



5.4 Extreme Temperature

2023 SHMP UPDATE CHANGES

- ❖ Extreme temperature events that occurred in the State of West Virginia (the State) from January 1, 2018, through December 31, 2022, were researched for this 2023 State Hazard Mitigation Plan (SHMP) update.
- ❖ New and updated figures from federal and State agencies are incorporated.
- ❖ A qualitative vulnerability assessment was conducted, at the State level, to discuss extreme temperature impacts to State assets, critical facilities and lifelines, population, socially vulnerable population, and future changes.

5.4.1 Hazard Profile

HAZARD DESCRIPTION

Extreme temperature includes both heat and cold events, which can have a significant impact to human health, commercial/agricultural businesses, and primary and secondary effects on infrastructure (such as burst pipes and power failure). What constitutes “extreme cold” or “extreme heat” can vary across different areas of the country based on the population’s experience.

Extreme Cold

Extreme cold events occur when temperatures drop well below normal in an area. Extreme cold temperatures are generally characterized in temperate zones by the ambient air temperature dropping to approximately 0°F or below. Extreme cold temperatures often accompany a winter storm, which can cause power failures and icy roads. Staying indoors as much as possible can help reduce the risk of car crashes and falls on the ice, but individuals may also face indoor hazards. Many homes will be too cold, either due to a power failure or because the heating system is not adequate for the weather. According to the Centers for Disease Control and Prevention (CDC), the use of space heaters and fireplaces to keep warm increases the risk of household fires and carbon monoxide poisoning (CDC 2012).

