SECTION 4. RISK ASSESSMENT

2023 SHMP UPDATE CHANGES

- For the 2023 State Hazard Mitigation Plan (SHMP) update, all information on the risk assessment can be found in Section 4 and Section 5, particularly in the hazard profiles in Sections 5.1 through 5.16. For ease of review, the vulnerability assessment and consequence analysis follow each hazard profile so that all information about a specific hazard is in one continuous section. This section describes the identification of hazards, assets that were analyzed for vulnerability, and hazard-specific data and methodologies that were used in the risk assessment.
- A State-owned and -leased building dataset and a more robust critical facility inventory were available and utilized in the risk assessment update, though there remains an opportunity to further enhance the data maintained by the State of West Virginia (the State) regarding State facilities, critical facilities, and community lifelines.
- Updated hazard spatial data sets were used to assess vulnerability.

4.1 Overview

44 C.F.R. §201.4(c)(2): States are required to undertake a risk assessment that provides '…the factual basis for activities proposed in the strategy portion of the mitigation plan. Statewide risk assessments must characterize and analyze natural hazards and risks to provide a statewide overview.'

The risk assessment is a process by which the State determines which hazards are of concern and addresses the potential impacts of those hazards statewide. The risk assessment helps communicate vulnerabilities, develop priorities, and inform decision-making for both the SHMP and for other emergency management efforts.

The risk assessment for the 2023 SHMP Update provides the factual basis for developing a State mitigation strategy. It makes the connection between vulnerability and the proposed hazard mitigation actions.

Risk

For the purposes of the 2023 SHMP, risk is the potential for damage or loss created by the interaction of hazards with assets such as people, buildings, infrastructure, and/or natural and cultural resources.

The West Virginia Emergency Management Division (WVEMD) envisions the 2023 SHMP to serve as a reference for the local hazard mitigation plan (LHMP) updates in the State. With that in mind, the 2023 SHMP included a comprehensive update to the 2018 SHMP risk assessment process. The process used to analyze hazards for the SHMP is described in this section and the hazard profiles included in Sections 5.1 through 5.16. Regional/local planners can follow the same or similar processes to update the LHMPs. The risk assessment in the SHMP focuses on evaluating State-owned and -leased facilities and State-level critical resources.

For the 2023 SHMP, the risk assessment for each hazard is divided into three parts: (1) hazard profile, (2) vulnerability assessment, and (3) consequence analysis. The vulnerability assessment now follows the hazard profile, so that all information about a particular hazard is found in one continuous section. The following is the consistent outline for each hazard's risk assessment section (Sections 5.1 through 5.16):

- Hazard Profile
  - Identification and description of the hazard
  - Location of the hazard and areas vulnerable to damage
  - Extent (i.e., strength or magnitude of the hazard)
  - Previous occurrences of the hazard
  - Probability of future hazard events, including due to changes in weather patterns and conditions
- Vulnerability Assessment
  - Vulnerability of State-owned and -leased buildings
  - Vulnerability of critical facilities
  - Vulnerability of the population, including socially vulnerable populations
  - Future changes that may impact vulnerability
- Consequence Analysis
  - Impacts to the public
  - Impacts to responders
  - Impacts to continuity of operations
  - Impacts to property, facilities, and infrastructure
  - Impacts to the environment
  - Impacts to the economic condition of the State
  - Impacts to public confidence in the State's governance

4.2 Identification of Hazards

The first step of the risk assessment is to identify and profile all natural hazard occurrences. The goal of this first step is to identify and understand the characteristics of the state's most significant risks (FEMA State Mitigation Planning Key Topics Bulletin: Risk Assessment 2016).

WVEMD considered a full range of hazards that could affect the State for the 2023 SHMP. The process included a review of the State's disaster history, the 2018 SHMP, hazard events that have occurred in West Virginia in the last five years, and the Federal Emergency Management Agency's (FEMA) National Risk Index (NRI). Outreach was conducted to include subject-matter experts in the planning process and on the State Planning Team (SPT) to ensure the appropriate elements of each hazard were included and best-available data was used for the risk assessment.

4.2.1 Disaster History

The State's disaster history, in combination with an understanding of the location and type of State-owned and -leased buildings and natural assets, provides direction on the identification of hazards and their significance. Of

the 77 federal disasters declared in the State from 1954 to December 2022, West Virginia received 66 major disaster declarations (DR), 9 emergency declarations (ER), and 2 fire suppression assistance/fire management assistance declarations (FM). In late 2001, the FSA Program transitioned to the FM Program (FEMA 2021), though the State has not received any declarations under the FM Program. Table 4-1 outlines each FEMA declaration that the State has received since 1954. It should be noted that declarations prior to 1964 do not contain county data as it is not available (FEMA 2023). Additional details regarding declarations during the performance period of the 2018 SHMP are discussed further in Sections 5.1 through 5.16.

Table 4-1. State of West Virginia FEMA Major Disaster, Emergency, and Fire Suppression Assistance/Fire Management Assistance Declarations

Date Declared	Incident Type	Disaster Number	Counties Affected
August 4, 1954	Flood	DR-21-WV*	Statewide
January 31, 1957	Flood	DR-67-WV*	Statewide
July 23, 1961	Flood	DR-117-WV*	Statewide
March 9, 1962	Flood	DR-125-WV*	Statewide
March 13, 1963	Flood	DR-147-WV*	Statewide
March 20, 1964	Flood	DR-165-WV*	Statewide
March 13, 1967	Flood	DR-224-WV	Barbour, Boone, Braxton, Cabell, Calhoun, Clay, Doddridge, Fayette, Gilmer, Greenbrier, Hampshire, Hardy, Harrison, Jackson, Kanawha, Lewis, Lincoln, Logan, Marion, Mason, Mercer, Mineral, Mingo, Monroe, Nicholas, Pocahontas, Putnam, Raleigh, Randolph, Summers, Tucker, Upshur, Wayne, Wirt, Wood, Wyoming
September 3, 1969	Hurricane	DR-278-WV	Greenbrier, Nicholas, Pocahontas
September 24, 1969	Flood	DR-279-WV	Greenbrier
February 27, 1972	Flood	DR-323-WV	Boone, Kanawha, Lincoln, Logan, Mingo, Raleigh, Wyoming
July 3, 1972	Flood	DR-344-WV	Barbour, Berkeley, Brooke, Greenbrier, Hampshire, Hancock, Hardy, Jefferson, Marshall, Monongalia, Monroe, Morgan, Ohio, Preston, Wetzel
August 23, 1972	Flood	DR-349-WV	Logan, McDowell, Mingo, Wyoming
January 29, 1974	Flood	DR-416-WV	Kanawha, Lincoln, Logan, Mingo, Wayne
April 11, 1974	Flood	DR-426-WV	Fayette, Greenbrier, Raleigh, Wyoming
September 12, 1975	Flood	DR-481-WV	Marshall, Ohio
January 19, 1977	Drought	EM-3021-WV	Fayette, Grant, Greenbrier, Hampshire, Hardy, Mercer, Mineral, Monroe, Pendleton, Raleigh, Summers, Wyoming
April 7, 1977	Flood	DR-531-WV	Cabell, Greenbrier, Lincoln, Logan, McDowell, Mercer, Mingo, Raleigh, Summers, Wayne, Wyoming
August 24, 1977	Drought	EM-3051-WV	Grant, Greenbrier, Hampshire, Hardy, Mineral, Monroe, Pendleton, Pocahontas, Summers
August 24, 1977	Flood	EM-3052-WV	Boone, Logan, Mingo
December 14, 1978	Flood	DR-569-WV	Cabell, Jackson, Lincoln, Mingo, Wayne
August 15, 1980	Flood	DR-628-WV	Fayette, Nicholas, Raleigh, Hancock, Harrison, Jackson, Kanawha, Marion, Marshall, Monongalia, Ohio, Preston, Putnam, Taylor, Webster
May 15, 1984	Flood	DR-706-WV	Logan, McDowell, Wayne, Mingo
November 7, 1985	Flood	DR-753-WV	Barbour, Berkeley, Braxton, Calhoun, Doddridge, Gilmer, Grant, Greenbrier, Hampshire, Hardy, Harrison, Jefferson, Lewis, Marion, Mineral, Monongalia, Monroe, Morgan, Nicholas, Pendleton, Pocahontas, Preston, Randolph, Summers, Taylor, Tucker, Tyler, Upshur, Webster
March 17, 1993	Snowstorm	EM-3109-WV	Barbour, Berkeley, Boone, Braxton, Brooke, Cabell, Calhoun, Clay, Doddridge, Fayette, Gilmer, Grant, Greenbrier, Hampshire, Hancock, Hardy, Harrison, Jackson, Jefferson, Kanawha, Lewis, Lincoln, Logan, McDowell, Marion, Marshall, Mason, Mercer, Mineral, Mingo, Monongalia, Monroe, Morgan, Nicholas, Ohio, Pendleton, Pleasants, Pocahontas, Preston, Putnam, Raleigh, Randolph, Ritchie, Roane, Summers, Taylor, Tucker, Tyler, Upshur, Wayne, Webster, Wetzel, Wirt, Wood, Wyoming
July 12, 1995	Severe Storm	DR-1060-WV	Mercer, Mineral, Nicholas

