5.2 METHODOLOGY AND TOOLS

2019 HMP Update Changes

General Building Stock and Critical Facilities

- Updated general building stock used:
  - Updated building footprints provided by the Burlington County Department of Information Technology were used.
  - RS Means 2018 building valuations were used to estimate replacement cost value for each building in the inventory.
- Updated critical facility inventory used:
  - Burlington County Department of Information Technology provided updated critical facility inventories that were used to generate the final inventory used.

Hazard-Specific Changes

- Earthquake
  - An updated version of FEMA's HAZUS-MH earthquake module (version 4.0) was used to estimate potential losses. The latest version of HAZUS-MH has a longer historical record to pull from when generating probabilistic events; therefore, different probabilistic earthquake scenarios were developed by the model for Burlington County for this plan update and the updated potential loss estimates are reported.
- Flood
  - The 2017 effective Burlington County FEMA Digital Flood Insurance Rate Map (DFIRM) was used for this plan in place of the preliminary and advisory DFIRM used in the 2013 HMP.
  - An updated version of FEMA's HAZUS-MH flood module (version 4.0/version 4.2) and updated 1-percent annual chance flood event depth grid were used to estimate potential losses for the 1-percent annual chance food event. An exposure analysis was conducted for the 0.2-percent annual chance flood event.
- Landslide
  - Areas of steep slopes greater than 15 percent were generated using 2016 USGS 3-meter resolution elevation data to delineate the landslide hazard area.
  - Subsidence and sinkholes were not assessed as part of the 2014 HMP; Burlington County requested the hazard be included in the assessment.
- Severe Storm
  - An updated version of FEMA's HAZUS-MH hurricane module (version 4.0) was used to estimate potential losses. Several changes to the HAZUS-MH model have been implemented since the 2014 HMP including a longer historical record to pull from when generating probabilistic events. Therefore, different probabilistic hurricane wind scenarios were developed by the model for Burlington County for this plan update and the updated potential loss estimates are reported.

A risk assessment is the process of measuring the potential loss of life, personal injury, economic and property damage resulting from identified hazards. It allows planning personnel to address and reduce hazard impacts and emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets. Results of the risk assessment are used in subsequent mitigation planning processes, including determining and prioritizing mitigation actions that reduce each jurisdiction's risk to a specified hazard. Past, present, and future conditions must be evaluated to most accurately assess risk for the County and each jurisdiction. The process focuses on the following elements:

- **Hazard identification**—Use all available information to determine what types of hazards may affect a jurisdiction

- **Profile each hazard** – Understand each hazard in terms of:
    - Location - geographic area most affected by the hazard
    - Extent – severity of each hazard
    - Previous Occurrences and Losses
    - Impacts of Climate Change
    - Probability of Future Hazard Events
- **Assess Vulnerability –**
    - Exposure identification—Estimate the total number of assets in the jurisdiction that are likely to experience a hazard event if it occurs by overlaying hazard maps with the asset inventories.
    - Vulnerability identification and loss estimation—Assess the impact of hazard events on the people, property, environment, economy and lands of the region, including estimates of the cost of potential damage or cost that can be avoided by mitigation.

The following summarizes the asset inventories, methodology and tools used to support the risk assessment process.

5.2.1 Asset Inventories

Burlington County assets were identified to assess potential exposure and loss associated with the hazards of concern. For the HMP update, Burlington County assessed vulnerability of the following types of assets: population, buildings and critical facilities/infrastructure and the environment. Some assets may be more vulnerable because of their physical characteristics or socioeconomic uses. To protect individual privacy and the security of critical facilities, information on properties assessed is presented in aggregate, without details about specific individual personal or public properties.

Population

As discussed in Section 4 (County Profile) research has shown that some populations are at greater risk from hazard events because of decreased resources or physical abilities. For the purposes of this planning process, vulnerable populations in Burlington County include children, elderly, low-income, the physically or mentally disabled, non-English speakers and the medically or chemically dependent.