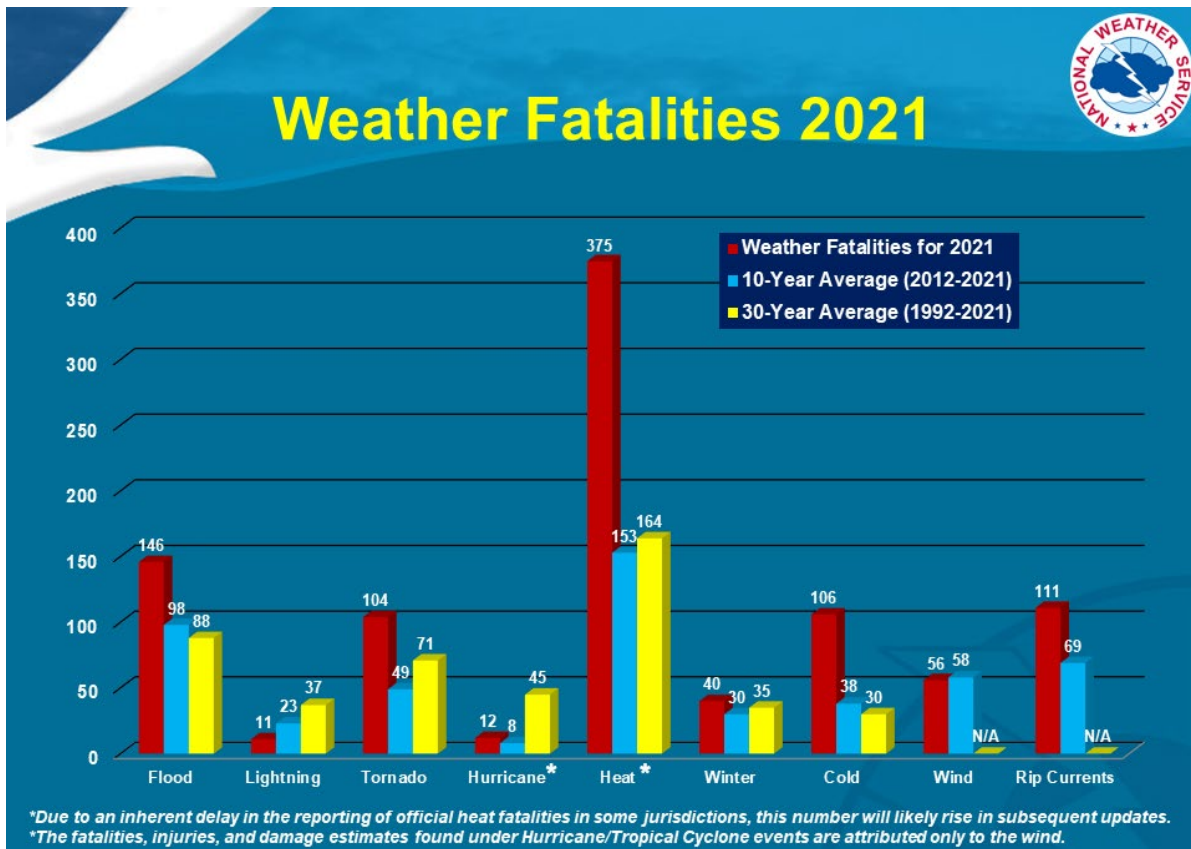
Extreme Heat

Extreme heat is defined as summertime temperatures that are much hotter and/or humid than average. Because some areas are hotter than others, extreme heat temperatures depend on what is considered average for a particular location at that time of year (CDC 2012). A heat wave is a period of abnormally hot weather generally lasting more than two days. Heat waves can occur with or without high humidity. They have the potential to cover a large area, exposing a high number of people to hazardous heat (NOAA 2009).

Extreme heat is the number one weather-related cause of death in the U.S. On average, nearly 150 people die each year in the United States from excessive heat (NWS 2021). Figure 5.4-1 shows the number of weather fatalities based on a 10-year average and a 30-year average. Heat caused the highest average of weather-related fatalities between 2012 and 2021.



Figure 5.4-1. Average Number of Weather-Related Fatalities in the U.S.



Source: NWS 2021

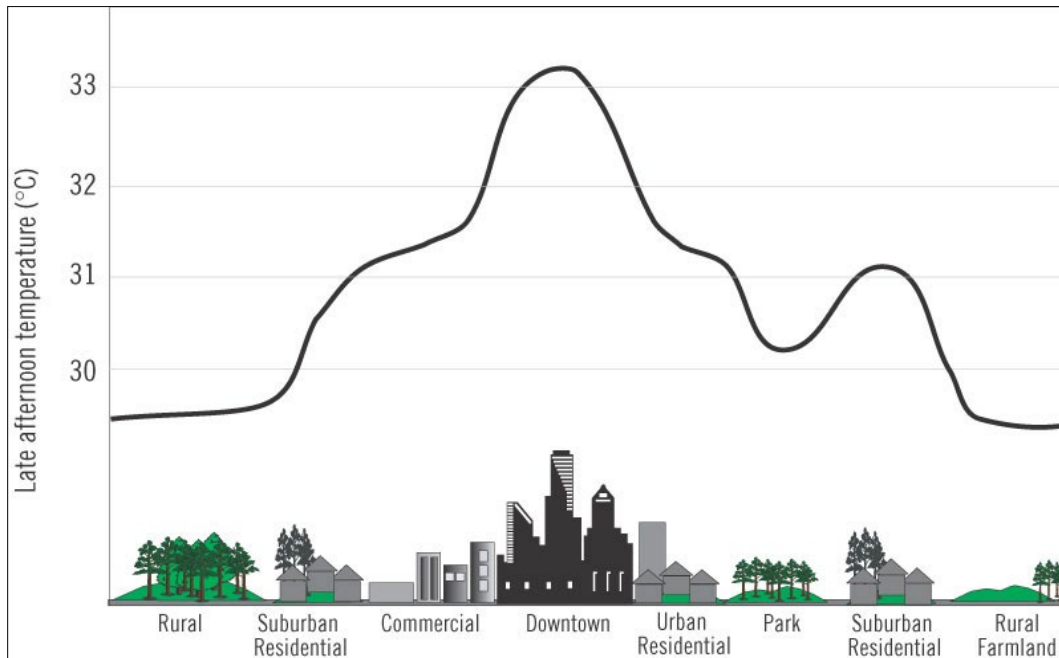
LOCATION

All of West Virginia is vulnerable to extreme temperature events. Due to the State’s rugged topography, temperature conditions vary considerably. West Virginia’s elevation—the highest average elevation east of the Mississippi River—moderates summer temperatures. Summer average maximum temperatures range from around 85°F in the southwest, near the Ohio River, to less than 80°F in the east-central mountains. Winter average minimum temperatures range from the low 20s (°F) in the mountainous central and northeastern portions of the State to around 30°F in the far south (NOAA NCEI 2022).

Urbanized areas and urbanization exacerbate risk during an extreme heat event compared to rural and suburban areas in the State, as indicated in Figure 5.4-2. As these urban areas develop and change, so does the landscape. Buildings, roads, and other infrastructure replace open land and vegetation. Surfaces that were once permeable and moist are now impermeable and dry. These changes cause urban areas to become warmer than the surrounding areas. This forms an “island” of higher temperatures. This effect increases energy costs (e.g., for air conditioning), air pollution levels, and heat-related illness and mortality (U.S. EPA 2022).