Date Declared	Incident Type	Disaster Number	Counties Affected
January 13, 1996	Snowstorm	DR-1084-WV	Barbour, Berkeley, Boone, Braxton, Brooke, Cabell, Calhoun, Clay, Doddridge, Fayette, Gilmer, Grant, Greenbrier, Hampshire, Hancock, Hardy, Harrison, Jackson, Jefferson, Kanawha, Lewis, Lincoln, Logan, McDowell, Marion, Marshall, Mason, Mercer, Mineral, Mingo, Monongalia, Monroe, Morgan, Nicholas, Ohio, Pendleton, Pleasants, Pocahontas, Preston, Putnam, Raleigh, Randolph, Ritchie, Roane, Summers, Taylor, Tucker, Tyler, Upshur, Wayne, Webster, Wetzel, Wirt, Wood, Wyoming
January 25, 1996	Flood	DR-1096-WV	Raleigh, Berkeley, Brooke, Grant, Greenbrier, Hampshire, Hancock, Hardy, Jefferson, Marshall, Mason, Mercer, Mineral, Monroe, Morgan, Nicholas, Ohio, Pendleton, Pleasants, Pocahontas, Preston, Randolph, Summers, Tucker, Tyler, Webster, Wetzel, Wood
May 23, 1996	Flood	DR-1115-WV	Wayne, Barbour, Boone, Harrison, Lincoln, Logan, McDowell, Mercer, Mingo, Pendleton, Pocahontas, Raleigh, Randolph, Tucker, Upshur, Wetzel, Wyoming
August 14, 1996	Fire	DR-1132-WV	Cabell, Upshur, Barbour, Braxton, Clay, Gilmer, Monongalia, Nicholas, Randolph, Webster
September 11, 1996	Severe Storm	DR-1137-WV	Jefferson, Randolph, Berkeley, Grant, Hampshire, Hardy, Mineral, Morgan, Pendleton, Tucker
March 7, 1997	Flood	DR-1168-WV	Braxton, Cabell, Calhoun, Clay, Gilmer, Jackson, Kanawha, Lincoln, Mason, Putnam, Roane, Tyler, Wayne, Wetzel, Wirt, Wood
July 1, 1998	Severe Storm	DR-1229-WV	Webster, Cabell, Braxton, Calhoun, Clay, Doddridge, Gilmer, Harrison, Jackson, Kanawha, Lewis, Marion, Marshall, Ohio, Pleasants, Ritchie, Roane, Tyler, Wetzel, Wirt, Wood
February 28, 2000	Flood	DR-1319-WV	Pocahontas, Barbour, Braxton, Cabell, Calhoun, Doddridge, Gilmer, Harrison, Jackson, Kanawha, Lewis, Lincoln, Marion, Mason, Monongalia, Preston, Putnam, Randolph, Ritchie, Roane, Taylor, Tucker, Tyler, Upshur, Wetzel, Wirt
June 3, 2001	Severe Storm	DR-1378-WV	Cabell, Calhoun, Marion, Mason, Mingo, Preston, Putnam, Roane, Summers, Kanawha, Doddridge, Fayette, McDowell, Taylor, Boone, Clay, Greenbrier, Lincoln, Logan, Mercer, Nicholas, Raleigh, Wayne, Wyoming
November 16, 2001	Fire	FSA-2391-WV	Boone, Cabell, Clay, Kanawha, Lincoln, Logan, McDowell, Mercer, Mingo, Raleigh, Wayne, Wyoming
November 16, 2001	Fire	FSA-2392-WV	Grant, Hardy
May 5, 2002	Severe Storm	DR-1410-WV	Logan, Summers, Kanawha, Raleigh, McDowell, Mercer, Mingo, Wyoming
March 14, 2003	Severe Storm	DR-1455-WV	Brooke, Hancock, Hardy, Marion, Marshall, Monongalia, Ohio, Pendleton, Summers, Taylor, Tucker, Tyler, Wetzel, Berkeley, Clay, Gilmer, Grant, Hampshire, Jefferson, Mineral, Morgan, Pocahontas, Preston, Wirt, Fayette, Harrison, Braxton, Cabell, Calhoun, Greenbrier, Jackson, Kanawha, Lewis, Lincoln, Logan, McDowell, Mason, Mercer, Mingo, Monroe, Nicholas, Putnam, Raleigh, Roane, Upshur, Wayne, Webster, Wyoming
June 21, 2003	Severe Storm	DR-1474-WV	Tucker, Marion, Berkeley, Harrison, Ritchie, Preston, Boone, Cabell, Doddridge, Kanawha, Lincoln, Logan, McDowell, Mason, Mingo, Monongalia, Nicholas, Putnam, Wayne, Wyoming
September 23, 2003	Hurricane	DR-1496-WV	Berkeley, Grant, Hampshire, Hardy, Jefferson, Mineral, Morgan, Pendleton, Randolph, Tucker
November 21, 2003	Severe Storm	DR-1500-WV	Barbour, Doddridge, Marshall, Pendleton, Pocahontas, Ritchie, Upshur, Cabell, Boone, Braxton, Calhoun, Clay, Fayette, Gilmer, Greenbrier, Harrison, Kanawha, Lewis, Lincoln, Logan, McDowell, Marion, Mercer, Monongalia, Monroe, Nicholas, Putnam, Raleigh, Summers, Taylor, Wayne, Webster, Wetzel, Wyoming
June 7, 2004	Severe Storm	DR-1522-WV	Boone, Cabell, Calhoun, Clay, Fayette, Kanawha, Lewis, Lincoln, McDowell, Mason, Nicholas, Wayne, Braxton, Gilmer, Jackson, Logan, Mercer, Mingo, Putnam, Raleigh, Roane, Webster, Wirt, Wyoming
August 6, 2004	Severe Storm	DR-1536-WV	Fayette, Lincoln, Logan, Mingo,

