5.1 METHODOLOGY AND TOOLS

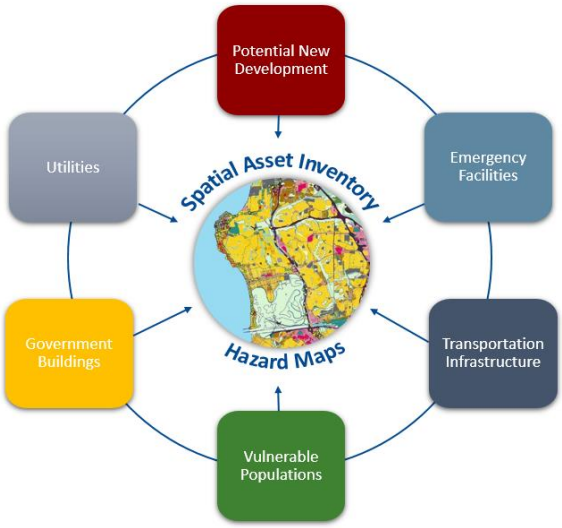
2021 HMP Changes

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

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

5.1.1 Asset Inventories

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



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

Population

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

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

Buildings

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

Critical Facilities and Lifelines

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

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

Environment and Land Use Area

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

New Development

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

5.4.1 Methodology

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

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

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

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

Table 5.1-1. Summary of Risk Assessment Analyses

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

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

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

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

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

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

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

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

Disease Outbreak

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

Drought

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

Extreme Temperatures

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

Flood

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

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

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

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

Harmful Algal Bloom

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

Invasive Species

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

Natural Gas Incidents

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

Severe Storm

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

Severe Winter Storm

All of Chenango County is exposed and vulnerable to the winter storm hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Current modeling tools are not available to estimate specific losses for this hazard. A percentage of the custom-building stock structural replacement cost value was utilized to estimate damages that could result from winter storm conditions (i.e., 1-percent, 5-percent, and 10-percent of total replacement cost value). Given professional knowledge and currently available information, the potential losses for this hazard are considered to be overestimated; hence, providing a conservative estimate for losses associated with winter storm events.

Wildfire

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

Asset data (population, building stock, critical facilities, and new development) were used to support an evaluation of assets exposed and potential impacts and losses associated with this hazard. To determine what assets are exposed to wildfire, available and appropriate GIS data were overlaid with the hazard area; Assets with their centroid located in the hazard area were totaled to estimate the totals and values exposed to a wildfire event.

Considerations for Mitigation and Next Steps

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

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

5.4.2 Data Source Summary

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

Table 5.1-3. Risk Assessment Data Documentation

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

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

Limitations

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

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

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. These results do not predict precise results and should be used to understand relative risk. Over the long term, Chenango County will collect additional data to collect additional data, update and refine existing inventories, to assist in estimating potential losses.

Potential economic loss is based on the present value of the general building stock utilizing best available data. The County acknowledges significant impacts may occur to critical facilities and infrastructure as a result of these hazard events causing great economic loss. However, monetized damage estimates to critical facilities and infrastructure, and economic impacts were not quantified and require more detailed loss analyses. In addition, economic impacts to industry such as tourism and the real-estate market were not analyzed.