Figure 5.4-2. Urban Heat Island Profile



Source: NWS 2021

EXTENT

Extreme Cold

The extent (severity or magnitude) of extreme cold temperatures is generally measured through the Wind Chill Temperature (WCT) Index, illustrated in Figure 5.4-3. The WCT Index uses advances in science, technology, and computer modeling to provide an accurate, understandable, and useful formula for calculating the dangers from wind chill. For details regarding the WCT Index, refer to: <http://www.nws.noaa.gov/om/winter/windchill.shtml>

Figure 5.4-3. National Weather Service WCT Chart

Wind (mph)	Temperature (°F)																		
	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63	-69
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72	-78
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77	-83
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81	-87
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84	-90
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87	-93
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89	-95
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91	-97
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93	-99
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95	-101
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-96	-102
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98	-104

Source: NWS n.d.



Warning Time

Warnings, watches, and advisories related to colder temperatures are issued by the NWS, typically within a 24 to 36 hour period. Table 5.4-1 describes the general alerts related to extreme cold events.

Table 5.4-1. NWS Alerts for Extreme Cold

Alert	Criteria
Wind Chill	
Wind Chill Warning: Take Action!	NWS issues a wind chill warning when dangerously cold wind chill values are expected or occurring. If you are in an area with a wind chill warning, avoid going outside during the coldest parts of the day. If you do go outside, dress in layers, cover exposed skin, and make sure at least one other person knows your whereabouts. Update them when you arrive safely at your destination.
Wind Chill Watch: Be Prepared	NWS issues a wind chill watch when dangerously cold wind chill values are possible. As with a warning, adjust your plans to avoid being outside during the coldest parts of the day. Make sure your car has at least a half a tank of gas, and update your winter survival kit.
Wind Chill Advisory: Be Aware	NWS issues a wind chill advisory when seasonably cold wind chill values but not extremely cold values are expected or occurring. Be sure you and your loved ones dress appropriately and cover exposed skin when venturing outdoors.
Freeze	
Hard Freeze Warning: Take Action!	NWS issues a hard freeze warning when temperatures are expected to drop below 28°F for an extended period of time, killing most types of commercial crops and residential plants.
Freeze Warning: Take Action!	When temperatures are forecasted to go below 32°F for a long period of time, NWS issues a freeze warning. This temperature threshold kills some types of commercial crops and residential plants.
Freeze Watch: Be Prepared	NWS issues a freeze watch when there is a potential for significant, widespread freezing temperatures within the next 24-36 hours. A freeze watch is issued in the autumn until the end of the growing season and in the spring at the start of the growing season.
Frost Advisory: Be Aware	A frost advisory means areas of frost are expected or occurring, posing a threat to sensitive vegetation.

Source: NWS 2023

More specifically, the NWS Weather Forecast Offices in West Virginia will issue advisories and warnings for extreme cold events. For West Virginia, the NWS issues the following related to colder temperatures:

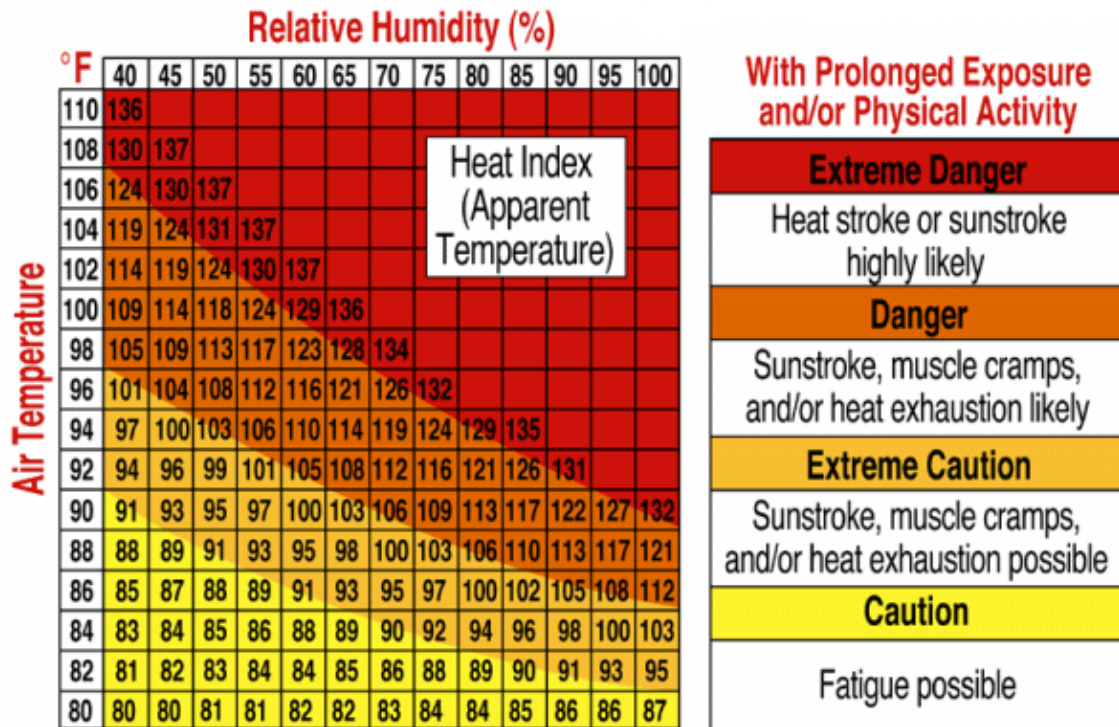
- **Freeze Warning** – Widespread temperatures are forecast to be 32°F or below for 2 hours or more during the growing season.
- **Frost Advisory** – Widespread frost during the growing season.
- **Wind Chill Advisory** – Wind chills of 10 below to 24 below are expected for 3 hours or more with wind speeds greater than 5 mph.
- **Wind Chill Watch/Warning** – Wind chills of 25 below or colder are expected for 3 hours or more with wind speeds greater than 5 mph (Charleston, WV Weather Forecast Office 2023).

