



5.3 HAZARD RANKING

A comprehensive range of hazards that pose a significant risk to Monroe County were selected and considered during the development of this plan; see Section 5.2 (Identification of Hazards of Concern). However, each community has differing levels of exposure and vulnerability to each of these hazards. It is important for each community participating in this plan to recognize those hazards that pose the greatest risk to their community and direct their attention and resources accordingly to most effectively and efficiently manage risk and reduce losses. The hazard ranking for the County and each participating jurisdiction can be found in their jurisdictional annexes in Volume II, Section 9 (Jurisdictional Annexes) of this plan.

To this end, a hazard risk ranking process was conducted for Monroe County and its municipalities using the method described below. This method includes four risk assessment categories—probability of occurrence, impact (population, property and economy), adaptive capacity, and changing future conditions (i.e., climate change). Each was assigned a weighting factor to calculate an overall ranking value for each hazard of concern. Depending on the calculation, each hazard was assigned a high, medium, or low ranking. Details regarding each of these categories is described below.

5.3.1 Hazard Ranking Methodology

Estimates of hazard risk for the County were developed using methodologies promoted by FEMA’s hazard mitigation planning guidance, generated by FEMA’s Hazus risk assessment tool, and input from Monroe County and participating jurisdictions.

As described in Section 5.1 (Methodology and Tools), three different levels of analysis were used to estimate potential impacts: 1) historic loss/qualitative analysis; 2) exposure analysis; and 3) loss estimation. All three levels of analysis are suitable for planning purposes; however, with any risk analysis, there is underlying uncertainty resulting from assumptions used to describe and assess vulnerability and the methodologies available to model impacts. Impacts from any hazard event within the County will vary from the analysis presented here based on the factors described for each hazard of concern; namely location, extent, warning time, and mitigation measures in place at the time of an event.

The hazard ranking methodology for some hazards of concern is based on a scenario event, while others are based on their potential risk to the County as a whole. In order to account for these differences, the quantitative hazard ranking methodology was adjusted using professional judgement and subject-matter input; assumptions are included, as appropriate, in the following subsections. The limitations of this analysis are recognized given the scenarios do not have the same likelihood of occurrence; nonetheless, there is value in summarizing and comparing the hazards using a standardized approach to evaluate relative risk. The following categories were considered when evaluating the relative risk of the hazards of concern.

- **Probability of Occurrence** - The probability of occurrence of the scenario evaluated was estimated by examining the historic record and/or calculating the likelihood of annual occurrence. When no scenario was assessed, an examination of the historic record and judgement was used to estimate the probability of occurrence of an event that will impact the County.
- **Impact**—The following three hazard impact subcategories were considered: impact to people; impact to buildings; and impact to the economy. The results of the updated risk assessment and/or professional judgement were used to assign the numeric values for these three impact subcategories. A factor was applied to each subcategory, giving impact on population the greatest weight.
 - Population—Numeric value x 3
 - Buildings—Numeric value x 2



- Economy—Numeric value x 1
- **Adaptive Capacity** - Adaptive capacity describes a jurisdiction’s current ability to protect from or withstand a hazard event. This includes capabilities and capacity in the following areas: administrative, technical, planning/regulatory and financial. Mitigation measures already in place increases a jurisdiction’s capacity to withstand and rebound from events (e.g. codes/ordinances with higher standards to withstand hazards due to design or location; deployable resources; or plans and procedures in place to respond to an event). In other words, assigning ‘weak’ for adaptive capacity means the jurisdiction does not have the capability to effectively respond, which increases vulnerability; whereas ‘strong’ adaptive capacity means the jurisdiction does have the capability to effectively respond, which decreases vulnerability. These ratings were assigned using the results of the core capability assessment with subject-matter input from each jurisdiction.
- **Climate Change (Changing Future Conditions)** - Current climate change projections were considered as part of the hazard ranking to ensure the potential for an increase in severity/frequency of the hazard was included. This was important to Monroe County to include because the hazard ranking helps guide and prioritize the mitigation strategy development, which should have a long-term future vision to mitigate the hazards of concern. The potential impacts climate change may have on each hazard of concern is discussed in Sections 5.4.1 through 5.4.11. The benchmark values in the methodology are similar to confidence levels outlined in the National Climate Assessment 2017.

