Accidents Waiting to Happen

Toxic Threats to Our Rivers, Lakes, and Streams

FRONTIER GROUP
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Executive Summary

Clean water is essential to America's health and welfare. Our lakes, rivers, streams and creeks provide us with water to drink, give character to our most beautiful natural places, and give us places to fish and swim. Yet, across the country, thousands of miles of waterways are threatened by at least one of five major potential sources of contamination: coal ash pits, oil pipelines and trains, fracking wastewater pits, animal waste lagoons, and toxic chemical storage facilities.

The following analysis and review finds thousands of "accidents waiting to happen" across the country, including 31 toxic facilities in flood zones in New Jersey; 170 hog waste lagoons in flood zones in North Carolina; and at least 326 coal ash ponds at coal plants within a quarter-mile of a waterway. Many of these facilities could, in the event of a spill, devastate the environment and threaten human health.

To protect our waterways, policymakers must reduce our dependence on these inherently risky facilities and stop siting them near the water's edge.

Industrial sites use toxic chemicals that pose long-term threats to the health of humans and wildlife:

- Many industrial facilities use and store harmful chemicals that can damage waterways in the event of an accident. In 2016, more than 21,000 facilities nationwide reported managing 14 million tons of toxic waste – a number likely far lower than all non-waste toxic material stored and used in production processes.[1]
- Recent spills from a wide variety of industrial sites have threatened drinking water and damaged the environment:
    - In 2017, a storage facility spilled chemicals into a creek near Roanoke, Virginia, killing tens of thousands of fish.[2]
    - In 2017 a steel plant in Portage, Indiana, spilled chromium, a heavy metal, into Lake Michigan, causing a nearby community to shut off its drinking water intake.[3]
    - In March 2018, a spill of ferric chloride at a Georgia chicken processing plant killed more than 8,000 fish.[4]
- In New Jersey, which requires facilities to report on hazardous chemical storage, 31 industrial facilities with at least five toxic chemical storage units on site are located in a 100-year flood zone. Of those facilities, 16 are in the heavily populated Newark-Jersey City area across the Hudson River from New York City.

Oil is transported via train and pipeline routes along and across America's rivers.

- Millions of gallons of oil are transported daily across the country on America's 140,000 miles of freight railroads and through roughly 400,000 miles of long-distance pipelines, often alongside and across rivers and streams.[5]
- Oils spills frequently occur during transportation by rail and pipeline. Since 2000, 21 railway spills and 734 pipeline spills of crude oil over

1,000 gallons have been reported by the Pipeline and Hazardous Materials Safety Administration (PHMSA).[6]

- One rail oil route linking the Bakken shale fields of North Dakota with Chicago travels alongside the Mississippi River and through a 100-year flood zone for at least 154 miles. A train traveling this route was responsible for a 2015 spill that came close to contaminating the Mississippi River. And the Keystone Pipeline travels for 455 miles through flood zones on its route from North Dakota to Texas, while crossing 2,370 waterways.

Animal waste lagoons at factory farms threaten lakes and streams with pollution.

- In 2007, 2.2 billion livestock and poultry in the U.S. produced 1.1 billion tons of manure.[7] Most livestock in the U.S. are raised in concentrated animal feeding operations (CAFOs) where waste must be managed and stored.[8] A CAFO produces about 20,000 tons of waste per year on average, and a single farm with 2,500 dairy cows produces as much solid waste as a city of 411,000 people.[9]
- Lagoons frequently spill or overflow. In 2018, Hurricane Florence caused at least 32 hog waste lagoon overflows in North Carolina.[10] And a study published in 2000 found that, from 1995 to 1998 in just 10 surveyed states, there were more than 1,000 animal waste spills that killed 13 million fish.[11]
- In North Carolina alone, there are 170 hog waste lagoons within 100-year floodplains, and 136 within a half-mile of a public water well, according to an Environmental Working Group/Waterkeeper Alliance analysis of satellite imagery.[12]

Pits of toxic coal ash sit along America's major rivers and lakes.

- Large impoundments at coal-fired power plants store ash, a toxic byproduct of burning coal. As most coal-fired electric power plants are located next to bodies of water for cooling purposes, these coal ash pits are often located along rivers and lakes, sometimes separated from waterways by only a thin retaining wall.
- Coal ash pits frequently spill and leak.
    - In 2018, floodwaters from Hurricane Florence inundated a coal ash pond at the Sutton Plant in North Carolina, sending toxic ash waste into a nearby lake and the Cape Fear River.[13]
    - In 2008, a coal ash pit at the Kingston Plant in Tennessee spilled 5.4 million cubic yards of coal ash waste into the Emory and Clinch rivers.[14] Following the spill, sediment samples were devoid of life, and fish were found with elevated levels of toxic selenium and mercury.
    - An analysis of electric utility reporting by Earthjustice in December 2018 found evidence of harmful groundwater contamination in 22 states at 67 different coal plants.[15]
- In the U.S., 181 coal plants with on-site coal ash pits lie within a quarter-mile of freshwater or ocean, and 26 lie in a Federal Emergency Management Agency 100-year flood zone.[16] These 181 plants generate at least 50 million tons of coal ash each year.[17] They are also home to at least 326 coal ash pits, including 22 that were found to be in poor condition according to a 2014 U.S. Environmental Protection Agency (EPA) assessment.

Fracking waste pits store toxic and radioactive wastes.

- Fracking wastewater pits contain waste from hydraulic fracturing, a method of producing oil and gas. For each well, hydraulic fracturing can require pumping millions of gallons of fracking fluid – water often mixed with sand and hundreds of chemicals – underground. After the fracking process is complete, the fluid that flows back to the surface also contains additional toxic substances from underground, and is then often stored in uncovered pits that are prone to spills and leaks.

- Fracking wastewater pits frequently spill. A 2017 study in *Environmental Science & Technology* found approximately 400 wastewater pit spills in just four states between 2005 and 2014.[18]
- In Pennsylvania, among 254 fracking wastewater pits identified by SkyTruth in 2015, more than one in four – 69 in total – were located within a quarter-mile of a stream or river.

To protect our waterways, state and local governments should strictly regulate activities that involve the production, storage or use of large quantities of dangerous substances, and ensure that, to the extent those activities occur, they take place far from water. Policymakers should:

- Transition away from industrial operations that use or generate huge volumes of toxic or other waste that threatens our water and our health. For each type of "accident prone" operation profiled in this report, safer alternatives exist. For example, many manufacturers have reduced their use of toxic chemicals by switching to safer alternatives or making production less wasteful.
- As that transition is underway, ensure that facilities that use or store large quantities of toxic material are not permitted near our waterways. In particular, officials should keep areas near our rivers, lakes, streams and wetlands free from facilities that pose major pollution, and should work to close or relocate facilities currently sited by water.
- Strengthen and enforce regulations on the storage and handling of toxic materials at sites that cannot be relocated or closed.
- Reject any efforts to weaken existing federal clean water protections – including current measures to undermine modest rules for coal ash and severely limit the jurisdiction of the Clean Water Act.