Extreme Heat

Extreme heat temperatures generally is measured through the heat index, identified in Figure 5.4-4. Created by the NWS, the heat index is a chart that accurately measures what the temperature feels like to the human body when relative humidity is combined with the air temperature (NWS n.d.). To determine the heat index, the temperature and relative humidity are needed. Once both values are identified, the heat index is the corresponding number of both values. This provides a measure of how temperatures feel; however, the values are devised for shady, light wind conditions. Exposure to full sun can increase the index by up to 15°F.



Figure 5.4-4. NWS Heat Index



Source: NWS 2023

Warning Time

Warnings, watches, and advisories related to warmer temperatures are issued by the NWS, typically within a 24 to 36 hour period.

Table 5.4-2. NWS Alerts for Extreme Heat

Alert	Criteria
Excessive Heat Warning—Take Action!	An Excessive Heat Warning is issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this Warning is when the maximum heat index temperature is expected to be 105° or higher for at least 2 days and nighttime air temperatures will not drop below 75°; however, these criteria vary across the country, especially for areas not used to extreme heat conditions. If you do not take precautions immediately when conditions are extreme, you may become seriously ill or even die.
Excessive Heat Watches—Be Prepared!	Heat watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. A Watch is used when the risk of a heat wave has increased but its occurrence and timing is still uncertain.
Heat Advisory—Take Action!	A Heat Advisory is issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this Advisory is when the maximum heat index temperature is expected to be 100° or higher for at least 2 days, and nighttime air temperatures will not drop below 75°; however, these criteria vary across the country, especially for areas that are not used to dangerous heat conditions. Take precautions to avoid heat illness. If you do not take precautions, you may become seriously ill or even die.
Excessive Heat Outlooks—Be Aware!	The outlooks are issued when the potential exists for an excessive heat event in the next 3-7 days. An Outlook provides information to those who need considerable lead-time to prepare for the event.

Source: NWS 2023



More specifically, the NWS Weather Forecast Offices in West Virginia will issue advisories and warnings for extreme heat events. For West Virginia, the NWS issues the following related to warmer temperatures:

- **Excessive Heat Warning** – Issued when the heat index is expected to reach around 105°F or higher for a period of at least 2 hours. A warning would also be appropriate if heat advisory criteria are expected to be reached for 4 consecutive days.
- **Heat Advisory** – Issued for heat index of equal to 100°F and less than 105°F for a period of at least 2 hours (Charleston, WV Weather Forecast Office 2023).

PREVIOUS OCCURRENCES AND LOSSES

Federal Emergency Management Agency (FEMA) Disaster Declarations

Between 1954 and 2022, West Virginia was not included in any major disaster (DR) or emergency (EM) declarations for extreme temperature-related events (FEMA 2023).

U.S. Department of Agriculture (USDA) Disaster Declarations

The Secretary of Agriculture from the USDA is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Between 2012 and 2022, West Virginia was included in nine extreme temperature-related agricultural disaster declarations. Table 5.4-3 provides the USDA Secretarial disaster declarations in all West Virginia counties from January 1, 2012, through December 31, 2022 (USDA 2023).

