

# CLIMATE CHANGE

*"The Lehigh Valley is one of the fastest warming regions in Pennsylvania."*



A CREATE Resilience Resource

## *The hazard...*

Climate change is the change in long-term trends and patterns of average weather for a given place. As human use of fossil fuels leads to an increase of carbon dioxide in the atmosphere, the global average temperature increases, changing weather patterns and creating more extreme weather events that can affect human and ecosystem health. 2019 was the 2nd warmest year since 1880 with the upper ocean the warmest on record. Nine of the 10 warmest years occurred since 2005, with the five warmest occurring since 2015. The Lehigh Valley is one of the fastest warming regions in Pennsylvania.

► For more see <https://www.climate.gov/> or <https://climate.nasa.gov/>

## *The impacts...*

Climate change affects many of the other natural hazards we experience, leading to increased frequency of heavy precipitation events, more intense storms, higher risk of flooding, more days of extreme heat, and more variability in winter storms. Loss of property and life result from these events, costing billions. The U.S. experienced 119 billion-dollar natural disasters in the 2010s compared to just 59 in the 2000s. In the Lehigh Valley the economic impact of high heat and strong storms is seen in agriculture losses and property damage, but disruptions to ecosystem health and habitats can have lasting impacts as well.



Flooding along Route 611 north of Easton (2006).  
Photo courtesy of Patty Caffrey.

## Some solutions...

Individuals can purchase renewable energy through their utility supplier; eat more plant-based meals and eat locally as much as possible; drive less or use public transportation; create more green spaces on their property; switch to LED lights in their home; air dry clothes; plant trees; get involved in their communities; and talk to others about climate change solutions and strategies.

Communities can improve communication and education; adopt emergency alert systems and emergency plans; conduct a vulnerability assessment and develop a climate action plan; adopt ordinances to increase energy efficiency in buildings; create more bike and walking paths and support ride-sharing and other sustainable public transportation options; prepare for future changes in weather patterns; limit development in floodplains; encourage and create more green spaces; and plant trees.

\*There are many strategies for reducing fossil fuel emissions – these are just a sampling of options. For more see

▶ <https://www.sustainlv.org/focus-on/climate-action-planning/>

## Local examples...

**Bethlehem Area School District** – after adopting a master energy plan in 2011 to address its commitment to reduce emissions and promote sustainable operations, the District has gained over \$9 million in energy savings through energy management services and facility upgrades. Managing energy use actively led to halving energy consumption, and solar panels provide 10% of the energy used across District.

**City of Easton** - following a major flood in 2004, the City's Public Works Department implemented a series of plans to ensure long-term preparedness for future flood risk. City complexes can now be evacuated in three hours and there are procedures for how to evacuate certain areas. The City of Easton also signed onto the *Global Covenant of Mayors* (a voluntary international commitment to reduce emissions contributing to climate change) and completed a climate vulnerability assessment in 2018. A vulnerability assessment determines the nature, type, consequences and extent of risks posed by climate change by evaluating existing social and landscape vulnerabilities and how they may be affected by future change. The City adopted an emissions reduction target of 80% reduction by 2050 and is considering completing a climate action plan to outline how to meet this target. It has already switched to powering 100% of municipal operations from renewable energy sources among other actions.

For more information about the CREATE Resilience project visit: [www.nurturenaturecenter.org/create-resilience/](http://www.nurturenaturecenter.org/create-resilience/)



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# WINTER STORMS

*Winter storms are one of the leading hazards in the Lehigh Valley.*



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## *The hazard...*

A winter storm is a weather system that forms at low temperatures in which the main types of precipitation are snow, sleet, or freezing rain.

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***“Make sure all community members are aware of the symptoms of hypothermia, the dangers of driving during a storm, and how to access emergency services that are available.”***

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Freezing rain can cause major tree damage and widespread power outages as it accumulates and weighs down everything it touches. Barely visible “black ice” forms on roads and walkways and is very dangerous to pedestrians and motorists.

## *The impacts...*

During winter storms, transportation disruptions can impact mobility and low temperatures can affect human health and property function. The risks include: hypothermia and frostbite when exposed to the cold for a long period of time, damage to home from falling branches, roof instability, frozen pipes, and generator issues, car accidents, cell phone service loss, and supply shortage.

