



City of Philadelphia
Managing Director's
Office of Emergency Management

Natural



**Overview of Natural Hazards
that May Affect Philadelphia**

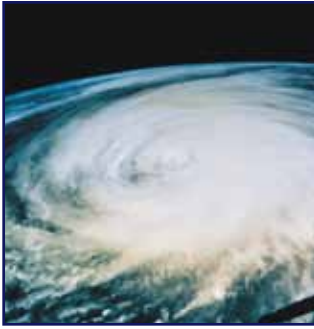


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Overview

Each year there are many emergencies in the City of Philadelphia. Our ability to act in response to these depends on understanding the risks posed by hazards, developing coordinated plans to address the impacts of these risks, and coordinating emergency operations effectively.

This Overview focuses on Natural Hazards. Natural hazards are those elements of the physical environment that are harmful to people and caused by the forces of nature, such as flooding and tornadoes.

Based on the identification of hazards that can affect Philadelphia, the Office of Emergency Management can coordinate planning activities designed to minimize the impact of these potential risks.

Philadelphia Office of Emergency Management Mission Statement

The Managing Director's Office of Emergency Management is responsible for ensuring the readiness of the City of Philadelphia for emergencies of any kind through an integrated and collaborative program that:

- educates the public on how to prepare for emergencies
- works to mitigate the impact of emergencies
- develops plans to coordinate the City's response to emergencies
- conducts training and exercise activities to practice the plans
- coordinates on-scene response
- coordinates recovery operations following an emergency



Flooding Hazard

Hazard Background

Floods are the most prevalent type of natural disaster occurring in the Commonwealth of Pennsylvania. Floods—seasonal or flash—have been the cause of millions of dollars in annual property damages, loss of lives, and disruption of economic activities. In Pennsylvania, floods cause over \$1 billion worth of property damage annually. Over 94 percent of Pennsylvania’s municipalities, including Philadelphia, have been designated as flood prone.

History

The greatest flood on record in Philadelphia was the August 1955 flood associated with Hurricane Diane which was estimated to have a 0.33 percent chance of occurring in any one year, or once in 300 years. Diane hit Philadelphia with 30 mph winds and 6-12 inches of rain. The Delaware River flooded to record levels in the North and Northeast coastal region of Philadelphia and caused \$4.2 billion in damages to Pennsylvania, New York, and New England.

Within the flood vulnerable areas of Philadelphia, it is expected that the frequency and likeliness of flooding will remain the same from what Philadelphia has experienced in the past. However, some increase in the severity and frequency of flooding may result due to planned or recent development within the floodplains of the various streams. For Philadelphia, the number of flood events recorded during the 1950-2007 time period by the National Climactic Data Center is 77. Only by continued monitoring of floodplain development can Philadelphia diminish yearly flood damages.

Impact on the City

Philadelphia has areas designated as being flood prone:

Cobbs Creek along the western county border and the marshlands in the southwest sector of the City are flood prone.

The Philadelphia Naval Base is flood prone in many areas. Formerly a federal property, flooding statistics for the base were not previously included in Philadelphia statistics.

The Delaware River can often cause flooding problems when widespread heavy rains occur or higher than normal tides are experienced in the Delaware Basin. This can usually be first observed **along Delaware Avenue underneath the Ben Franklin Bridge** as rising river water covers the roadways.

In the Northeast where Linden Avenue meets the Delaware River, some parking lot flooding can be observed.

Areas along Kelly and Lincoln Drives are also affected by flooding in the roadway from the Schuylkill River. Streams most prone to flooding include the Pennypack, Poquessing and Cobbs Creeks.



Winter Weather Hazard

Hazard Background

A winter weather emergency involves one or more of the following hazardous conditions: severe cold, ice, freezing rain, snowstorms, Nor'easters, severe freezing.

