5.1 Methodology and Tools

This section describes the methodology and tools used to support the risk assessment process.

5.1.1 Methodology

The risk assessment process used for the Allegany County Hazard Mitigation Plan (HMP) Update is consistent with the process and steps presented in Federal Emergency Management Agency (FEMA) 386-2, State and Local Mitigation Planning How-to Guide, Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA 2001). This process identifies and profiles hazards of concern and assesses vulnerability of assets (population, structures, critical facilities, and the economy) at risk in the community. A risk assessment provides the foundation for the community's decision makers to evaluate mitigation measures that can help reduce impacts of a hazard when one occurs (Section 9 of this plan describes risks faced in each jurisdiction).

The four-step risk assessment process is as follows:

Step 1: Identify the hazards of concern. FEMA's current regulations require an evaluation of only natural hazards, although Allegany County is threatened by several man-made and technological hazards as well. Hazards are events that threaten lives, property, and many other assets. Often natural hazards related to weather patterns or physical characteristics of areas can be predicted because they tend to occur repeatedly at those same geographical locations. Man-made and technological hazards are more difficult to predict.

Step 2: Prepare a profile of each hazard of concern. Hazard profiles assist communities in evaluating and comparing hazards that can impact their areas. Each type of hazard has unique characteristics that vary from event to event. That is, impacts associated with a specific hazard can vary depending on the magnitude and location of each event (a hazard event is a specific, uninterrupted occurrence of a particular type of hazard). Further, probability of occurrence of a hazard at a given location affects the priority assigned to that hazard. Each hazard impacts different communities in different ways, based on geography, local development, population distribution, age of buildings, and mitigation measures already implemented.

Steps 3 (Inventory Assets) and 4 (Estimate Losses): Evaluate community assets and identify assets exposed or vulnerable to the identified hazards of concern. Hazard profile information combined with data regarding population, demographics, general building stock, and critical facilities at risk (described in Section 4) prepares the community to develop risk scenarios and estimate potential damages and losses from each hazard.

5.1.2 Tools

To address the requirements of Disaster Mitigation Act of 2000 (DMA 2000) and better understand potential vulnerability and losses associated with hazards of concern, Allegany County used standardized tools combined with local, state, and federal data and expertise to conduct the risk assessment. The standardized tools used to support the risk assessment are described below.

Hazards U.S. – Multi-Hazard

In 1997, FEMA developed a standardized model for estimating losses caused by earthquakes, known as Hazards U.S. (HAZUS). HAZUS was developed in response to the need for more effective national, state, and community-level planning, and for identification of areas facing highest risk and potential for loss. HAZUS was expanded into Hazards U.S. – Multi-Hazard (HAZUS-MH), a multi-hazard methodology 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 developed by hazard and information technology experts to provide defensible damage and loss estimates. These methodologies are accepted by FEMA and furnish a consistent framework for assessing risk across a variety of hazards. The GIS framework also supports evaluation of hazards and assessment of losses of inventory and other losses from these hazards.

HAZUS-MH applies GIS technology to produce detailed maps and analytical reports that estimate a community's risk of 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 regarding inventory, vulnerability, and hazards; these default data can be supplemented with local data to achieve a more refined analysis. Damage reports can include induced damage (inundation, fire, threats posed by hazardous materials [HazMat] 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 at a central location. Employing of this software also promotes consistency of data output now and in the future, and standardization of data collection and storage. The guidance titled Using HAZUS-MH for Risk Assessment: How to Guide (FEMA 433) was used to support the application of HAZUS-MH for this risk assessment and HMP Update (FEMA 2004).

Generally, probabilistic analyses were performed to develop expected/estimated distribution of losses (mean return period [MRP] losses) from the flood, earthquake, and wind hazards. The probabilistic hazard analysis generates estimates of damage and loss for specified return periods (for example, 100- and 500-year). For annualized losses, HAZUS-MH version 3.0 calculates the maximum potential annual dollar loss resulting from various return periods averaged on a per-year basis. The resulting calculated estimate is the sum of all HAZUS-supplied return periods (for example, 10, 50, 100, 200, and 500) multiplied by the return period probability (as a weighted calculation). In summary, the estimated cost of a hazard each year is calculated.

The following custom methodologies in HAZUS-MH version 3.0 were applied to assess potential exposure and losses associated with hazards of concern for Allegany County:

Inventory: The 2010 U.S. Census data at the Census-block level were used to estimate hazard exposure at the municipal level. Default demographic data in HAZUS-MH 3.0, based on the 2010 U.S. Census, were used to estimate potential sheltering and injuries in this analysis.

Building and critical facility inventories (essential facilities, utilities, transportation features, and user-defined facilities) were updated beginning with all spatial data provided by Allegany County. Both the critical facility and building inventories were formatted to be compatible with HAZUS-MH and its Comprehensive Data Management System (CDMS). Once completed, HAZUS-MH was updated with the final inventory and used for the risk assessment.

