4.4 HAZARD RANKING

A comprehensive range of hazards that pose a significant risk to Rockland County were selected and considered during the development of this plan; see Section 4.1 (Hazards of Concern Identification) for how these were selected. 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 manage risk and reduce losses most effectively and efficiently. The hazard rankings can be found in the jurisdictional annexes in Volume II, Section 9 (Annexes) of this plan.

A hazard risk ranking process was conducted for the County 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 category 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 in the following sections.

This hazard ranking exercise serves the following four purposes:

1) Describe the probability of occurrence for each hazard,
2) Describe the impact each would have on the people, property, and economy,
3) Evaluate the capabilities a community has with regards to the hazards of concern.
4) Consider changing future conditions (i.e., climate change) in Rockland County.

4.4.1 Hazard Ranking Methodology

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

As described in Section 4.2 (Methodology and Tools), three different levels of analysis were used to estimate potential impacts: historic loss/qualitative analysis; exposure analysis; and 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** 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** was considered through the following three hazard impact subcategories: 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** 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** 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 the 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 4.3.1 through 4.3.14. The benchmark values in the methodology are similar to confidence levels outlined in the National Climate Assessment 2017.

Hazard Ranking Equation

[Probability of Occurrence x 0.3] + [(Impact on Population x 3) + (Impact on Property x 2) + (Impact on Economy x 1) x 0.3] + [Adaptive Capacity x 0.3] + [Climate Change x 0.1]

Table 4.4-1 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 is values less than 3.9; Medium is between 3.9 and 4.9; and High is greater than 4.9.

Table 4.4-1. 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	0.3
		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 your population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	1	0.3
		Medium	15 percent to 29 percent of your 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 your 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 percent to 29 percent of the total number of structures for your community.	2	
		High	Property exposure is 30 percent or more of the total number of structures for your community.	3	
	Economy (Numeric Value x 1)	Low	Loss estimate is 9 percent or less of the total replacement cost for your community.	1	
		Medium	Loss estimate is 10 percent to 19 percent of the total replacement cost for your community.	2	
		High	Loss estimate is 20 percent or more of the total replacement cost for your 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	0.3
		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 is available; modeling projections are uncertain on whether there is increased future risk; confidence level is low (inconclusive evidence).	1	0.1
		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.
- Medium—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.

4.4.2 Hazard Ranking Results

Using the process described above, the ranking for the identified hazards of concern was determined for County (refer to Table 4.4-2).

The hazard ranking is detailed in the subsequent tables that present the stepwise process for the ranking. The ranking includes the entire County 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. Table 4.4-3 presents the total calculations for each hazard ranking value for the hazards of concern in Rockland County.

Table 4.4-2. Ranking for Hazards of Concern for Rockland County

Hazard of Concern	Probability		Impact									Total Impact Value	Adaptive Capacity	Climate Change
			Population			Property			Economy					
	Category	Numeric Value	Impact	Numeric Value	Weighted Value (x3)	Impact	Numeric Value	Weighted Value (x2)	Impact	Numeric Value	Weighted Value (x1)			
Dam Failure	Occasional	2	Medium	2	2 x 3 = 6	Medium	2	2 x 2 = 4	Medium	2	2 x 1 = 2	3.6	Moderate	Medium
Disease Outbreak	Occasional	2	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	3.6	Strong	High
Drought	Occasional	2	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	3.6	Strong	Medium
Earthquake	Rare	1	Low	1	1 x 3 = 3	Medium	2	2 x 2 = 4	High	3	3 x 1 = 3	3.0	Moderate	Medium
Extreme Temperature	Frequent	3	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	3.6	Moderate	High
Flood	Frequent	3	Medium	2	2 x 3 = 6	Medium	2	2 x 2 = 4	Low	1	1 x 1 = 1	3.3	Strong	High
Landslide	Occasional	2	Medium	2	2 x 3 = 6	Low	1	1 x 2 = 2	Medium	2	2 x 1 = 2	3.0	Moderate	Medium
Severe Weather	Frequent	3	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	High	3	3 x 1 = 3	4.2	Strong	High
Severe Winter Weather	Frequent	3	High	3	3 x 3 = 9	Low	1	1 x 2 = 2	Low	1	1 x 1 = 1	3.6	Strong	High
Wildfire	Occasional	2	Medium	2	2 x 3 = 6	Medium	2	2 x 2 = 4	Medium	2	2 x 1 = 2	3.6	Strong	High

Table 4.4-3. Total Hazard Ranking Values for the Hazards of Concern for Rockland County

Hazard of Concern	Probability (0.3)	Total Impact (0.3)	Adaptive Capacity (0.3)	Changing Future Conditions (0.1)	Total Hazard Ranking Value	Hazard Ranking
Dam Failure	0.6	3.6	0	0.2	4.4	Medium
Disease Outbreak	0.6	3.6	-0.3	0.3	4.2	Medium
Drought	0.6	3.6	-0.3	0.2	4.1	Medium
Earthquake	0.3	3.0	0	0.2	3.5	Low
Extreme Temperature	0.9	3.6	0	0.3	4.8	Medium
Flood	0.9	3.3	-0.3	0.3	4.2	Medium
Landslide	0.6	3.0	0	0.2	3.8	Medium
Severe Weather	0.9	4.2	-0.3	0.3	5.1	High
Severe Winter Weather	0.9	3.6	-0.3	0.3	4.5	Medium
Wildfire	0.6	3.6	-0.3	0.3	4.2	Medium