Frigid temperatures pose a hazard to public health and safety, especially for the elderly, the homeless, and persons who spend time outdoors. Ice storms and freezing rain can have a significant impact on Philadelphia. Ice can accumulate on power lines, telephone lines, and cable lines, which may snap and cause power outages. Ice covered roads become slippery and hazardous and the weight of the ice can break trees and branches. Heavy snow can disrupt road networks and mass transit, close airports, produce dangerous conditions for pedestrians, and can lead to structural collapse due to the weight of snow on certain kinds of roofs. Nor'easters, which are extra-tropical cyclones, can bring severe cold, ice, snow, high winds, or torrential rains and flooding. Frozen ground can affect gas and water mains and can cause pipes to break.

History

The coldest temperature ever recorded in Philadelphia was minus 11 degrees Fahrenheit on February 9, 1934. Philadelphia averages 19.3 inches of snow annually. The biggest single snowfall event dumped 30.7 inches on the City on January 8, 1996.

Impact on the City

All areas of the City are susceptible to winter weather, and a winter weather event can occur with little or no warning. Therefore, all existing structures, including critical facilities such as hospitals, throughout the entire region are vulnerable to this hazard.

Winter storms cause road closings, especially on secondary roads that become virtually impassable. During a winter storm, households become vulnerable to interruptions in utilities for heat and electricity. Loss of water supplies is also a concern due to frozen or ruptured lines, or loss of power to well pumps in rural areas.

The severity and frequency of major winter storms has remained fairly constant. However, due to increased dependence on various modes of transportation and use of public utilities for heat and power, the disruption caused by these storms may have much more of an impact today.



Tornado Hazard

Hazard Background

A tornado is a violently rotating column of air which is in contact with both a cloud base and the surface of the earth. Most tornadoes have wind speeds of 110 mph or less, are approximately 250 feet across, and travel a few miles before dissipating. Tornadoes vary in intensity regardless of shape, size, and location, though strong tornadoes are typically larger than weak tornadoes.

Tornadoes and other windstorms are a common occurrence in the Commonwealth of Pennsylvania, especially in the spring and summer months. Tornadoes are ranked in severity and intensity using the Fujita Scale damage specifications. Tornadoes rank from F0 to F12. F0 designates light damage and F12 designates inconceivable damage. No tornadoes rated F4 or above have been recorded within 100 miles of Philadelphia.

History

Philadelphia's 140-year record shows 11 confirmed instances of tornadic activity with varied intervals and severity. It is likely that this type of pattern will continue for the City of Philadelphia. Although loss of life is small, property damage still remains a significant concern.

In the 1990s, Pennsylvania averaged 22 tornadoes per year. An F2 touched down in Northeast Philadelphia on June 1, 1998. The worst damage was done in the area around Byberry Road, McNulty Road, Roosevelt Boulevard and Southampton Road. PECO Energy reported 34,000 customers in Philadelphia lost power. An F0 tornado touched down briefly in Marconi Plaza in South Philadelphia on January 18, 1999. Though this tornado was only twenty yards wide and on the ground for just two-tenths of a mile, it injured eighteen people because it touched down in a highly populated area.



Impact on the City

There are no areas of Philadelphia that are designated as being more tornado-prone than others. There are times of year which are most prone to tornado occurrences in Pennsylvania, but not in Philadelphia in particular. If there were to be a time of year in Philadelphia considered "tornado season", it would be the period from late May through the end of July. Most tornadoes in the Delaware Valley are rated F0 or F1 and are short-lived, lasting only a few minutes. The month of July has the highest number of tornadoes in the state of Pennsylvania, with 161 tornadoes identified between the years of 1950 and 2000. May witnessed 117 in this time period, and June saw 143. This is also the time of year that Pennsylvania receives the greatest number of thunderstorms.

Extreme Heat Hazard

Hazard Background

In the Philadelphia area, the National Weather Service defines a heat wave as a period of at least three straight days when temperatures reach 90 degrees Fahrenheit. Extreme heat waves usually come on subtly, raising summer temperatures higher than normal. Excessive heat can have a major impact on personal health and safety, but is usually sparing to property. With extreme heat, there is little physical destruction, although roads can buckle.

History

A heat wave, rather than a hurricane, tornado, blizzard, or flood resulted in the highest death toll in modern Philadelphia weather history. In July 1993, 118 people died from heat-related causes.