Flood: A digitized Flood Insurance Rate Map (FIRM) was not available on the FEMA Map Service Center for use in the County's vulnerability assessment. A Quality 3 (Q3) spatial layer depicting FEMA flood data of Allegany County, released June 1996, was provided by the County and used to evaluate the County's exposure to this hazard. An exposure analysis of the 1- and 0.2-percent annual chance flood events was performed. To estimate potential losses, the HAZUS-MH flood model was used. The County provided 20-foot contour lines, which were used to generate a Digital Elevation Model (DEM). A depth grid was created by using 3D spatial analysis tools in ArcMap 10.2.2. Using this method, the flood zone boundaries are intersected with the DEM, with the assumption that the flood zone boundary marks the water surface elevation edge. The boundary is then interpolated to 3D and converted to a water surface grid. The grid is then intersected with the DEM to generate the flood depth grid. The depth grid was integrated into HAZUS-

MH, and the model was run to estimate potential losses at the structure level using the County's custom structural building inventory for the 1-percent annual chance flood event.

Dam and Levee Failure: As noted above, a digitized FIRM is not available for the vulnerability assessment. Allegany County provided a Q3 to be used to evaluate flood risk; the Q3 is dated 1996. It is unknown if the U.S. Army Corps of Engineers' (USACE) levees in the Village and Town of Wellsville or any dams were analyzed and mapped in the Q3 to depict the effect on the landward side of these systems. Further, levee and dam failure inundation areas were not provided for the purposes of this planning effort. Therefore, qualitative assessments were conducted.

Earthquake: A probabilistic assessment was conducted for Allegany County for the 100-, 500- and 2,500-year MRPs via a Level 2 analysis in HAZUS-MH 3.0 to analyze the earthquake hazard and provide a range of loss estimates for Allegany County. The probabilistic method uses information from historical earthquakes and inferred faults, locations, and magnitudes, and computes probable ground-shaking levels during a recurrence period by U.S. Census tract.

The HAZUS-MH Earthquake User Manual states that, "Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainly in loss estimates produced by the HAZUS Earthquake Model, possibly at best a factor of two or more" (FEMA 2009). However, HAZUS potential loss estimates are acceptable for the purposes of this HMP.

Ground shaking is the primary cause of earthquake damage to man-made structures, and soft soils amplify ground shaking. One contributor to site amplification is velocity at which rock or soil transmits shear waves (S-waves). The National Earthquake Hazards Reduction Program (NEHRP) developed five soil classifications defined by their S-wave velocity that affect severity of an earthquake. The soil classification system ranges from A to E, whereby A represents hard rock that reduces ground motion from an earthquake, and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses.

When unchanged, HAZUS-MH default soil types are class D. However, for this analysis, HAZUS-MH was updated with the specific NEHRP soil types in Allegany County provided by the New York State Division of Homeland Security and Emergency Services (NYS DHSES).

Severe Storm: After reviewing historical data, the HAZUS-MH methodology and model were applied to analyze the severe storm hazard in Allegany County. Data used to assess this hazard included data available in the HAZUS-MH 3.0 wind model, professional knowledge, information provided by the Steering and Planning Committees, and input from the public.

A probabilistic scenario was run for Allegany County for annualized losses, and the 100- and 500-year MRPs were examined for the wind/severe storm hazard. HAZUS-MH contains data on historical hurricane events and wind speeds, and includes surface roughness and vegetation (tree coverage) maps of the area. Surface roughness and vegetation data support modeling of wind force across various types of land surfaces. Hurricane and inventory data available in HAZUS-MH were used to evaluate potential losses from the 100- and 500-year MRP events (severe wind impacts).

Wildfire: The Wildland-Urban Interface (WUI) (interface and intermix), obtained through the SILVIS Lab, Department of Forest Ecology and Management, University of Wisconsin – Madison, was referenced to

define the wildfire hazard areas. The University of Wisconsin-Madison wildland fire hazard areas are based on the 2010 U.S. Census and 2006 National Land Cover Dataset and the Protected Areas Database. For the purposes of 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.

The asset data (population, building stock, and critical facilities) presented in the County Profile (Section 4) were used to support an evaluation of assets exposed and potential impacts and losses associated with this hazard. To identify assets exposed to wildfire, available and appropriate GIS data were overlaid upon the hazard area. Limitations of this analysis are recognized, and as such, the analysis is used only to provide a general estimate.

Other Hazards: At this time, historical data are not adequate to model future losses from many of the hazards evaluated in this risk assessment. For some of the other hazards of concern, areas and inventory susceptible to specific hazards were mapped and exposure was evaluated to help guide mitigation efforts discussed in Section 9 of this HMP. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment.

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

1. Approximations and simplifications necessary to conduct such a study
2. Incomplete or outdated inventory, demographic, or economic parameter data
3. The unique nature, geographic extent, and severity of each hazard.
4. Mitigation measures already employed by Allegany County, and the amount of advance notice given to residents to prepare for a specific hazard event

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of two (2) or more. Therefore, potential exposure and loss estimates are approximate. These results do not predict results with exactness, and should be used to understand relative risk. Over the long term, Allegany County will collect additional data to assist in developing refined estimates of vulnerabilities to natural hazards.