Date Declared	Incident Type	Disaster Number	Counties Affected
September 20, 2004	Severe Storm	DR-1558-WV	Boone, Clay, Putnam, Berkeley, Brooke, Cabell, Hancock, Jackson, Kanawha, Lincoln, Logan, Marshall, Mason, Mingo, Morgan, Ohio, Pleasants, Tyler, Wayne, Wetzel, Wirt, Wood
February 1, 2005	Severe Storm	DR-1574-WV	Brooke, Hancock, Marshall, Ohio, Tyler, Wetzel
September 5, 2005	Hurricane	EM-3221-WV	Statewide
May 1, 2007	Severe Storm	DR-1696-WV	Barbour, Boone, Cabell, Gilmer, Grant, Hardy, Lewis, Lincoln, Logan, McDowell, Mingo, Pendleton, Pocahontas, Putnam, Upshur, Wayne, Webster, Wyoming
June 19, 2008	Severe Storm	DR-1769-WV	Braxton, Calhoun, Lewis, Ritchie, Webster, Wirt, Jackson, Jefferson, Wetzel, Barbour, Clay, Doddridge, Gilmer, Harrison, Marion, Taylor, Tucker, Tyler
May 15, 2009	Severe Storm	DR-1838-WV	Gilmer, Lewis, Roane, Upshur, Wirt, Mercer, Raleigh, Calhoun, McDowell, Mingo, Wyoming
March 2, 2010	Snowstorm	DR-1881-WV	Boone, Calhoun, Clay, Fayette, Greenbrier, Jefferson, Kanawha, McDowell, Mercer, Mingo, Nicholas, Pendleton, Pocahontas, Raleigh, Randolph, Ritchie, Roane, Wyoming
March 29, 2010	Severe Storm	DR-1893-WV	Summers, Kanawha, Fayette, Greenbrier, Mercer, Raleigh
April 23, 2010	Snowstorm	DR-1903-WV	Berkeley, Brooke, Doddridge, Grant, Hampshire, Hancock, Hardy, Jefferson, Marion, Marshall, Mineral, Monongalia, Morgan, Ohio, Pocahontas, Preston, Ritchie, Tucker, Tyler, Wetzel
June 24, 2010	Flood	DR-1918-WV	Lewis, Logan, McDowell, Mingo, Wyoming
March 16, 2012	Severe Storm	DR-4059-WV	Doddridge, Mingo, Monongalia, Ritchie, Roane, Harrison, Lincoln, Marion, Preston, Taylor, Wayne
March 22, 2012	Severe Storm	DR-4061-WV	Lincoln, Logan, Mingo
June 30, 2012	Severe Storm	EM-3345-WV	Statewide
July 23, 2012	Severe Storm	DR-4071-WV	Barbour, Berkeley, Braxton, Calhoun, Doddridge, Gilmer, Grant, Hardy, Harrison, Jefferson, Lewis, Logan, Marshall, Pendleton, Pleasants, Preston, Putnam, Randolph, Ritchie, Summers, Taylor, Tucker, Upshur, Wayne, Wetzel, Wirt, Wyoming, Boone, Cabell, Clay, Fayette, Greenbrier, Jackson, Kanawha, Lincoln, McDowell, Mason, Mercer, Mingo, Monroe, Nicholas, Pocahontas, Raleigh, Roane, Tyler, Webster, Wood
October 29, 2012	Hurricane	EM-3358-WV	Statewide
November 27, 2012	Hurricane	DR-4093-WV	Barbour, Boone, Braxton, Clay, Fayette, Kanawha, Lewis, Nicholas, Pendleton, Pocahontas, Preston, Raleigh, Randolph, Taylor, Tucker, Upshur, Webster, Wyoming
July 26, 2013	Flood	DR-4132-WV	Mason, Roane
January 10, 2014	Chemical	EM-3366-WV	Boone, Cabell, Clay, Jackson, Kanawha, Lincoln, Logan, Putnam, Roane
March 31, 2015	Severe Storm	DR-4210-WV	Barbour, Boone, Braxton, Cabell, Doddridge, Fayette, Gilmer, Harrison, Jackson, Kanawha, Lewis, Lincoln, Logan, McDowell, Marshall, Mercer, Mingo, Monongalia, Putnam, Raleigh, Ritchie, Roane, Summers, Tucker, Tyler, Upshur, Wayne, Webster, Wetzel, Wirt, Wood, Wyoming
May 14, 2015	Severe Storm	DR-4219-WV	Boone, Cabell, Lincoln, Logan, Mingo, Wayne
May 18, 2015	Flood	DR-4220-WV	Braxton, Brooke, Doddridge, Gilmer, Jackson, Lewis, Marshall, Ohio, Pleasants, Ritchie, Tyler, Wetzel
May 21, 2015	Flood	DR-4221-WV	Cabell, Calhoun, Greenbrier, Jackson, Pleasants, Roane, Summers, Wirt
August 7, 2015	Severe Storm	DR-4236-WV	Braxton, Clay, Jackson, Lincoln, Logan, Nicholas, Roane, Webster, Wood
June 25, 2016	Flood	DR-4273-WV	Braxton, Gilmer, Lewis, Randolph, Upshur, Wayne, Clay, Fayette, Greenbrier, Jackson, Kanawha, Lincoln, Monroe, Nicholas, Pocahontas, Roane, Summers, Webster
August 18, 2017	Severe Storm	DR-4331-WV	Doddridge, Monongalia, Ohio, Preston, Randolph, Taylor, Tucker, Tyler, Harrison, Marion, Marshall, Wetzel

Date Declared	Incident Type	Disaster Number	Counties Affected
April 17, 2018	Mud/Landslide	DR-4359-WV	Brooke, Cabell, Calhoun, Doddridge, Hancock, Harrison, Lincoln, Logan, Marshall, Mason, Monongalia, Ohio, Pleasants, Preston, Ritchie, Taylor, Tyler, Wayne, Wetzel, Wirt, Wood
July 12, 2018	Severe Storm	DR-4378-WV	Grant, Hampshire, Hardy, Jefferson, Mineral, Morgan, Pendleton
August 2, 2019	Flood	DR-4455-WV	Grant, Pendleton, Preston, Randolph, Tucker
March 13, 2020	Biological	EM-3450-WV	Statewide
April 3, 2020	Biological	DR-4517-WV	Statewide
May 13, 2021	Severe Ice Storm	DR-4603-WV	Cabell, Lincoln, Mason, Putnam
May 20, 2021	Flood	DR-4605-WV	Boone, Lincoln, Logan, Cabell, Kanawha, Mingo, Wayne
November 28, 2022	Flood	DR-4678-WV	McDowell
November 28, 2022	Severe Storm	DR-4679-WV	Fayette

Source: FEMA 2023
** For this event, as per the FEMA website, no additional information was filed for this event*
DR Major Disaster Declaration
EM Emergency Declaration
FEMA Federal Emergency Management Agency
FSA Fire Suppression Assistance Declaration

4.2.2 LHMP Risk Assessment Roll-Up

44 C.F.R. §201.4(c)(2)(ii): The State plan much include an overview and analysis of jurisdictions'' vulnerability to the identified hazards and the potential losses including jurisdictions most threatened and most vulnerable.

The 11 regional hazard mitigation plan (HMP) and the Jefferson County HMP (i.e., the LHMPs) were reviewed during the 2023 SHMP update process. Rolling up the risk assessments of the LHMPs was challenging because the 12 plans differ in structure, hazards of concern, data used, and analysis methods. The hazards profiled in each LHMP were reviewed to ensure that the 2023 SHMP incorporates information from local risk assessments; this information is integrated into the hazard profiles found in Sections 5.1 through 5.16. The hazard profiles identify the jurisdictions most vulnerable to and threatened by each hazard of concern. The 2023 SHMP risk assessment included a vulnerability assessment for the counties utilizing statewide population, building, and environmental resource spatial datasets. Table 4-2 lists the hazards identified in the LHMPs and the hazards of concern analyzed in the 2023 SHMP.