## Some solutions...

Homeowners can make sure gutters are clean, hire a contractor to check roof stability, and cut hanging tree branches. Before a storm, individuals can make sure to follow weather forecasts, identify emergency routes, find shelter, and prepare a winter storm survival kit for home and car to stay safe. During a storm, it is advised to stay inside and off roads. For more on how to stay safe before, during, and after a winter storm check out

▶ <https://www.weather.gov/safety/winter-after>



*Remember to plan for all members of your home, including your pets, when preparing your storm survival kit.*

Communities can be prepared for storms by adopting a notification system such as Code Red or Nixle. Designated emergency snow routes and free parking garage access during the storms can keep drivers off the road. Shelters and warming centers can protect the homeless, and delivery service for elderly or disabled people can deliver necessary supplies if they are unable to get out during a storm. Make sure all community members are aware of the symptoms of hypothermia, the dangers of driving during a storm, and how to access emergency services that are available.

## Local examples...

**City of Easton:** maintains a page on their website about snow emergency operations. This includes regulations about being parked along emergency routes and free parking garage access for residents who live along the emergency routes. The page also includes information about other general snow operations and suggestions

▶ <https://www.easton-pa.com/public-works/pages/snow-emergency-winter-operations>

**City of Allentown:** set out on a rescue mission for the homeless in 2013. The city worked with shelters, churches, and agencies to provide food and shelter to homeless people during dangerously cold weather.

✳ **CREATE Resilience is a project of the Nurture Nature Center is a grant-funded project to educate and explore natural hazards and mitigation strategies in the local areas of Easton, Wilson and Bangor. For more information about the CREATE Resilience project visit: [www.nurturenaturecenter.org/](http://www.nurturenaturecenter.org/)**



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# STORMWATER RUNOFF

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## *The hazard...*

In urban communities, as green space is replaced with asphalt and concrete, rain and meltwater can't be absorbed. The excess water, including any pollutants, is carried away to larger bodies of water, flooding homes and roads and contaminating drinking water. The accumulating volume of stormwater causes rivers to overflow and flood surrounding areas.

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*To help prevent localized flooding, it is important to keep storm drains and gutters clear of debris.*

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## *The impacts...*

Stormwater runoff can impact the Lehigh Valley by bringing pollutants into rivers, affecting the health of the local fish population within the Delaware River as well as the people living around the area. Runoff can also cause localized flooding.



A "storm drain" or "storm sewer" carries polluted stormwater underground away from roads and property. These systems often release the untreated water directly into nearby rivers and streams.

## Some solutions...

Rain gardens are a form of 'bioretention,' in which a garden is planted over layers of soil, sand, and organic mulch; this is a visually attractive and natural way to filter out pollutants and minimize flooding. Rain barrels collect and filter rainwater, saving it for use in your lawn or garden. Green roofs soak up precipitation and minimize runoff. Pervious pavers and pervious concrete are alternatives to sidewalk, patio or playground pavement. Pervious materials allow water to leak through it, soaking into the dirt or gravel bed below.



**EPA Soak up the Rain** <https://www.epa.gov/soakuptherain>

**Green Infrastructure Options to Reduce Flooding** <https://coast.noaa.gov/data/docs/digitalcoast/gi-econ.pdf>

**Stormwater Management Model** <https://toolkit.climate.gov/tool/storm-water-management-model>

**National Stormwater Calculator** <https://toolkit.climate.gov/tool/national-stormwater-calculator%E2%80%94climate-assessment-tool>

## Local examples...

**Bushkill Township** - a rain garden was constructed in 2019 on a 90-acre tract, which had been experiencing problems with stormwater runoff since a parking lot had been built nearby. This garden allows stormwater to permeate into the ground and educates the local community on rain gardens and best management practices for stormwater.

**Lafayette College, Easton, PA** - a green roof was installed on the roof of the Acopian Engineering Center. The roof is able to hold a half inch of stormwater, greatly lessening the volume of stormwater runoff and contributing to the insulation of the building.

