Ensuring Safe Drinking Water, Protecting and Restoring the Health of Waterways, and Reducing Flooding in Pennsylvania

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Problems and Solutions

Problems

Flooding and water pollution are two of the most significant problems facing Pennsylvania. Addressing them is a top priority because they:

- **Take a massive economic and environmental toll on Pennsylvania.** Flooding damages property, infrastructure, and landscapes; water pollution destroys wildlife and limits opportunities for outdoor recreation.
- **Put people in danger.** Floods and polluted water pose major threats to public health.
- **Affect nearly all communities.** Flooding and water pollution impact communities across Pennsylvania—rural and urban, large and small, rich and poor.
- **Will only get worse.** As more open space is replaced by impermeable surfaces and extreme storms become more common, flooding and water pollution will become even bigger problems.
- **Can be addressed effectively.** Proven, cost-effective strategies to reduce flooding and water pollution already exist—there is no need to wait for new technology or further study (as is the case with some other challenges).

Below is more detail about the numerous negative consequences of flooding and water pollution.

Flooding

Flooding in Pennsylvania inflicts billions of dollars of damage, endangers people, and decimates communities. Many municipalities have inadequate stormwater infrastructure that cannot handle the water load of extreme storms, causing sewer backup and basement flooding. Many also lack the means to mitigate flooding from rising waterways, putting their residents at risk of catastrophic floods when rivers jump their banks or dams fail.

Economic Cost

Floods destroy valuable private property like homes, offices, and cars, as well as crucial public infrastructure like roads and bridges. Just one inch of flooding can cause $27,000 in damages to a home; altogether, flood damage costs Pennsylvania residents and local governments billions of dollars each year. Flooding forces taxpayers to spend their hard-earned money rebuilding their lives instead of on daily necessities, and forces local governments to dip into already-tight budgets to repair roads and bridges.

Public-Health Cost

Flooding can kill people—in fact, Pennsylvania ranks second in the nation in flood deaths since 1959, with more than 250 fatalities (that doesn't even include the Johnstown Flood of 1889, which killed over 2,000 people). More commonly, floodwater—which is often contaminated by sewage and other toxic substances, and can hide sharp objects like metal and glass—causes a variety of illnesses and injuries. Standing water increases the chance of contracting mosquito-borne viruses like West Nile. Mold left behind after the water recedes can cause severe lung damage. And when large groups of people take shelter together in spaces with inadequate hygiene, germs can spread rapidly.

Social Cost

When floodwaters destroy a beloved community landmark or a person's cherished collection of family photos, something more than dollars and cents is lost. That loss—as well as the stress of financial hardship or medical issues caused by floods—can be emotionally devastating to individuals and communities, especially those that are already facing poverty, opioid addiction, or other challenges that make hope and opportunity seem out of reach.

Water Pollution

Over 24,000 miles of Pennsylvania's rivers and streams are too polluted to support aquatic life or are unsafe for fishing, swimming, or drinking. A major source of this pollution is stormwater runoff from developed areas, which carries trash, bacteria, and chemicals into waterways. Runoff from farms—carrying pesticides, herbicides, and livestock waste—is also a major source.

Economic Cost

Outdoor recreation is one of Pennsylvania's major industries, supporting [251,000 jobs and generating $29 billion] in annual consumer spending. But polluted water currently makes fishing, boating, and swimming impossible in over 7,000 miles of rivers and streams—which constitutes 40% of the 18,000 miles assessed for recreational use. This hurts Pennsylvania's economy, especially rural communities trying to remake themselves as outdoor-recreation destinations after the decline of traditional industries. If the water is too polluted to enjoy safely, anglers, boaters, and paddlers won't spend money in these communities.

And because a majority of Pennsylvanians drink treated surface water, pollution increases water treatment costs for municipalities. Money that could be invested in schools, roads, and other important services must instead be used to remove the toxins from people's drinking water. Polluted waterways can also reduce the property values of nearby homes—after all, who wants to live next to a lake covered by toxic algal blooms or a stream full of dead fish?