Table 4-2. Summary of Hazards of Concern Captured in State and Local Hazard Mitigation Plans

State/ Region/ County	Acts of Violence/ Violent Disturbance	Dam Failure	Drought	Earthquake	Extreme Temperature	Fire/Wildfire	Flood	Hazardous Materials	Invasive Species	Landslide	Land Movements	Levee/Floodwall Failure	Manufacturing Incidents	Opioid Crisis	Pandemic/ Epidemic/ Public Health Crisis	Radiological Incidents	Radon Exposure	Severe Storm/Severe Summer Weather	Severe Wind and/or Tornadoes	Subsidence	Terrorism	Utility Failure	Winter Weather
State (2018)		X	X	X	X[1]		X			X		X						X		X			X
Region 1 (2022)		X	X	X		X	X			X								X	X			X	X
Region 2 (2018)	X	X	X	X	X	X	X	X			X	X		X				X					X
Region 3 (2022)		X	X	X	X	X	X	X		X		X			X			X	X	X		X	X
Region 4 (2022)		X	X	X	X	X	X			X					X			X	X	X	X		X
Region 5 (2022)		X	X	X	X	X	X			X			X		X			X	X	X			X
Region 6 (2018)		X	X	X		X	X			X								X	X	X			X
Region 7 (2018)	X	X	X	X	X	X	X	X										X		X		X	X
Region 8 (2018)		X	X	X		X	X	X							X			X		X	X		X
Region 9 (2022)			X	X	X	X	X		X	X					X		X	X	X	X			X
Region 10 (2022)		X	X	X		X	X	X		X					X			X	X	X	X		X
Region 11 (2018)	X	X	X	X	X	X	X	X		X	X					X		X		X			
Jefferson County (2018)	X	X	X	X	X	X	X	X	X	X					X			X	X	X	X		X

Notes:

1: The 2018 SHMP evaluated extreme heat together with drought

Sources: West Virginia Region I Planning and Development Council 2022; Region 2 Planning and Development Council 2018; Regional Intergovernmental Council 2022; Region 4 Planning and Development Council 2022; Mid-Ohio Valley Regional Council 2022; Region VI Planning and Development Council 2018; Region VII Planning and Development Council 2017; Region 8 Planning and Development Council 2018; Region 9 Regional Planning and Development 2022; Belomar Regional Council 2022; Brooke Hancock Jefferson Metropolitan Planning Commission 2018; Jefferson County 2018

4.2.3 2023 SHMP Update Hazards of Concern

44 C.F.R. §201.4(c)(2)(i): The State plan much include an overview and analysis of jurisdictions'' vulnerability to the identified hazards and the potential losses including jurisdictions most threatened and most vulnerable.

In accordance with the FEMA's State Mitigation Planning Policy Guide (FEMA 2022), the SHMP must provide an overview of all natural hazards that can affect the State. The Steering Committee and SPT evaluated the 2018 SHMP hazards of concern by examining the historic events that have taken place in the State since 2018, and reviewing the LHMPs, NRI information, and other data provided by FEMA. A review of natural hazards that can affect the State is provided in Table 4-3. Table 4-3 lists each natural hazard, identifies if the hazard was profiled in the 2018 SHMP, identifies if the hazard was profiled in the 2023 SHMP (i.e., if the hazard is a current hazard of concern to the State), and provides a reason if the hazard was omitted in the 2023 SHMP.

Table 4-3. Review of NRI Hazards for Inclusion in the 2023 SHMP

NRI Hazard	Profiled in the 2018 SHMP?	Profiled in the 2023 SHMP?	Review Notes
Avalanche	-	-	The State recognizes that this hazard may occur, but it was omitted; NRI indicates hazard does not apply to West Virginia.
Coastal Flooding	-	-	This hazard was omitted. West Virginia does not have any coastal areas.
Cold Wave	X	X	Included in the Extreme Temperature hazard profile
Drought	X	X	Included in the 2023 SHMP
Earthquake	X	X	Included in the 2023 SHMP
Hail	X	X	Included in the Severe Storms hazard profile
Heat Wave	X	X	Included in the Extreme Temperature hazard profile
Hurricane	X	X	Wind impacts are included in the Severe Storms hazard profile
Ice Storm	X	X	Included in the Winter Weather hazard profile
Landslide	X	X	Included in the 2023 SHMP
Lightning	X	X	Included in Severe Storms hazard profile
Riverine Flooding	X	X	Included in in the Flood hazard profile
Strong Wind	X	X	Included in the Severe Storms hazard profile
Tornado	X	X	Included in the Severe Storms hazard profile
Tsunami	-	-	This hazard was omitted. West Virginia does not have any coastal areas subject to tsunamis.
Volcanic Activity	-	-	The State recognizes that this hazard could theoretically occur, but it was omitted; NRI indicates hazard does not apply to West Virginia
Wildfire	X	X	Included in the 2023 SHMP
Winter Weather	X	X	Included in the 2023 SHMP

Notes: X = Yes; - = No

Based on the above reviews and the inclusion of additional non-natural hazards of concern, the hazards of concern evaluated for the 2023 SHMP are as follows:

- Dam Failure
- Drought
- Earthquake
- Extreme Temperatures
- Flood
- Hazardous Materials
- Landslide
- Levee Failure
- Pandemic
- Radiological Incidents
- Radon Exposure
- Severe Storms
- Subsidence
- Utility Failure
- Wildfire
- Winter Weather

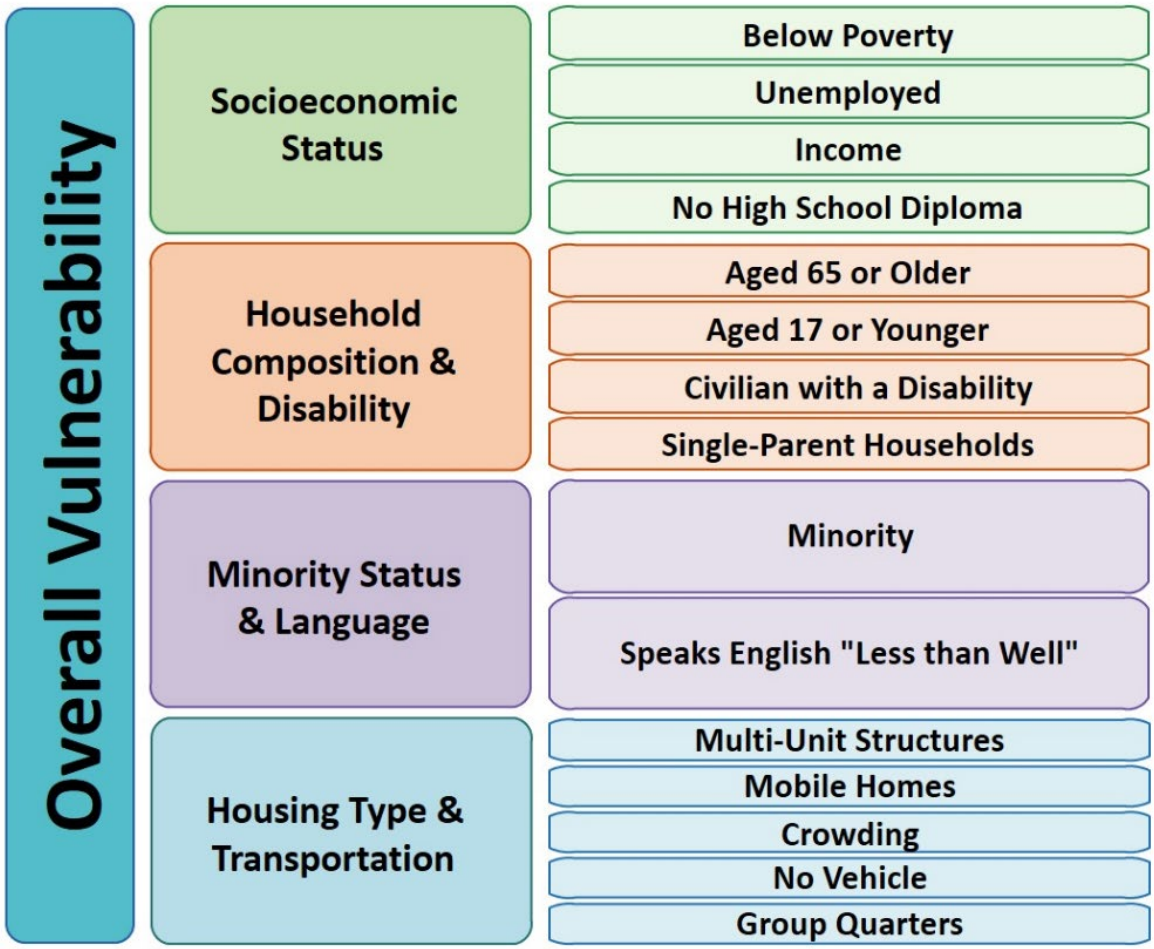
4.3 Population

Research has shown that some populations are at greater risk from hazard events because of decreased resources or physical abilities. As discussed in Section 2 (State Profile), these vulnerable populations include individuals experiencing economic hardships; older adults; children; Black, Indigenous, and People of Color; individuals experiencing homelessness; and visitors.