**Lehigh Valley, PA** - many local watershed organizations offer rain barrel building workshops. A rain barrel collects water off of your roof during each rain event; the water can be saved and used to water plants in your yard. Rain barrels help to decrease the amount of stormwater runoff and reduces the amount of pollution that could be picked up from the rain water as it passes over driveways and roads. To find your local watershed organization, visit: [www.watershedcoalitionlv.org](http://www.watershedcoalitionlv.org).



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# INVASIVE SPECIES



Spotted Lanternfly

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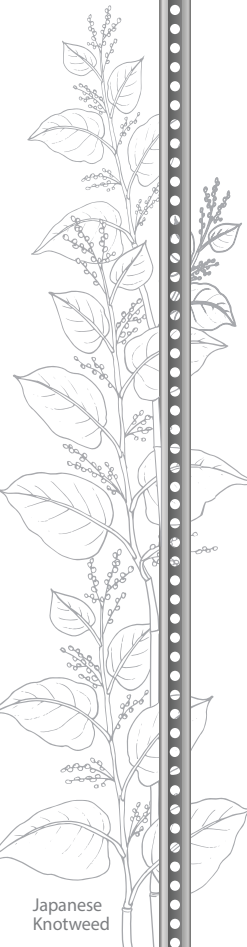
## *The hazard...*

Invasive species are any non-native species (not typically found in an area) that outcompete native plant/animal populations for resources. Historically, invasive species have been spread accidentally or on purpose in well-intended efforts to create habitat, prevent soil erosion, or eradicate a pest. Invasive plants threaten the homes of native Pennsylvania animals and insects and choke out the native plants they rely on. Out of the most common invasive plants in the Lehigh Valley (Multiflora Rose, Japanese Barberry, Garlic Mustard, Bush Honeysuckle, Autumn Olive, Japanese Knotweed, and Tree of Heaven) most are native to East Asia, with the exception of Garlic Mustard, which is native to Europe.

## *The impacts...*

Invasive species can result in mortality of other native species of flora and fauna, and can impact an area's agriculture and local economy. When a new species is introduced it often has no predators so that it can quickly expand and outcompete other species for the same resources. Existing species often do not have defense mechanisms against the new species. The Spotted Lanternfly has the potential to cost Pennsylvania billions in damage to the grape, hops and apple industries.

Climate change can have a drastic impact on invasive species populations, enabling them to move to new environments and spread farther while making existing ecosystems more vulnerable.



Japanese Knotweed

## Some solutions...

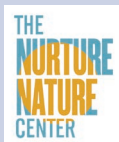
Share information with the public about why invasive species are dangerous to the environment, health and agriculture of an area. Early detection by communities, before invasive species begin to grow exponentially, can save time and money and help the community develop a plan to eliminate or control the population. For example, every year in March and June, USGS researchers in central Florida sample freshwater bodies for non-native fish. Homeowners can watch for invasive species like the Spotted Lanternfly and Japanese Knotweed and report sightings to local authorities (the Pennsylvania Department of Agriculture - for the Spotted Lanternfly. People can even dial 1-888-4BADFLY to report sightings of the bug outside the official quarantine zone.) For invasive plants such as Japanese Knotweed, smothering - blocking the plants from getting sunlight - or digging out the roots can be vital in controlling their population. This can be a tedious process, as Japanese Knotweed is very resistant, and will require persistent efforts. Mowing knotweed is **not** an effective means of culling as it helps spread seeds.

## Local examples...

**City of Easton-** after spotting Japanese Knotweed on the riverbanks of Hugh

Moore park in 2012, City employees realized it needed to be eradicated due to the threat to local plant life. Although herbicides were originally used, Nurture Nature Center hosted a forum to explore non-chemical methods to invasive species. One of these methods was use of goats, which the City of Easton ultimately used to help control the spread of knotweed. In the Easton area, the goal was to avoid use of herbicides on knotweed and other invasives, instead relying on alternative methods.

**Northeast Pennsylvania-** with the exponential growth of the Spotted Lanternfly, an invasive insect native to East Asia first discovered in Berks County, PA in 2014, research has been ongoing to find the most effective way of stopping their spread. Focus has been on two native fungi (*Batkoa major* and *Beauveria bassiana*) which can be lethal to the Lanternfly. The Pennsylvania Department of Agriculture updated its Order of Quarantine and Treatment policies in 2018 to help better prevent the spread to new areas out of the quarantine zone. Residents should check camping equipment, outdoor household items and child toys for lanternfly egg masses; and businesses need a Spotted Lanternfly permit to move products in and out of quarantine zones.