Public-Health Cost

Clean, safe drinking water is a basic human need. In the U.S., contaminated drinking water in public water systems has caused a variety of health problems, including gastrointestinal illness, reproductive issues, and neurological disorders. Many communities in Pennsylvania depend on surface-water sources for their drinking water; pollution can make this water unsafe, putting people in danger.

Water pollution also makes eating fish unsafe. In Pennsylvania, 25% of waterways assessed for fish consumption are so polluted that it is unsafe to eat any fish from them; even in non-impaired waterways, DEP recommends eating no more than one fish per week because mercury and PCBs are still present in trace amounts.

Environmental Cost

Water pollution decimates populations of fish, amphibians, and other wildlife that need clean rivers and streams to survive; nearly 10,000 miles of Pennsylvania's rivers and streams are impaired for aquatic life. The impacts also extend downstream: water pollution in Pennsylvania is substantially responsible for declining oyster, crab, and fish populations in the Chesapeake Bay.

Solutions

There are tools and strategies that have a long track record of effectively reducing flooding and water pollution. Three of the most effective are green infrastructure, land conservation, and implementing best management practices (BMPs) on farms. Treating drainage from abandoned mines is another solution, focused primarily on reducing water pollution.

Green Infrastructure

The term *green infrastructure* refers to features that reduce flooding and water pollution by absorbing and filtering stormwater into the ground, unlike conventional stormwater-management tools such as storm drains and pipes that carry polluted runoff into waterways (known as *grey infrastructure*). Green infrastructure is especially effective—and necessary—in built environments, where runoff would otherwise flow unimpeded over impervious surfaces like streets and parking lots, contributing to flooding and water pollution.

Green infrastructure features can be included in the design of new projects or incorporated into existing streetscapes and landscapes. Often, green infrastructure features make cities and neighborhoods more colorful and interesting. They can also provide excellent educational opportunities for local students, who can learn firsthand about water, soil, and wildlife without having to travel to a faraway nature center.

Green Infrastructure Tools

Follow links to learn more detailed information about each tool.

- **Constructed wetlands**. Marsh systems planted with vegetation designed to treat stormwater runoff.
- **Filter strips**. Strips of vegetation between paved areas that intercept and absorb stormwater.
- **Green roofs**. Roofs covered with a system of contained vegetation, waterproofing, and drainage designed to reduce the amount of stormwater entering gutters.
- **Infiltration basins**. Basins with capacity to store excess water during storms, then filter it back into the ground through plants and soils.
- **Infiltration berms**. Mounds of compacted earth that can stop or redirect runoff and absorb stormwater.
- **Infiltration trenches** and **beds**. Linear ditches or beds that collect runoff, often from roadsides or parking lots, and absorb it into highly porous soil.
- **Porous pavement**. Pavement that allows stormwater to soak through it and into the ground rather than flowing across the surface and into sewers.
- **Rain barrels/cisterns**. Basins that capture stormwater before it reaches the ground, allowing it to be used later for things like watering lawns or washing cars.
- **Rain gardens**. Areas with native plants that absorb and filter stormwater but can also thrive in dry weather.

- **Riparian buffers**. Vegetation planted along waterways that absorbs runoff and filters pollutants before they can enter the water.
- **Urban trees**. Besides benefits like shade and aesthetics, trees absorb and filter stormwater.
- **Vegetated swales**. Channels planted with trees, shrubs, or grasses that slow runoff and help absorb it into the ground; similar to rain gardens, but often larger and designed to manage runoff from a specific impermeable area like a parking lot.

Green vs. Grey Infrastructure

There are a few key reasons why it makes sense to pursue green infrastructure tools as solutions to flooding and water pollution instead of (or in conjunction with) grey infrastructure:

Green infrastructure reduces water pollution and flooding simultaneously. Green infrastructure kills two birds with one stone. It protects water quality by absorbing stormwater into the ground, keeping polluted runoff from flowing into waterways. This also reduces flooding—rivers with lower water volumes are less likely to jump their banks or cause dams to fail. Grey infrastructure, on the other hand, doesn't reduce water pollution or the volume of water entering rivers and streams—in fact, it does the exact opposite, carrying runoff directly into waterways, worsening both pollution and downstream flooding.