Social vulnerability is the likelihood of an individual, community, or group to be negatively affected by external stressors, creating barriers to the community's resilience and ability to recover from a disaster or emergency (FEMA n.d.). These external stressors may include access to transportation, access to broadband and reliable communications services, or socioeconomic factors (e.g., income, educational attainment, employment). Identifying concentrations of underserved and historically marginalized populations and geographic areas with high social vulnerability can assist communities in prioritizing support and resources to build resilience across the whole community.

Information collected through the U.S. Census Bureau, American Community Survey, and other sources is used to provide data on vulnerable populations and barriers contributing to social vulnerability. To identify areas in the State experiencing a higher rate of social vulnerability, the Centers for Disease Control and Prevention's (CDC) Social Vulnerability Index (SVI) was utilized. The SVI is a combination of 15 different social factors that contribute to social vulnerability as shown in Figure 4-1.

Figure 4-1. CDC's Social Vulnerability Index U.S. Census Variables



Source: CDC 2022

The 2020 U.S. Census block data layers were used to estimate exposure and potential impacts to the general population. The 2020 U.S. Census demographic data available in FEMA's Hazus model was used to estimate potential impacts to older adults (over 65 years of age) and populations with income below the poverty threshold for the State. Populations vulnerable to each hazard are identified in the hazard profiles provided in Section 5.1 through 5.16.

4.4 Asset Inventories

National, State, and county resources were reviewed to identify best-available data to update the risk assessment. To protect individual privacy and the security of critical facilities, information on properties assessed is presented in aggregate, without details about specific individual properties.

4.4.1 State Assets

44 C.F.R. §201.4(c)(2)(ii): …. State owned or operated critical facilities located in the identified hazard areas shall also be addressed;

44 C.F.R. §201.4(c)(2)(iii): …. The State shall estimate the potential dollar losses to State owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

FEMA requires the State to identify its assets, which may include State-owned or operated buildings, infrastructure, and critical facilities. For the 2023 SHMP, the State assessed vulnerability of the following types of assets: State-owned and -leased buildings, state roads, and critical facilities identified by the State and others, including local and State-owned critical facilities and infrastructure.

State-Owned and State-Leased Buildings

WVEMD did not have access to a consolidated list of State buildings. In West Virginia, State facilities are managed by the Real Estate Office and insured by the Board of Risk and Insurance Management (BRIM). To incorporate the locations of the State facilities into the risk assessment, WVEMD obtained the list of all BRIM-insured buildings. Within this data, multiple structures were listed at the same physical address and were not able to be geolocated. For instance, all of West Virginia University's buildings were coded to a single address. Each facility with a unique address in the BRIM data was geocoded using an online geocoding system (geocodeo). For multiple structures listed at the same address, WVEMD's planning consultant identified a central location on the property to place a centroid point to represent the locations of all structures at that address. WVEMD is committed to working with BRIM and the Real Estate Office to geolocate each individual State-owned and -leased building and integrate facility data for the next update of the SHMP. Table 4-5 shows the number of individual State-owned and -leased facilities, by department, that were used for the SHMP risk assessment, along with the total insured value of structures and contents (used for building values) for those facilities.

Table 4-4. Summary of State-Owned or State-Leased Buildings by Department

Agency	State-Owned or -Leased Buildings	
	Count	Insured Structure and Contents Value
Adjutant General's Office State of West Virginia	6	$ 1,568,001.00
Administration, Secretary of Department of Administration	1	$ 112,001.00
Agriculture, Department of State of West Virginia	9	$ 5,219,758.00
Air And Environmental Quality Boards State of West Virginia	1	$ 60,001.00
Alcohol Beverage Control Administration State of West Virginia	1	$ 13,773,535.00
Architects, Board of State of West Virginia	1	$ 17,001.00
Armory Board State of West Virginia	60	$ 350,862,607.00
Arts, Culture, & History, Department of State of West Virginia	4	$ 7,287,556.00
Attorney General, Office of The State of West Virginia	1	$ 40,001.00
Aviation, Division of	1	$ 2,250,000.00
Bar, State of West Virginia	1	$ 1,480,000.00
Barbers & Cosmetologists, Board of State of West Virginia	1	$ 100,001.00
Blue Ridge Community & Technical College	4	$ 26,092,964.00

Agency	State-Owned or -Leased Buildings	
	Count	Insured Structure and Contents Value
Bluefield State College	1	$ 141,604,089.00
Board of Treasury Investments	1	$ 70,001.00
Bridgevalley Community & Tech College	2	$ 65,886,767.00
Cedar Lakes Conference Center State of West Virginia	1	$ 12,669,653.00
Chiropractic Examiners Board State of West Virginia	1	$ 100,001.00
Commission For National and Community Service, WV	1	$ 80,001.00
Concord University	1	$ 172,928,924.00
Conservation Agency, State of West Virginia	17	$ 1,139,570.00
Consolidated Public Retirement Board Department of Administration	1	$ 1,500,001.00
Consumer Advocate, Division of WV Public Service Commission	1	$ 150,001.00
Corrections, Division of State of West Virginia	28	$ 479,106,106.00
Courthouse Facilities Improvement Authority	1	$ 500,000.00
Dentistry, Board of State of West Virginia	1	$ 35,001.00
Department of Transportation	3	$ 6.00
Dietitians, Board of Licensed	1	$ 20,001.00
Eastern Panhandle Instructional Coop	16	$ 4,080,008.00
Eastern WV Community & Tech. College	5	$ 11,643,087.00
Economic Development Authority, State of West Virginia	1	$ 850,000.00
Economic Development, WV Dept of	1	$ 3,000,001.00
Education, Department of State of West Virginia	39	$ 31,558,461.00
Educational Broadcasting Authority, State of West Virginia	4	$ 12,268,085.00
Enterprise Resource Planning Board, WV	1	$ 2,000,001.00
Environmental Protection, Division of, State of West Virginia	26	$ 7,788,009.00
Ethics Commission, West Virginia Department of Administration	1	$ 130,000.00
Examiners In Counseling, Board of, State of West Virginia	1	$ 6,001.00
Fairmont State University	1	$ 225,296,551.00
Fire Commission State of West Virginia	1	$ 500,001.00
Fleet Management Office, Dept of Admin, State of West Virginia	1	$ 50,001.00
Forestry, Division of, State of West Virginia	22	$ 1,963,813.00
General Services Division, Department of Administration	14	$ 262,991,129.00
Geological And Economic Survey, State of West Virginia	1	$ 6,543,469.00
Glenville State College	1	$ 100,837,230.00
Governor, Office of, The State of West Virginia	1	$ 2,000,001.00
Health & Human Resources, Department of, State of West Virginia	118	$ 470,059,093.00
Higher Education Policy Commission, WV	10	$ 110,167,247.00
Highways, Division of, State of West Virginia	131	$ 174,229,588.00
Homeland Security & Emergency Management Division	1	$ 205,000.00
Insurance Commissioner, Office of, The State of West Virginia	4	$ 1,395,004.00
Investment Management Board, State of West Virginia	1	$ 2,500,001.00
Joint Committee on Government & Finance, State of West Virginia	1	$ 73,872.00
Justice & Community Services, Div. of	1	$ 750,001.00
Juvenile Services, Division of	23	$ 49,746,260.00
Labor, Division of, State of West Virginia	1	$ 975,001.00
Land Division/Dept of Agriculture, State of West Virginia	2	$ 149,407.00

