



4.3.9 Lightning

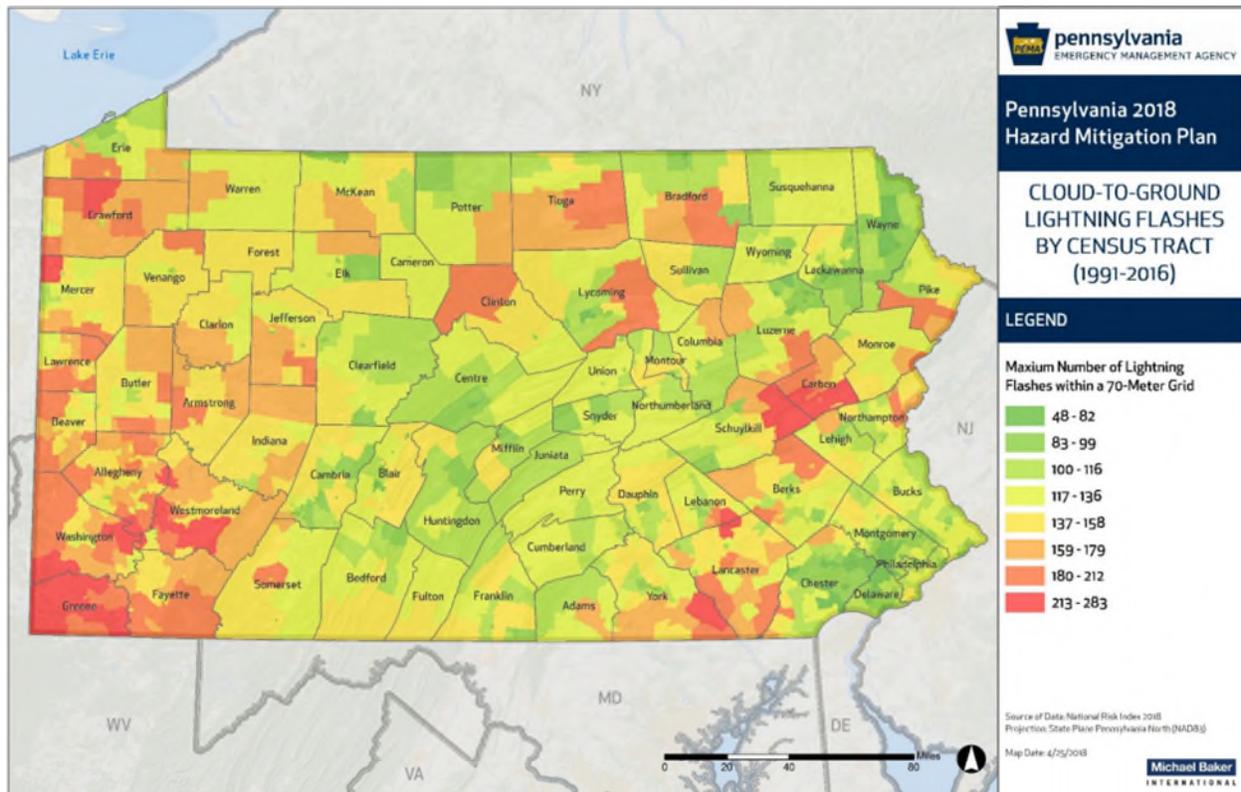
This section provides a profile and vulnerability assessment of the lightning hazard in Westmoreland County. Lighting is a rapid discharge of electrical energy in the atmosphere. The clap of thunder is the result of a shock wave created by the rapid heating and cooling of the air in the lightning channel. All thunderstorms produce lightning and are very dangerous. It ranks as one of the top weather killers in the United States and kills approximately 50 people and injures hundreds each year. Lightning can occur anywhere there is a thunderstorm (NOAA 2014).

4.3.9.1 Location and Extent

Lightning can occur anywhere in Westmoreland County. It can occur with all thunderstorms, making the entire county susceptible to the impacts of lightning. Different geographic areas may experience varying event frequencies, but in all cases, lighting strikes and associated fatalities occur primarily during the summer months.

According to the 2018 Commonwealth of Pennsylvania State Hazard Mitigation Plan, most lightning flashes occur in southwestern Pennsylvania and in the Lehigh Valley; however, eastern and southeastern portions of the Commonwealth are at greater risk for death, injury or damage to lightning than central and north-central due to high population density (PA HMP 2018). Figure 4.3.9-1 shows the frequency of cloud-to-ground lightning flashes by census tract across Pennsylvania.