On average, high temperatures reach 90 degrees Fahrenheit on 25 to 30 days a year in Philadelphia. The number of 90 degree F days is one way to gauge a summer's heat. 90 degrees Fahrenheit may be hot, but the threshold for extreme summer heat in the Philadelphia area is 100 degrees Fahrenheit. Philadelphia's all-time record high temperature is 106 degrees Fahrenheit, set on August 7, 1918.

Impact on the City

There is no defined geographic hazard boundary for extreme heat, which may affect any part of the City of Philadelphia. Although extreme heat is more likely to affect people than property, summer's intense sunshine can also dry out the ground quickly, which can lead to droughts. Extreme heat also taxes utility systems, heavily used in hot weather, which leads to power outages.

Elderly residents, young children, those who are overweight and people suffering from serious illnesses are especially prone to heat-related problems.

Extreme heat disorders include sunburn, heat cramps, heat exhaustion, and heat stroke. Heat stroke is a severe medical emergency. People living in urban areas may be at greater risk from the effects of a prolonged heat wave than people living in rural regions. An increased health problem can occur when stagnant atmospheric conditions trap pollutants in urban areas, thus adding contaminants to excessively hot temperatures.

Ground-level ozone, the main ingredient in smog, forms only in sunny, warm weather, making ground-level ozone a warm-season phenomenon. Besides being a health hazard, air pollution increases haze and reduces visibility. Breathing air with elevated ozone levels can irritate and inflame the respiratory system.



Earthquake Hazard

Hazard Background

An earthquake is the result of a sudden release of energy in the Earth’s crust that creates seismic waves. At the Earth’s surface, earthquakes manifest themselves by shaking and sometimes displacing the ground. Since earthquakes are events that are rarely isolated to the City of Philadelphia, the hazard must be approached as it applies to a larger geographic area, both in its cause and its effect. Pennsylvania is characterized by light earthquake activity compared to many other northeastern states.

History

Earthquakes in the Philadelphia area after 1938

Date	Epicenter	Remarks
May 1984	Montgomery County	Philadelphia and Montgomery counties affected
May 12, 1982	Penn del	Shock felt in Philadelphia at 12:01 am
April 12, 1982	Cornwell Heights	Shock felt in Philadelphia at 5:14 pm
Mar 11, 1980	Hatboro	Felt in Philadelphia and Montgomery counties
Mar 5, 1980	Hatboro	Felt in Philadelphia and Montgomery counties
Feb 28, 1973	Wilmington, DE	Shock cracked plaster and toppled glasses in Philadelphia
Dec 10, 1968	New Jersey	Darby and Philadelphia affected, breaking windows in New Jersey
Dec 27, 1961	PA & NJ border	Shock felt at 12:06 am at Bristol and in northeast Philadelphia; buildings creaked and dishes rattled, felt at Levittown and Langhorne
Aug 23, 1938	New Jersey	A dozen tremors felt in Philadelphia, breaking a few windows

Impact on the City

Southeastern Pennsylvania is the part of the Commonwealth with the highest level of earthquake hazard, though the probability of seismic intensity as high as VIII on the Mercalli scale (a scale used to measure the strength or intensity of an earthquake that ranges from I through XII, with I being of least intensity and XII being the highest intensity) is relatively low – about 10 percent in 250 years. An intensity of VIII is defined as “destructive”, with possible impacts including considerable damage to buildings, falling chimneys, and heavy furniture overturned.

The seismic hazard in Pennsylvania in terms of a “worst case” is a magnitude VII-VIII earthquake.



Hurricane Hazard

Hazard Background

A hurricane is described as a tropical cyclone that has peak sustained winds of 74 mph or greater and is accompanied by rain, thunder, and lightning. In the case of hurricanes, by the time most storms reach Pennsylvania, they fail to satisfy the definition of a hurricane. The City has been affected by the rains of hurricanes. Although the City of Philadelphia has not experienced the high winds associated with “hurricanes,” rainfall from these storms has caused flooding throughout different parts of the City.