Table 5.4-3. Extreme Temperature-Related USDA Declarations, 2012 to 2022

Date(s) of Event	Designation Number	Description of Disaster	Counties Declared
February – September 2012	USDA-S3384	Heat, Excessive Heat, High Temperatures	Brooke, Hancock, Marshall, Ohio, Pleasants, Tyler, Wetzel, Wood
March 1 – August 25, 2015	USDA-S3934	Excessive Rain, Flash Flooding, Flooding, Excessive Heat, Landslides, Mudslides, High Winds, Hail, and Lightning	Cabell, Hancock, Jackson, Marshall, Mason, Ohio, Pleasants, Tyler, Wayne, Wetzel, Wood
June – December 2017	USDA-S4297	Drought and Excessive Heat	Hardy
June – December 2019	USDA-S4605	Drought and Excessive Heat	McDowell, Mercer, Mingo, Monroe, Summers
July – December 2019	USDA-S4589	Drought and High Temperatures	Wayne
April 10 – May 30, 2020	USDA-S4733	Excessive Moisture and Cold Temperatures	Pleasants, Tyler, Wood
April 10 – May 30, 2020	USDA-S4735	Excessive Rain and Cold Temperatures	Cabell, Jackson, Mason, Wayne, Wood
April 23 – June 5, 2020	USDA-S4747	Excessive Rain and Cold Temperatures	Wood
May 5 – September 30, 2021	USDA-S5122	Drought and Excessive Heat	Berkeley, Jefferson, and Morgan

Source: USDA 2023

Notes: USDA U.S. Department of Agriculture

Previous Events

West Virginia has experienced numerous extreme heat and cold events. The 2018 SHMP did not chronicle past extreme temperature events. Table 5.4-4 lists prominent events since 2018 that resulted in property damage,



crop damage, or casualties. Table 5.4-5 summarizes the number of extreme temperature events, including those reported to NOAA-NCEI and the recorded highs and lows at weather stations located throughout the State.



Table 5.4-4. Extreme Temperature Events in the State of West Virginia (2018 to 2022)

Date(s) of Event	Event Type	Federal Disaster Declaration (if applicable)	Counties Affected	Description
June – December 2019 (no specific dates)	Drought and Excessive Heat	S4605 (USDA)	McDowell, Mercer, Mingo, Monroe, and Summers	In June and July, hot and humid conditions were experienced across the state. Temperatures ranged from 96°F to over 100°F. The extreme high temperatures were experienced through October. This resulted in drought conditions (refer to Section 5.2 for details on this drought). Over \$200,000 in crop losses related to drought and heat, impacting the soybean, corn, and other crops in the state.
July – December 2019 (no specific dates)	Drought and High Temperatures	S4589 (USDA)	Wayne	No losses recorded.
April 10 – May 30, 2020	Excessive Moisture and Cold Temperatures	S4733 (USDA)	Pleasants, Tyler, and Wood	No losses recorded.
April 10 – May 30, 2020	Excessive Rain and Cold Temperatures	S4735 (USDA)	Cabell, Jackson, Mason, Wayne, and Wood	No losses recorded.
April 23 – June 5, 2020	Excessive Rain and Cold Temperatures	S4747 (USDA)	Wood	No losses recorded.
May 5 – September 30, 2021	Drought and Excessive Heat	S5122 (USDA)	Berkeley, Jefferson, and Morgan	Over \$800,000 in crop losses related to drought and heat, impacting the soybean, corn, and other crops in the state.
December 23-25, 2022	Extreme Cold/Wind Chill	N/A	Statewide	Temperatures dropped more than 40 degrees over the course of 6 hours. In West Virginia, residents were without water due to water line breaks from freezing temperatures, with some not having water until January 1, 2023. The hardest hit counties were Raleigh and Wayne, where millions of gallons of water were lost to frozen pipes from water main breaks. Overall, the state had over \$5 million in property damage from this event.

Sources: FEMA 2023; NOAA NCEI 2023; USDA 2023



Table 5.4-5. Summary of Extreme Temperature Events in West Virginia, 1954 to 2022

Hazard Type	Number of Occurrences	Total Fatalities	Total Injuries	Total Property Damage (\$)	Total Crop Damage (\$)
Excessive Heat	14	Not recorded	Not recorded	Not recorded	Not recorded
Extreme Cold/Wind Chill	40	Not recorded	Not recorded	\$7.4 million	Not recorded
≥100°F	87	-	-	-	-
≤0°F	156	-	-	-	-

Sources: NOAA NCEI 2023; Midwest Regional Climate Center 2023

Notes:

- Excessive heat events occur whenever the heat index values meet or exceed locally/regionally established Excessive Heat Warning thresholds.
- Heat events occur whenever heat index values meet or exceed locally/regionally established advisory thresholds.
- Extreme Cold/Wind Chill are periods of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria.