At the Kingston Fossil Plant, Ash Pond C contained decades worth of toxic coal ash waste. When the coal ash pit's dike failed, more than 1 billion gallons of coal ash waste flowed into the nearby Emory and Clinch rivers.[28] *Image: ©2019 Google*

Introduction

Early in the morning of December 22, 2008, a dike burst at the Kingston Fossil Plant in Harriman, Tennessee. The dike was the only barrier preventing coal ash, a waste byproduct of coal burning, from spilling into the Emory River just a few feet away.[19]

When the dike broke, more than 5.4 million cubic yards of ash – 1.1 billion gallons, more than the amount of oil spilled during the BP Deepwater Horizon oil spill – came pouring out, flowing into the Emory and nearby Clinch rivers, damaging 15 homes and rendering three others permanently uninhabitable.[20] Coal ash contains dangerous substances such as arsenic, lead, mercury, cadmium, chromium and selenium, which threaten human health and wildlife.[21]

Video footage revealed large numbers of dead fish washed up on the shore downstream from the spill, despite assurances from the Tennessee Valley Authority that contaminants in water samples were within acceptable levels.[22] The next year, samples from the river were devoid of life.[23] "It looks like something you would have got off the moon," Appalachian State University biologist Shea Tuberty told National Public Radio in 2009.[24] A Duke University study of downstream river sediment found levels of arsenic at 2,000 parts per billion – 200 times the level safe for drinking water.[25]

In the years since the spill, its long-term consequences for human health have become clearer. By 2018, ten years after the spill, more than 30 people who had worked to clean up the spill had died of illness.[26] Their survivors, along with sick workers, won a lawsuit in 2018 against the company that handled the cleanup, alleging that exposure to coal ash led to illness and death.[27]

Generating billions of gallons of toxic waste makes little sense. Storing that waste so close to a major river invites disaster. Yet the Kingston Fossil Plant is far from the only place where highly toxic and dangerous substances are located a stone's throw from our most important waterways. Across the country, thousands of facilities storing toxic chemicals and dangerous waste – such as fracking fluid, agricultural waste, and caustic industrial chemicals – sit alongside America's rivers, streams and lakes. Many of these facilities are poorly regulated or barely monitored.

In many cases, the risks posed by these facilities can be avoided. Safer methods of industrial production and more sustainable farming operations can alleviate the need to store toxic chemicals or vast quantities of animal waste. Clean energy can eventually eliminate or dramatically reduce the need to frack for oil and gas or store coal ash alongside waterways. In the meantime, we can prevent these risks from getting worse by preventing the construction of risky facilities, especially near waterways. And for existing facilities, strong regulation and effective enforcement of environmental laws can lessen the risk to our waterways and our health.

Thousands of Dangerous Sites Threaten America's Water

Clean water is essential to America's health and welfare. Fresh water is where we fish, swim and play, and it is critical to wildlife, our economy, and our basic survival.

Each day, America's waterways are put at risk by the thousands of industrial, agricultural and fossil fuel facilities and operations that line their shores, sometimes mere feet from the water's edge. Many of these facilities are poorly maintained and poorly regulated, and spills can occur as a result of events ranging from bad weather to simple deterioration.

In daily life, these sites often appear in isolation – a pipeline through the neighborhood, or a chemical plant sitting by the local river. A review of the multitude of hazardous facilities near our waterways reveals that these facilities constitute a systemic problem that puts waterways across the country in peril.

The following sections illustrate five types of threats facing American waterways. Each section presents information on the threat, case studies on recent spills, and data on looming problems.

- Industrial facilities that store toxic substances.
- Oil rail lines and pipelines.
- Manure lagoons at factory farms.
- Coal ash pits.
- Fracking waste pits.

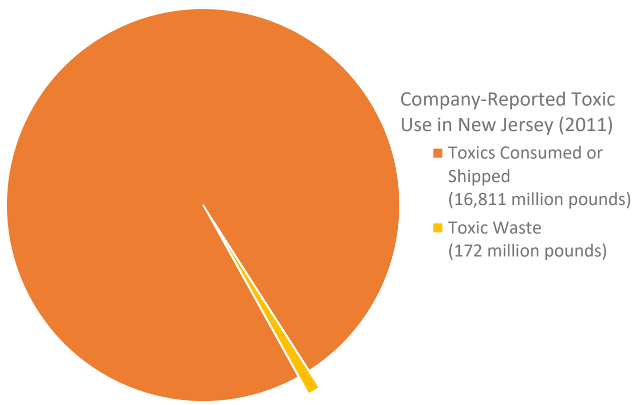
Industrial Use of Toxic Chemicals Puts Water at Risk

Many facilities, from a wide variety of industries, use large quantities of harmful chemicals that can damage waterways in the event of an accident. According to the EPA, "facilities in industrial sectors like chemical and metal manufacturing, mining and food processing are responsible for nutrient and metal pollution in lakes, rivers and streams, and can degrade water quality and threaten drinking water sources."[29]

The quantity of chemicals kept in storage or used in processes on industrial sites is unknown. In 2016, more than 21,000 facilities submitted data to the EPA's Toxic Release Inventory (TRI) and reported managing 14 million tons of toxic waste.[30] Yet this amount

A tank rupture at this Freedom Industries plant in West Virginia spilled up to 7,500 gallons of the chemical MCHM into the Elk River, poisoning residents and interrupting the water supply of 300,000 people. Image: U.S. Chemical Safety Board

Figure 1. In New Jersey, the Total Weight of Toxics Used Is Almost 100 Times Higher Than Toxic Waste Produced[32]



does not include non-waste chemicals. In New Jersey, where companies are required to report total toxic chemical use along with toxic waste, the total weight of toxics in use is almost 100 times higher than toxic waste produced.[31]

Industrial sites are often located near bodies of water in order to use water for cooling, to have access to water transportation, or to make waste discharges. Sites far from water's edge can also pose a spill threat. In the case of a Louisiana paper mill, a malfunction in a water treatment system caused a fish kill in a river 1.5 miles away, after waste was discharged through the plant's water treatment system connecting it to the waterway. (See page 7 for more details.)

Industrial Spills Are Common

Data collected by the National Toxic Substance Incidents Program (NTSIP) indicates that toxic industrial spills are common. In 2012, NTSIP estimated that 15,483 acute, emergency toxic release incidents occurred across the country. Of those, approximately 3,700 were spills of toxic liquids or solids that occurred at fixed facilities (as opposed to during transportation).[33]

In recent years, industrial spills from many types of industries have damaged water.

