

# When it rains, it pours—the effects of stormwater runoff

April 4 2018, by Neil Stalter

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Finger Lakes region of New York. Credit: Neil Stalter

The lovely smell that follows a spring rain as you sit on your porch and

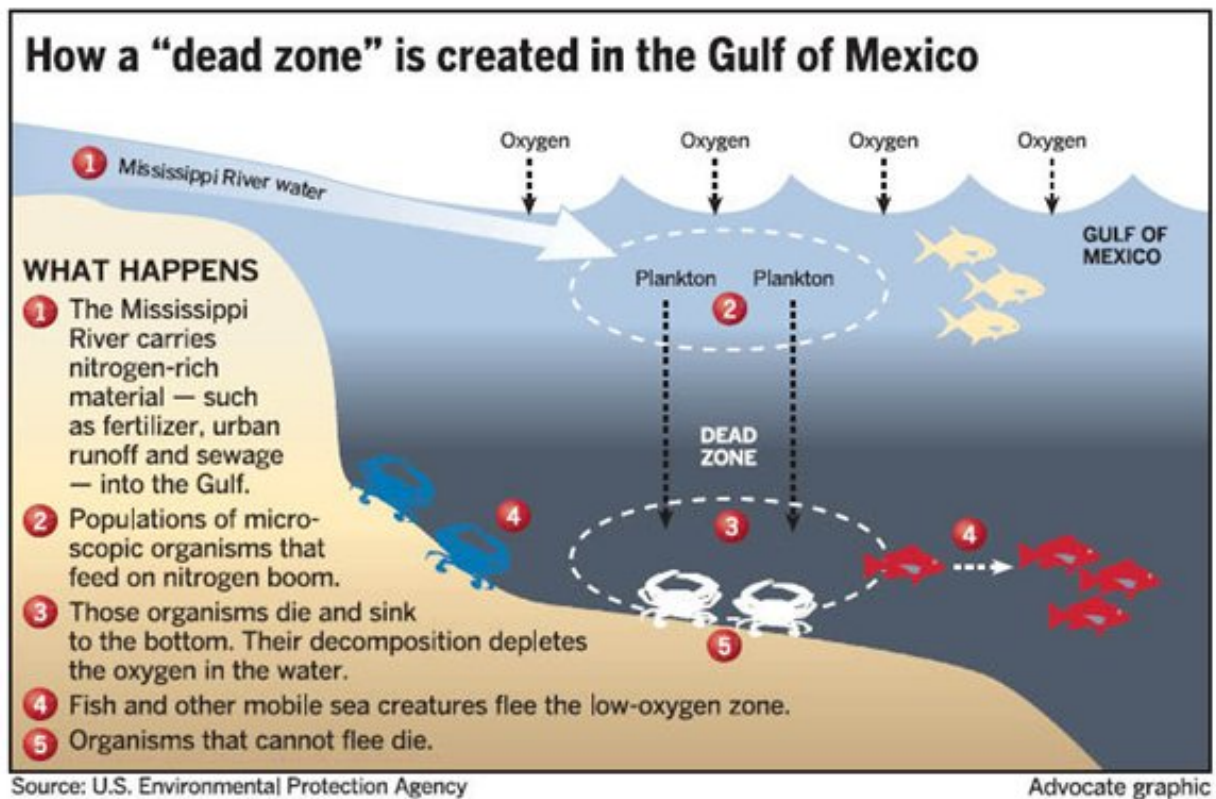
enjoy the sound of drips pattering on the lawn is so loved that it has earned the distinct honor of its own word: "petrichor." Somewhat less romantic is the source of the smell: a mix of plant oil and bacterial by-product. Despite that, when I was young, living in Conesus, New York, I learned to love rainy days. There is something especially relaxing about being inside while the sky outside is unleashing millions of gallons of water onto the earth.

But [rain](#) is also synonymous with sadness and difficulty; for good reason. Rain, in all of its forms, causes billions of dollars in damage in the US every year. And every time it rains, all of those millions of gallons of [water](#) that tumble onto the ground need to go somewhere—and not all of it soaks into the soil below our feet. All that water that rolls off of your roof, through your yard, and over the street is called stormwater runoff. This runoff is incredibly good at picking up whatever it comes into contact with as it travels downward to the lowest elevation. Dirt, [nutrients](#), trash; storm water does not discriminate. By some twist of fate, the nutrients that it picks up as it travels actually cause significant damage to the surrounding ecosystem.