The 2010 U.S. Census block data layers were used to estimate exposure and potential impacts to the general population. The 2010 U.S. Census demographic data available in FEMA's Hazus model was used to estimate potential impacts to the elderly (over 65 years of age) and populations with income below the poverty threshold. The 2012-2016 American Community Survey was utilized to examine the residents living with a disability and that are non-English speaking.

U.S. Census blocks do not follow the boundaries of the hazard areas, possibly leading to gross overestimates or underestimates of exposed populations from use of centroids or intersects of Census blocks with these zones. Limitations of these analyses are recognized, and thus the results are used only to provide a general estimate.

Buildings

The general building stock was updated countywide with a custom-building inventory. To develop the building inventory the building footprint spatial layer and parcel information provided by the county and MODIV tax assessor data obtained from the New Jersey Department of the Treasury were utilized. Attributes provided in the spatial files were used to further define each structure in terms of occupancy class, construction type, etc. The centroid of each building footprint was used to estimate the building location. Structural and content replacement cost values (RCV) were calculated for each building utilizing available assessor data and RSMeans 2018 values; a regional location factor for Burlington County was applied (1.13) for all occupancy classes. Replacement cost value is the current cost of returning an asset to its pre-damaged condition, using present-day cost of labor and materials. Total replacement cost value consists of both the structural cost to replace a building and the estimate value of contents of a building. The occupancy classes available in HAZUS-MH v4.2 were condensed into the following categories (residential, commercial, industrial, agricultural, religious, governmental, and educational) to facilitate the analysis and the presentation of results. Residential loss estimates address both multi-family and single-family dwellings.

Critical Facilities

The critical facility inventory, which includes essential facilities, utilities, transportation features and user-defined facilities as outlined in Section 4, was updated beginning with all GIS data provided by the Burlington County Department of Information Technology and then reviewed by the Planning Committee allowing for municipal input. To protect individual privacy and the security of assets, information is presented in aggregate, without details about specific individual properties or facilities.

Environment

NJDEP 2012 Land Use/Land Cover spatial data released in February 2015 was used to delineate the areas of forest and wetlands in the County. The data is available for each HUC8 Watershed in the State; the Land Use/Land Cover spatial data for the Crosswicks-Neshaminy, Lower Delaware, and Mullica-Toms watersheds was merged and clipped to the Burlington County boundary in ArcGIS to generate the County's composite Land Use/Land Cover spatial layer. Version 3.3 of the NJDEP's Landscape Project released in May 2017 was used to delineate the areas of critical habitats for endangered species in the State. The Landscape Project provides data that documents threatened and endangered species habitat for landscape regions in the State. The Piedmont Plains and Pinelands Landscape spatial data were merged and clipped to the Burlington County boundary in ArcGIS to generate the spatial layer of the County's critical habitat areas for endangered species.

New Development

In addition to summarizing the current vulnerability, Burlington County examined recent and anticipated new development that can affect the County's vulnerability to hazards. Identifying these changes and integrating into the risk assessment ensures they are considered when developing the mitigation strategy to reduce these vulnerabilities in the future. An exposure analysis was conducted using anticipated and recent new development provided by each jurisdiction. The development is presented in Section 9, as a table in each annex.

5.2.2 Methodology

To address the requirements of the DMA 2000 and better understand potential vulnerability and losses associated with hazards of concern, Burlington County used standardized tools, combined with local, state, and federal data and expertise to conduct the risk assessment. Three different levels of analysis were used depending upon the data available for each hazard as described below.

1. **Historic Occurrences and Qualitative Analysis** – This analysis includes an examination of historic impacts to understand potential impacts of future events of similar size. In addition, potential impacts and losses are discussed qualitatively using best available data and professional judgement.
2. **Exposure Assessment** – This analysis involves overlaying available spatial hazard layers, or hazards with defined extent and locations, with assets in GIS to determine which assets are located in the impact area of the hazard. The analysis highlights which assets may be affected by the hazard. *If the center of each asset is located in the hazard area, it is deemed exposed and potentially vulnerable to the hazard.*
3. **Loss estimation** — The FEMA Hazus modeling software was used to estimate potential losses for the following hazards: Flood, Earthquake, Hurricane. In addition, an examination of historic impacts and an exposure assessment was conducted for these spatially-delineated hazards.