In April 2017, a U.S. Steel Corporation plant in Portage, Indiana, spilled 298 pounds of hexavalent chromium into a waterway connected to Lake Michigan.[34] The chemical spilled from a corroded pipe. Long-term exposure to even small amounts of hexavalent chromium can damage DNA, and cause lung, skin and kidney cancer. The chemical was made infamous by the movie *Erin Brockovich*. Chicago's Department of Water Management sampled water in Lake Michigan one mile from the spill and detected a hexavalent chromium level of two parts per billion, 13 times higher than normal although below the threshold of what is considered safe by the EPA.[35] Three local beaches were closed as a result of the incident, and a nearby community shut off its drinking water intake.[36] Just six months later, the same plant spilled chromium (and likely hexavalent chromium) a second time; in November 2017, the city of Chicago threatened a lawsuit.[37]

In January 2014, a tank containing 4-methylcyclohexane methanol (MCHM) and a mix of glycol ethers (PPH) ruptured at a Freedom Industries chemical processing plant, spilling approximately 10,000 gallons of MCHM into the Elk River in Charleston, West Virginia, the community's primary source of drinking water.[38] The U.S. Chemical Safety Board found that Freedom Industries had "failed to inspect or repair corroding tanks." Little is known about the human health effects of MCHM, a chemical used for cleaning coal. However, nearly 700 residents reported poisoning symptoms, and local hospitals recorded symptoms including nausea, rashes, vomiting, abdominal pain and diarrhea in patients who had been exposed to the water.[39] Approximately 300,000 people served by a local water company were advised not to drink, shower, or cook with tap water, and the local water treatment facility needed to be completely flushed in order to eliminate the chemical.[40] For weeks after the spill, residents reported a strong licorice odor coming from the water, a smell that was later determined to be detectable in water containing 1.5 parts per trillion MCHM.[41]

In August 2011, a paper mill in Bogalusa, Louisiana, spilled "black liquor," a byproduct of paper manufacturing, into the nearby Pearl River, resulting in the deaths of thousands of fish.[42] The liquid was released as a result of a malfunction in the plant's wastewater treatment system.[43] A fisherman reported that water turned jet black and foam trailed behind his boat, and an ecologist reported to the *Times-Picayune* that the spill and fish kill spanned at least 47 miles of the river.[44]

Other recent industrial incidents have also damaged waterways or put them at risk. In March 2018, a spill of ferric chloride at a Georgia chicken processing plant killed more than 8,000 fish.[45] In November, 2018, an oil refinery in San Antonio spilled 50 gallons of the toxic chemical naphtha into the San Antonio River, although officials did not report environmental damage.[46] In 2017, Hurricane Harvey caused more than 100 toxic releases in the Houston area, including some that impacted waterways, according to an analysis by the Associated Press and the Houston Chronicle.[47] In October 2017, Dover Chemical spilled sodium hydroxide (lye) into Sugar Creek in Ohio, killing fish in a two-mile stretch of the river.[48] In July 2017, the Ford Truck Plant in Kentucky spilled urea into Hite Creek, killing as many as 700 fish.[49] Also in July 2017, a store spilled a chemical additive for herbicides and pesticides into a creek in Roanoke, Virginia, killing tens of thousands of fish.[50]

This U.S. Steel Corporation plant on the shore of Lake Michigan spilled hexavalent chromium, forcing the closure of adjacent beaches. Image: ©2018 DigitalGlobe, IndianaMap Framework Data, Landsat / Copernicus, U.S. Geological Survey, USDA Farm Service Agency

THREAT SPOTLIGHT:

Industrial Toxic Chemical Storage in New Jersey Flood Zones

New Jersey has a long history of industrial damage to waterways and a large and active chemical industry.[52] Today, New Jersey has more Superfund hazardous waste sites than any other state.[53] New Jersey is also one of the few states that tracks storage of dangerous chemicals, as required by its Community Right to Know law, making it possible to identify facilities with dangerous chemicals that may put water at risk.[54]

An analysis of data for 2017 finds that at least 31 facilities have at least five toxic chemical storage units on site and are located within a flood zone.[55] Sixteen of these facilities are in the Newark-Jersey City area near New York City, an area with numerous waterways including the Hackensack River.

Among the flood zone-located companies with the highest number of hazardous storage units on site are International-Matex Tank Terminals, a chemical storage and transfer company; Chemtex, a chemical importer for the fragrance industry; and Buckey Pennsauken Terminal, a warehousing and storage facility.

Figure 2. New Jersey Has 31 Facilities with at Least Five Toxic Storage Units on Site in Flood Zones, Including Many in the New York City Area[51]

