



5.3 HAZARD RANKING

As discussed in Section 5.2, Identification of Hazards of Concern, a comprehensive range of natural hazards that pose a significant risk to Livingston County were selected and considered during the development of this plan. However, each community in Livingston County has differing levels of exposure and vulnerability to each of these hazards. It is important for each community participating in this plan to recognize the 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 of this plan in Volume II, Section 9.

To this end, a hazard risk ranking process was conducted for Livingston 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

The methodology used to rank the hazards of concern for Livingston County is described below. Estimates of risk for the county were developed using methodologies promoted by the Federal Emergency Management Agency’s (FEMA) hazard mitigation planning guidance and generated by FEMA’s HAZUS-MH risk assessment tool, and input from Livingston County and participating jurisdictions. The ranking includes a factor to evaluate capacity of the participating jurisdiction to address the hazard through plans, policies, and mitigation strategies. For example, a community participating in CRS has a high capacity to address and mitigate flooding issues, which will be reflected in the ranking benchmark. In addition, a factor addressing the degree of climate change impact is included in the methodology to adjust rankings for hazards expected to be significantly impacted by climate change. Table 5.3-1 shows the values for the four risk assessment categories for each of Livingston County’s hazards. Details for each category are further described below.

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 the 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 the 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 the population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	3	
	Property	Low	Property exposure is 14 percent or less of the total number of structures for the community.	1	



Category		Level / Category	Degree of Risk / Benchmark Value	Numeric Value	Weighted Value
	(Numeric Value x 2)	Medium	Property exposure is 15 to 29 percent of the total number of structures for the community.	2	
		High	Property exposure is 30 percent or more of the total number of structures for the community.	3	
	Economy (Numeric Value x 1)	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	
Capability	Low	Weak/outdated/inconsistent plans, policies, codes, and ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	3	30%	
	Medium	Plans, policies, codes, and 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.	2		
	High	Plans, policies, codes, and ordinances in place and exceed minimum requirements; mitigation and 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		

Probability of Occurrence

The probability of occurrence is the likelihood of a hazard event occurring in any given year. A review of historic events assists with this determination. Each hazard of concern is rated in accordance with the numerical ratings and definitions described in Table 5.3-2. The probability of occurrence is given a weighted value of 30 percent.

Table 5.3-2. Probability of Occurrence Ranking Factors

Numeric Value	Probability Category	Definition
0	Unlikely	A hazard event is not likely to occur or is unlikely to occur with less than a 1-percent annual chance probability.
1	Rare	Between 1 and 10-percent annual probability of a hazard event occurring.
2	Occasional	Between 10 and 100-percent annual probability of a hazard event occurring.
3	Frequent	100-percent annual probability; a hazard event may occur multiple times per year.

Hazard Impacts

The impact of each hazard is considered in three categories: impact on population, impact on property (general building stock including critical facilities), and impact on the economy. Based on documented historic losses and individual assessments by each participating municipality, an impact rating of high, medium, or low is assigned with a corresponding numeric value for each hazard of concern. In addition, a weighting factor is assigned to each impact category: 3 for population, 2 for property, and 1 for economy. This gives the impact on



population the greatest weight in evaluating the impact of a hazard. The total of each category is assigned a weighted value of 30 percent. Table 5.3-3 presents the numerical rating, weighted factor and description for each impact category.

Table 5.3-3. Numerical Values and Definitions for Impacts on Population, Property, and Economy

Category	Weighted Value	Low Impact* (1)	Medium Impact (2)	High Impact (3)
Population	3	14 percent or less of the population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	15 to 29 percent of the population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.	30 percent or more of the population is exposed to a hazard with potential for measurable life safety impact, due to its extent and location.
Property	2	Property exposure is 14 percent or less of the total number of structures for the community.	Property exposure is 15 to 29 percent of the total number of structures for the community.	Property exposure is 30 percent or more of the total number of structures for the community.
Economy	1	Loss estimate is 9 percent or less of the total replacement cost for the community.	Loss estimate is 10 to 19 percent of the total replacement cost for the community.	Loss estimate is 20 percent or more of the total replacement cost for the community.

Note: A numerical value of 0 is assigned if there is no impact.

*For the purposes of this exercise, “impacted” means exposed for population and property and loss for economy.

Additional Impacts

Along with impacts on population, property, and economy, the overall risk ranking looks at two additional impacts that affect the county’s vulnerability: Capability and Climate Change. Table 5.3-4 presents the numerical rating and description for each category.

Capability

Capability refers to a jurisdiction’s ability to protect the community from or withstand a hazard event. Mitigation measures are already in place, including codes, ordinances, plans, and procedures to withstand hazards based on design or location, deployable resources, or plans and procedures in place to respond to an event. The capability category has a weighted factor of 30 percent.

Climate Change or Changing Future Conditions

Climate change refers to the impact that climate change projections have on increasing or decreasing the severity and frequency of a hazard. The climate change category has a weighted factor of 10 percent.

Table 5.3-4. Numerical Values and Definitions for Changing Future Conditions and Adaptive Capacity

Category	Low Impact (1)	Medium Impact (2)	High Impact (3)
Capability	Weak/outdated/inconsistent plans, policies, codes, and ordinances in place; no redundancies; limited to no deployable resources; limited capabilities to respond; long recovery.	Plans, policies, codes, and 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.	Plans, policies, codes, and 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.



Category	Low Impact (1)	Medium Impact (2)	High Impact (3)
Climate Change	No local data are available; modeling projects are uncertain on whether there is increased future risk; confidence level is low (inconclusive evidence).	Studies and modeling projections indicate a potential for exacerbated conditions due to climate change; confidence level is medium to high (suggestive to moderate evidence).	Studies and modeling projections indicate exacerbated conditions and increased future risk due to climate change; very high confidence level (strong evidence, well documented and acceptable methods).