Table 5.2-1. Summary of Risk Assessment Analyses

Hazard	Data Analyzed				
	Population	General Building Stock	Critical Facilities	Environment	New Development
Coastal Erosion	E	E	E	-	E
Drought	Q	Q	Q	Q	Q
Earthquake	H	H	H	-	Q
Flood	E, H	E, H	E, H	E	E
Landslide	E	E	E	-	E
Severe Storm	E, H	E, H	E, H	-	E
Severe Winter Storm	Q	Q	Q	-	Q
Wildfire	E	E	E	-	E

E – Exposure analysis; H – Hazus analysis; Q – Qualitative analysis

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. or HAZUS. HAZUS was developed in response to the need for more effective national-, state-, and community-level planning and the need to identify areas that face the 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, which have been developed by hazard and information technology experts, to provide defensible damage and loss estimates. These methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards. The GIS framework also supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards.

HAZUS-MH uses GIS technology to produce detailed maps and analytical reports that estimate a community's 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 for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. Damage reports can include induced damage (inundation, fire, threats posed by hazardous materials 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 in a central location. The use of this software also promotes consistency of data output now and in the future and standardization of data collection and storage. More information on HAZUS-MH is available at http://www.fema.gov/hazus.

In general, probabilistic analyses were performed to develop expected/estimated distribution of losses (mean return period losses) for the flood, wind and seismic hazards. The probabilistic model generates estimated damages and losses for specified return periods (e.g., 100- and 500-year). For annualized losses, HAZUS-MH calculates the maximum potential annual dollar loss resulting from various return periods averaged on a "per year" basis. It is the summation 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. Table 5.2-2 displays the various levels of analyses that can be conducted using the HAZUS-MH software.

Table 5.2-2. Summary of HAZUS-MH Analysis Levels

HAZUS-MH Analysis Levels

Level 1	HAZUS-MH provided hazard and inventory data with minimal outside data collection or mapping.
Level 2	Analysis involves augmenting the HAZUS-MH provided hazard and inventory data with more recent or detailed data for the study region, referred to as "local data"
Level 3	Analysis involves adjusting the built-in loss estimation models used for the hazard loss analyses. This Level is typical done in conjunction with the use of local data.

Coastal Erosion

While Burlington County has no open water on the Atlantic Ocean or Delaware Bay, it has two distinct areas that are at risk of shoreline erosion: the western border along the Delaware River and the southeastern portion along Mullica River Great Bay and its tributaries. The coastal boundary of the State of New Jersey encompasses the latter area (NJDEP, 2007; NJDEP, 2002).

A USGS report for the National Assessment of Shoreline Change entitled *Historical Shoreline Change along the New England and Mid-Atlantic Coasts* was released in 2011. The New England and Mid-Atlantic shores were subdivided into a total of 10 analysis regions for the purpose of reporting regional trends in shoreline change rates. The average rate of long-term shoreline change for the New England and Mid-Atlantic coasts was -0.5 meters per year. The average net long-term rate of shoreline change for the New Jersey 'North' region (located from Sandy Hook to south to Little Egg Inlet) was -0.6 meters per year. Meanwhile, the long-term net shoreline change rate in the New Jersey 'South' region (located from Little Egg Inlet south to Cape May Point) is strongly accretional (0.8 meters per year) (USGS 2011).