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# RIVERINE FLOODING

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## *The hazard...*

Riverine flooding occurs when a river overflows its banks because of excess water flowing down the river. Causes include: high-intensity rainfall from tropical systems; persistent, heavy precipitation events; and rapid snow-melt and ice dams. Flooding along larger rivers, such as the Delaware, usually can be forecast a day or more in advance, and will cause a rise and peak that will last for a number of hours before receding.



Flooding at the confluence of the Lehigh and Delaware Rivers in 2006.  
Photo courtesy of Frank Chisesi

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*In the event of a flood, community members should listen to evacuation orders and never drive into a flooded roadway.*

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## *The impacts...*

The Lehigh Valley has experienced the environmental and economic impacts of flooding, including property damage and loss, streambank erosion, disruption to businesses and households and temporary loss of electricity and running water. The highest recorded flood was in 1955 but recent floods in 2004, 2005 and 2006 brought much damage and loss. Climate change is expected to increase the frequency of heavy precipitation events in the region, leading to a higher risk of flooding. Human development can exacerbate flooding impacts by increasing impervious surfaces.

## Some solutions...

Flood control solutions include environmental, physical, and planning and communication approaches.

Natural flood control involves allowing rivers to flow naturally rather than try to control them with channels, dams, walls or levees. Restricting building and development in the floodplain, and maintaining vegetation and riparian buffers, prevents erosion and helps absorb water, preventing property damage and lessening flooding downstream.

Physical solutions, such as levees and floodwalls, are used in some locations to redirect floodwaters from highly vulnerable areas and to redirect the flow of floodwater.

Municipal and regional planning can identify high-risk areas and local governments can work to ensure riparian buffer zones are protected and maintained. The adoption of strong local floodplain regulations and ordinances can ensure that floodplains are used safely and that future development is discouraged in high-risk areas.

Communicating risk and impacts to communities is critical – before, during and after flood events. Residents can help by following weather forecasts, preparing for flooding and responding to orders for evacuation, and signing up for warning systems.

## Local examples...

Locally, efforts to respond to flooding have included planning and ordinance revisions, environmental projects and household planning.

In **Williams Township**, homes heavily affected by flooding on the Delaware in 2004, 2005 and 2006 elevated their structures to reduce future impacts.

The **City of Easton Fire Department** is developing an education and communication program for floodplain properties. This program is working with **Lafayette College** to map properties in the floodplain, and the City has adopted a new notification platform that can send targeted messages to floodplain property owners during emergency times. Additionally, the city is developing an ongoing education program to build flood risk awareness in between flood events.

An update to the **Lehigh Valley Hazard Mitigation Plan** identified flooding as a priority hazard. Municipalities, including the Borough of Bangor, Lower Mt. Bethel Township and others report that they strengthened ordinances to require stricter flood protections for properties.



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# EXTREME TEMPERATURES

**WARNING**  
**DANGEROUS**  
**HEAT/COLD**

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## *The hazard...*

Extreme cold temperatures are temperatures at or below freezing for an extended time period. Extreme hot temperatures are considered temperatures 10 degrees or more above average that last for several days or weeks. Heat waves can occur when extreme heat persists for several days with temperatures above 90 degrees and high humidity. It can occur quickly and without warning. Urban areas with minimal vegetation frequently experience a condition called "heat island effect" where the prevalence of concrete and asphalt contributes to temperatures higher than surrounding vegetated areas.

## *The impacts...*

Both extreme heat and cold can result in serious illness or injury due to rapid increase or decrease in body temperature when one is unprepared and exposed to extreme temperature. **Heat-related illnesses are a leading cause of death from natural weather-related hazards.** The human body has to work extra hard to maintain normal temperature which can lead to heat exhaustion and even death. Extreme cold can cause hypothermia, a life-threatening condition, when exposure to the cold leads to an abnormally low body temperature. Children, the elderly, and sick individuals are at a higher risk.



