6. Flood Events in Livingston County, 2015 to 2021

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Event Details
May 10, 2015	Flash Flood	N/A	N/A	Thunderstorms dropped four inches of rain across northern Livingston County in an hour. The heavy rain resulted in flash flooding in the Towns of Avon and Ashantee. Numerous roads were inundated and/or closed including, for example, Pole Bridge Road, Lake Road and Boyd Road. Several roads and bridges sustained damage including Spring Street, North Littleville, Huston, Ashantee, Hogmire, Boyd and Reservoir Roads. Emergency responders were called upon to rescue several people trapped in stalled cars in the flooded area. Flood waters slowly receded through the evening hours. Preliminary damage estimates were around $200,000.
May 18, 2015	Flash Flood	N/A	N/A	Thunderstorms moved across the Finger Lakes region producing heavy rains. Three inches of rain were received. Flash flooding occurred near Reed Corners on Route 63 at Parker Hill Road, near PreEmption on County Road near Route 6, and in Geneva on Route 14.
June 14, 2015	Flash Flood	N/A	N/A	Slow-moving thunderstorms dropped 2 to 3 inches of rain across the area; however, rainfall amounts of 1 to 1.5 inches in less than 0.5 hour were received. Rainfall intensity proved to be a bigger factor than total rainfall; flash flooding and damage included washouts of culverts, roads, and driveways.
May 29, 2016	Flash Flood	N/A	N/A	Scattered showers and thunderstorms were reported across the region. Some storms produced damaging wind gusts that downed trees and power lines. Hail up to ½ inch was reported near Lakeville in Livingston County. Heavy rain washed out a culvert on North Lima Road.
April 20-21, 2017	Flood	N/A	N/A	Several rounds of thunderstorms brought one to three inches of rain to the area in just a couple of hours. This resulted in ponding of water on area roadways. Several roads were closed by flood waters. Several basements were reported flooded.
June 15, 2017	Flood	N/A	N/A	Thunderstorms reached sever limits with trees and wires reported down in parts of Livingston County. Several roads were inundated and closed.
July 13, 2017	Flash Flood	N/A	N/A	Two to four inches quickly fell across the region. The flash flooding resulted in numerous road closures. The heavy rain also resulted in river and creek flooding which is relatively rare for July.
November 6, 2017	Flood	N/A	N/A	The heavy precipitation fell on already saturated ground resulting in both area and river flooding. Rainfall amounts of three to four inches were reported and some roads were closed.
June 20, 2019	Flood	N/A	N/A	Multiple locations saw rainfall totals over 3 inches in less than 12 hours. Numerous road closures occurred during the event. The flooding was so extensive that a State of Emergency was

Dates of Event	Event Type	FEMA Declaration Number (if applicable)	County Designated?	Event Details
				declared for the entire county on Thursday afternoon. Many flash flood and areal flood warnings were issued during this event and some of these persisted well into Friday morning.
June 20, 2020	Flash Flood	N/A	N/A	3.7-5 inches of rain fell across the region. Route 408, Ridge Road, Creed Road, River Road, Dutch Road, and Cleveland Road were all closed due to high water.
July 11, 2020	Flash Flood	N/A	N/A	1.65-2 inches of rain were reported. Route 36 in West Sparta was closed due to flash flooding.

Sources: FEMA 2021; NOAA-NCEI 2021 NYS DHSES 2019
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.

Probability of Future Occurrences

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

As defined by FEMA, geographic areas within the 1-percent annual chance flood area in Livingston 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. Geographic areas in Livingston County located within the 0.2-percent annual chance flood area boundary are estimated to have a 0.2-percent chance of being flooded in any given year (FEMA 2007).

According to the 2019 New York State HMP (NYS DHSES 2019), between 1996 and 2017, Livingston County flooding events resulted in $13.0 million in property damage. According to the NOAA NCEI and the CRREL database, Livingston County experienced 83 flood events between 1950 and 2021, including 12 floods, 32 flash floods, 39 ice jams, and no dam failures. Table 5.4.3-7 shows these statistics, as well as the annual average number of events and the percent chance of these individual flood hazards occurring in Livingston County in future years based on the historic record (NOAA-NCEI 2020).

Table 5.4.3-7. Probability of Future Occurrence of Flooding Events

Hazard Type	Number of Occurrences Between 1950 and 2021	Recurrence Interval (in years) (# years/number of events)	Percent chance of occurrence in any given year
Flash Flood	32	2.25	44.4%
Flood	12	6	16.7%
Dam Failure	0	0	0.0%
Ice Jam	39	1.846153846	54.2%
Total	**83**	0.86746988	115.3%

Source: NOAA-NCDC 2021; CRREL 2021; NPDP 2021

Climate change is expected to increase the severity and frequency of heavy rain events in Livingston County. This is likely to lead to an increase in flooding events and dam failure events.

The identified hazards of concern for Livingston County were ranked in Section 5.3 of this HMP. 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*, having a 100 percent annual probability of the hazard occurring, as presented in Table 5.3-2 in Section 5.3, Hazard Ranking.