Hurricanes that could potentially affect the Delaware Valley form in the Atlantic Basin which includes the North Atlantic Ocean, Caribbean Sea, and the Gulf of Mexico. Officially, Atlantic hurricane season runs from June 1 to November 30, but August, September and October are by far the most active months. The Saffir-Simpson scale is used to categorize the intensity of hurricanes on a scale of 1 to 5, with 1 being minimal and 5 being catastrophic.

History

In an average year, about ten tropical storms form in the Atlantic Basin, with six of them becoming hurricanes. It is reasonable to assume that Philadelphia will continue to incur the effects of storms as they pass by or pass over every few years. Excessive rain may cause local flooding, and damages may result.

Impact on the City

The great majority of tropical storms and hurricanes in the Atlantic Basin have no direct effect on the Delaware Valley and nearby coastal areas. In order to make landfall on the Jersey or Delaware coasts, a tropical system needs to move toward the northwest. Only one hurricane since 1900 has made landfall on the Jersey or Delaware coast, coming ashore near Atlantic City in 1903.

The National Hurricane Center states that a coastal storm, with strong, sustained Southeast winds could be devastating to the Philadelphia region. If a storm takes an inland track, staying just west of the Delaware Bay with a persistent onshore flow, it could maximize coastal flooding because of the push of water toward shore. This track could also cause tremendous flooding on the Delaware Bay and the Schuylkill and Delaware Rivers. River flooding would depend greatly on how much rain falls and how quickly.

The rains from Hurricane Floyd in 1999 overwhelmed streams and creeks and then smaller rivers, all in little more than 12 hours. Floyd set new records in Philadelphia for the most amount of rain in a calendar day, 6.63 inches. The pre-storm ground and river conditions also play an important role. A ground saturated from recent rains, as well as rivers already at high levels, make an area much more vulnerable to serious flooding.

Land Subsidence Hazard



Hazard Background

Land subsidence is a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials caused by groundwater or oil extraction.

Natural sinkholes form by the collapse of rock into underground caverns created when the limestone dissolves. There are three distinct geologic rock types under the Philadelphia area:

- (1) limestone and sandstone rocks of the Northern Piedmont
- (2) complex metamorphic bedrock of the Southern Piedmont
- (3) layers of sediments that occupy the Coastal Plain.

Piedmont is a plateau region located in the eastern United States between the Atlantic Coastal Plain and the main Appalachian Mountains, stretching from New Jersey in the north to central Alabama in the south. Essentially, the Piedmont is the remnant of several ancient mountain chains that have eroded away. In Philadelphia, land subsidence was related to stream valleys that had been filled with coal ash and cinders that were susceptible to compaction and piping.

History

According to area planners from the Philadelphia City Planning Commission, there are six sinking home areas that have been identified in Philadelphia:

- 1. Mill Creek** - In the 1930s there was a collapse of homes on Walnut Street between 43rd and 44th Streets in the Spruce Hill neighborhood.
- 2. Overbrook** - In April 2001, Philadelphia evacuated 18 houses on Daggett Street because the properties were sinking.
- 3. Wynnefield** - In 1993 the City commissioned an engineering report that recommended demolition of 28 homes.
- 4. Roxborough** - Approximately 12 homes on Mitchell Street and two homes on Pensdale Street underwent relocation and demolition.
- 5. W. Mount Airy** - Homes are settling in a serious manner on the 6600 blocks of Springer and Burnham Streets which intersect with Lincoln Drive. More homes are noticeably settling and leaning on Lincoln Drive.
- 6. Logan** - The City determined that 957 homes were affected by the subsidence problem.



Impact on the City

Beneath the City of Philadelphia lies 6,000 miles of gas mains; 3,300 miles of water mains; and 3,000 miles of sewers collecting nearly 500 million gallons of sewage per day; as well as communications cables and fiber optics; electrical conduits; oil plumes; storage tanks; tunnels; abandoned subway stations; graves; hidden waterways; archaeological sites; mines; landfills; and more. The primary problems related to subsidence include the disruption of utility services and damages to private and public property.



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Contact us at:

www.phila.gov/ready

OEM@phila.gov

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