Agency	State-Owned or -Leased Buildings	
	Count	Insured Structure and Contents Value
Landscape Architects, Board of, State of West Virginia	1	$ 2,501.00
Library Commission, State of West Virginia	2	$ 333,920.00
Lottery Commission, State of West Virginia	3	$ 61,700,001.00
Marshall University	1	$ 82,724,214.00
Military Affairs and Public Safety, Secretary of	1	$ 350,001.00
Miner's Health Safety and Training, Division of, State of West Virginia	6	$ 24,025,004.00
Motor Vehicles, Division of, State of West Virginia	21	$ 8,175,730.00
Mountain State Esc	1	$ 1,250,000.00
Mountwest Community & Technical College	1	$ 3,013,114.00
National Coal Heritage Area Authority	3	$ 2,450,001.00
Natural Resources, Division of, State of West Virginia	19	$ 13,718,915.00
New River Community & Technical College	4	$ 17,223,666.00
Northern Community & Tech College, WV College Square	1	$ 10,900,000.00
Occupational Therapy Board, State of West Virginia	1	$ 10,001.00
Office of Technology/IS&C, Department of Administration	6	$ 24,832,005.00
Osteopathic Medicine, Board of, State of West Virginia	1	$ 25,001.00
Osteopathic Medicine, WV School of	13	$ 75,094,174.00
Parks, West Virginia State C\O Division of Natural Resources	73	$ 248,441,289.00
Pharmacy, Board of, State of West Virginia	1	$ 930,000.00
Physical Therapy, Board of, State of West Virginia	1	$ 80,001.00
Pierpont Community and Technical College	4	$ 13,816,298.00
Practical Nurses, Board of, State of West Virginia	1	$ 60,001.00
Prosecuting Attorneys Institute, WV	1	$ 121,001.00
Psychologists Examiners, Board of, State of West Virginia	1	$ 45,001.00
Public Service Commission, State of West Virginia	2	$ 18,209,069.00
Purchasing, Division of Department of Administration	2	$ 1,351,001.00
Rail Authority, State of West Virginia	1	$ 3,351,381.00
Real Estate Commission, State of West Virginia	1	$ 150,001.00
Regional Jail & Corr. Fac. Authority, State of West Virginia	5	$ 133,925,243.00
Registered Nurses, Board of, State of West Virginia	1	$ 250,001.00
Rehabilitation Services Division of Commerce	27	$ 12,297,773.00
Respiratory Care, WV Board of	1	$ 100,001.00
School Building Authority, West Virginia	1	$ 800,000.00
Schools For the Deaf and the Blind State of West Virginia	1	$ 55,747,270.00
Senior Services, Bureau of, State of West Virginia	2	$ 155,002.00
Shepherd University	1	$ 273,574,445.00
Southern Educational Services Coop	1	$ 1,000,000.00
Southern WV Community & Tech College	4	$ 64,142,169.00
Speech Pathology & Audiology Examiners West Virginia Board of	1	$ 20,001.00
State Police, West Virginia Dept of Military Affairs & Public Safety	90	$ 69,469,473.00
Supreme Court of Appeals, State of West Virginia	79	$ 7,052,070.00
Tax Appeals, WV Office of	1	$ 130,001.00
Tax Department, State of West Virginia	6	$ 5,400,006.00
Treasurer of State, State of West Virginia	4	$ 1,876,004.00

Agency	State-Owned or -Leased Buildings	
	Count	Insured Structure and Contents Value
University Physicians and Surgeons	12	$ 17,220,009.00
Veterans Assistance, Department of, State of West Virginia	16	$ 52,927,954.00
Veterinary Medicine, Board of, State of West Virginia	1	$ 25,001.00
Water Development Authority, State of West Virginia	1	$ 7,500,000.00
West Liberty University	3	$ 6,804,888.00
West Virginia Parkways Authority	17	$ 73,617,502.00
West Virginia State University - Institute	1	$ 140,023,150.00
West Virginia State University - Malden	1	$ 1,229,000.00
West Virginia University	1	$ 1,535,431,232.00
West Virginia University Arthurdale	1	$ 74,928.00
West Virginia University at Parkersburg	1	$ 61,770,204.00
West Virginia University Beckley	1	$ 520,502.00
West Virginia University Bruceton Mills	1	$ 3,435,337.00
West Virginia University Charleston	1	$ 791,798.00
West Virginia University Fort Ashby	1	$ 3,452,022.00
West Virginia University Granville	1	$ 19,775,502.00
West Virginia University Jacksons Mill	1	$ 14,600,207.00
West Virginia University Kearneysville	1	$ 4,127,255.00
West Virginia University Keyser	1	$ 126,627,242.00
West Virginia University Montgomery	1	$ 4,857,375.00
West Virginia University Reedsville	1	$ 8,769,528.00
West Virginia University Union	1	$ 506,330.00
West Virginia University Wardensville	1	$ 7,642,096.00
West Virginia University Weston	1	$ 2,240,145.00
Workforce West Virginia	11	$ 754,011.00
WV Public Employees Grievance Board	1	$ 285,001.00
WVsom Clinic Inc Dba Robert C Byrd Clinic	1	$ 2,250,001.00
Unknown	56	$ 112.00
TOTAL	**1,117**	**$6,103,990,952.00**

Source: WVBRIM 2022

State Roads

The State Department of Transportation's State route inventory was used to determine the State road exposure to spatially delineated hazards. For the analyzed hazards, the State roads were clipped to the hazard boundary, and mileage of roadway was calculated to estimate the exposed State road mileage per county within West Virginia. Economic impact of hazard events on road infrastructure has not been monetized, although exposure is identified and discussed. Section 2: State Profile includes a map of West Virginia that depicts the major highways located throughout the State.

Critical Facilities

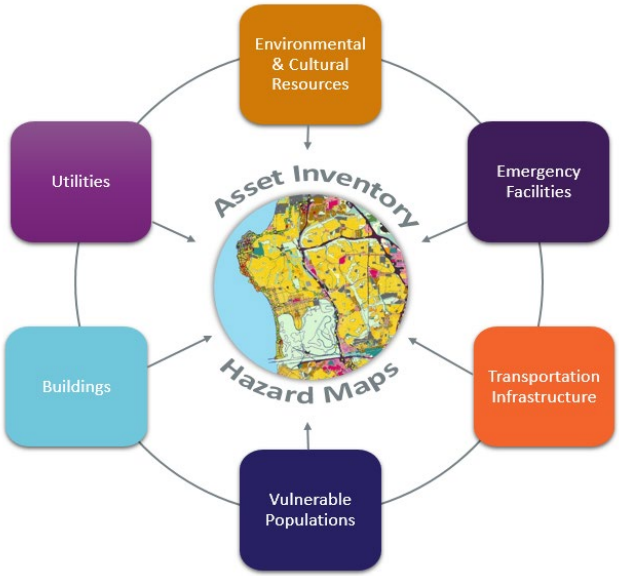
WVEMD provided a list of 185 critical facilities to utilize for the risk assessment. Whereas the State focused on State-owned or State-leased facilities to assess vulnerability to its assets, the list of critical facilities included local

and private facilities as well. The list included addresses with street numbers for the majority of the facilities. For the facilities that did not have spatial coordinates or the original coordinates were invalid, other location attributes were used to geocode the facilities.

An estimated 144 critical facilities are State-owned and -leased buildings that appear in both inventories used for the risk assessment. The duplication of these assets is acknowledged and the datasets are reported separately.

Defaults were assigned to populate the required fields needed to estimate potential losses using Hazus. Structure values provided by West Virginia were left as-is in the dataset. Structures that did not have a pre-determined structure value in the provided data were assigned a default value of 1 for the structure and content costs as Hazus does not accept zero or NULL values for these fields. Assumptions were defined for the number of stories where a value did not exist and defaulted to a value of 1. Assumptions were also defined for Hazus defaults for year built, building types for the earthquake analysis, foundation type for the flood analysis, square footage, and first floor heights of structures where the values did not exist. The Hazus default attribute data for essential facilities (fire, police, medical care, and school facilities) was used to replace the default attribute values where the essential facilities could be matched to the critical facilities using the facility name.

Figure 4-2. Asset Inventory



The 2023 SHMP risk assessment included the collection and use of an expanded and enhanced asset inventory to estimate state vulnerability.

Table 4-5 summarizes the total number of critical facilities by lifeline category and the insured value used to represent facility value in the risk assessment.