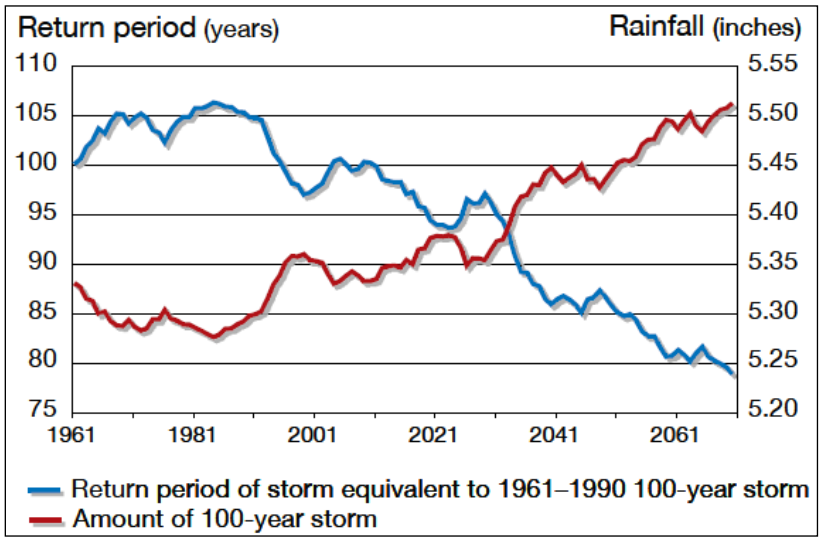
Climate Change Projections

Climate change is beginning to affect both people and resources of Livingston County and the impacts of climate change will continue. Impacts related to increasing temperatures are already being felt in the county. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the state's vulnerability to climate change and to facilitate the development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA] 2011). Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Livingston County is part of Region 1, Western New York and the Great Lakes Plain. In Region 1, temperatures are estimated to increase by 4.3 to 6.3 ºF by the 2050s, and 5.7 to 9.6 ºF by the 2080s (baseline of 47.7 ºF, middle range projection). Precipitation totals will increase between 4 and 10 percent by the 2050s and 6 to 13 percent by the 2080s (baseline of 34.0 inches, middle-range projection).

The projected increase in precipitation is expected to fall in heavy downpours and less in light rains. The increase in heavy downpours has the potential to affect drinking water; heighten the risk of riverine flooding; flood key rail lines, roadways, and transportation hubs; and increase delays and hazards related to extreme weather events (NYSERDA 2014).

Increasing air temperatures intensify the water cycle by increasing evaporation and precipitation. This can cause an increase in rain totals during events with longer dry periods in between those events. These changes can have a variety of effects on the State's water resources (NYSERDA 2014). Figure 5.4.3-4 displays the project rainfall and frequency of extreme storms in New York State. The amount of rain fall in a 100-year event is projected to increase, while the number of years between such storms (return period) is projected to decrease. Rainstorms will become more severe and more frequent (NYSERDA 2011).

Figure 5.4.3-4. 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 the possibility that floodwaters would overtop the dam or create unintended loads, which could lead to a dam failure.

5.4.3.2 Vulnerability Assessment

To assess Livingston County's risk to the flood hazard, a spatial analysis was conducted using the FEMA Q3 flood risk data. The 1- and 0.2-percent annual chance flood events were examined to determine the assets located in the hazard areas and to estimate potential loss using the FEMA Hazus model. These results are summarized below. Refer to Section 5.1 (Methodology and Tools) 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 or not 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. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but everyone 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.

To estimate population exposure to the 1-percent- and 0.2-percent annual chance flood events, the Q3 flood boundaries were used. Based on the spatial analysis, there are an estimated 2,922 residents living in the SFHA (or 1-percent annual chance floodplain), or 4.6-percent of the County's total population. There are an estimated 4,259 residents living in the 0.2-percent annual chance floodplain, or 6.7-percent of the County's total population. The Town of Geneseo has the greatest number of residents living in the 1-percent annual chance event flood area with approximately (i.e., 616 persons) and the Village of Dansville has the greatest number of residents living in the 0.2-percent annual chance flood hazard area (i.e., 1,393 persons). Table 5.4.3-8 summarizes the population exposed to the flood hazard by jurisdiction.

Table 5.4.3-8. Estimated Population Located in the FEMA Flood Hazard Zones

Jurisdiction	Total Population (American Community Survey 2015-2019)	Estimated Population Located in the Flood Hazard Areas			
		Number of Persons Located in the 1-percent Annual Chance Flood Event Hazard Area	Percent of Total	Number of Persons Located in the 0.2-percent Annual Chance Flood Event Hazard Area	Percent of Total
Avon (T)	3,637	2	0.1%	2	0.1%
Avon (V)	3,260	0	0.0%	18	0.5%
Caledonia (T)	2,060	25	1.2%	43	2.1%
Caledonia (V)	2,078	65	3.1%	161	7.8%
Conesus (T)	2,325	75	3.2%	101	4.3%
Dansville (V)	4,586	596	13.0%	1,393	30.4%
Geneseo (T)	2,540	616	24.2%	618	24.3%
Geneseo (V)	8,095	64	0.8%	64	0.8%