Example Risk Ranking Equation

$$\text{Risk Ranking} = [(\text{Impact on Population} \times 3) + (\text{Impact on Property} \times 2) + (\text{Impact on Economy} \times 1) \times 0.3] + [\text{Capability} \times 0.3] + [\text{Climate Impact} \times 0.1] + [\text{Probability of Occurrence} \times 0.3]$$

Table 5.3-1 summarizes the categories, benchmark values, and weights used to calculate the risk factor for each hazard. Using the weighting applied, the highest possible risk factor value is 6.9. The higher the number, the greater the relative risk. Based on the total for each hazard, a priority ranking is assigned to each hazard of concern (high, medium, or low). The rankings were categorized as follows: Low = Values less than 3.9; Medium = Values between 3.9 and 4.9; High = Values greater than 4.9.

Table 5.3-1. Summary of Hazard Ranking Approach

Category		Level / Category	Degree of Risk / Benchmark Value	Numeric Value	Weighted Value
Probability of Occurrence		Unlikely	A hazard event is not likely to occur or is unlikely to occur with less than a 1 percent annual chance probability.	0	30%
		Rare	Between 1 and 10 percent annual probability of a hazard event occurring.	1	
		Occasional	Between 10 and 100 percent annual probability of a hazard event occurring.	2	
		Frequent	100 percent annual probability; a hazard event may occur multiple times per year.	3	
Impact (Sum of all 3)	Population (Numeric Value x 3)	Low	14 percent or less of population is exposed to a hazard with potential for measurable life-safety impact due to its extent and location.	1	30%
		Medium	15 to 29 percent of population is exposed to a hazard with potential for measurable life-safety impact due to its extent and location.	2	
		High	30 percent or more of population is exposed to a hazard with potential for measurable life-safety impact, due to its extent and location.	3	
	Property (Numeric Value x 2)	Low	Property exposure is 14 percent or less of the total number of structures for your community.	1	
		Medium	Property exposure is 15 to 29 percent of the total number of structures for the community.	2	



Category	Level / Category	Degree of Risk / Benchmark Value	Numeric Value	Weighted Value
Economy (Numeric Value x 1)	High	Property exposure is 30 percent or more of the total number of structures for the community.	3	
	Low	Loss estimate is 9 percent or less of the total replacement cost for the community.	1	
	Medium	Loss estimate is 10 to 19 percent of the total replacement cost for the community.	2	
	High	Loss estimate is 20 percent or more of the total replacement cost for the community.	3	
Adaptive Capacity	Weak	Weak/outdated/inconsistent plans, policies, codes/ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	1	30%
	Moderate	Plans, policies, codes/ordinances in place and meet minimum requirements; mitigation strategies identified but not implemented on a widespread scale; county/jurisdiction can recover but needs outside resources; moderate county/Jurisdiction capabilities.	0	
	Strong	Plans, policies, codes/ordinances in place and exceed minimum requirements; mitigation/protective measures in place; county/jurisdiction has ability to recover quickly because resources are readily available, and capabilities are high.	-1	
Climate Change	Low	No local data are available; modeling projects are uncertain on whether there is increased future risk; confidence level is low (inconclusive evidence).	1	10%
	Medium	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change; confidence level is medium to high (suggestive to moderate evidence).	2	
	High	Studies and modeling projections indicate exacerbated conditions/increased future risk due to climate change; very high confidence level (strong evidence, well documented, and acceptable methods).	3	

Note: A numerical value of zero is assigned if there is no impact.

*For the purposes of this exercise, “impacted” means exposed for population and property and estimated loss for economy. For non-natural hazards, although they may occur anywhere in the County, an event will not likely cause countywide impacts; therefore, impact to population was scored using an event-specific scenario.

In an attempt to summarize the confidence level regarding the input utilized to populate the hazard ranking, a gradient of certainty was developed. A certainty factor of high, medium or low was selected and assigned to each hazard to provide a level of transparency and increased understanding of the data utilized to support the resulting ranking. The following scale was used to assign a certainty factor to each hazard:

- High—Defined scenario/event to evaluate; probability calculated; evidenced-based/quantitative assessment to estimate potential impacts through hazard modeling.
- Moderate—Defined scenario/event or only a hazard area to evaluate; estimated probability; combination of quantitative (exposure analysis, no hazard modeling) and qualitative data to estimate potential impacts.
- Low—Scenario or hazard area is undefined; there is a degree of uncertainty regarding event probability; majority of potential impacts are qualitative.