PROBABILITY OF FUTURE HAZARD EVENTS

Overall Probability

According to FEMA, USDA, NOAA-NCEI, and the 2018 SHMP, the State experienced over 14 extreme heat and 40 extreme cold events between 1996 and 2002, as summarized in Table 5.4-6. Overall, the State is likely to experience about one excessive heat day every two years and two excessive cold days each year, with the possibility of an increase in frequency due to future changing conditions.

Table 5.4-6. Probability of Future Extreme Temperature Events in West Virginia

Hazard Type	Number of Occurrences Between 1996 And 2022	Percent Chance of Occurrence in Any Given Year
Excessive Heat/Heat	14	51.85%
Extreme Cold/Wind Chill	40	100%
Total	54	100%

Sources: NOAA NCEI 2023

Projected Future Conditions

Temperatures in West Virginia have risen approximately 1°F over the last century. Warming is projected in the upcoming century with increases in the intensity of extreme heat events and decreases in intensity of extreme cold events. Rising temperatures will melt snow earlier in spring and increase evaporation, thereby drying the soil during summer and fall (NOAA NCEI 2022). As a result, the projected change in future conditions is likely to intensify droughts during summer and fall (U.S. Environmental Protection Agency 2016).

5.4.2 Vulnerability Assessment

STATE ASSETS

All State assets are exposed to extreme temperatures; however, direct impacts are expected to be minimal. This includes all 1,117 State facilities, 185 community lifelines, and 3,924 miles of State-owned roads.



Extreme heat generally does not affect buildings; however, losses may be associated with overheating of heating, ventilation, and air conditioning (HVAC) systems. Extreme cold temperature events can damage buildings through freezing and bursting pipes and freeze/thaw cycles. Additionally, antiquated or poorly constructed facilities may have inadequate capabilities to withstand extreme temperatures.

Functional downtime associated with power interruption is the most significant impact on critical facilities and community lifelines from extreme temperature events. The level of impact depends on the amount of time it takes to restore power to operational status at impacted facilities.

CRITICAL FACILITIES AND COMMUNITY LIFELINES

Similar to State assets, all critical facilities and community lifelines are exposed and vulnerable to the extreme temperature hazard. However, direct impacts are expected to be minimal. Impacts to critical facilities are the same as were described for general State assets. Additionally, it is essential that critical facilities remain operational during natural hazard events. Extreme heat events can sometimes cause short periods of utility failures, commonly referred to as “brown-outs,” created by increased usage from air conditioners, appliances, and similar equipment. Similarly, heavy snowfall and ice storms, associated with extreme cold temperature events, can interrupt power as well. Backup power is recommended for critical facilities and infrastructure.

POPULATION

In West Virginia, the entire population is exposed and vulnerable to the extreme temperature hazard.

Extreme Heat

Extreme heat is one of the leading causes of weather-related deaths in the United States, killing more than 600 people in the United States each year (CDC 2023). Heat-related illness includes a spectrum of illnesses ranging from heat cramps to severe heat exhaustion and life-threatening heat stroke. Table 5.4-7 describes common heat-related illnesses are listed.

Table 5.4-7. Typical Heat-Related Illnesses

Definition	Symptoms	First Aid
Heat Stroke Heat stroke occurs when the body can no longer control its temperature: the body’s temperature rises rapidly, the sweating mechanism fails, and the body is unable to cool down. When heat stroke occurs, the body temperature can rise to 106°F or higher within 10 to 15 minutes.	Confusion, altered mental status, slurred speech; loss of consciousness (coma); hot, dry skin or profuse sweating; seizures; very high body temperature; fatal if treatment delayed	<ul style="list-style-type: none"> • Call 911 • Stay with sufferer until help arrives • Move sufferer to a shaded, cool area and remove outer clothing • Circulate air to speed cooling • Place cold wet cloths or ice on head, neck, armpits, and groin
Heat Exhaustion Heat exhaustion is the body’s response to an excessive loss of water and salt, usually through excessive sweating. Heat exhaustion is most likely to affect older adults, infants and children, people with chronic medical conditions, athletes, pregnant women, and those working outdoors or in a hot environment.	Headache; nausea; dizziness; weakness; irritability; thirst; heavy sweating; elevated body temperature; decreased urine output	<ul style="list-style-type: none"> • Take sufferer to a clinic or emergency room for medical evaluation and treatment • Call 911 if medical care is unavailable • Stay with sufferer until help arrives • Remove sufferer from hot area and give liquids to drink