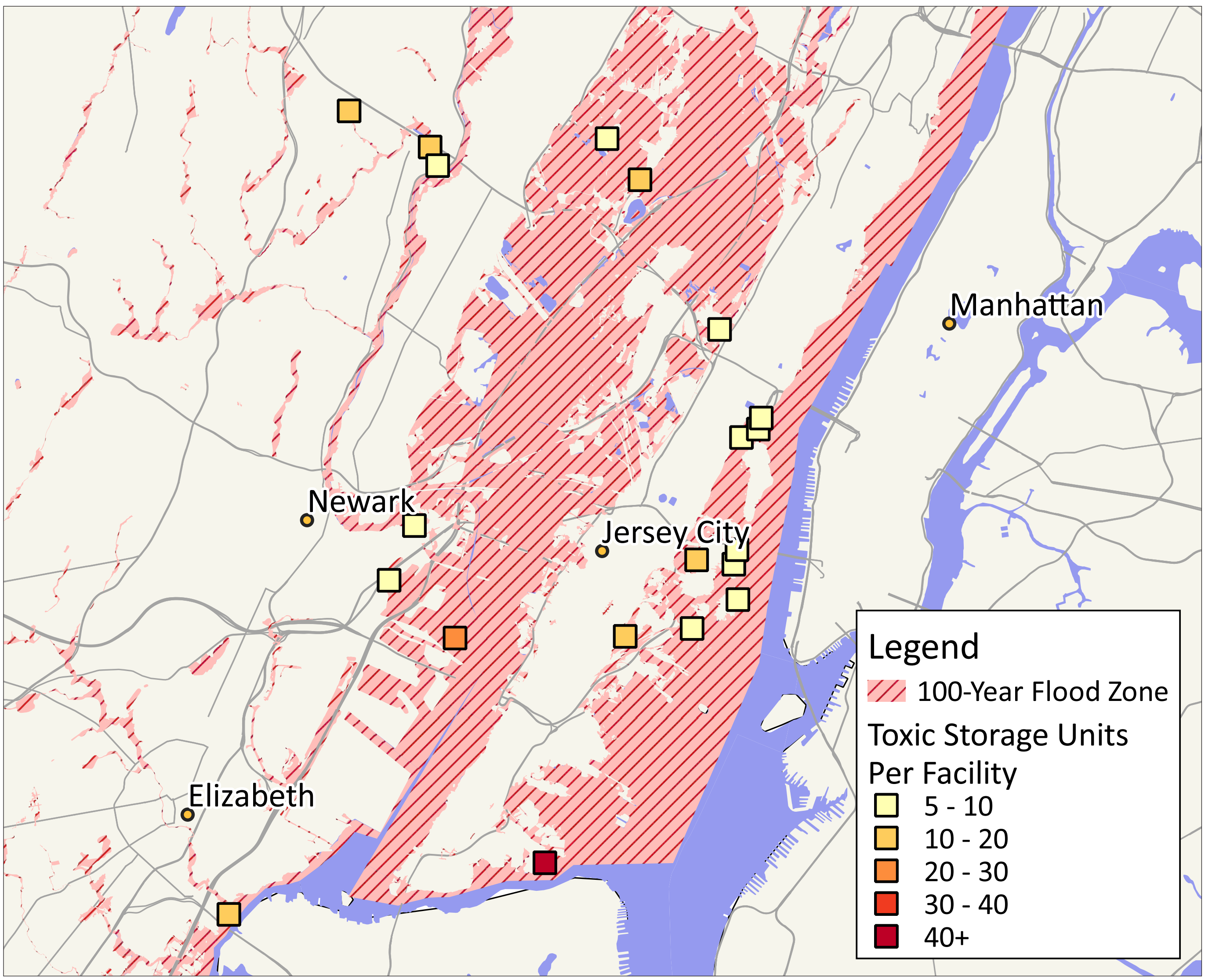


Table 1. New Jersey Facilities in Flood Zones with Most Toxic Storage Units on Site[56]

Company Name	Number of Toxic Storage Units on Site	Company Description	County
International-Matex Tank Terminals (IMTT)	183	Storage and transfer shipments of bulk liquids	Hudson
Chemtex USA	39	Chemical raw importer for fragrance industry	Essex
Buckeye Pennsauken Terminal LLC	34	Other warehousing and storage	Camden
Buckeye Terminals LLC	23	Other warehousing and storage	Essex
Harris Corporation	19	Electronic assembly	Passaic
Lawson Products Inc.	18	Distribution center	Essex
Citroil Enterprises, Inc.	17	Manufacturing food flavorings	Bergen
Salomone Bros Inc.	15	General contractor	Passaic
Eastern Concrete Materials	13	Ready mix concrete manufacturing	Hudson
International Flavors & Fragrances Inc.	13	Basic research to discover new flavors and fragrance	Monmouth
New York Terminals LLC	13	Chemical storage terminal	Union
Broadview Technologies, Inc.	10	Distributor of anhydrides, phosphates and anti-rust additives	Essex

Risky Oil Trains and Pipelines Run Along and Across Waterways

Millions of gallons of crude oil and petroleum products are transported daily across the country on America's 140,000 miles of mainline freight rail and through roughly 400,000 miles of long-distance pipelines.[57] Each year, pipelines carry approximately 9 billion barrels of crude oil and 7 billion barrels of petroleum products (refined products and natural gas liquids), and freight rail lines carry approximately 150 million barrels of crude oil.[58]

These transportation systems, which carry huge amounts of environmentally destructive oil products and frequently travel near or across vulnerable rivers and streams, pose a threat to America' s waterways.

Oil is a highly toxic material, and oil spills can devastate natural ecosystems. Crude oil's toxicity depends on its source and makeup; however, common component chemicals include known human carcinogens such as benzene.[59] Crude oil also contains polycyclic aromatic hydrocarbons (PAHs), which have been linked to skin, lung, bladder and stomach cancers.[60]

Oil can affect all levels of aquatic ecosystems. In many fish species, oil is highly toxic to eggs and larvae and can result in decreased reproductive success.[61] Oil can kill birds and mammals when it fouls their feathers or fur, harming their ability to insulate themselves from the cold.[62] Oil is directly toxic to some forms of algae.[63] Oil pollution is also extremely persistent; in some cases oil has been detected in ecosystems 30

In 2015, a crude oil train derailed on the banks of the Galena River in Illinois. Image: U.S. Environmental Protection Agency

years after a spill.[64] Oil extracted from tar sands is particularly difficult to remove from the environment because of its high viscosity and density.[65]

Trains and pipelines used for transporting oil frequently pass near or over water. Rail lines in particular are often built along rivers to maintain moderate grades.[66]

Thousands of miles of crude oil pipelines crisscross the country. Image: U.S. Energy Information Administration

Both rail and pipeline oil transportation are vulnerable to spills. Major rail spills can occur following derailments, which can be caused by track defects or human error.[67] Most pipeline spills are caused by corrosion or equipment failure.[68] Pipelines deteriorate over time, and about 60 percent of U.S. fuel pipelines were built before 1970.[69] Buried pipelines can breach when they are accidentally struck during digging.[70] Pipelines are also frequently found with construction faults soon after they are built; many faults have been found in the Keystone Pipeline, the first leg of which spilled 12 times in its first year of operation.[71]

Despite the potential for and history of damaging spills, oil transportation, particularly by pipeline, is poorly regulated. As of 2012, only about 10 percent of country's 240,000 miles of "gathering" pipeline – the pipelines that carry oil and gas to processing facilities – fell under federal safety and construction regulations.[72] Meanwhile, rail oil shipments are permitted to travel in mile-long trains, meaning that a single derailment can result in a serious spill.[73]