Jurisdiction	Total Population (American Community Survey 2015-2019)	Estimated Population Located in the Flood Hazard Areas			
		Number of Persons Located in the 1-percent Annual Chance Flood Event Hazard Area	Percent of Total	Number of Persons Located in the 0.2-percent Annual Chance Flood Event Hazard Area	Percent of Total
Groveland (T)	3,241	486	15.0%	486	15.0%
Leicester (T)	1,798	121	6.7%	121	6.7%
Leicester (V)	518	0	0.0%	0	0.0%
Lima (T)	1,833	48	2.6%	48	2.6%
Lima (V)	2,278	0	0.0%	0	0.0%
Livonia (T)	6,231	216	3.5%	426	6.8%
Livonia (V)	1,353	24	1.8%	24	1.8%
Mount Morris (T)	1,340	16	1.2%	16	1.2%
Mount Morris (V)	2,931	237	8.1%	360	12.3%
North Dansville (T)	696	67	9.6%	103	14.8%
Nunda (T)	1,716	59	3.4%	59	3.4%
Nunda (V)	1,211	65	5.3%	65	5.3%
Ossian (T)	701	10	1.4%	10	1.4%
Portage (T)	837	12	1.4%	18	2.2%
Sparta (T)	1,591	6	0.4%	6	0.4%
Springwater (T)	2,233	37	1.7%	37	1.7%
West Sparta (T)	1,229	23	1.9%	23	1.9%
York (T)	3,273	54	1.6%	58	1.8%
Livingston County (Total)	**63,591**	**2,922**	**4.6%**	**4,259**	**6.7%**

Source: ACS 2019; Livingston County Q3 Data from FEMA 1970/1980; Livingston County 2014
Note: T – Town; V – Village; % - Percent

Research has shown that some populations, while they may not have more hazard exposure, may experience exacerbated impacts and prolonged recovery if/when impacted. 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 may have difficulty evacuating. They also may need to seek or need medical attention that may not be available because of isolation during a flood event. Within Livingston County, there are approximately 10,929 people over the age of 65 and 7,572 people below the poverty level. The Village of Dansville, which has the highest percentage of people in the floodplain, has one of the higher percentages of low-income population compared to other jurisdictions within the County at 20-percent.

The Centers for Disease Control and Prevention (CDC) 2018 Social Vulnerability Index (SVI) ranks U.S. Census tracts on socioeconomic status, household composition and disability, minority status and language, and housing and transportation. Livingston County's overall score is 0.3424, indicating that its communities have low vulnerability (CDC 2018).

Using 2010 U.S. Census data, Hazus estimates the potential sheltering needs as a result of a 1-percent annual chance flood event. For the 1-percent flood event, Hazus estimates 2,844 households will be displaced, and 643

people will seek short-term sheltering. The Village of Dansville has the greatest displaced population (586 people) and the greatest number of persons seeking short-term shelter (128 people). These statistics, by jurisdiction, are presented in Table 5.4.3-9. 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 5.4.3-9. Estimated Population Displaced or Seeking Short-Term Shelter from the 1-Percent Annual Chance Flood Event

Jurisdiction	Total Population (American Community Survey 2015-2019)	1-Percent Annual Chance Flood Event	
		Displaced Population	Persons Seeking Short-Term Sheltering
Avon (T)	3,637	4	1
Avon (V)	3,260	28	5
Caledonia (T)	2,060	25	7
Caledonia (V)	2,078	55	21
Conesus (T)	2,325	27	23
Dansville (V)	4,586	586	128
Geneseo (T)	2,540	279	34
Geneseo (V)	8,095	111	82
Groveland (T)	3,241	461	42
Leicester (T)	1,798	199	20
Leicester (V)	518	7	2
Lima (T)	1,833	38	10
Lima (V)	2,278	16	12
Livonia (T)	6,231	207	91
Livonia (V)	1,353	32	17
Mount Morris (T)	1,340	23	3
Mount Morris (V)	2,931	233	70
North Dansville (T)	696	102	4
Nunda (T)	1,716	58	7
Nunda (V)	1,211	117	34
Ossian (T)	701	13	0
Portage (T)	837	19	2
Sparta (T)	1,591	30	4
Springwater (T)	2,233	64	7
West Sparta (T)	1,229	33	3
York (T)	3,273	77	14
Livingston County (Total)	**63,591**	**2,844**	**643**

Source: Hazus v5.0; American Community Survey 2019 5-year estimates; Livingston County Q3 Data from FEMA 1970/1980; Livingston County 2014
Note: T = Town; V = Village

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

Cascading impacts may also include exposure to pathogens such as mold. After flood events, excess moisture and standing water contribute to the growth of mold in buildings. Mold may present a health risk to building occupants, especially those with already compromised immune systems such as infants, children, the elderly and

pregnant women. The degree of impact will vary and is not strictly measurable. 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 2020).

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

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

Impact on General Building Stock

Exposure to the flood hazard includes those buildings located in the flood zone. Potential damage is the modeled loss that could occur to the exposed building stock measured by the structural and content replacement cost value. Table 5.4.3-10 and Table 5.4.3-11 summarize these results countywide.

In summary, there are 1,552 buildings located in the 1-percent annual chance flood event area with an estimated $972 million of building and contents at risk. In total, this represents approximately 4.5-percent of the County's total general building stock inventory (approximately $21.4 billion). The Town of Geneseo has the greatest number of buildings and proportion of buildings located in the 1-percent annual chance flood event area (i.e., 319 buildings, or 18.2-percent).

In addition, there are 2,231 buildings located in the 0.2-percent annual chance flood boundary with an estimated $1.5 billion of building and contents at risk. In total, this represents approximately 6.4-percent of the County's total general building stock inventory. Based on this analysis, the Town of Dansville has the greatest number and percentage of buildings located in the 0.2-percent annual chance flood event area.