Definition	Symptoms	First Aid
		<ul style="list-style-type: none"> Remove unnecessary clothing Cool the sufferer with cold compresses or cold water Encourage frequent sips of cool water
Rhabdomyolysis		
Rhabdomyolysis is a medical condition associated with heat stress and prolonged physical exertion. It causes the rapid breakdown, rupture, and death of muscle. When muscle tissue dies, electrolytes and large proteins are released into the bloodstream. This can cause irregular heart rhythms, seizures, and damage to the kidneys.	Muscle cramps/pain; abnormally dark urine; weakness; exercise intolerance	<ul style="list-style-type: none"> Stop activity Drink more liquids (water preferred) Seek immediate care at the nearest medical facility Ask to be checked for rhabdomyolysis
Heat Syncope		
Heat syncope is a fainting (syncope) episode or dizziness that usually occurs when standing for too long or suddenly standing up after sitting or lying. Factors that may contribute to heat syncope include dehydration and lack of acclimatization.	Fainting (short duration); dizziness; light-headedness from standing too long or suddenly rising from a sitting or lying position	<ul style="list-style-type: none"> Sit or lie down in a cool place Slowly drink water, clear juice, or a sports drink
Heat Cramps		
Heat cramps usually affect workers who sweat a lot during strenuous activity. This sweating depletes the body's salt and moisture levels. Low salt levels in muscles cause painful cramps. Heat cramps may also be a symptom of heat exhaustion.	Muscle cramps, pain, or spasms in the abdomen, arms, or legs	<ul style="list-style-type: none"> Drink water and have a snack or drink that replaces carbohydrates or electrolytes every 15 to 20 minutes Avoid salt tablets Get help if the sufferer has heart problems, is on a low-sodium diet, or has cramps that do not subside within 1 hour
Heat Rash		
Heat rash is a skin irritation caused by excessive sweating during hot, humid weather.	Red clusters of pimples or small blisters, usually on the neck, upper chest, groin, under the breasts, and in elbow creases	<ul style="list-style-type: none"> Work in a cooler, less humid environment if possible Keep rash area dry Apply powder to increase comfort Do not use ointments or creams

Source: CDC 2022

Impacts on Socially Vulnerable Populations

Overall, the entire population of the State is exposed and vulnerable to extreme heat. Therefore, the exposed socially vulnerable population to extreme heat is equal to the statewide percentage: 60.4 percent of the total population. Older populations, infants and children, pregnant people, and people with chronic illnesses can be especially sensitive to heat exposure. Low-income individuals are more likely to live in poorly ventilated dwellings, lack air conditioning, or be unable to afford cooling; people experiencing homelessness lack shelter, cooling apparatus, and consistent access to water to minimize heat impacts (Center for Climate and Energy Solutions 2021).



Extreme Cold

Extreme cold is a dangerous situation that can bring on health emergencies in susceptible people, such as those without shelter or who are stranded, or who live in a home that is poorly insulated or without heat. In addition, extreme cold can cause serious health problems when exposed to prolonged periods of cold. The most common cold-related problems are hypothermia and frostbite.

- **Hypothermia** is caused by prolonged exposures to very cold temperatures. While hypothermia is most likely at very cold temperatures, it can occur even at cool temperatures (above 40°F) if a person becomes chilled from rain, sweat, or submersion in cold water. The most vulnerable to hypothermia include older adults with inadequate food, clothing, or heating; babies sleeping in cold bedrooms; people who remain outdoors for long periods—the homeless, hikers, hunters, etc.; and people who drink alcohol or use illicit drugs (CDC 2023).
- **Frostbite** is a type of injury caused by freezing. It leads to a loss of feeling and color in the areas it affects, usually extremities such as the nose, ears, cheeks, chin, fingers, and toes. Frostbite can permanently damage the body, and severe cases can lead to amputation (removing the affected body part). Those with poor blood circulation or those not properly dressed for extremely cold temperatures are most at risk to develop frostbite (CDC 2023).

Impacts on Socially Vulnerable Populations

Overall, the entire population of West Virginia is exposed and vulnerable to extreme cold. Therefore, the exposed socially vulnerable population to extreme cold is equal to the statewide percentage: 60.4 percent of the total population. Cold temperatures most immediately impact populations who lack the resources to access a warm environment during the cold weather event.