## The solutions...

Communities can provide warming or cooling centers for those without access to air conditioning or heating. In cities, the urban heat island effect can be mitigated with green roofs (buildings with a layer of vegetation on the roof), cool roofs (made of materials that reflect sunlight instead of absorbing it), and cool pavements (similar to cool roofs and are not as hot as regular pavement). Growing more trees and vegetation in urban areas also provides shade and cooling, lowering the air and surface temperature. Individuals should be sure to recognize signs of heat illness, drink lots of water, seek shade, and wear light clothing during heat events.

For extreme cold, it is important for homes to have their pipes insulated to prevent the pipes from bursting during freezing weather. Families should also think about having a weather preparedness kit, including things like food (that does not need electricity to cook), water, warm clothing, flashlights or candles, and more to help prepare you for cold days or a power outage.



## Local examples...

**Easton, PA** - when temperatures soared into the upper 90's in July 2019 and the heat index was close to 110 degrees, the city opened up six cooling centers during the hottest hours of the day, extended the hours of its two public pools and opened up eight fire hydrants in key neighborhoods to provide the opportunity for residents to cool themselves at critical times.

**Wilson Borough, PA** - a Shade Tree Commission was formed to promote healthy trees on public lands and right-of-ways. Among its other benefits, trees can block the sun from heating up roofs and windows, cooling areas by nearly 9° to 36°F compared to unshaded surfaces. In 2018, volunteers in Wilson Borough planted 100 street trees.

**Bangor, PA** - in January of 2019, a winter combination of wind, snow and extreme cold led to a chill factor of 15° below zero. Recognizing the potential danger to students who may be exposed on their way to school, Bangor Area School District cancelled school and kept its close to 3,000 students safe and warm at home.



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# FLASH FLOODING

*The increased occurrence of heavy precipitation events associated with climate change raises the risk of flash flooding*

**TURN  
AROUND  
DON'T  
DROWN**

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## *The hazard...*

Flash flooding is the rapid flooding (in less than six hours) of low-lying areas, such as streams, washes, rivers, dry lakes, and depressions, usually caused by heavy rainfall, hurricanes, tropical thunderstorms, or meltwater from snow and ice. Climate change contributes to the hazard, as it has increased the occurrence of heavy precipitation events, which raises the risk of flash flooding in the Northeast region.

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*Communities can work together to create open spaces to restore and maintain buffers to limit the overall effect of flooding along streambanks.*

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## *The impacts...*

Flash flooding in the Lehigh Valley generally occurs on smaller tributaries and in some urban environments without adequate stormwater infrastructure. Flooding can damage properties, disrupt transportation, and even lead to loss of life. Attempting to drive through flooded roadways is especially dangerous.



It is NEVER safe to drive or walk into flood waters. More than half of all flood-related drownings occur when a vehicle is driven into hazardous flood water.

## *The solutions...*

There are several mitigation strategies that individuals and communities can take to lessen the impacts of flash flooding:

### **Don't Wait, Elevate!**

If homeowners live in high flood risk area, they should elevate their furnace, water heater, and electrical panels as soon as possible. For more see:

▶ [https://www.fema.gov/media-library-data/14041503061227-fa382623802512d66e4835281547fd0/FEMA\\_P312\\_Chap\\_9.pdf](https://www.fema.gov/media-library-data/14041503061227-fa382623802512d66e4835281547fd0/FEMA_P312_Chap_9.pdf)

### **Be Tougher and Build a Buffer!**

Riparian buffers are the natural vegetation that grows along rivers and creeks. The vegetation and soils in riparian buffers reduce flooding impacts by increasing storage and infiltration of flood waters and slowing floodwater velocities, protecting riverfront and streamside properties from maximum flood damage. Communities can work together to create open spaces to restore and maintain buffers to limit the overall effect of flooding along stream banks. For more see:

▶ <https://www.chescoplanning.org/MuniCorner/Tools/RiparianBuff.cf>

▶ <https://www.brandywine.org/sites/default/files/media/BrandywineConservancy-RiparianBufferGuide.pdf>

## *Local examples...*

### **Coffeetown, Williams Township:**

Heavy rainfall events along the small waterway of the Fry's Run have caused dangerous flash flooding, damaging homes in this small village and causing streambanks to collapse. In 2014-15, local and state organizations, along with watershed volunteers, stabilized the streambanks with heavy log structures and planted the banks with 190 trees and shrubs. The newly graded banks and structures slow and direct the flow of water away from the banks and help to protect it from further erosion.