To estimate risk to long-term coastal erosion for purposes of this assessment, the following shoreline types as defined by NJDEP were used: (1) "beach," which includes waterfront areas composed of 100 percent sand; and (2) "erodible," which includes any soft shoreline other than beach, such as rock, marsh, sea wall or earthen dike. To generate the extent of the estimated coastal erosion hazard area, an erosion rate of 0.6 meters per year was multiplied by 60 to include all structure types and developed/undeveloped areas (annual erosion rate of 0.6 meters x 60 years = 36 meters or approximately 120 feet). Although the 'South' region indicated an average accretion rate, the average rate of erosion of the 'North' region was used as a conservative estimate. Therefore, population, buildings, and infrastructure within 120 feet of the identified beach or erodible shoreline types are identified as potentially vulnerable to coastal erosion. Please note this methodology assumes that once lost to erosion, an area of land is not subsequently restored. This methodology is consistent with that used to evaluate coastal erosion in the 2014 New Jersey State Hazard Mitigation Plan.

In addition, projected sea-level rise data (in one-foot increments) available from the NOAA Office of Coastal Management (https://coast.noaa.gov/slrdata/) was considered and used for this analysis. Please note these levels do not include additional storm surge due to a hurricane or Nor'easter. The current Flood Insurance Rate Maps (FIRMs) also do not include the effects of sea-level rise. Miller et al. projects an approximate 2-foot in sea-level rise by 2050 for the State of New Jersey in *A geological perspective on sea-level rise and impacts along the U.S. mid-Atlantic coast* (July 2013, Submitted to Earth's Future). For the purposes of this planning effort, the year 2050 and associated projected 2-foot rise was used as a reasonable and responsible planning horizon.

According to sea-level rise mapping, a 2-foot rise in sea level would impact more than just the CAFRA identified portion of Burlington County. Washington Township along the Mullica River and the City of Burlington would both have significant area that would likely experience flooding. Elsewhere, a 2-foot rise would cause modest shoreline retreat in many tidally impacted rivers.

Asset data (population, building stock, critical facilities, and new development) were used to support an evaluation of assets exposed and potential impacts and losses associated with this hazard. To determine what assets are exposed to sea-level rise, the County's assets were overlaid with the hazard area. Assets with their centroid located in the hazard area were totaled to estimate the totals and values exposed to sea-level rise.

Drought

To assess the vulnerability of the State to drought and its associated impacts, a qualitative assessment was conducted. The United States Department of Agriculture Census of Agriculture 2012 was used to estimate economic impacts to the County. Information regarding the number of farms, land area in farms, total market value of products sold, etc. was extracted from the report and summarized in the vulnerability assessment. Additional resources from the Center for Disease Control and North Carolina State University were used to assess the potential impacts to the population from a drought event.

Earthquake

A probabilistic assessment was conducted for Burlington County for the 100-, 500- and 2,500-year MRPs through a Level 2 analysis in HAZUS-MH v4.0 to analyze the earthquake hazard and provide a range of loss estimates. The probabilistic method uses information from historic earthquakes and inferred faults, locations and magnitudes, and computes the probable ground shaking levels that may be experienced during a recurrence period by Census tract.

> As noted in the HAZUS-MH Earthquake User Manual, "*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 uncertainty in loss estimates produced by the HAZUS Earthquake Model, possibly at best by a factor of two or more*" (FEMA 2015f). 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 the site amplification is the velocity at which the rock or soil transmits shear waves (S-waves). The National Earthquake Hazard Reductions Program (NEHRP) has developed five soil classifications defined by their shear-wave velocity that impact the severity of an earthquake. The soil classification system ranges from A to E, where 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.

NEHRP soil classifications were not available for Burlington County at the time of this analysis. Soils were estimated as NEHRP soil Type D across Burlington County, as a conservative approach to this risk assessment. Groundwater was set at a depth of 5 feet (default setting). The default assumption is a magnitude 7.0 earthquake for all return periods. Damage and loss due to liquefaction, landslide, or surface fault rupture were not included in this analysis. The model estimated potential losses to buildings at the Census tract level; results are presented by municipalities contained within each Census tract.

In addition to the probabilistic scenarios cited, an annualized loss run was conducted to estimate annualized general building stock dollar losses in the County. The loss methodology combines estimated losses associated with ground shaking for eight return periods: 100-, 250-, 500-, 750-, 1,000-, 1,500-, 2,000-, and 2,500-year, which are based on values from USGS seismic probabilistic curves.