The Hazus flood model estimated potential damages to the buildings in Livingston County at the structure level using the custom structure inventory developed for this HMP and the depth grid generated using the Q3 FEMA flood data. The potential damage estimated by Hazus to the general building stock inventory associated with the 1-percent annual chance flood is approximately $223 million or 1-percent of the total building stock replacement cost value. The Town of Geneseo has the greatest amount of estimated building loss—approximately $54.8 million (i.e., 4.7-percent of the total replacement cost value). Refer to Table 5.4.3-12 for the estimated losses by jurisdiction, which also shows the estimated losses for residential, commercial, and other occupancy structures, respectively.

Table 5.4.3-10. Estimated General Building Stock Located in the 1-Percent Annual Chance Flood Boundary

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Building Stock Located in the Flood Hazard Area			
			Number of Buildings Located in the 1-percent Annual Chance Flood Event Hazard Area	Percent of Total	Total Replacement Cost Value of Buildings Located in the 1-percent Annual Chance Flood Event Hazard Area	Percent of Total
Avon (T)	2,149	$1,324,846,766	3	0.1%	$816,328	0.1%
Avon (V)	1,245	$1,365,771,007	3	0.2%	$879,133	0.1%
Caledonia (T)	1,362	$792,755,652	15	1.1%	$5,116,244	0.6%
Caledonia (V)	979	$735,609,120	35	3.6%	$13,444,296	1.8%
Conesus (T)	1,774	$625,005,723	53	3.0%	$15,144,785	2.4%
Dansville (V)	1,950	$1,341,807,175	235	12.1%	$74,142,602	5.5%
Geneseo (T)	1,753	$1,161,720,041	319	18.2%	$128,033,590	11.0%
Geneseo (V)	1,329	$1,570,704,963	10	0.8%	$16,907,981	1.1%
Groveland (T)	1,330	$1,203,662,583	123	9.2%	$46,459,350	3.9%
Leicester (T)	1,214	$715,987,145	89	7.3%	$45,897,960	6.4%
Leicester (V)	240	$142,879,953	1	0.4%	$1,107,443	0.8%
Lima (T)	1,436	$859,636,929	32	2.2%	$11,337,804	1.3%
Lima (V)	777	$452,768,112	0	0.0%	$0	0.0%
Livonia (T)	3,888	$1,866,897,181	126	3.2%	$40,337,077	2.2%
Livonia (V)	569	$371,319,429	13	2.3%	$9,442,773	2.5%
Mount Morris (T)	1,115	$646,574,328	38	3.4%	$75,752,372	11.7%
Mount Morris (V)	1,337	$785,505,655	127	9.5%	$106,387,292	13.5%
North Dansville (T)	607	$497,159,183	73	12.0%	$197,612,641	39.7%
Nunda (T)	1,354	$544,934,442	45	3.3%	$19,697,007	3.6%
Nunda (V)	641	$392,488,596	35	5.5%	$16,576,985	4.2%
Ossian (T)	817	$488,703,931	21	2.6%	$18,388,756	3.8%
Portage (T)	620	$338,465,763	8	1.3%	$2,146,153	0.6%
Sparta (T)	1,151	$449,674,840	8	0.7%	$4,289,969	1.0%
Springwater (T)	1,822	$702,256,303	27	1.5%	$7,793,484	1.1%
West Sparta (T)	1,010	$423,213,015	46	4.6%	$50,245,056	11.9%
York (T)	2,183	$1,677,949,006	67	3.1%	$64,058,517	3.8%
Livingston County (Total)	**34,652**	**$21,478,296,842**	**1,552**	**4.5%**	**$972,015,597**	**4.5%**

Source: Livingston County Q3 Data from FEMA 1970/1980; Livingston County 2015/2021; RS Means 2021
Note: % - Percent; T - Town; V - Village

Table 5.4.3-11. Estimated General Building Stock Exposure to the 0.2-Percent Annual Chance Flood Event

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Building Stock Located in the Flood Hazard Area			
			Number of Buildings Located in the 0.2-percent Annual Chance Flood Event Hazard Area	Percent of Total	Total Replacement Cost Value of Buildings Located in the 0.2-percent Annual Chance Flood Event Hazard Area	Percent of Total
Avon (T)	2,149	$1,324,846,766	3	0.1%	$816,328	0.1%
Avon (V)	1,245	$1,365,771,007	16	1.3%	$8,073,750	0.6%
Caledonia (T)	1,362	$792,755,652	25	1.8%	$8,637,814	1.1%