Note: "Low impact" for adaptive capacity means the jurisdiction does not have the capability to effectively respond, which increases vulnerability; whereas "high impact" for adaptive capacity means the jurisdiction does have the capability to effectively respond, which decreases vulnerability.

Risk Ranking Value

Each impact was weighted, and the risk ranking for each hazard was then calculated using the following formula:

Example Risk Ranking Equation

$$\text{Risk Ranking} = [(Impact\ on\ Population \times 3) + (Impact\ on\ Property \times 2) + (Impact\ on\ Economy \times 1) \times .30] + [Capability \times .30] + [Climate\ Impact \times .10] + [Probability\ of\ Occurrence \times .30]$$

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 are less than or equal to 3.8; medium = values are between 3.9 and 4.9; and high = values are greater than or equal to 5.0.

5.3.2 Hazard Ranking Results

Using the process described above, the risk level for the identified hazards of concern were ranked for Livingston County. The hazard ranking for Livingston 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 Livingston County. Estimates of risk for Livingston County were developed using methodologies promoted by FEMA’s hazard mitigation planning guidance and generated by FEMA’s HAZUS-MH risk assessment tool, and input from the county and participating municipalities.

Table 5.3-5 shows the probability ranking assigned for the likelihood of occurrence for each hazard.

Table 5.3-5. Probability of Occurrence Ranking for Hazards of Concern for Livingston County

Hazard of Concern	Probability	Numeric Value
Drought	Rare	1
Earthquake	Rare	1
Flood	Frequent	3



Hazard of Concern	Probability	Numeric Value
Hazardous Materials	Occasional	2
Invasive Species	Occasional	2
Landslide	Rare	1
Mine Subsidence	Unlikely	0
Pandemic	Occasional	2
Severe Storm	Frequent	3
Severe Winter Storm	Frequent	3
Terrorism	Rare	1
Utility Failure	Occasional	2
Wildfire	Occasional	2

Table 5.3-6 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 5.3-6. Impact Ranking for Hazards of Concern for Livingston 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)	
Drought	Medium	2	6	Low	1	2	Medium	1	2	10
Earthquake	High	3	9	High	3	6	Low	1	1	16
Flood	Low	1	3	Low	1	2	Low	1	1	6
Hazardous Materials	Medium	2	6	High	3	6	High	3	3	15
Invasive Species	Medium	2	6	Low	1	2	Medium	2	2	10
Landslide	Low	1	3	Low	1	2	Low	1	1	6
Mine Subsidence	Low	1	3	Low	1	2	Low	1	1	6
Pandemic	High	3	9	Low	1	2	Low	2	2	13
Severe Storm	High	3	9	Medium	2	4	Low	1	1	14
Severe Winter Storm	High	3	9	Low	1	2	Low	1	1	12
Terrorism	Low	1	3	Low	1	2	Low	1	1	6
Utility Failure	Medium	2	6	High	3	6	Medium	2	2	14
Wildfire	Medium	2	6	Medium	2	4	High	1	3	13

Table 5.3-7 shows the additional impact rankings for the hazards of concern. These rankings consider the overall capabilities of the county and municipalities, and changing future conditions, such as climate change.

Table 5.3-7. Additional Impact Ranking for Hazards of Concern for Livingston County

Hazard of Concern	Capabilities	Numeric Value	Climate Change	Numeric Value
Drought	Medium	0	High	3



Hazard of Concern	Capabilities	Numeric Value	Climate Change	Numeric Value
Earthquake	Medium	0	Low	1
Flood	Medium	0	High	3
Hazardous Materials	Medium	0	Low	1
Invasive Species	Medium	0	High	3
Landslide	Medium	0	Medium	2
Mine Subsidence	Medium	0	Medium	2
Pandemic	Medium	0	Medium	2
Severe Storm	High	-1	High	3
Severe Winter Storm	High	-1	Medium	2
Cyber Terrorism	Medium	0	Low	1
Utility Failure	Medium	0	Medium	2
Wildfire	Medium	0	High	3

Table 5.3-8 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 are less than or equal to 3.8 (green); medium = values are between 3.9 and 4.9 (yellow); and high = values are greater than or equal to 5.0 (red).

Table 5.3-8. Total Hazard Ranking Values for the Hazards of Concern for Livingston County

Hazard of Concern	Probability x 30%	Total Impact x 30%	Adaptive Capacity x 30%	Changing Future Conditions x 10%	Total Risk Ranking Value
Drought	0.3	3.0	0.0	0.3	3.6
Earthquake	0.3	4.8	0.0	0.1	5.2
Flood	0.9	1.8	0.0	0.3	3.0
Hazardous Materials	0.6	4.5	0.0	0.1	5.2
Invasive Species	0.6	3.0	0.0	0.3	3.9
Landslide	0.3	1.8	0.0	0.2	2.3
Mine Subsidence	0.0	1.8	0.0	0.2	2.0
Pandemic	0.6	3.9	0.0	0.2	4.7
Severe Storm	0.9	4.2	-0.3	0.3	5.1
Severe Winter Storm	0.9	3.6	-0.3	0.2	4.4
Terrorism	0.3	1.8	0.0	0.1	2.2
Utility Failure	0.6	4.2	0.0	0.2	5.0
Wildfire	0.6	3.9	0.0	0.3	4.8

Notes: Low = Values less than or equal to 3.8; Medium = Values between 3.9 and 4.9; High = Values greater than or equal 5.0

These rankings have been used to identify 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 high in the county because of the exposure and impact countywide, and therefore is addressed in the county mitigation strategy accordingly. Jurisdictional ranking results are presented in each local annex of this plan in Section 9, Jurisdictional Annexes.