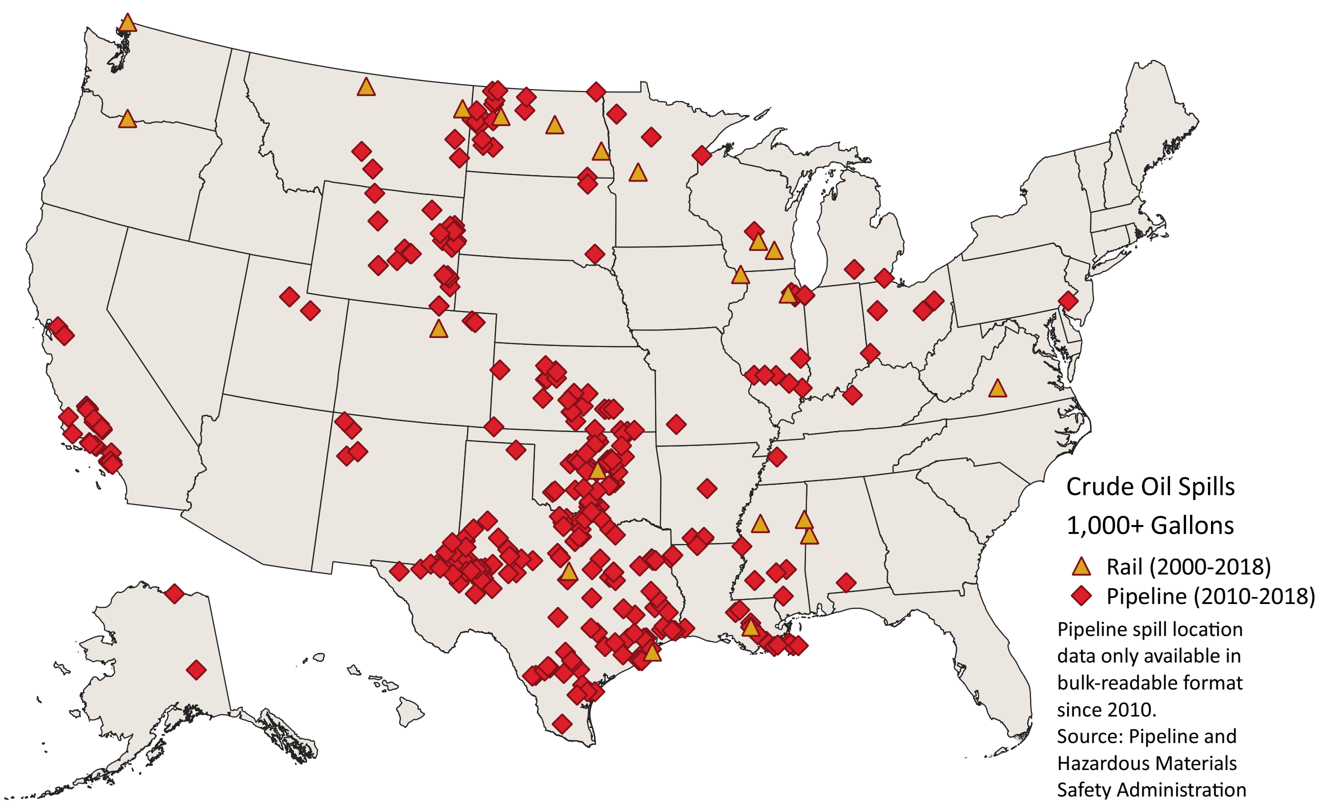
Rail and Pipeline Oil Spills Happen Frequently

Oils spills frequently occur during transportation by rail and pipeline. Since 2000, at least 21 railway spills and 734 pipeline spills of crude oil over 1,000 gallons have been reported by the Pipeline and Hazardous Materials Safety Administration (PHMSA).[74] Many oil rail and pipeline spills in recent years have had serious consequences for waterways.

In February 2015, a train carrying crude oil from North Dakota derailed in Mount Carbon in central West Virginia. Investigators found that a broken rail on the track was likely the cause of the derailment.[75] Twenty-seven tank cars, each carrying nearly 30,000 of crude oil, derailed.[76] Approximately half of the cars ignited, leading to several multiday fires which burned down a home and caused evacuations in the area.[77] Some oil flowed into the nearby Kanawha River and Armstrong Creek, forcing the shutdown of two nearby water intakes and affecting water access for thousands of customers of the West Virginia American Water Company.[78]

In January 2015, a pipeline burst near Glendive, Montana, dumping approximately 50,000 gallons of oil into the Yellowstone River and causing the governor to declare a state of emergency.[80] Benzene was found in the water in the range of 10-15 parts per billion; long-term consumption of concentrations above 5 parts per billion presents a cancer risk in humans.[81] Residents were told not to drink the tap water due to possible toxicity and reported that the water smelled like diesel. The spill happened in winter, when much of the river was frozen over, and oil was found in unfrozen areas of open water as far as 60 miles from the spill site. The spill harmed fish, causing gill, kidney and liver problems.[82] It also harmed migratory and other birds, including bald eagles.[83] According to a report prepared by state and federal trustees for Montana and the U.S. Department of the Interior, "[t]hese open water areas are important habitats for migratory birds as they often provide the only available water when ice and snow blanket the area."[84]

Figure 3. Rail Crude Oil Spills Since 2000 and Pipeline Crude Oil Spills Since 2010 (Spills of 1,000+ Gallons)[79]



THREAT SPOTLIGHT:

The Bakken-Chicago Oil Rail Route Runs Along the Mississippi River for 150 Miles

The Mississippi River is the nation's most iconic river, critically important to America's economy, environment and wildlife. The Upper Mississippi – the section of the river that flows from the headwaters of Lake Itasca, Minnesota, until it converges with the Ohio River in Cairo, Illinois – is the only river to be congressionally designated as both a nationally significant ecosystem and a nationally significant navigation system. It is also home to 127 species of fish and 30 species of freshwater mussels, while nearly 300 species of birds migrate through the river valley.[100] The banks of the Upper Mississippi River also serve as a transportation corridor for a major oil rail route – one that has already suffered a major spill.

Information about rail routes used for transporting crude oil is not publicly available.[101] However, information

The Kalamazoo River Spill

On July 25, 2010, a 40-foot long section of pipeline carrying crude oil burst just south of Marshall, Michigan.[85] The pipeline was operated by Enbridge Energy, which owns the "largest, longest and most complex petroleum pipeline system in the world," according to the company.[86] The pipeline was part of a system that starts in the Canadian tar sands in Alberta, running past dozens of small Minnesota lakes and ponds and alongside three of the Great Lakes before terminating in Sarnia, Canada, at the southern tip of Lake Huron.[87]