While grey infrastructure does address localized flooding, it isn't very effective—the grey infrastructure systems of many municipalities are outdated and cannot handle the water load of severe or extended storms, resulting in standing water in streets and flooding in basements. Green infrastructure does a better job of mitigating localized flooding because it can absorb larger volumes of water and doesn't rely on drains and pipes, which can clog, back up, and break.

Philadelphia's stormwater-management plan, which invests heavily in green infrastructure approaches instead of grey infrastructure, is projected to reduce the stormwater pollution entering waterways by 85% over the next 20 years. Since the plan was introduced in 2011, green infrastructure is already keeping 1.5 billion gallons of runoff out of Pennsylvania's waterways each year.

Green infrastructure is more cost effective. Green infrastructure is often cheaper to build, operate, and maintain—and has a longer lifespan—than grey infrastructure. This is because green infrastructure typically involves simpler construction and maintenance methods (aboveground vs. underground) and cheaper materials (plants and soils vs. pipes and pumping systems), and because natural features are more resilient over time.

There are numerous examples from Pennsylvania and across the U.S. that demonstrate this:

- An EPA study of Lancaster's stormwater system found that green infrastructure would save up to $190 million over 25 years compared to grey infrastructure (green infrastructure investment would cost $94.5 million. Grey infrastructure would $120 million to build and $661,000 per year to operate).
- Philadelphia's *Green City, Clean Waters* plan, created to guide the city's stormwater-management in the coming decades, estimates that a green infrastructure–based approach would cost $2.4 billion over 25 years, while grey infrastructure would cost $8 billion—a savings of over $5.5 billion.
- A Trust for Public land study found that parks and green spaces in Philadelphia save the city $5.9 million annually in water-treatment costs.
- The *New York City Green Infrastructure Plan* estimates that a green infrastructure–based stormwater strategy will be $1.5 billion cheaper than a grey infrastructure strategy over the next 20 years.
- An American Society of Landscape Architects study found that, out of nearly 500 stormwater projects nationwide, green infrastructure reduced project costs in 44% of projects and did not influence costs in 30%.
- Grass swales cost between $6.50 and $20 per foot, while traditional conveyance systems (curb and gutter with storm-drain inlet and pipe) cost $40-50 per foot, according to a study by the Conservation Research Institute.
- A study of Milwaukee's green infrastructure found that most green infrastructure is far cheaper than grey infrastructure when measured by cost per gallon of water removed (e.g., $0.06 for constructed wetlands compared to $2.42 for stormwater pipe).

And even when capital costs for green infrastructure are higher than for grey infrastructure, the added benefits of green infrastructure—including wildlife habitat, higher property values, cleaner air, educational opportunities—often make it a more cost-effective solution.

Green infrastructure is more flexible. Green infrastructure tools can be adapted for a wide variety of locations, circumstances, budgets, and projects. Compared to grey infrastructure systems, which rely on a limited set of materials and strategies to manage stormwater, the green infrastructure toolbox is relatively large and flexible. Communities can choose different green infrastructure solutions based on local needs, conditions, and capabilities.

Incorporating green infrastructure features into already-built environments can also be easier and less disruptive than grey infrastructure—just imagine the process of building an aboveground rain garden alongside a street versus installing an underground stormwater pipe and drain system on the same street.