I spent much of my life growing up in the Finger Lakes region of New York, where beautiful bodies of water are home to thousands of species and allow for all sorts of recreation— boating, swimming, fishing, you name it. But whenever it rained the stormwater would flow over farms and pick up manure and fertilizer as it traveled down to the lakes. These nutrients would then feed seaweed and phytoplankton living in the lake that make swimming and recreating much less enjoyable. The growth of this plant life due to runoff not only damages the picturesque quality of the lake, but also boxes out other important native species from growing in a healthy way. This phenomenon is called eutrophication.

## Creating a Dead Zone

When rain falls onto the ground, it can do one of two things: flow into the ground and become groundwater, or flow on top of the ground and become runoff. As water flows into the ground, the soil acts as a "filter," catching and holding onto most anything that the [rain water](#) brought with it. Trees and other plant-life also capture the nutrients that the water brings along. However, when water has no way to enter the ground, like when it falls onto a parking lot, it will keep travelling above ground until it hits the nearest river, lake, or sea. Since this water had no opportunity to deposit whatever it grabbed along the way, it deposits that matter into the water body, where it can begin to have [negative effects](#) on the ecosystem.



Aquatic dead zones. Credit: US EPA

Somewhat diabolically, some of the organisms that most benefit from this are invasive species that are already hurting the ecosystem. As these species feed on the nutrients brought to them by storm water, they continue to outcompete other species, thus aggravating the negative effects they have on food chains. As phytoplankton and plants bloom and grow from the runoff nutrients, it would be natural to think that they would at least contribute oxygen to the surrounding water, encouraging the existence of other non-photosynthetic species. Somewhat ironically, the opposite is often true. As more of this plant matter grows, more dies and sinks to the bottom of the water body. Bacteria waiting at the bottom then feed on this dead matter while using oxygen and creating more carbon dioxide. This creates what is widely known as a hypoxic, or "dead" zone. This oxygen-free zone pushes species of fish and other mobile species out, creating an area that is almost unusable in any commercial or recreational way.

As the water goes from a beautiful blue swimming hole to a green swampy mess, fewer people will want to use it for swimming or fishing, or even for just looking at. Quickly, money from tourism and recreation will dry up and leave these areas with a green water body that is doing nothing but hosting extensive plant life. Endangered native species will either begin the painful road toward extinction or move on to a different, more hospitable area. In fact, due in part to the growth of this phenomenon, more than 20 percent of the 10,000 known freshwater fish species have either gone extinct or become endangered in the past few decades. All of this to say, eutrophication is bad for the health of aquatic ecosystems, as well as the economic health of the communities that are built around them.

## **What is Contributing to the Problem?**

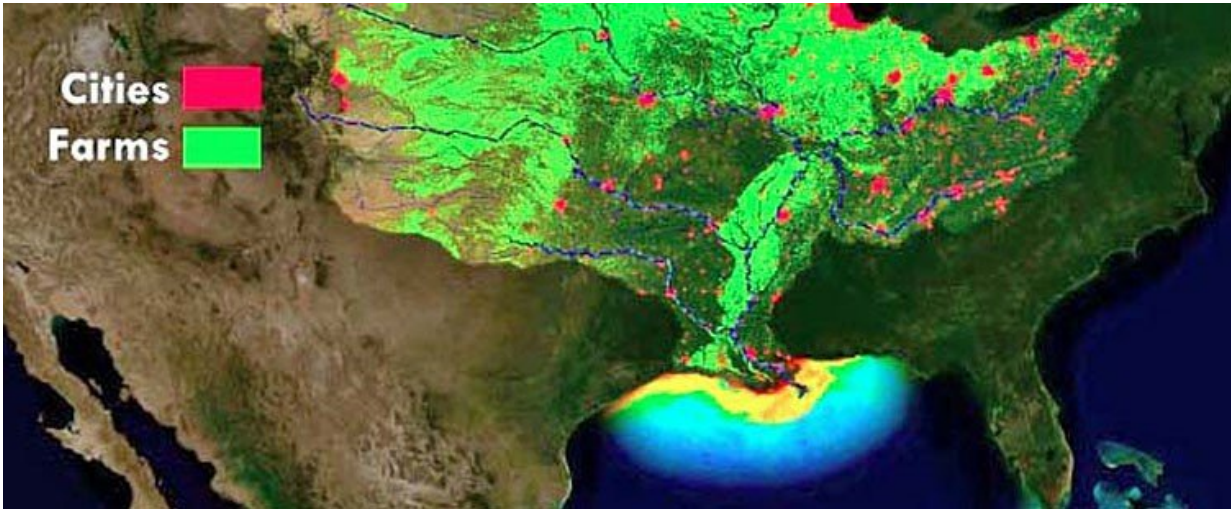
The first thing we need to do to address the problem of nutrient-rich stormwater runoff is finding out what exactly is causing it. First and