Figure 4.3.9-1. Cloud-to-Ground Lightning Flashes by Census Tract, 1991-2016





4.3.9.2 Range of Magnitude

Lightning causes an average of 44 fatalities and hundreds of injuries each year in the United States and millions of dollars in property damage (NWS 2018). Many case histories show observed heart damage, inflated lungs, and brain damage in lightning-related fatalities. Many who have survived lightning strikes reported loss of consciousness, amnesia, paralysis, and burns. Death and injury to livestock and other animals; thousands of forest and brush fires; and damage to buildings, communications systems, power lines, and electrical systems are also the result of lightning (PEMA 2018).

Between 1959 and 2016, Pennsylvania ranked ninth among all states in the United States for the number of lightning deaths with 134 deaths. This represents approximately 3% of all fatalities that occurred throughout the United States over this time frame (PEMA 2018). Damages to property and crops as a result of lightning events totaled over \$16.6 million in Pennsylvania (NCEI 2019).

The worst-case scenario for lightning strikes would be a strike in a large group of people, such as at an outdoor sporting event or concert, in Westmoreland County (PEMA 2018). Numerous injuries or deaths could occur.

4.3.9.3 Past Occurrence

According to the NOAA-NCEI Storm Events Database, Westmoreland County has been impacted by 10 lightning-specific events since 1996. However, this number does not represent the total number of events, such as thunderstorms, where lightning occurred. NOAA-NCEI defines a lightning “event” as a lightning strike, which results in fatality, injury, and/or property or crop damage. For this HMP update, known lightning events that have impacted Westmoreland County are identified in Table 4.3.9-1. Please note that not all lightning events that have occurred in Westmoreland County are included due to the extent of documentation and the fact that not all sources may have been identified or researched. Loss and impact information could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP update.

Table 4.3.9-1. Lightning Events in Westmoreland County, 1996 to 2019

Date	Location	Fatalities	Injuries	Property Damage (\$)
June 8, 1996	Latrobe Airport	0	6	No property damage reported.
June 11, 1996	Greensburg	0	0	Lightning struck a house in Greensburg and sparked a small attic fire. Approximately \$3,000 in damages were reported.
August 8, 1996	Harrison City	0	0	Lightning struck a house and started a small attic fire. Approximately \$5,000 in damages were reported.
July 18, 1997	New Stanton	0	0	Lightning sparked a fire that destroyed a barn and its contents. Approximately \$10,000 in damages were reported.
July 18, 1997	Derry	0	0	Lightning sparked a fire that destroyed a mobile home. Approximately \$20,000 in damages were reported.
August 16, 1997	Donegal	0	0	Lightning sparked a barn fire. Approximately \$5,000 in damages reported.
May 31, 1998	Mount Pleasant	0	0	Lightning sparked a fire and caused damage to the attic and outside overhang of the house, causing \$15,000 in damages.
May 31, 1998	Herminie	0	1	A man was reported to have been struck and injured by lightning.
June 20, 2001	Ligonier	1	2	No property damage reported.
June 5, 2002	Salina	0	5	No property damage reported.

Sources: NOAA-NCEI 2019



4.3.9.4 Future Occurrence

Lightning can be expected in any severe storm event. While injuries or fatalities caused by lightning strikes are rare, lightning events severe enough to be reported can be expected at least once every two years. It is estimated that the County will continue to experience lightning events annually. For the 2019 HMP update, the most up-to-date data was collected to calculate the probability of future occurrence of lightning events for Westmoreland County. Information from NOAA-NCEI Storm Events Database was used to identify the number of lightning strike events that occurred between 1996 and 2019. Using these sources ensures the most accurate probability estimates possible. The table below shows these statistics as well as the annual average number of events and the estimated percent chance of an incident occurring in a given year. Based on these statistics, there is an estimated 43.5-percent chance of a lightning strike event occurring in any given year in Westmoreland County.

Table 4.3.9-2. Probability of Future Lightning Events

Hazard Type	Number of Occurrences Between 1996 and 2019	Percent Chance of Occurrence in Any Given Year
Lightning	10	42%

Sources: NOAA-NCEI 2019

Note: NOAA-NCEI lightning reports start in 1996.