Flood

The 1- and 0.2-percent chance flood events were examined to evaluate Burlington County risk and vulnerability to the riverine flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as the NFIP.

The effective Burlington County FEMA Digital Flood Insurance Rate Map (DFIRM) dated December 2017 was used to evaluate exposure and determine potential future losses. A FEMA Risk MAP depth grid for Burlington County generated in 2017 was integrated into the HAZUS-MH v4.0 riverine flood model used to estimate potential losses for the 1-percent annual chance flood event.

To estimate exposure to the 1-percent- and 0.2-percent annual chance flood events, the DFIRM flood boundaries, updated building and critical facility inventories and 2010 U.S. Assets (population, building stock, critical facilities, and new development) with their centroid in the hazard areas were totaled to estimate the numbers and values vulnerable to a flooding event. A Level 2 HAZUS-MH v4.0 riverine flood analysis was performed. Both the critical facility and building inventories were formatted to be compatible with HAZUS-MH v4.2 and its Comprehensive Data Management System (CDMS). Once updated with the inventories, the HAZUS-MH v4.0 riverine flood model was run to estimate potential losses in Burlington County for the 1-percent annual chance flood event. A user-defined analysis was performed for the building stock; buildings located within the floodplain were imported as user-defined facilities to estimate potential losses to the building stock at the structural level. HAZUS-MH v4.0 calculated the estimated potential losses to the population (default 2010 U.S. Census data) and potential damages to the general building stock and critical facility inventories based on the depth grid generated and the default HAZUS-MH v4.0 damage functions in the flood model.

To estimate debris generated by the 1-percent annual chance flood event, HAZUS-MH v4.2, which was released on January 29, 2018, was used instead of HAZUS-MH v4.0. This is because a FEMA-known error in v4.0 was detected, and the issue appears to have been resolved with the latest software release.

Locations of the properties with policies, claims, and repetitive and severe repetitive flooding were geocoded by FEMA with the understanding that differences (and variations in those differences) were possible between listed longitude and latitude coordinates of properties and actual locations of property addresses—namely, that indications of some locations were more accurate than others. For properties without longitude or latitude coordinates provided, addresses provided in datasets were used to geocode each location.

Areas of forests, wetlands, and critical habitat landscapes located within the 1- and 0.2-percent annual chance flood event boundaries were also calculated to estimate impacts on the environment. The boundaries of these areas were intersected with the floodplains in ArcGIS to calculate the areas exposed to the 1- and 0.2-percent annual chance flood events.

Landslide

To provide a more detailed vulnerability assessment, the 2016 USGS 3-meter resolution Digital Elevation Model (DEM) was used to generate areas of steep slopes for the County. In ArcGIS 10.5.2, the percent slope spatial layer was derived using Spatial Analysis tools. Areas with slopes greater than 15% were extracted and used as the hazard area.

The NJGS' Carbonate Formations GIS layer differentiates areas of carbonate and non-carbonate geological formations for New Jersey; this layer was used to estimate the County's vulnerability to ground failure due to subsidence and sinkholes. The Carbonate Formations GIS layer was derived from selecting out bedrock types from the Bedrock Geology of New Jersey (2000) that were categorized as having carbonate lithologies.

Asset data (population, building stock, critical facilities, and new development) were used to support an evaluation of assets exposed and potential impacts and losses associated with this hazard. To determine what assets are exposed to landslide, the County's assets were overlaid with the hazard area. Assets with their centroid located in the hazard area were totaled to estimate the totals and values exposed to a hazard event.

Severe Storm

A HAZUS-MH v4.0 probabilistic analysis was performed to analyze the wind hazard losses for Burlington County. The probabilistic hurricane hazard activates a database of thousands of potential storms that have tracks and intensities reflecting the full spectrum of Atlantic hurricanes observed since 1886 and identifies those with tracks associated with Burlington County. HAZUS-MH contains data on historic hurricane events and wind speeds. It also includes surface roughness and vegetation (tree coverage) maps for the area. Surface roughness and vegetation data support the modeling of wind force across various types of land surfaces. Annualized losses and the 100- and 500-year MRPs were examined for the wind/severe storm hazard. Default demographic and updated building and critical facility inventories in HAZUS-MH v4.0 were used for the analysis.