Table 4-5. Summary of Critical Facilities by Community Lifeline Category

Lifeline Category	Number	Total Insured Building and Contents Value
Communications	7	$10,240,007.00
Energy	0	$0
Food, Water, Shelter	8	$2,384,067.00
Hazardous Material	0	$0
Health & Medical	12	$200,276,228.00
Safety & Security	150	$946,402,599.00
Transportation	9	$44,654,481.00
Total	**186**	**$1,203,957,382.00**

Source: WVEMD 2022

4.4.2 Local Assets

44 C.F.R. §201.4(c)(2)(ii): The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events.

In addition to assessing the vulnerability of State assets, a key component to the risk assessment is to evaluate potential losses to jurisdictions in the State. As a first step, the 12 LHMPs were reviewed in an attempt to roll up the local risk assessment results in the 2023 SHMP to summarize losses in each county. However, the local plan risk assessment roll-up proved challenging because the LHMPs and specifically their risk assessments differ in structure, data used, and analysis methods. Therefore, the 2023 SHMP risk assessment included a vulnerability assessment for the counties utilizing statewide population, building, and environmental resource spatial datasets. Estimated exposure and potential impacts to these assets are reported in each hazard section. In addition, economic impacts are discussed qualitatively for each hazard.

General Building Stock

The 2023 SHMP focused on assessing vulnerability to State assets. As such, only property exposure and losses to State-owned and -leased facilities are included in the vulnerability assessments in the hazard profiles. The 2023 SHMP does not include estimates for exposure or losses to the general building stock throughout the State. The State relies on the regions/counties to assess exposure and losses to the general building stock as part of the development of the LHMPs.

Environmental Resources

WVEMD identified the following assets to include in the risk assessment based on the availability of spatial data: critical habitats (or habitats that are known to be essential for an endangered or threatened species), wetlands, parks and reserves, and watersheds. The spatial hazard layers were overlaid with these environmental resources in geographic information systems (GIS) to determine which environmental resources are located in the impact area of the hazard. Refer to Section 2 (State of WV Profile) for a more detailed description of these assets in the State.

Cultural Assets

Cultural asset information in the State of West Virginia is managed by the West Virginia Department of Arts, Culture & History. Facilities managed by that department were included in the set of State-owned and -leased facilities described above.

Changes That Impact Vulnerability

State hazard mitigation plans must be revised to reflect changes in development, including recent development, potential and projected land use and development, or conditions that may affect risk and vulnerability to the state and jurisdictions such as changes in population demographics. (FEMA State Mitigation Planning Key Topics Bulletin: Risk Assessment; 2016).

In addition to summarizing the current vulnerability, the State has identified three factors of change that can affect its vulnerability to hazards: (1) changes in population; (2) changes in development; and (3) other identified conditions as relevant and appropriate, including the impacts of future hazard conditions. 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.

As summarized in Section 2 (State of WV Profile) the State of West Virginia has experienced little development over the performance period of the 2018 SHMP. There is no statewide system that tracks where this development has occurred or its location in hazard areas; however, members of the SPT report that development that has occurred has been concentrated in already-developed areas rather than in new areas. The State expects that trend to continue.

The 2018 SHMP did not include an analysis of State-owned and/or leased buildings and did not use the same critical facility inventory; therefore, changes in risk and vulnerability of these facilities over the performance period of the plan cannot be assessed. In addition, different general building inventories, hazard data, and methodologies were used in the 2018 SHMP than the 2023 SHMP making it impossible to conduct a side-by-side comparison analysis to determine changes in vulnerability. It is WVEMD and the Hazard Mitigation Officer's (HMO) vision that the 2023 SHMP set the new baseline for risk and will be used to assess changes of risk over time as future updates to the plan occur.

The impacts of changing future conditions on the hazards of concern are described in each hazard profile.

4.5 Hazard-Specific Data and Methodologies

44 C.F.R. §201.4(c)(2)(i): The risk assessment shall include the following: An overview of the type and location of all natural hazards that can affect the State, including information on previous occurrences of hazard events, as well as the probability of future events, using maps where appropriate.

To assess vulnerability, three different levels of analysis were used depending upon the data available for each hazard as described below. Table 4-6 summarizes the types of analyses performed for each hazard followed by a discussion of each approach.

1. **Qualitative Analysis and Historic Occurrences** – 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 judgment.

2. **Exposure Analysis** – 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. **Hazus Analysis (Loss estimation)** — The Hazus modeling software was used to estimate potential losses for the event-based earthquake and severe storms (wind) hazards. The State's Total Exposure in Floodplain (TEIF) and Total Exposure in Areas of Landslides (TEAL) models were used to estimate losses

for the flood and landslide hazards, respectively (see Sections 4.5.3 and 4.5.5). In addition, an examination of historic impacts and an exposure assessment was conducted for these spatially delineated hazards.

Table 4-6. Summary of Risk Assessment Analyses

Hazard	Data Analyzed					
	Population	State Buildings	State Roads	Critical Facilities	Environmental Resources	Cultural Assets
Dam Failure	E	E	E	E	-	E
Drought	Q	Q	Q	Q	Q	Q
Earthquake	-	H	-	H	-	-
Extreme Temperature	Q	Q	Q	Q	Q	Q
Flood	E	E, H	E	E, H	-	E
Hazardous Materials	E	E	E	E	-	E
Landslide	E	E	E	E	-	E
Levee Failure	E	E	E	E	-	E
Pandemic	Q	Q	Q	Q	Q	Q
Radiological Incidents	E	E	E	E	-	E
Radon Exposure	-	-	-	-	-	-
Severe Storm	-	-	-	H	-	-
Subsidence	E	E	E	E	-	E
Utility Failure	Q	Q	Q	Q	Q	Q
Wildfire	E	E	E	E	-	E
Winter Weather	Q	Q	Q	Q	Q	Q

E – Exposure analysis; H – Hazus analysis; Q – Qualitative analysis
Note: The 12 LHMPs were also reviewed and potential losses summarized in hazard location and vulnerability assessment subsections when available.

Outreach was conducted at the early stages of the 2023 SHMP process to collaborate with hazard subject matter experts to obtain the best-available data and methodologies to assess risk (refer to Section 3). The following summarizes the data and analysis conducted to evaluate each hazard of concern. Sections 4.5.1 through 4.5.11 summarize the vulnerability assessment results.

4.5.1 Dam Failure

Statewide dam failure inundation area data was downloaded from the U.S. Army Corps of Engineers (USACE) National Inventory of Dams (NID). Point and polygonal data regarding mining-related impoundments regulated by the West Virginia Department of Environmental Protection's (WVDEP) Division of Mining and Reclamation (DMR) were provided by the West Virginia University GIS Technical Center (WVU GISTC). Between the USACE NID and the WVDEP DMR data, the risk assessment incorporated both coal and non-coal dams in the State.

For the 2023 SHMP, the total number of State buildings located in all spatially delineated dam failure inundation areas were examined. However, it is important to note that it is highly unlikely that all dams would fail at the same time. To assess local vulnerability, State buildings and critical facilities were analyzed for their proximity to the dam failure inundation areas along with their total replacement cost value. Socially vulnerable population counts, State highway mileage and acreage of land area were analyzed for their exposure to the dam inundation hazard area per county.

4.5.2 Earthquake

A Level 2 analysis was performed in Hazus v6.0 to estimate potential losses as a result of the 500-year probabilistic scenario (Section 4.6).

The State buildings and critical facilities were imported into Hazus as individual facilities to support this assessment (also known as a Hazus user-defined analysis). Default Hazus National Earthquake Hazards Reduction Program (NEHRP) D soils were identified as areas potentially more vulnerable to damage; these areas were used as the hazard extent for the exposure analysis. Damages are estimated at the census tract level, and for this assessment, results were summarized by the total for the State; as the results broken out by jurisdiction were too minimal for reporting. Results for critical facilities were reported by estimated damage per lifeline category. Damage estimates are calculated for losses to buildings (structural and non-structural) and contents; structural losses include load carrying components of the structure, and non-structural losses include those to architectural, mechanical, and electrical components of the structure, such as nonbearing walls, veneer and finishes, HVAC systems, boils, etc.