Based on available historical data, the future occurrence of lightning strikes that cause deaths, injuries, or property damage can be considered *possible* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

4.3.9.5 Vulnerability Assessment

To understand risk, a community must evaluate the assets that are exposed or vulnerable in the identified hazard area. For lightning events, all of Westmoreland County has been identified as the hazard area. Therefore, all assets (population, structures, critical facilities, and lifelines), as described in Section 2, are potentially vulnerable. This section evaluates and estimates the potential impact of lightning strike events on Westmoreland County, including the following subsections:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on (1) life; (2) health and safety; (3) general building stock; (4) critical facilities, (5) economy; and (6) future growth and development
- Effect of climate change on vulnerability
- Additional data and next steps.

Overview of Vulnerability

Evaluation of NOAA-NCEI lightning data for Westmoreland County, along with data from the current and previous versions of the PA HMP, show that while the absolute number of lightning events has changed for individual municipalities, the basic pattern of vulnerability across the County has remained relatively consistent.

The potential for lightning strikes will continue to exist for all municipalities. The direct and indirect losses associated with these events include injury and loss of life, damage to structures and infrastructure, agricultural losses, utility failure (power outages), and stress on community resources.



Westmoreland County is a StormReady county. This designation is obtained through participation in the NWS StormReady Program, which includes the following six guidelines met by the County:

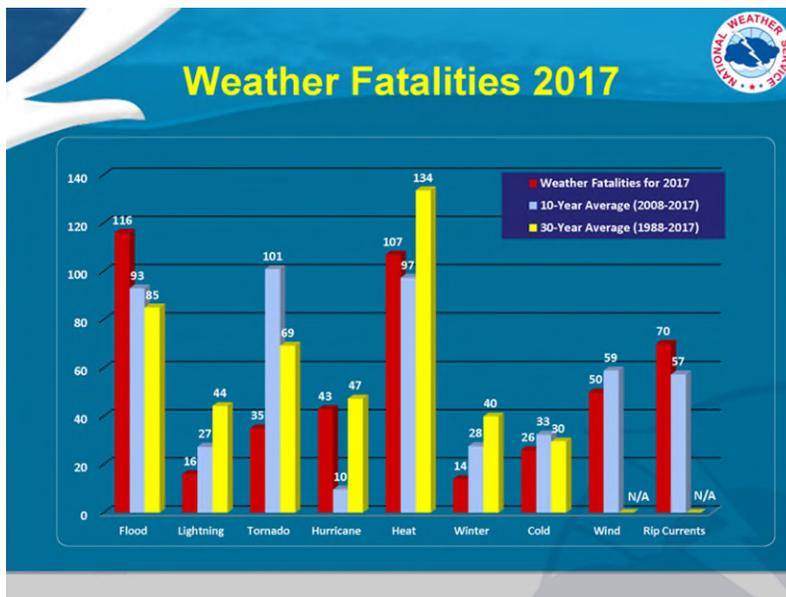
- Communication – A 24-hour warning point (WP) must be fully staffed at all times, and a County Emergency Operations Center (EOC) must be established.
- NWS Information Reception – At least four redundant systems must be in place at the WP to receive weather warnings.
- Hydrometeorological Monitoring – At least four methods of monitoring hydrometeorological data must be available.
- Local Warning Dissemination – At least four redundant systems must be in place to notify the County of severe weather warnings, and there must be National Weather Radio-Specific Area Messaging Encoding receivers in public facilities.
- Community Preparedness – The County must present at least four annual weather safety talks, spotters and dispatchers must be trained biennially, and the County must host or co-host NWS spotter training annually.
- Administration – The County must also meet a number of administrative criteria that include formal hazardous weather operations planning, biennial visits of the County Emergency Management Coordinator (EMC) to the NWS office, and annual visits by an NWS official to the County.

Meeting the criteria of the StormReady program results in a decrease in vulnerability to all severe weather events, including lightning strikes.

Impact on Life, Health, and Safety

Across the United States, the 10-year average (2008 to 2017) for fatalities caused by lightning is 27, while the 30-year average (1988 to 2017) is 44 (NWS 2018). Figure 4.3.9-2 illustrates these statistics. According to NOAA-NCEI, there has been one fatality and 14 injuries associated with lightning strike events from 1996 to 2019 in Westmoreland County (NCEI 2019).