Land Conservation

Clean water is one of the many benefits of land conservation. Protecting a piece of open space from development prevents water pollution on that property, which improves water quality in the immediate landscape as well as downstream. Improved water quality results in a host of economic and environmental benefits even hundreds of miles away. Some examples:

- A report from The Nature Conservancy found that for every 10% increase in forest cover in a source-water area, water-treatment costs in that area decrease by 20%.
- The city of Auburn, Maine saved $30 million in capital costs and an additional $750,000 in annual water-treatment costs by spending $570,000 to protect land in its watershed.
- According to the *Outdoor Recreation Economy Report*, water sports like fishing and paddling—which depend on clean water—generate $29 billion in annual consumer spending across the U.S.
- Research on the Land and Water Conservation Fund found that 131,000 acres of land conserved with LWCF funds provide $2 billion in water-quality protection, flood prevention, habitat improvement, and other ecosystem services.

Protecting open space also reduces flood risk: forests, meadows, and other natural areas absorb and filter a significantly higher percentage of stormwater into the ground, keeping it from flowing into waterways. According to one study, less than 5% of rain falling on forests is converted to runoff, compared to 95% for impermeable surfaces. By absorbing stormwater, conserved lands prevent floods downstream, potentially saving lives and averting millions of dollars in damage. For instance, a study in Vermont estimated that undeveloped open space along Otter Creek reduced flood damage in nearby Middlebury by 84–95% during Tropical Storm Irene and by 54–78% across nine other flood events. The study also estimated that the annual value of flood mitigation services is as high as $450,000 each year.

Agricultural BMPs

Runoff from farms carries chemical fertilizers, pesticides, and livestock waste into waterways, killing wildlife and making waterways unsafe for fishing, paddling, and swimming. Implementing best management practices (BMPs) on farms can drastically reduce this water pollution. While the primary goal of agricultural BMPs is protecting water quality, many BMPs—particularly forested buffers, conservation tillage, cover cropping, and erosion control—also help mitigate flooding downstream by absorbing more stormwater into the soil, reducing the volume of runoff flowing into waterways.

BMPs

- **Riparian buffers**. Vegetated buffers that capture pollutants that might otherwise flow into waterways and reduce flooding downstream.
- **Streambank fencing**. Fences to keep livestock out of streams, preventing their waste from polluting the water while also reducing streambank erosion.
- **Cover cropping**. Fields planted in crops all year; cover-cropped fields filter pollutants, stabilize the soil, and absorb 70% more water than fallow fields.
- **Nutrient management**. Avoiding using excess amounts of fertilizer and spilling fertilizer during transport and application, which prevents it from flowing into waterways during storms.
- **Conservation tillage**. Leaving crop residue on the soil surface; this preserves organic matter in the soil, reducing erosion and allowing the ground to absorb more stormwater.
- **Pest management**. Pest-management strategies (such as habitat manipulation and resistant crop varieties) that require fewer chemical pesticides and minimize spillage and overspray, resulting in fewer pollutants entering waterways.
- **Irrigation management**. Improving the efficiency of irrigation systems to reduce the amount of excess water running off fields and into waterways.
- **Animal feeding operations management**. Runoff controls and proper waste storage that minimize the impacts of animal feeding operations.
- **Erosion and sediment control**. Stabilizing soil with vegetation or physical structures to reduce the amount of sediment flowing into waterways; sediment chokes biodiversity and clogs waterways, making floods more likely.

Treating Abandoned Mine Drainage

The drainage flowing—sometimes gushing—from abandoned underground coal mines (abandoned mine drainage, or AMD) pollutes thousands of miles of Pennsylvania's waterways with toxic chemicals that can harm humans, animals, and plants. There are a variety of passive and active systems that can effectively treat AMD, turning miles of waterways from brown to clear and restoring wildlife populations and recreational opportunities. There are numerous successful AMD treatment projects Pennsylvania. Examples include:

- **Montour Run**. Two systems combine to remove 23,000 pounds of acid, aluminum, and iron from the water each year.
- **Blue Valley**. Facility treats a discharge flowing at 500 gallons per minute and the treated water is used to raise 6,000 rainbow trout each year (with a 99.9% survival rate).
- **Wingfield Pines**. System treats 1,200 gallons per minute, filtering 43 tons of iron oxide each year, and also includes environmental education stations.

- **Catawissa Creek**. System treats 12 million gallons of water each year and has restored 34 miles of the creek.

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