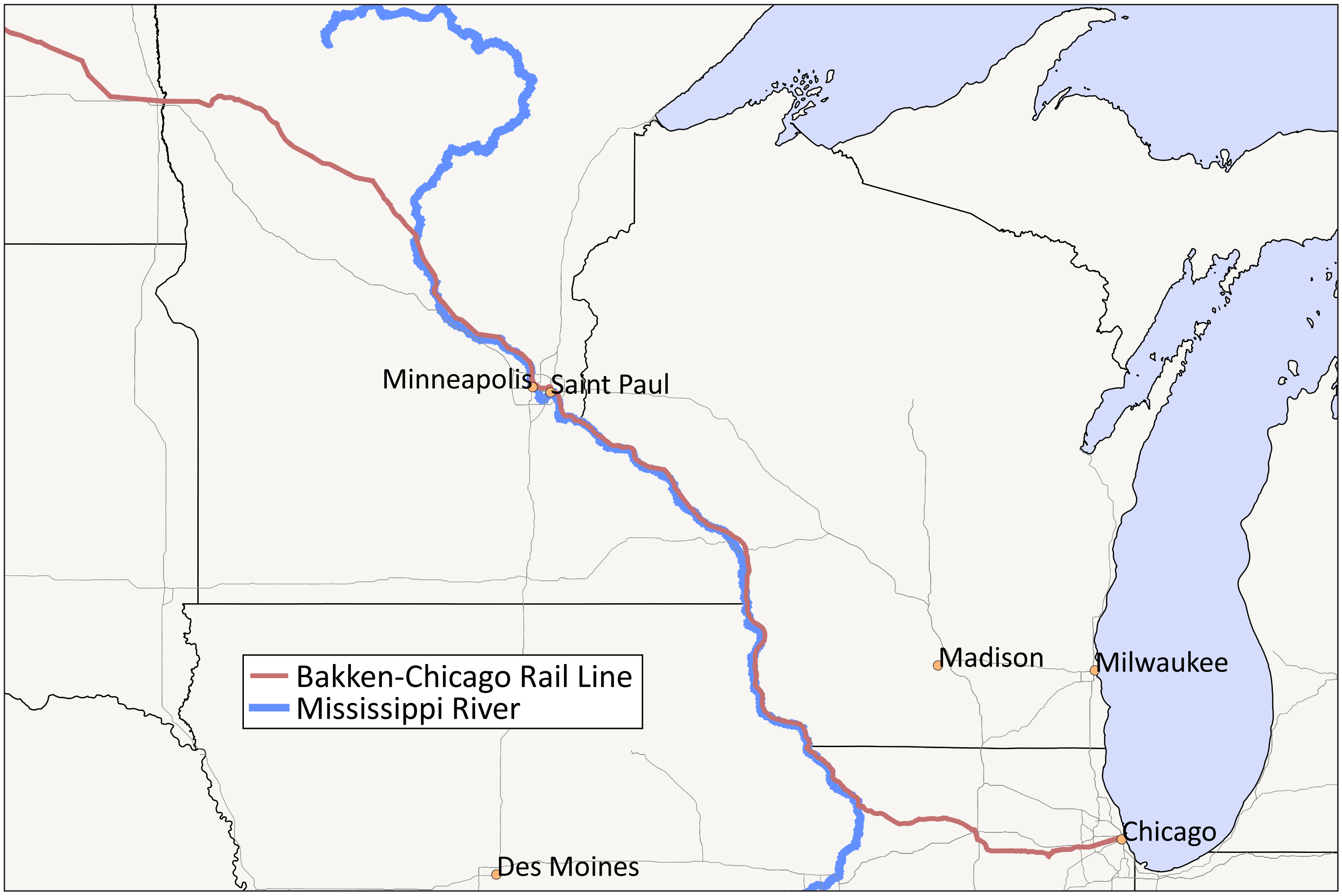
The probable cause of the rupture was "corrosion fatigue cracks," according to the National Transportation Safety Board.[88] The leak went undetected for more than 17 hours, until a local utility employee called Enbridge's emergency number.[89] At least 1.2 million gallons of tar sands oil, equivalent to almost two full Olympic swimming pools, spilled into the nearby Talmadge Creek, flowing into and blackening almost 36 miles of the Kalamazoo River.[90] It was the largest inland oil spill in American history.[91]

The Enbridge pipeline was carrying diluted bitumen, sometimes called "dilbit" or "tar sands oil," a dense and dangerous substance that is heavier than water. The spilled oil sank to the bottom of the river, making standard cleanup equipment ineffective.[92] Large stretches of the river were closed and remained off-limits for nearly two years.[93] Benzene, a cancer-causing chemical that is toxic at low doses, was measured in the area's waters at dangerous concentrations, at times up to 10,000 parts per billion, more than 2,000 times the health standard for benzene in drinking water.[94] Following the spill, a USGS fish survey found fish that were sick, deformed and suffering from lesions.[95]

In 2010, a crude oil pipeline spilled 1.2 million gallons of tar sands oil into the Talmadge Creek and Kalamazoo River, requiring a years-long cleanup effort. Image: U.S. Environmental Protection Agency

Because of the chemistry of tar sands oil, consequences of the spill are particularly long-term. Oil still remains in the sands beneath the Kalamazoo River, buried too deep for dredging to remove it.[96] More than 150 families were forced to permanently relocate.[97] Six years after the spill, trees along the river were found with rings of oil around their bark, still carrying the marks of oil from contaminated river water.[98]

Figure 4. One Oil Rail Route Stretches from North Dakota to Chicago, Often Closely Following the Mississippi River[99]



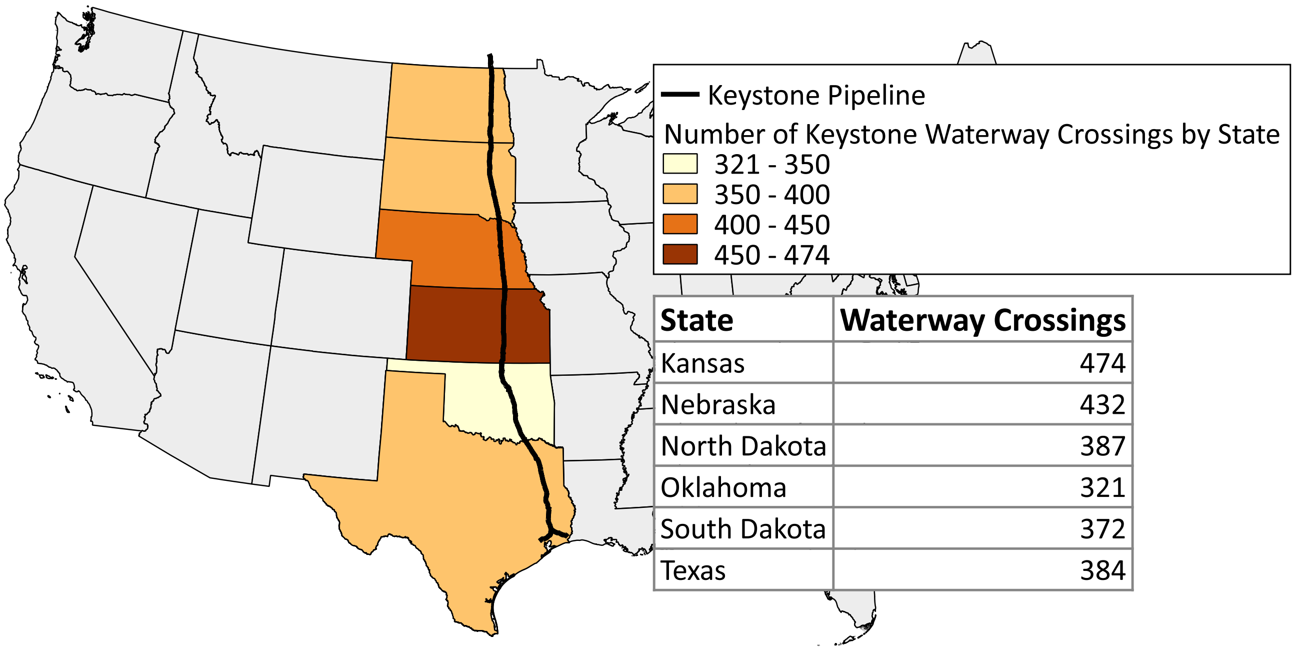
about oil rail routes can become public following rail oil spills, as in the case of a 2015 train derailment and spill near the city of Galena, Illinois, which narrowly avoided contaminating the Mississippi and Galena rivers.[102]