Jurisdiction	Total Number of Buildings	Total Replacement Cost Value (RCV)	Estimated Building Stock Located in the Flood Hazard Area			
			Number of Buildings Located in the 0.2-percent Annual Chance Flood Event Hazard Area	Percent of Total	Total Replacement Cost Value of Buildings Located in the 0.2-percent Annual Chance Flood Event Hazard Area	Percent of Total
Caledonia (V)	979	$735,609,120	87	8.9%	$45,314,174	6.2%
Conesus (T)	1,774	$625,005,723	71	4.0%	$19,254,955	3.1%
Dansville (V)	1,950	$1,341,807,175	570	29.2%	$345,944,319	25.8%
Geneseo (T)	1,753	$1,161,720,041	320	18.3%	$128,403,939	11.1%
Geneseo (V)	1,329	$1,570,704,963	12	0.9%	$23,493,979	1.5%
Groveland (T)	1,330	$1,203,662,583	126	9.5%	$72,784,188	6.0%
Leicester (T)	1,214	$715,987,145	93	7.7%	$49,066,640	6.9%
Leicester (V)	240	$142,879,953	1	0.4%	$1,107,443	0.8%
Lima (T)	1,436	$859,636,929	32	2.2%	$11,337,804	1.3%
Lima (V)	777	$452,768,112	0	0.0%	$0	0.0%
Livonia (T)	3,888	$1,866,897,181	247	6.4%	$79,147,561	4.2%
Livonia (V)	569	$371,319,429	13	2.3%	$9,442,773	2.5%
Mount Morris (T)	1,115	$646,574,328	39	3.5%	$76,042,469	11.8%
Mount Morris (V)	1,337	$785,505,655	196	14.7%	$195,887,760	24.9%
North Dansville (T)	607	$497,159,183	111	18.3%	$217,251,928	43.7%
Nunda (T)	1,354	$544,934,442	45	3.3%	$19,697,007	3.6%
Nunda (V)	641	$392,488,596	35	5.5%	$16,576,985	4.2%
Ossian (T)	817	$488,703,931	21	2.6%	$18,388,756	3.8%
Portage (T)	620	$338,465,763	12	1.9%	$3,425,877	1.0%
Sparta (T)	1,151	$449,674,840	8	0.7%	$4,289,969	1.0%
Springwater (T)	1,822	$702,256,303	27	1.5%	$7,793,484	1.1%
West Sparta (T)	1,010	$423,213,015	46	4.6%	$50,245,056	11.9%
York (T)	2,183	$1,677,949,006	75	3.4%	$68,942,891	4.1%
Livingston County (Total)	**34,652**	**$21,478,296,842**	**2,231**	**6.4%**	**$1,481,367,850**	**6.9%**

Source: Livingston County Q3 Data from FEMA 1970/1980; Livingston County 2015/2021; RS Means 2021
Note: % - Percent; T - Town; V - Village

Table 5.4.3-12. Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event

Jurisdiction	Total Replacement Cost Value (RCV)	All Occupancies		Residential		Commercial		Agricultural, Industrial, Religious, Education and Government	
		Estimated Loss	Percent of Total Replacement Cost Value	Estimated Loss	Percent of Total Replacement Cost Value	Estimated Loss	Percent of Total Replacement Cost Value	Estimated Loss	Percent of Total Replacement Cost Value
Avon (T)	$1,324,846,766	$101,291	<0.1%	$70,312	<0.1%	$0	0.0%	$30,979	<0.1%
Avon (V)	$1,365,771,007	$137,265	<0.1%	$0	0.0%	$137,265	<0.1%	$0	0.0%
Caledonia (T)	$792,755,652	$1,647,828	0.2%	$1,635,056	0.2%	$0	0.0%	$12,772	<0.1%
Caledonia (V)	$735,609,120	$3,976,904	0.5%	$2,634,544	0.4%	$562,204	0.1%	$780,156	0.1%
Conesus (T)	$625,005,723	$2,561,556	0.4%	$2,561,556	0.4%	$0	0.0%	$0	0.0%
Dansville (V)	$1,341,807,175	$21,320,381	1.6%	$20,141,471	1.5%	$976,297	0.1%	$202,613	<0.1%
Geneseo (T)	$1,161,720,041	$54,831,741	4.7%	$50,825,389	4.4%	$1,160,117	0.1%	$2,846,235	0.2%
Geneseo (V)	$1,570,704,963	$3,162,503	0.2%	$1,954,573	0.1%	$1,207,929	0.1%	$0	0.0%
Groveland (T)	$1,203,662,583	$19,711,202	1.6%	$15,113,692	1.3%	$1,752,934	0.1%	$2,844,576	0.2%
Leicester (T)	$715,987,145	$8,871,766	1.2%	$5,915,682	0.8%	$2,044,853	0.3%	$911,231	0.1%
Leicester (V)	$142,879,953	$687,337	0.5%	$0	0.0%	$687,337	0.5%	$0	0.0%
Lima (T)	$859,636,929	$4,604,336	0.5%	$4,206,765	0.5%	$0	0.0%	$397,572	<0.1%
Lima (V)	$452,768,112	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
Livonia (T)	$1,866,897,181	$10,188,721	0.5%	$9,636,199	0.5%	$482,936	<0.1%	$69,586	<0.1%
Livonia (V)	$371,319,429	$5,708,654	1.5%	$2,320,183	0.6%	$3,388,471	0.9%	$0	0.0%
Mount Morris (T)	$646,574,328	$1,569,662	0.2%	$620,182	0.1%	$180,873	<0.1%	$768,607	0.1%
Mount Morris (V)	$785,505,655	$16,233,486	2.1%	$925,106	0.1%	$15,308,379	1.9%	$0	0.0%
North Dansville (T)	$497,159,183	$11,141,213	2.2%	$2,589,576	0.5%	$2,605,342	0.5%	$5,946,295	1.2%
Nunda (T)	$544,934,442	$6,225,881	1.1%	$6,062,299	1.1%	$163,583	<0.1%	$0	0.0%
Nunda (V)	$392,488,596	$4,742,047	1.2%	$2,494,993	0.6%	$1,062,746	0.3%	$1,184,308	0.3%
Ossian (T)	$488,703,931	$7,927,017	1.6%	$1,454,810	0.3%	$0	0.0%	$6,472,207	1.3%
Portage (T)	$338,465,763	$644,362	0.2%	$520,920	0.2%	$0	0.0%	$123,442	0.0%
Sparta (T)	$449,674,840	$647,545	0.1%	$379,073	0.1%	$0	0.0%	$268,472	0.1%
Springwater (T)	$702,256,303	$3,605,201	0.5%	$3,580,976	0.5%	$24,224	<0.1%	$0	0.0%
West Sparta (T)	$423,213,015	$21,347,661	5.0%	$1,327,851	0.3%	$18,132,900	4.3%	$1,886,909	0.4%
York (T)	$1,677,949,006	$11,841,265	0.7%	$3,239,853	0.2%	$36,688	<0.1%	$8,564,724	0.5%
Livingston County (Total)	**$21,478,296,842**	**$223,436,826**	**1.0%**	**$140,211,063**	**0.7%**	**$49,915,079**	**0.2%**	**$33,310,685**	**0.2%**