5.3.2 Hazard Ranking Results

Using the process described above, the risk ranking for the identified hazards of concern was determined for Monroe County. The hazard ranking for Monroe County is detailed in the subsequent tables that present the step-wise process for the ranking. The countywide risk ranking includes the entire planning area and may not reflect the highest risk indicated for any of the participating jurisdictions. The resulting ranks of each municipality indicate the differing degrees of risk exposure and vulnerability. The results support the appropriate selection and prioritization of initiatives to reduce the highest levels of risk for each municipality. Both the county and the participating jurisdictions have applied the same methodology to develop the countywide risk and local rankings



to ensure consistency in the overall ranking of risk; jurisdictions had the ability to alter rankings based on local knowledge and experience in handling each hazard.

This hazard ranking exercise serves four purposes: (1) to describe the probability of occurrence for each hazard; (2) to describe the impact each would have on the people, property, and economy; (3) to evaluate the capabilities a community has with regards to natural hazards; and (4) to consider changing future conditions (i.e., climate change) in Monroe County. Estimates of risk for Monroe County were developed using methodologies promoted by FEMA’s hazard mitigation planning guidance, generated by FEMA’s HAZUS-MH risk assessment tool and input from the county and participating municipalities.

Table 5.3-2 shows the probability ranking assigned for the likelihood of occurrence for each hazard.

Table 5.3-2. Probability of Occurrence Ranking for Hazards of Concern for Monroe County

Hazard of Concern	Probability	Numeric Value
Disease Outbreak	Occasional	2
Drought	Occasional	2
Earthquake	Unlikely	0
Extreme Temperature	Occasional	2
Flood	Occasional	2
Hazardous Materials	Rare	1
Invasive Species	Occasional	2
Landslide	Unlikely	0
Severe Storm	Frequent	3
Severe Winter Storm	Frequent	3
Wildfire	Occasional	2

Table 5.3-3 shows the impact evaluation results for each hazard of concern, including impact on property, structures, and the economy on the County level. The weighting factor results and a total impact for each hazard also are summarized. It is noted that several hazards that have a high impact on the local jurisdictional level can have a lower impact when analyzed countywide.

Table 5.3-3. Impact Ranking for Hazards of Concern for Monroe County

Hazard of Concern	Population			Property			Economy			Total Impact Rating (Population + Property + Economy)
	Impact	Numeric Value	Multiplied by Weighing Factor (3)	Impact	Numeric Value	Multiplied by Weighing Factor (2)	Impact	Numeric Value	Multiplied by Weighing Factor (1)	
Disease Outbreak	Medium	2	6	Low	1	2	Low	1	1	9
Drought	Medium	2	6	Low	1	2	Medium	2	2	10
Earthquake	Medium	2	6	Medium	2	4	Medium	2	2	12
Extreme Temperature	Medium	2	6	Low	1	2	Medium	2	2	10
Flood	Medium	2	6	High	3	6	Low	1	1	13
Hazardous Materials	Medium	2	6	Low	1	2	Medium	2	2	10
Invasive Species	Low	1	3	Low	1	2	Medium	2	2	7
Landslide	Medium	2	6	Medium	2	4	Medium	2	2	12
Severe Storm	High	3	9	Medium	2	4	Low	1	1	14



Hazard of Concern	Population			Property			Economy			Total Impact Rating (Population + Property + Economy)
	Impact	Numeric Value	Multiplied by Weighing Factor (3)	Impact	Numeric Value	Multiplied by Weighing Factor (2)	Impact	Numeric Value	Multiplied by Weighing Factor (1)	
Severe Winter Storm	High	3	9	Medium	2	4	Medium	2	2	15
Wildfire	Low	1	3	Low	1	2	Low	1	1	6

Table 5.3-4 shows the additional impact rankings for the hazards of concern. This includes the overall capabilities of the County and municipalities and the consideration of changing future conditions, such as climate change.