Figure 4.3.9-2. Weather Fatalities in the United States



Source: NWS 2018



The entire population of the County is considered exposed to the lightning hazard. Lightning strikes in Pennsylvania occur primarily during the summer months. In general, population and building density have a correlation with hazard vulnerability and loss. The more-developed areas of Westmoreland County are at greater risk to lightning strikes than others because of the greater population density. Populations located outdoors are considered at risk and more vulnerable to a lightning strike compared to those inside a shelter. Moving to a lower-risk location will decrease a person’s vulnerability.

Impact on General Building Stock, Critical Facilities, and the Economy

For the purposes of this HMP, the entire general building stock and all infrastructure of Westmoreland County are considered exposed to the lightning strike hazard. In general, developed areas in the County are at greater risk than more rural areas others due to population and structure density. Taller buildings can act as lightning rods; therefore, they naturally have experienced greater vulnerability and loss during past lightning strike events (PEMA 2018). The 2018 Commonwealth of Pennsylvania State Hazard Mitigation Plan identifies Allegheny and Westmoreland Counties as having the highest concentrations of vulnerable populations and buildings susceptible to lightning strikes within the state (PEMA 2018).

The precise vulnerability of lightning strikes will depend on a facility’s height in relation to surrounding buildings as well as the absence or presence of a lightning rod or other lightning channeling technology on the structure. According to the PA HMP, fire departments, schools, police departments, and dams are the most vulnerable to lightning strikes. Food and agriculture facilities that raise livestock may also be more vulnerable to lightning strikes as these animals tend to shelter under trees in storm situations (PEMA 2018).

According to NOAA’s Technical Paper titled *Lightning Fatalities, Injuries, and Damage Reports in the United States from 1959–1994*, monetary losses for lightning events range from less than \$50 to greater than \$5 million (larger losses associated with forest fires with homes destroyed and crop loss) (NOAA 1997). Lightning can be responsible for damages to buildings; cause electrical, forest, and/or wildfires; and damage infrastructure such as power transmission lines and communication towers. Agricultural losses caused by lightning and lightning-resulting fires can be devastating.

The 2018 State HMP estimated jurisdictional losses for the 30 counties most vulnerable to lightning strike, including Westmoreland County. Using GIS, the value of exposed buildings is estimated to total over \$13.8 billion. Note that losses due to lightning strikes will differ based on the magnitude of the event and the lightning protection measures on a given facility (PEMA 2018).

Impact on the Environment

The environmental impacts most often associated with lightning strikes include damage or death to trees or ignition of wildfires (PEMA 2018). Refer to Section 4.3.13 (Wildfire) for the impacts on the environment from wildfires.

Future Growth and Development

Areas targeted for potential future growth and development within the next 5 years have been identified across Westmoreland County; refer to Section 2.4 of this HMP. New development is anticipated to be exposed to the lightning strike hazard.

Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by the type, frequency, and intensity of weather events. Both globally and the local level, climate change has the potential to alter the prevalence and severity of weather extremes such as storms, including those that may bring lightning. While



predicting changes of lightning events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society and the environment (U.S. Environmental Protection Agency [EPA] 2006).

Climate change may lead to an increase in the number of lightning-producing storms. Major clusters of summertime thunderstorms in North America will grow larger, more intense, and more frequent later this century in a changing climate, unleashing far more rain and posing a greater threat of flooding across wide areas (UCAR 2017). At century's end, the number of summertime storms that produce extreme downpours could increase by more than 400% across parts of the United States, including sections of the Gulf Coast, Atlantic Coast, and the Southwest. In addition, the volume of rainfall during mesoscale connective systems (MSCs) could increase by as much as 80% in some areas (UCAR 2017). An increase in atmospheric moisture could also lead to an increase in lightning strikes, ultimately causing an increase in wildfire ignitions (Lee, 2014).

Thunderstorms and other heavy rainfall events are estimated to cause more than \$20 billion of economic losses annually in the United States. Particularly damaging, and often deadly, are mesoscale convective systems (MSCs): clusters of thunderstorms that can extend for many dozens of miles and last for hours, producing flash floods, debris flows, landslides, high winds, and/or hail. The persistent storms over Houston in the wake of Hurricane Harvey were an example of an unusually powerful and long-lived MCS.

Additional Data and Next Steps

The assessment above identifies vulnerable populations and potential structural and economic losses associated with the lightning strike hazard. Research performed at NOAA and other private organizations is ongoing to improve warning and threat information for the public. The continued collection of additional/actual loss data specific to the Plan participants will further enhance Westmoreland County's vulnerability assessment.