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 Monroe 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 Monroe County is threatened by several manmade 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. Manmade 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. Acquisition of 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, Monroe 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 (HAZUS-MH)

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 needs 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 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 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 from 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 utilized to manage community GIS data at a central location. Use 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 application of HAZUS-MH for this risk assessment and plan (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 (e.g., 100- and 500-year). For annualized losses, HAZUS-MH version 2.1 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 (e.g., 10, 50, 100, 200, 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 versions 2.2 and 2.1 (HAZUS-MH) were applied to assess potential exposure and losses associated with hazards of concern for Monroe 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 2.2, based on the 2010 U.S. Census, were used to estimate potential sheltering and injuries in this analysis. As noted below, HAZUS-MH 2.1 was utilized for the severe storm hazard.

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

Flood: The FEMA effective work map of Monroe County, released in May 2015, was referenced to evaluate the County's exposure to this hazard. An exposure analysis of the 1- and 0.2-percent annual chance flood events occurred. To estimate potential losses, the HAZUS-MH flood model was used. A depth grid was created by use of base-flood elevation and cross section data from the 2015 effective FEMA Digital Flood Insurance Rate Map (DFIRM) and the 1/3 arc-second Digital Elevation Map (DEM) model provided by the U.S. Geological Survey (USGS); for areas without elevation data from FEMA, those data were generated by use of the HAZUS-MH Enhanced Quick Look tool. Depth grids were

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.

Earthquake: A probabilistic assessment was conducted for Monroe County for the 100-, 500- and 2,500-year MRPs via a Level 2 analysis in HAZUS-MH 2.2 to analyze the earthquake hazard and provide a range of loss estimates for Monroe 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 Census tract.

The HAZUS-MH Earthquake User Manual states: "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 manmade 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 shear-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 motions 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 Monroe County provided by the New York State Division of Homeland Security & 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 Monroe County. Because errors were encountered in the wind model when using HAZUS-MH 2.2, the 2.1 model was utilized. Data used to assess this hazard include data available in the HAZUS-MH 2.1 wind model, professional knowledge, and information provided by the Steering and Planning Committees.

A probabilistic scenario was run for Monroe 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. It also 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 Monroe County, and how much advance notice residents have 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 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, Monroe County will collect additional data to assist in developing refined estimates of vulnerabilities to natural hazards.