Source: Hazus v5.0; Livingston County Q3 Data from FEMA 1970/1980; Livingston County 2014
Notes: % - Percent; T - Town; V – Village; < - Less Than

NFIP Statistics

The State of New York Office of Emergency Management provided a list of existing NFIP policies, the number of past claims recorded since 1978, and the total amount of claims paid in Livingston County since 1978. The number of claims submitted by individual properties can inform the County how many repetitive loss (RL) properties are within each jurisdiction. 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 severe repetitive loss (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 5.4.3-13 summarizes the NFIP policies and claims for Livingston County. At this time, there is not enough data available to summarize the number of RL or SRL properties in Livingston County. In total, there are 258 policy holders and there have been 134 claims totaling $625,847 since 1978.

Table 5.4.3-13. NFIP Data for Livingston County

Jurisdiction	Number of Policies	Number of Claims Since 1978	Total Losses Claimed Since 1978
Avon (T)	1	2	$58,964
Avon (V)	3	5	$48,639
Caledonia (T)	1	6	$26,014
Caledonia (V)	9	1	$ 0
Conesus (T)	22	21	$57,065
Dansville (V)	62	19	$50,796
Geneseo (T)	29	12	$51,889
Geneseo (V)	4	0	$ 0
Groveland (T)	5	5	$4,905
Leicester (T)	13	5	$31,667
Leicester (V)	1	0	$ 0
Lima (T)	3	2	$ 0
Lima (V)	0	0	$0
Livonia (T)	36	30	$120,079
Livonia (V)	1	0	$ 0
Mount Morris (T)	7	2	$3,547
Mount Morris (V)	9	1	$ 0
North Dansville (T)	16	1	$ 977
Nunda (T)	9	4	$60,410
Nunda (V)	4	4	$5,713
Ossian (T)	1	0	$ 0
Portage (T)	2	0	$ 0
Sparta (T)	4	1	$10,233
Springwater (T)	6	4	$39,376
West Sparta (T)	2	7	$53,436

Jurisdiction	Number of Policies	Number of Claims Since 1978	Total Losses Claimed Since 1978
York (T)	8	2	$2,137
Livingston County (Total)	**258**	**134**	**$624,870**

Source: NYS OEM 2021
Note: NFIP - National Flood Insurance Program; T - Town; V - Village

Impact on Critical Facilities and Lifelines

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.

Critical facility exposure to the flood hazard was examined. Table 5.4.3-14 and Table 5.4.3-15 summarize the critical facilities and number of lifelines within each jurisdiction located within the 1-percent and 0.2-percent annual chance flood boundaries, respectively. Of the 93 critical facilities located in the 1-percent annual chance flood event boundary, bridges are the most vulnerable. Additionally, there are 122 critical facilities located in the 0.2-percent annual chance flood event boundary, 111 of which are considered lifelines for the County. A majority of the critical facilities located in the 1-percent and 0.2-percent annual chance flood event boundaries are in the Town of Livonia and the Town of North Dansville. Furthermore, Table 5.4.3-16 summarizes the number of lifelines located in the flood hazard areas and estimates that the most of the lifelines within the 1-percent and 0.2-percent annual chance flood events are transportation lifelines. Refer to Appendix E which summarizes the distribution of critical facilities by critical facility type and jurisdiction located in each respective flood hazard area.

In cases where short-term functionality is impacted by flooding, other facilities of neighboring municipalities may need to increase support response functions during a disaster event. Mitigation planning should consider means to reduce flood impacts to critical facilities and ensure sufficient emergency and school services remain when a significant event occurs.

Table 5.4.3-14. Total Number of Critical Facilities and Lifelines Located in the 1-Percent Annual Chance Flood Event

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Located in the 1-Percent Annual Chance Flood Event Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Avon (T)	51	46	0	0.0%	0	0.0%
Avon (V)	36	27	0	0.0%	0	0.0%
Caledonia (T)	19	16	1	5.3%	1	6.3%
Caledonia (V)	28	25	1	3.6%	1	4.0%
Conesus (T)	26	26	1	3.8%	1	3.8%
Dansville (V)	46	37	4	8.7%	3	8.1%
Geneseo (T)	48	45	6	12.5%	6	13.3%
Geneseo (V)	46	39	0	0.0%	0	0.0%
Groveland (T)	63	59	11	17.5%	11	18.6%
Leicester (T)	26	26	6	23.1%	6	23.1%
Leicester (V)	13	13	1	7.7%	1	7.7%
Lima (T)	16	14	0	0.0%	0	0.0%
Lima (V)	21	19	0	0.0%	0	0.0%