foremost, where are the nutrients coming from? Certainly there is some floating around the environment for water to pick up on its long journey to the sea. However, the major source of these nutrients, as well as other chemicals like pesticides, are lawns and farms. Water captures the fertilizer that residents put on their lawns and gardens, as well as the pesticides that people apply to the plants that reside in those gardens. Farms also use massive amounts of fertilizer, and animals that are raised on these farms create manure that also contributes to this pollution.

Urban infrastructure can also contribute to the problem in a major way. Remember how soil and trees can filter out some of these nutrients and pollutants on their way down stream? Unfortunately, our roads, buildings, and all sorts of other things humans build prevent much of that storm water from entering the soil at all. When water reaches the pavement, carrying everything it caught along the way, it will either run over it and reach a water body, or enter our sewer infrastructure and eventually be diverted via pipe into our rivers and lakes. In incredibly large storms, this can even overwhelm the sewer infrastructure and send raw sewage into our freshwater bodies. This is known as a combined sewage overflow, and is unfortunately common in many cities like New York. It continues to have a negative effect on the Gowanus Canal, a relatively famous Superfund site. Illegal plumbing connections in your home can be contributing to this problem, too, without you realizing, and could end up costing you \$300 a day in fines once discovered. Having plumbing inspected regularly to ensure compliance can prevent this and go a long way to protect the environment. But even apart from combined sewer overflow, human infrastructure can contribute to a 25 percent increase in the volume of stormwater runoff.

## **What Can We Do?**





Pollution from nutrient-rich stormwater runoff. Credit: Maria Willhoit/Population Education

Thankfully, [stormwater runoff](#) is a problem that scientists have been researching and deciphering for decades, and engineers and city planners have created exciting new initiatives and strategies for curbing some of the negative effects of storm water.

There are clear and easy steps that anyone with a yard or garden can take to help. The main way that both cities and homeowners can begin to address this problem is through the construction of rain gardens! It seems simple, but it really works. Rain gardens can trap and use most or all of the water your yard captures from an average storm. An easy way to create a plan of attack is to look at your yard during and after your next big rain storm. See where in the yard a lot of water seems to flow and where the grass and soil is the wettest. This is a prime location for a rain garden. Then, you can hire someone or build a rain garden yourself and fill it with whatever plants you love. There are many different kinds of plants that work, but I personally suggest the addition of mushrooms

because they are great at filtering out nutrients and waste from storm water, and can even be later picked and used for cooking. The King Stropharia mushroom (a.k.a. the garden giant) would be a great addition to a rain garden.

It can also help to limit or eliminate the use of fertilizers, pesticides, or manures in your lawns, farms, and gardens. In fact, by some measures, the average suburban lawn is sprayed with 10 times more pesticide per acre than farmland. So right off the bat, you can decrease the amount of pesticide and it will still have the same effect. There are also other eco-friendly options for fertilizer that will still help your lawn but contribute much less to the negative impact of eutrophication.

Rain is never going away, and neither is human infrastructure. But emerging technologies like permeable pavement, rain garden construction in urban centers, and public education can go a long way in protecting the beauty and health of the lakes, rivers, and oceans that so many people and animals call home. By working together to preserve plant life that filters [storm water](#) and taking steps in our everyday lives to slow runoff and instead use it for something beautiful like a rain garden, we can begin to tackle the problem of stormwater pollution together. As somebody who lived on a large lake for over 10 years, I know how important that lake is to me; I can only imagine how important it is for the fish who live in it. At times it can seem like these difficult problems are impossible to face, but by everyone taking small steps to help make a difference, we can make huge strides together.

*This story is republished courtesy of Earth Institute, Columbia University <http://blogs.ei.columbia.edu>.*

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Citation: When it rains, it pours—the effects of stormwater runoff (2018, April 4) retrieved 2

May 2024 from <https://phys.org/news/2018-04-poursthe-effects-stormwater-runoff.html>

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