Following that incident, rail experts contacted by the *Chicago Tribune* were able to conclude that the train must have been traveling from the Bakken oil fields in North Dakota to Chicago, and would ultimately have been headed for refineries on the East Coast.[103] Based on that information, combined with information about the rail operator (BNSF), detailed rail routes from the Department of Transportation, and information about oil loading and unloading facilities collected by Oil Change International, it is possible to make a reasonable guess as to which train route the derailed oil train was on.[104]

Site of the rail oil spill by the Mississippi and Galena Rivers, near Galena, Illinois. Image: ©2018 Digital Globe, Google

An analysis of the rail oil route in question finds that the route closely follows the Mississippi River for much of its length.[105] Of the 942-mile route from an oil loading station in Minot, North Dakota, in the Bakken shale fields to the city of Chicago, 149 miles of the rail line are within a half-mile of the Mississippi River. 154 miles of the total route fall within a Federal Emergency Management Agency (FEMA) flood zone. This rail line – with a demonstrated history of failure – puts one of America's most beloved rivers at risk.

Figure 5. The Keystone Pipeline Makes 2,370 Waterway Crossings in the U.S.[106]



State	Waterway Crossings
Kansas	474
Nebraska	432
North Dakota	387
Oklahoma	321
South Dakota	372
Texas	384

THREAT SPOTLIGHT:

The Keystone Pipeline Crosses Thousands of Waterways and Runs through Hundreds of Miles of Flood Zone

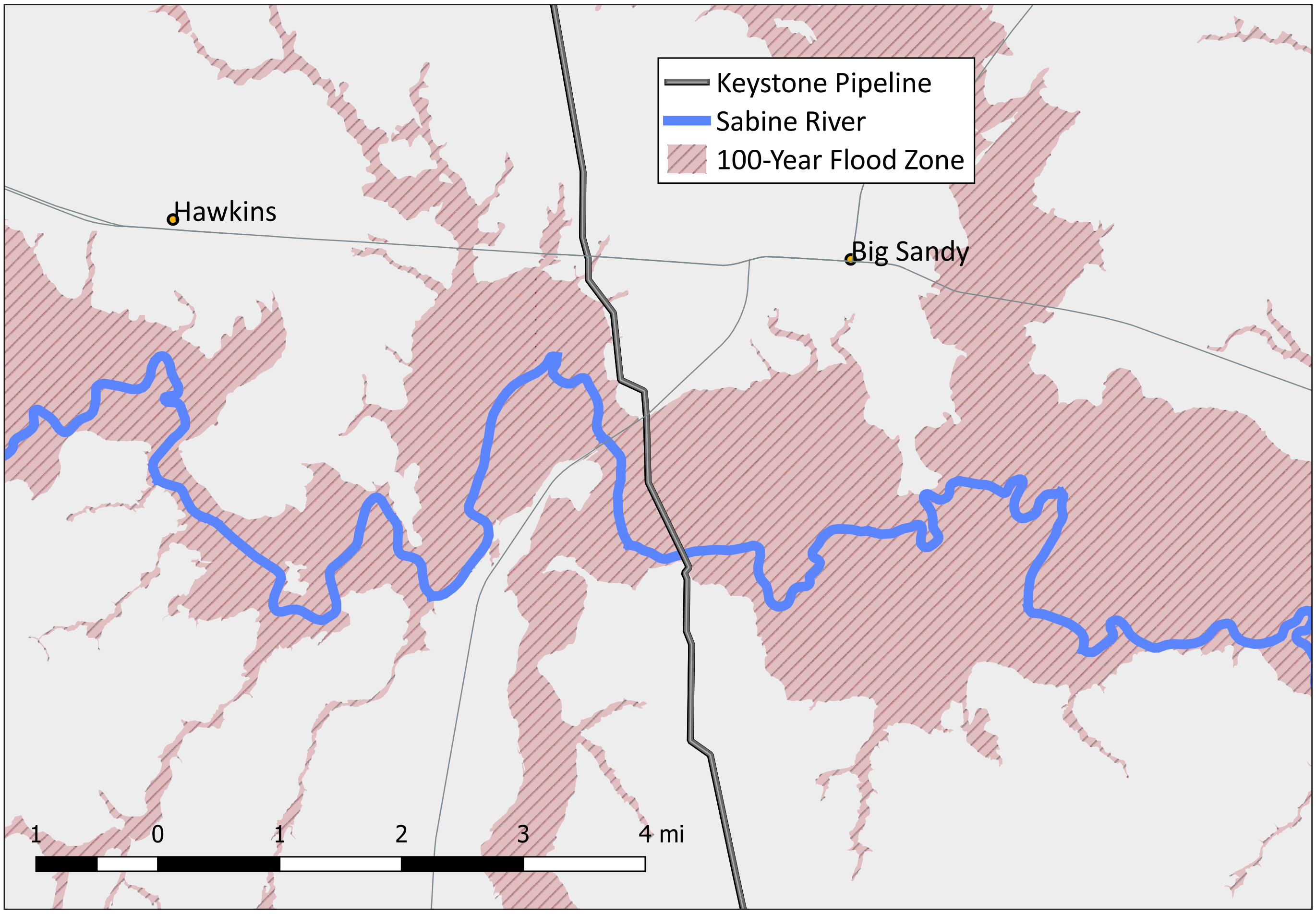
For most crude oil pipelines, publicly available geographic data is too low-resolution to perform an accurate analysis.[107] For the Keystone Pipeline, however, a non-governmental effort called the Keystone Mapping Project has created a more detailed map using information from a variety of sources (for example, environmental impact statements).[108]

The Keystone Pipeline has already suffered multiple spills, including a 210,000-gallon spill in November 2017.[109] A geographic analysis of the pipeline finds that it likely threatens thousands of waterways along much of its route. The pipeline makes 2,370 waterway crossings, more than 300 crossings in each of the six states it passes through. The pipeline also passes through 455 miles of FEMA flood zones, 11 percent of the total length of the pipeline. Much of the pipeline runs through areas that have not been mapped by FEMA, so this estimate is likely conservative.