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Located in the 1-Percent Annual Chance Flood Event Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Livonia (T)	70	65	12	17.1%	12	18.5%
Livonia (V)	16	12	1	6.3%	1	8.3%
Mount Morris (T)	30	29	2	6.7%	2	6.9%
Mount Morris (V)	28	24	7	25.0%	6	25.0%
North Dansville (T)	35	31	11	31.4%	10	32.3%
Nunda (T)	25	25	6	24.0%	6	24.0%
Nunda (V)	23	20	7	30.4%	7	35.0%
Ossian (T)	20	20	3	15.0%	3	15.0%
Portage (T)	23	22	0	0.0%	0	0.0%
Sparta (T)	18	18	3	16.7%	3	16.7%
Springwater (T)	27	26	1	3.7%	1	3.8%
West Sparta (T)	25	25	2	8.0%	2	8.0%
York (T)	58	54	7	12.1%	6	11.1%
Livingston County (Total)	**837**	**763**	**93**	**11.1%**	**89**	**11.7%**

Source: Livingston County Planning Partners 2014/2021; HIFLD 2020; Livingston County Q3 Data from FEMA 1970/1980
Notes: T – Town; V – Village; % - Percent

Table 5.4.3-15. Total Number of Critical Facilities and Lifelines Located in the 0.2-Percent Annual Chance Flood Event

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Located in the 0.2-Percent Annual Chance Flood Event Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Avon (T)	51	46	0	0.0%	0	0.0%
Avon (V)	36	27	0	0.0%	0	0.0%
Caledonia (T)	19	16	1	5.3%	1	6.3%
Caledonia (V)	28	25	1	3.6%	1	4.0%
Conesus (T)	26	26	2	7.7%	2	7.7%
Dansville (V)	46	37	12	26.1%	8	21.6%
Geneseo (T)	48	45	6	12.5%	6	13.3%
Geneseo (V)	46	39	0	0.0%	0	0.0%
Groveland (T)	63	59	14	22.2%	14	23.7%
Leicester (T)	26	26	6	23.1%	6	23.1%
Leicester (V)	13	13	1	7.7%	1	7.7%
Lima (T)	16	14	0	0.0%	0	0.0%
Lima (V)	21	19	0	0.0%	0	0.0%
Livonia (T)	70	65	14	20.0%	14	21.5%
Livonia (V)	16	12	1	6.3%	1	8.3%
Mount Morris (T)	30	29	3	10.0%	3	10.3%
Mount Morris (V)	28	24	11	39.3%	9	37.5%
North Dansville (T)	35	31	19	54.3%	15	48.4%
Nunda (T)	25	25	6	24.0%	6	24.0%
Nunda (V)	23	20	7	30.4%	7	35.0%
Ossian (T)	20	20	3	15.0%	3	15.0%
Portage (T)	23	22	1	4.3%	1	4.5%
Sparta (T)	18	18	3	16.7%	3	16.7%
Springwater (T)	27	26	1	3.7%	1	3.8%
West Sparta (T)	25	25	2	8.0%	2	8.0%
York (T)	58	54	8	13.8%	7	13.0%

Jurisdiction	Total Critical Facilities Located in Jurisdiction	Total Lifelines Located in Jurisdiction	Number of Critical Facilities and Lifeline Facilities Located in the 0.2-Percent Annual Chance Flood Event Hazard Area			
			Critical Facilities	Percent of Total Critical Facilities	Lifelines	Percent of Total Lifelines
Livingston County (Total)	**837**	**763**	**122**	**14.6%**	**111**	**14.5%**

Source: Livingston County Planning Partners 2014/2021; HIFLD 2020; Livingston County Q3 Data from FEMA 1970/1980
Notes: T – Town; V – Village; % - Percent

Table 5.4.3-16. Number of Lifelines Categorized by FEMA Lifeline Category Located in the 1-Percent and 0.2-Percent Annual Chance Flood Events

FEMA Lifeline Category	Number of Lifelines	Number of Lifelines Located in the 1-percent Annual Chance Flood Event Hazard Area	Number of Lifelines Located in the 0.2-percent Annual Chance Flood Event Hazard Area
Communications	72	0	0
Energy	18	1	1
Food, Water, Shelter	100	8	13
Hazardous Materials	50	7	12
Health and Medical	36	1	1
Safety and Security	269	12	17
Transportation	218	60	67
Livingston County (Total)	**763**	**89**	**111**

Source: Livingston County Planning Partners 2014/2021; HIFLD 2020; Livingston County Q3 Data from FEMA 1970/1980; FEMA 2021

Impact on the Economy

Flood events can significantly impact the local and regional economy. This includes but is not limited to general building stock damages and associated tax loss, impacts to utilities and infrastructure, business interruption, impacts on tourism, and impacts on the tax base to Livingston County. In areas that are directly flooded, renovations of commercial and industrial buildings may be necessary, disrupting associated services. Refer to the 'Impact on Buildings' subsection earlier which discusses direct impacts to buildings in Livingston County. Other economic components such as loss of facility use, functional downtime and socio-economic factors are less measurable with a high degree of certainty. Flooding can cause extensive damage to public utilities and disruptions to delivery of services. Loss of power and communications may occur, and drinking water and wastewater treatment facilities may be temporarily out of operation.