### **Lower Mount Bethel Township:**

When Hurricane Ivan (2004) caused severe erosion along Little Martin's Creek, local and state agencies implemented a plan to stabilize then restore the streambank with a more tapered profile that would allow flood waters to spread and slow through the area. The area was then planted with deep-rooted trees to help contain the soil and buffer the creek.



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# RADON

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## *The hazard...*

Radon is a naturally occurring radioactive, odorless, colorless gas that is a decay product of radium, which is a decay product of uranium. Radon is present at low concentration in the environment, but high levels can cause lung cancer. Certain underlying rock layers have more radon than others and a radon potential map can identify areas of highest risk. The maximum amount of radon a home can have is 4 pCi/L.

## *The impacts...*

In Pennsylvania, the Reading Prong is an area where radon levels are extremely high. Radon affects the Lehigh Valley due to this geology, resulting in high levels in some homes. In addition, many homes are unaware of the dangerous levels of radon present. In the past, high levels of radon have been found in the Paxinos Ridge area where about 16 homes had high and dangerous levels of radon. Some had level 10 radon exposure, which is the equivalent of smoking 100 packs of cigarettes a day.

## *Some solutions...*

The best way to prevent radon exposure is to first know the level of exposure. Families can purchase a radon test kit that is placed in the basement or crawl space for a period of time and determines the level of radon. Individuals can also install a system of pipes and vent fans to avoid additional radon and draw radon out from the home. These vent pipes and fans are “sub-slab depressurization” systems and do not require much change to living conditions. They cost from \$1,000 to \$4,000, but are the most effective. For more, see:

▶ [https://www.epa.gov/sites/production/files/201602/documents/2013\\_consumers\\_guide\\_to\\_radon\\_reduction.pdf](https://www.epa.gov/sites/production/files/201602/documents/2013_consumers_guide_to_radon_reduction.pdf)

## *Local examples...*

**Easton, PA** - after high levels of radon were found along the ridge in Easton and Forks Township, a Palmer Township resident ventilated a crawl space to drop radon levels from 0.5 to 0.002.

**Center Valley, PA** - after a house in Center Valley had a radon level of 6,176 pCi/L, the township gave 500 nearby residents letters to get their homes tested. This prevented further homes from experiencing dangerous levels of radon. In addition, many homeowners in the area installed mitigation systems. The mitigation systems were effective and permanent, as the geology of the area will always have high levels of radon.



# SINKHOLES/SUBSIDENCE

## *The hazard...*

A sinkhole is a subsidence feature resulting from the downward movement of surface material into a subsurface void. Sinkholes come in many shapes and sizes, and although caused by naturally occurring processes such as dissolution of limestone, their formation can be accelerated by human activities, such as by pumpage and drainage of groundwater.

## *The impacts...*

Depending on where they occur, sinkholes can cause devastating property damage, or roads to collapse. They can be large and they can recur - one sinkhole in Florida, measuring 17 feet wide and 20 feet deep, had occurred in the same location two years prior, swallowing a house and killing the man who lived there.

## *Some solutions...*

Individuals can invest in sinkhole insurance if they live in sinkhole-prone areas. In Pennsylvania, property owners are responsible for sinkhole damage on their property, even if the issue was not caused by the owner. Many residents have no idea that they live in sinkhole-prone areas, and education can help teach community

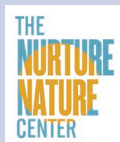
members what to look for before a sinkhole occurs. Public education sessions can teach citizens what to do in case they suspect a potential sinkhole, or if an actual sinkhole happens. Municipalities should do regulatory inspections of existing utility lines to ensure that they are not a risk for sinkholes.

▶ <https://www.heliconusa.com/sinkhole-warning-signs/>

## *Local examples...*

**Easton, PA** - following a sinkhole incident on South Side, Easton Suburban Water Authority worked to upgrade the south Easton water mains to ensure no further danger to the public as of spring 2020.

**Bethlehem, PA** - while standard homeowners' insurance policy excludes coverage for damage resulting from sinkholes, water and sewer main breaks, and sewer backups, the City of Bethlehem has committed that if its negligence is a cause, it will cover homeowners' expenses.



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