There is currently a FEMA-acknowledged issue with importing user-defined facilities in HAZUS-MH v4.0. To estimate potential losses to user-defined facilities identified by Burlington County, they were appended to the Emergency Operation Centers input in HAZUS-MH Comprehensive Data Management System (CDMS) and uploaded to the program.

In addition to estimating potential losses due to wind, an exposure analysis was conducted using the "Sea – Lake Overland Surge from Hurricanes – SLOSH Model incorporated into FEMA's 2012 Coastal Flood Loss Atlas, which represents potential flooding from worst-case combinations of hurricane direction, forward speed, landfall point, and high astronomical tide were used to estimate exposure. Please note these inundation zones do not include riverine flooding caused by hurricane surge or inland freshwater flooding. The model, developed by the National Weather Service to forecast surges that occur from wind and pressure forces of hurricanes, considers only storm surge height and does not consider the effects of waves. The SLOSH spatial data includes boundaries for Category 1 through Category 4 hurricane events.

Asset data (population, building stock, critical facilities, and new development) were used to support an evaluation of assets exposed and potential impacts and losses associated with this hazard. To determine what assets are exposed to storm surge, the County's assets were overlaid with the SLOSH hazard area. Assets with their centroid located in the hazard area were totaled to estimate the totals and values exposed to the hazard.

Severe Winter Storm

The entire general building stock inventory in Burlington County is exposed and vulnerable to the winter storm hazard. In general, structural impacts include damage to roofs and building frames, rather than building content. Current modeling tools are not available to estimate specific losses for this hazard. A percentage of the custom-building stock structural replacement cost value was utilized to estimate damages that could result from winter storm conditions. Given professional knowledge and the currently available information, the potential losses for this hazard are considered to be overestimated; hence, providing a conservative estimate for losses associated with winter storm events.

Wildfire

The NJFFS uses Wildfire Fuel Hazard data to assign wildfire fuel hazard rankings across the State. This data, developed in 2009, is based upon NJDEP's 2002 Land Use/Land Cover datasets and NJDEP's 2002 10-meter Digital Elevation Grid datasets. For the wildfire hazard, the NJFFS Wildfire Fuel Hazard "extreme', 'very high' and 'high' areas are identified as the wildfire hazard area. The defined hazard area was overlaid upon the asset data (population, building stock, critical facilities and potential new development) to estimate the exposure to each hazard.

Asset data (population, building stock, critical facilities, and new development) were used to support an evaluation of assets exposed and potential impacts and losses associated with this hazard. To determine what assets are exposed to landslide, the County's assets were overlaid with the hazard area. Assets with their centroid located in the hazard area were totaled to estimate the totals and values exposed to a wildfire event.

Considerations for Mitigation and Next Steps

The following items are to be discussed for considerations for the next plan update to enhance the vulnerability assessment:

- All Hazards
    - Utilize updated and current demographic data. If 2010 U.S. Census demographic data is the only data available at the U.S. Census Block level during the next plan update, estimate the current population for each census block using the American Community Survey 5-Year Estimate populations counts at the census block group or census tract level available at the time of the update. Additionally, residential building footprints or parcels can be utilized along with the County's average household size to estimate population exposure.
    - Update the custom general building stock inventory using updated County tax assessor data and building location data; See individual hazards below for additional attributes that can enhance loss estimates
- Coastal Erosion
    - If available during the next plan update, update the risk assessment using a comprehensive coastal erosion hazard area map.
    - Collect data on historic costs incurred to reconstruct buildings, cultural resources and/or infrastructure due to coastal erosion impacts.
- Flood
    - General building stock inventory can be updated to include attributes regarding first floor elevation and foundation type (basement, slab on grade, etc.) to enhance loss estimates.
    - Conduct a HAZUS-MH loss analysis for more frequent flood events (e.g., 10 and 50-year flood events).
- Earthquake
    - Identify unreinforced masonry in critical facilities and privately-owned buildings (i.e., residences) by accessing local knowledge, tax assessor information, and/or pictometry/orthophotos. These buildings may not withstand earthquakes of certain magnitudes and plans to provide emergency response/recovery efforts at these properties can be developed.
    - Should data become available regarding NEHRP soil classifications and/or liquefaction for the County, incorporated in the HAZUS-MH Earthquake model during the next plan update to provide a more accurate and detailed estimation of potential losses.
- Landslide
    - A pilot study conducted in Schenectady County, NY (Landslide Susceptibility – A Pilot Study of Schenectady County, NY) provided a detailed methodology for delineating high-risk landslide areas. This study looked at a variety of environmental characteristics including slope and soil conditions to determine areas at risk to landslide. To coincide with the methodology of that study, the generated slopes were categorized into five classes: 0%-2%; 3%-7%; 8%-15%; 16%-25%; Greater than 25%. Slopes greater than 25% should be used to delineate the hazard area for the vulnerability assessment. Should the County determine the need for a more

detailed assessment of risk, the additional environmental and soil characteristics used in the Schenectady County plan can be collected and used to follow the methodology used to further delineate the County's most at risk areas.

- Severe Weather
  - General building stock inventory can be updated to include attributes regarding protections against strong winds, such as hurricane straps, to enhance loss estimates.
  - Track extreme temperature data for injuries, deaths, shelter needs, pipe freezing, agricultural losses, and other impacts to determine distributions of most at risk areas.
- Severe Winter Storm
  - If available for the region, obtain average snowfall distributions to determine if various areas in the County have historically received higher snowfalls and may continue to be more susceptible to higher snowfalls and snow loads on the building stock and critical facilities and infrastructure.
- Wildfire
  - General building stock inventory can be updated to include attributes such as roofing material or fire detection equipment.

5.2.3 Data Source Summary

Table 5.2-3 summarizes the data sources used for the risk assessment for this plan.

Table 5.2-3. Risk Assessment Data Documentation

Data	Source	Date	Format
Population data	U.S. Census Bureau	2010	Digital (GIS) format
Building footprints	Burlington County Department of Information Technology	2017	Digital (GIS) format
MODIV Tax Assessor data	NJ Department of the Treasury	2017	Digital (Tabular) format
Critical facilities	Burlington County Department of Information Technology	2017	Digital (GIS) format
Digitized effective FIRM maps	FEMA	2017	Digital (GIS) format
RiskMAP 1-percent annual chance event depth grid	FEMA	2017	Digital (GIS) format
Landslide Incidence/Susceptibility	USGS	2011	Digital (GIS) format
Carbonate Formations	NJGS	2008	Digital (GIS) format
Wildfire Fuel Hazard	NJFFS	2012	Digital (GIS) format
Census of Agriculture	USDA	2012	Digital (PDF Report) format
2-foot Sea-Level Rise	NOAA	2016	Digital (GIS) Format
Sea-Lake Overland Surge from Hurricanes (SLOSH) Model	FEMA	2012	Digital (GIS) Format
3-meter Resolution Digital Elevation Model	USGS	2016	Digital (GIS) Format

Limitations

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 dated inventory, demographic, or economic parameter data

3) The unique nature, geographic extent, and severity of each hazard
4) Mitigation measures already employed by the participating municipalities
5) The amount of 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 precise results and should be used to understand relative risk. Over the long term, Burlington County will collect additional data to collect additional data, update and refine existing inventories, to assist in estimating potential losses.

Potential economic loss is based on the present value of the general building stock utilizing best available data. The County acknowledges significant impacts may occur to critical facilities and infrastructure as a result of these hazard events causing great economic loss. However, monetized damage estimates to critical facilities and infrastructure, and economic impacts were not quantified and require more detailed loss analyses. In addition, economic impacts to industry such as tourism and the real-estate market were not analyzed.