Debris management may also be a large expense after a flood event. Hazus estimates the amount of debris generated from the 1-percent annual chance 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.). The distinction is made because of the different types of equipment needed to handle the debris. Table 5.4.3-17 summarizes the debris Hazus estimates for these events. As a result of the 1-percent annual chance event, Hazus estimates approximately 15,151 tons of debris will be generated in total.

Table 5.4.3-17. Estimated Debris Generated from the 1-Percent Annual Chance Flood Event

Jurisdiction	1-Percent Annual Chance Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Avon (T)	22	8	8	6
Avon (V)	102	39	35	28
Caledonia (T)	132	63	38	31
Caledonia (V)	166	121	21	24
Conesus (T)	26	19	3	4

Jurisdiction	1-Percent Annual Chance Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Dansville (V)	884	874	6	4
Geneseo (T)	4,696	1,205	2,068	1,422
Geneseo (V)	61	61	0	0
Groveland (T)	1,553	333	717	503
Leicester (T)	1,240	344	506	390
Leicester (V)	186	37	85	64
Lima (T)	310	104	116	89
Lima (V)	154	37	68	49
Livonia (T)	845	331	289	225
Livonia (V)	617	115	279	223
Mount Morris (T)	81	60	12	10
Mount Morris (V)	354	116	80	158
North Dansville (T)	466	133	168	164
Nunda (T)	817	232	323	261
Nunda (V)	411	325	46	40
Ossian (T)	243	85	93	66
Portage (T)	121	44	39	38
Sparta (T)	138	81	31	25
Springwater (T)	674	201	225	247
West Sparta (T)	193	56	71	65
York (T)	660	207	245	208
Livingston County (Total)	**15,151**	**5,234**	**5,572**	**4,345**

Source: Hazus v5.0; Livingston County Q3 Data from FEMA - 1970/1980; Livingston County 2014
Notes: T = Town; V = Village

Impact on the Environment

Flood extents for the 1- and 0.2-percent annual flood events will continue to evolve alongside natural occurrences such as sea level rise, climate change, and/or severity of storms. Further, residents living in and around areas of wildfire may be at increased risk of flooding in the future due to changes in the natural landscape. Flood events will inevitably impact Livingston County's natural and local environment. Severe flooding not only influences the habitat of these natural land areas, but it can also be disruptive to species that reside in these natural habitats. Table 5.4.3-18 lists the number of acres exposed to the 1- and 0.2-percent annual chance flood extents by land use type.

Table 5.4.3-18. NLCD Land Use Types Located in the 1-Percent and 0.2-Percent Annual Chance Flood Events

NLCD Land Use Type	Total Acres of Land Use Type	Acres Located in the 1-percent Annual Chance Flood Event Hazard Area	Percent of Total	Acres Located in the 0.2-percent Annual Chance Flood Event Hazard Area	Percent of Total
Agriculture	209,953	18,484	8.8%	21,124	10.1%
Barren Land	760	38	5.0%	50	6.6%
Forest	147,662	3,743	2.5%	4,433	3.0%
Urban Area	27,784	1,246	4.5%	1,641	5.9%
Wetlands	16,677	6,045	36.3%	6,529	39.1%
Livingston County (Total)	**402,836**	**29,556**	**7.3%**	**33,777**	**8.4%**

Source: NLCD USGS 2016; FEMA - Q3 Data; Livingston County HMP 2014
Notes: % - Percent; NLCD – National Land Cover Dataset
**The total land use area excludes waterways*

Cascading Impacts on Other Hazards

Flood events can exacerbate the impacts of utility failure. After a flooding event, runoff can pick up and transport debris. Water containing debris can trigger utility failure by clogging treatment systems or inundating power sources. Furthermore, 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. More information about this hazard of concern can be found in this HMP in Section 5.4.12 Utility Failure.

Future Changes that May Impact Vulnerability

Understanding future changes that effect vulnerability in the county can assist in planning for future development and ensure establishment of appropriate mitigation, planning, and preparedness measures. 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 and illustrated in Section 4 (County Profile), areas targeted for future growth and development have been identified across the County. Development built in Q3 flood hazard areas may experience structural and content damages during a major flood event. These structures are also at risk to other cascading impacts caused by flooding such as utility failure or eroding foundations. Refer to Section 4, and Volume II Section 9 for more information about the potential new development in Livingston County.

Projected Changes in Population

According to the 2019 American Community Survey 5-year population estimates, the population of the County has decreased by approximately 3-percent since 2010. While less people will reside in the County, those that remain may move into 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.). Section 4, County Profile, provides 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 because of loss of service or access.

Change of Vulnerability Since the 2015 HMP

Since the 2015 HMP, population statistics have been updated using the 5-Year 2015-2019 American Community Survey Population Estimates. The general building stock was also updated using 2021 building footprint and tax assessor data from Livingston County. Furthermore, the replacement cost values of the building inventory were updated using 2021 RS Means values. 2021 critical facility inventory data provided by the Livingston County Planning Partners and the Homeland Infrastructure Foundation-Level Data (HIFLD) were used to assess the number of critical facilities and lifelines at risk to the 1-percent and 0.2-percent annual chance flood events using Q3 FEMA flood data. The building stock and critical facility inventories created for this HMP were assessed in Hazus v5.0 to determine the effects of the 1-percent annual chance flood event.

Overall, this vulnerability assessment uses a more precise and thorough approach, which provides increased accuracy for estimated exposure and potential losses for Livingston County.