FUTURE CHANGES THAT MAY IMPACT STATE VULNERABILITY

Understanding future changes that may impact vulnerability in the State can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The State considered the following factors in examining potential conditions that may affect hazard vulnerability:

- Potential or projected development
- Projected changes in population
- Other identified conditions as relevant and appropriate, including impacts of future conditions

Potential or Projected Development

Because all areas of West Virginia are exposed to the extreme temperature hazard, any sections of growth and development could be impacted by extreme temperatures.

Projected Changes in Population

While statewide population has declined over the past 10 years, population has increased in several areas throughout the State (e.g., Berkeley, Jefferson, and Monongalia Counties). From 2010 to 2019, the State's overall population decreased by 3.3 percent, and it is projected to decrease 7.8 percent by 2040 (West Virginia Department of Transportation 2020). As the overall population decreases, fewer people will be exposed to extreme temperatures and its impacts. However, counties with projected population increases, especially those



with higher percentages of socially vulnerable populations, may have increased risk of extreme temperature impacts.

Other Factors of Change

As discussed above, projected future conditions for West Virginia indicate more frequent extreme temperature events due to rising temperatures and changing precipitation patterns. Refer to Probability of Future Hazard Events for details on how future conditions can impact extreme temperatures.

5.4.3 Consequence Analysis

IMPACTS TO THE PUBLIC

In West Virginia, extreme temperature constitutes a low risk to the general populace. The elderly, small children, the chronically ill, and pets are considered to be more vulnerable to excessive heat and cold than the general population (West Virginia Emergency Management Division 2018).

IMPACTS TO RESPONDERS

Limited impacts to first responders related to extreme temperatures are anticipated in West Virginia. However, extreme heat conditions may increase the severity of wildfires and limit water supplies available for firefighting activities. Extreme cold conditions could create hazardous roadways for emergency personnel.

IMPACTS TO CONTINUITY OF OPERATIONS

As noted previously, extreme heat and cold events can sometimes cause short periods of utility failures. Backup power is recommended for critical facilities and infrastructure. While extreme temperatures can impact all of West Virginia, it is not anticipated that hot or cold conditions will impact the State's ability to continue operations during and after an extreme temperature event if backup power is in place.

IMPACTS TO PROPERTY, FACILITIES, AND INFRASTRUCTURE

As stated above, the entire State is exposed and vulnerable to extreme temperatures. Functional downtime associated with power interruption is the most significant impact from extreme temperature events. The level of impact depends on the amount of time it takes to restore power to operational status at impacted facilities.

IMPACTS TO THE ENVIRONMENT

Extreme heat events, especially when accompanied by drought conditions, can lead to environmental consequences. Increasing temperatures can lead to exacerbated risk of wildfire; drought and its effects on the health of watersheds; and increased stress, migration, and death in plants and animals. Freezing and warming weather patterns create changes in natural processes. An excess amount of snowfall followed by early warming periods may affect natural processes such as flow of water resources.

IMPACTS TO THE ECONOMIC CONDITION OF THE STATE

Extended periods of hot and cold weather can have significant impacts on crops, livestock, and people in West Virginia. According to the current Census of Agriculture 2017 State Profile, there are 23,622 farms across West



Virginia covering more than 3.6 million acres. The Counties of Preston (4.8 percent), Jackson (4.2 percent), and Berkeley (4.0 percent) have the greatest percentage of farms in the State. The market value of products sold is estimated at \$754.2 million (USDA 2017). Table 5.4-8 provides a summary of the market value for crops and livestock in the State.

Table 5.4-8. State of West Virginia Agriculture Market Value (2017)

Agricultural Products Sold	Market Value
Value of crops, including nursery and greenhouse	\$153,117,000.00
Value of livestock, poultry, and their products	\$601,162,000.00
Total value of agricultural products sold	\$754,279,000.00

Source: USDA 2017

IMPACTS TO PUBLIC CONFIDENCE IN STATE GOVERNANCE

Public confidence would largely depend upon how effectively the State and county and local governments prepare for and respond to an extreme temperature event. While establishing warming or cooling centers is a county and/or local responsibility, the public’s perception of the State’s governance in extreme temperature events will be impacted by the general trend of how well local governments perform in keeping their residents safe during these events. That is, if there are reports across the State of injuries or fatalities due to the extreme temperatures, the public’s perception may be that the State should have done a better job responding to the event.