Table 5.3-4. Additional Impact Ranking for Hazards of Concern for Monroe County

Hazard of Concern	Capabilities	Numeric Value	Climate Change	Numeric Value
Disease Outbreak	Medium	0	Medium	2
Drought	Medium	0	High	3
Earthquake	Medium	0	Low	1
Extreme Temperature	Medium	0	High	3
Flood	Medium	0	High	3
Hazardous Materials	Medium	0	Low	1
Invasive Species	Low	1	High	3
Landslide	Medium	0	Medium	2
Severe Storm	High	-1	High	3
Severe Winter Storm	High	-1	Medium	2
Wildfire	Medium	0	Medium	2

Table 5.3-5 presents the total calculations for each hazard ranking value for the hazards of concern. The rankings were categorized and assigned a color as follows: Low = values less than or equal to 3.8 (green); Medium = values between 3.9 and 4.9 (yellow); High = values greater than or equal to 5.0 (red).

Table 5.3-5. Total Hazard Ranking Values for the Hazards of Concern for Monroe County

Hazard of Concern	Probability x 30%	Total Impact x 30%	Adaptive Capacity x 30%	Changing Future Conditions x 10%	Total Risk Ranking Value
Disease Outbreak	0.6	2.7	0	0.2	3.5
Drought	0.6	3	0	0.3	3.9
Earthquake	0	3.6	0	0.1	3.7
Extreme Temperature	0.6	3	0	0.3	3.9
Flood	0.9	3.9	0	0.3	5.1
Hazardous Materials	0.3	3	0	0.1	3.4
Invasive Species	0.6	2.1	0.3	0.3	2.7
Landslide	0	3.6	0	0.2	3.8
Severe Storm	0.9	4.2	-0.3	0.3	5.1
Severe Winter Storm	0.9	4.5	-0.3	0.2	5.3
Wildfire	0.6	1.8	0	0.2	2.6

Notes: Low = Values less than 3.9; Medium = Values between 3.9 and 4.9; High = Values greater than 4.9



Table 5.3-6 presents the jurisdictional hazard ranking for each hazard. An evaluation of the total risk ranking score determined ranking categories that were grouped into three categories: low, medium, and high. It also includes input by the municipalities.

These rankings have been used as one of the bases for identifying the jurisdictional hazard mitigation strategies included in this plan in Section 9, Jurisdictional Annexes. The summary rankings for the county reflect the results of the vulnerability analysis for each hazard of concern and vary from the specific results of each jurisdiction. For example, the severe storm hazard may be ranked low in one jurisdiction, but due to the exposure and impact countywide, it is ranked as a high hazard and is addressed in the County mitigation strategy accordingly. Jurisdictional ranking results are presented in each local annex in this plan in Section 9, Jurisdictional Annexes.

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Table 5.3-6. Summary of Overall Ranking of Hazards by Jurisdiction

Monroe County Municipalities	Disease Outbreak	Drought	Earthquake	Extreme Temperature	Flood	Hazardous Material	Invasive Species	Landslide	Severe Storm	Severe Winter Storm	Wildfire
Town of Brighton	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Low
Village of Brockport	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	High
Town of Chili	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Medium
Village of Churchville	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Town of Clarkson	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	High
Town/Village of East Rochester	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Village of Fairport	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Town of Gates	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Low
Town of Greece	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Medium
Town of Hamlin	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Low
Town of Henrietta	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Low
Village of Hilton	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Village of Honeoye Falls	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Town of Irondequoit	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Town of Mendon	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Town of Ogden	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Town of Parma	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Medium
Town of Penfield	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Low
Town of Perinton	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Low
Town of Pittsford	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Low
Village of Pittsford	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Town of Riga	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Medium
City of Rochester	Low	Medium	Low	High	High	Low	Low	Low	High	High	Low
Town of Rush	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Low
Village of Scottsville	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Village of Spencerport	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Town of Sweden	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Town of Webster	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Low
Village of Webster	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Town of Wheatland	Low	Medium	Low	Medium	Low	Low	Low	Low	High	High	Low
Monroe County	Low	Medium	Low	Medium	High	Low	Low	Low	High	High	Low