4.5.3 Flood

The 1- and 0.2-percent annual chance flood events were examined to evaluate the State's risk from the flood hazard. These flood events are generally those considered by planners and evaluated under federal programs such as NFIP.

The following data was used to evaluate exposure and determine potential future losses for this plan update:

- Statewide FEMA 2022 Effective DFIRM Flood Data
- Flood Depth Grid provided by WVU GISTC

The 2022 FEMA Effective DFIRM Flood data was used to create the 1- and 0.2-percent annual chance flood boundaries and was used to evaluate exposure and determine potential future losses. The depth grid that was provided by WVEMD for the 2023 SHMP was from the TEIF analysis and was integrated into the FAST (Hazus Flood Assessment Structure Tool) to estimate potential losses for the 1 percent annual chance flood event; FAST is a Hazus tool that assists in determining structure damages based upon inventory and default Hazus attributes. To estimate exposure to the 1 percent and 0.2 percent annual chance flood events, the FEMA Effective DFIRM flood boundaries were overlaid on the centroids of updated assets (State facilities and critical facilities). Centroids that intersected the flood boundaries were totaled to estimate the building replacement cost value. Socially vulnerable populations and land area were estimated by completing an area calculation against the flood hazard area. State roadways were estimated by clipping the State roads to the flood hazard areas and calculating mileage.

A flood analysis for the 1 percent annual chance flood event was run in FAST. Both the State facility and critical inventories were formatted to be compatible with FAST and its Comprehensive Data Management System (CDMS). Once CDMS was updated with the inventories, the original depth grid was divided into four segments, and the FAST assessment was run four times (once per depth grid segment). FAST calculated the estimated potential damages to State facility and critical facility inventories based on the depth grid generated and the default Hazus attributes.

4.5.4 Hazardous Materials

The hazardous materials release hazard area was defined as areas within ½ mile of a major roadway, railway, pipeline, or Superfund Amendment and Reauthorization Act (SARA)-defined "reporting facility," or within 1 mile of a SARA-defined "planning facility." The 1-mile buffer around planning facilities was used due to the absence of the specific vulnerability radii associated with each planning facility in the State's data. To estimate exposure, the various hazardous materials areas were overlaid on the centroids of the State and critical facilities. Centroids that intersected the hazardous materials boundary were totaled to estimate the building replacement cost value. Socially vulnerable populations and land area were estimated by completing an area calculation against the hazardous materials hazard area. State roadways were estimated by clipping the State roads to the hazardous materials hazard areas and calculating mileage.

4.5.5 Landslide

Landslide susceptibility data for the State of West Virginia was downloaded by WVU. This is the same dataset that was utilized in the Total Exposure in Areas of Landslides (TEAL) analysis that the State developed.

For the landslide exposure analysis, we classified the landslide data into three landslide susceptibility areas described below, following the same classifications used in the TEAL analysis.

- Low: <0.3
- Medium: 0.3 – 0.7
- High: >0.7

The Medium Susceptibility hazard areas were analyzed during the exposure assessment to determine what population is located within the hazard area. The High Susceptibility hazard areas were analyzed during the exposure assessment to determine what population, State-owned and -leased facilities, critical facilities, mileage of State roadways, and acreage of land area are located within the hazard area. To estimate exposure, the landslide hazard data was overlaid on the centroids of the State and critical facilities. Centroids that intersected the landslide hazard area were totaled to estimate the building replacement cost value. Socially vulnerable populations and land area were estimated by completing an area calculation against the landslide hazard area. State roadways were estimated by clipping the State roads to the landslide hazard area and calculating mileage.

4.5.6 Levee Failure

The levee failure hazard area was determined using delineated flood hazard zones protected by a levee throughout the State. These areas were analyzed during the exposure assessment to determine what population, State-owned and -leased facilities, and critical facilities are located within the hazard area. To estimate exposure, the levee failure hazard data was overlaid on the centroids of the State and critical facilities. Centroids that intersected the levee failure area boundary were totaled to estimate the building replacement cost value. Socially vulnerable populations and land area were estimated by completing an area calculation against the levee failure hazard area. State roadways were estimated by clipping the State roads to the levee failure hazard area and calculating mileage.

4.5.7 Radiological Incidents

Radiological Incidents data was created by assigning both a 10-mile and 50-mile buffer around the Beaver Valley Atomic Power Station in Pennsylvania, to correspond to the plume exposure pathway emergency planning zone (EPZ) and the ingestion exposure pathway EPZ, respectively. During the exposure assessment, the State determined what population, State facilities, and critical facilities are located within the assigned EPZs. To estimate exposure, the radiological incidents buffers were overlaid on the centroids of the State and critical facilities. Centroids that intersected the radiological incidents buffer boundaries were totaled to estimate the building replacement cost value. Socially vulnerable populations and land area were estimated by completing an area calculation against the radiological incidents buffer hazard area. State roadways were estimated by clipping the State roads to the radiological incidents hazard area and calculating mileage.

4.5.8 Severe Storms

A Hazus probabilistic analysis was performed in Hazus v6.0 to analyze the wind hazard losses for West Virginia for the 1000-year Mean Return Period (MRP) event. The probabilistic Hazus hurricane model 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 the State. Hazus 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. The critical facility inventory was used for the analysis. Results are displayed for essential facilities by the estimated loss of days, and percent-probability of sustaining damage per facility type.

4.5.9 Subsidence

Subsidence data, including karst and abandoned mine lands were analyzed during the exposure assessment. To estimate exposure, the subsidence hazard datasets (i.e., areas underlain by limestone bedrock or mines) were overlaid on the centroids of the State and critical facilities. Centroids that intersected the subsidence hazard area boundaries were totaled to estimate the building replacement cost value. Socially vulnerable populations and land area were estimated by completing an area calculation against the subsidence hazard area. State roadways were estimated by clipping the State roads to the subsidence hazard area and calculating mileage.

4.5.10 Wildfire

An exposure assessment was conducted and results generated for the intermix and interface wildfire risk areas. For the purposes of the 2023 SHMP risk assessment, assets located in these two risk areas are deemed exposed and vulnerable. Wildfire data was analyzed during our exposure assessment to determine what population, State facilities, and critical facilities are located within the hazard area. To estimate exposure, the wildfire hazard data was overlaid on the centroids of the State and critical facilities. Centroids that intersected the wildfire hazard area boundaries were totaled to estimate the building replacement cost value. Socially vulnerable populations and land area were estimated by completing an area calculation against the wildfire hazard area. State roadways were estimated by clipping the State roads to the wildfire hazard area and calculating mileage.

4.5.11 Other Hazards

To assess the vulnerability of the State to the other hazards of concern (listed below) and their associated impacts, a qualitative assessment was conducted.

- Drought
- Extreme Temperatures
- Pandemic
- Radon Exposure
- Utility Failure
- Winter Weather

4.6 Limitations

The spatial hazard data used in this plan was generated by multiple agencies and organizations. Due to differing processes of data generation between these entities, spatial layer boundaries may not accurately align with each other.

The worst-case scenarios used are for planning purposes only and may not represent the actual worst-case a geographic area may experience. 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 hazards and their effects on the built environment. The reader is urged to use caution when interpreting these results as each hazard event is unique, and projections regarding future conditions may change over time as technology and science advances. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic, or economic parameter data
- The unique nature, geographic extent, and severity of each hazard event
- Mitigation measures already employed
- The amount of advance notice residents have to prepare for a specific hazard event

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate and should be used only to understand relative risk. Over the long term, the State of West Virginia will continue to collect additional data, and update and refine existing inventories, to assist in estimating potential losses.

Potential economic loss is based on the present value of the State buildings and general building stock utilizing best-available data. The State acknowledges significant impacts may occur to critical facilities and infrastructure (such as roads, airports, utilities) as a result of these hazard events, causing great economic loss not only to one community, but potentially cascading impacts throughout the State. 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 (e.g., mining, timber) and the real estate market were not analyzed.