For 1.3 miles of its route, the Keystone pipeline runs through a flood zone by the Sabine River in northeast Texas. According to a report by Public Citizen, "[d]ozens of anomalies, including dents and welds" were found along a stretch of the pipeline in the area north of the Sabine River.[110]

Aerial view of the point where the Keystone Pipeline crosses the Sabine River in Texas. Image: ©2018 Digital Globe, Texas Orthoimagery Program, USDA Farm Services Agency[112]

Figure 6. Pipeline Path Through Flood Zone by the Sabine River in Texas[111]



This rupture in the Keystone Pipeline near Amherst, South Dakota, led to the spill of approximately 5,000 barrels of oil.[113] Image: National Transportation Safety Board

Manure Lagoons Threaten Ecosystem Destruction

In recent decades, meat and dairy production in America has undergone a radical shift. Livestock farms have decreased dramatically in number, but those that remain have grown much larger.[114] More and more animals are being raised by industrial farming operations that keep hundreds or thousands of animals in confined facilities.[115] In 1992, for example, less than a third of all hogs were raised on farms with more than 2,000 animals; in 2012, 97 percent of hogs were.[116] As of the end of 2017, there were 19,961 "large" concentrated animal feeding operations (CAFOs) in the United States, defined as operations with at least 1,000 cattle, 10,000 swine or 125,000 chickens.[117]

Livestock produce huge amounts of waste. In 2007, 2.2 billion livestock and poultry in the U.S. produced 1.1 billion tons of manure.[118] On smaller farms where animals are grazed on fields, droppings can be naturally dispersed and absorbed by crops. Most livestock in the U.S., however, are raised in densely packed facilities where waste must be managed and stored.[119] A CAFO produces about 20,000 tons of waste per year on average, and a single farm with 2,500 dairy cows produces as much solid waste as a city of 411,000 people.[120]

At many industrial livestock and poultry operations, animal waste is mixed with water and stored in pits known as waste lagoons.[121] Often, lagoons are separated from waterways by only a narrow embankment.[122] Waste lagoons are prone to spills and leaks. Spills can occur when lagoons crumble or overflow, including following periods of heavy precipitation or flooding.[123] Lagoons frequently leach waste into groundwater, risking contamination of drinking water.[124] Waste can also spill into the environment when it is transported to fields via hoses and pipes, which can rupture or spring leaks.[125] When animal waste is applied to land, it can wash off of crops and contaminate waterways, particularly if waste is overapplied (either intentionally or accidentally) or applied before rainfall. Overapplication is common because U.S. factory farms generate far more waste than can be utilized by crops.[126] A 2018 University of Iowa study found that crop manure applications were leading to higher nitrate levels in two western Iowa watersheds, threatening water quality and public health.[127]

Animal waste spills can severely damage waterways. Manure contains high levels of nitrogen and phosphorus, which can cause algae blooms in lakes and ponds and can destroy aquatic ecosystems.[128] Waste can also contain dangerous pathogens like *E. coli*. Additional pollutants found in waste can include growth hormones used on livestock, antibiotics, chemical additives to manure, and animal blood.[129]

Hog waste lagoon in Georgia. Image: Natural Resources Conservation Service Georgia

Waste Lagoon Spills Are Common

Data on the full extent of waste lagoon spills is limited, but available evidence indicates that spills happen regularly and can be extremely damaging. A study published in 2000 found that, from 1995 to 1998 in just 10 surveyed states, there were over 1,000 livestock feeding operation spills that killed at least 13 million fish.[130] A study conducted by Missouri's Department of Natural Resources found that 63 percent of factory farms in the state suffered spills between 1990 and 1994.[131] A *Chicago Tribune* analysis of data for Illinois found that "pollution incidents from hog confinements killed at least 492,000 fish from 2005 through 2014, nearly half of the 1 million fish killed in water pollution incidents statewide during that period," and impaired 67 miles of the state's rivers, creeks and waterways.[132]

Waste lagoons are at increased risk of spilling during extreme weather. North Carolina, a major hog producing state, has seen repeated incidents of hog waste spills resulting from hurricanes. In 2018, Hurricane Florence caused at least 32 lagoons to overflow in the state, spilling millions of gallons of hog waste into tributaries of the South River and the Northeast Cape Fear River.[133] In 2016, Hurricane Matthew inundated at least 14 waste lagoons.[134] And in 1999, Hurricane Floyd resulted in the failure of at least 46 North Carolina waste lagoons, which contaminated tributaries of the Cape Fear, Neuse, and Tar Rivers.[135]

In 2015, at the Cargill Meat Solutions slaughtering plant outside of Beardstown, Illinois, a breach in a waste lagoon's retaining wall released 29 million gallons of hog waste into ditches and waterways in and around the plant.[136] Much of the waste flowed through drainage ditches until it reached a pumping station designed to protect low-lying Beardstown from flooding. The pumping station then pumped much of the waste into Muscooten Bay.[137] Ten days after the spill, state biologists counted 64,566 dead fish in the bay and linked waterways.[138]

In 1995, in the biggest waste lagoon spill in U.S. history, an eight-acre hog waste lagoon in North Carolina suffered a dike collapse, releasing 25 million gallons of waste into the New River – a spill twice the size of the Exxon Valdez oil spill.[139] The waste was so thick that it took nearly two months to travel 16 miles downstream the Atlantic Ocean, killing "virtually all aquatic life" along the way.[140] The spill killed 10 million fish, and resulted in the closure of more than 350,000 acres of coastal wetlands for shellfishing.[141]

Major spills and leaks can also occur in the systems that transport or apply waste from lagoons to fields. In July 2012, animal waste from Hopkins Ridge Farms spilled into nearby Beaver Creek in Iroquois County, Illinois.[142] The spill occurred when liquid manure was applied to cropland by an irrigation pivot at a rate of 300 gallons a minute for three days, as the liquid manure ran off the soaked earth and into the creek.[143] The spill contaminated 20 miles of river, killing 148,283 fish and 17,563 freshwater mussels.[144] Local resident Leland Ponton, 75, reported to the *Chicago Tribune* that the water "looked like ink," and was so dirty that "not even a wild animal could drink out of it." The spill may have eliminated nine fish species from the river, as well as two mussel species that were on the state list of threatened species.[145]

THREAT SPOTLIGHT:

North Carolina's Waste Lagoons Put Water at Risk

A 2016 analysis of waste lagoons in North Carolina by the Environmental Working Group and Waterkeeper Alliance (EWG/Waterkeeper) helps reveal the extent of waste lagoons threats to water.[146]

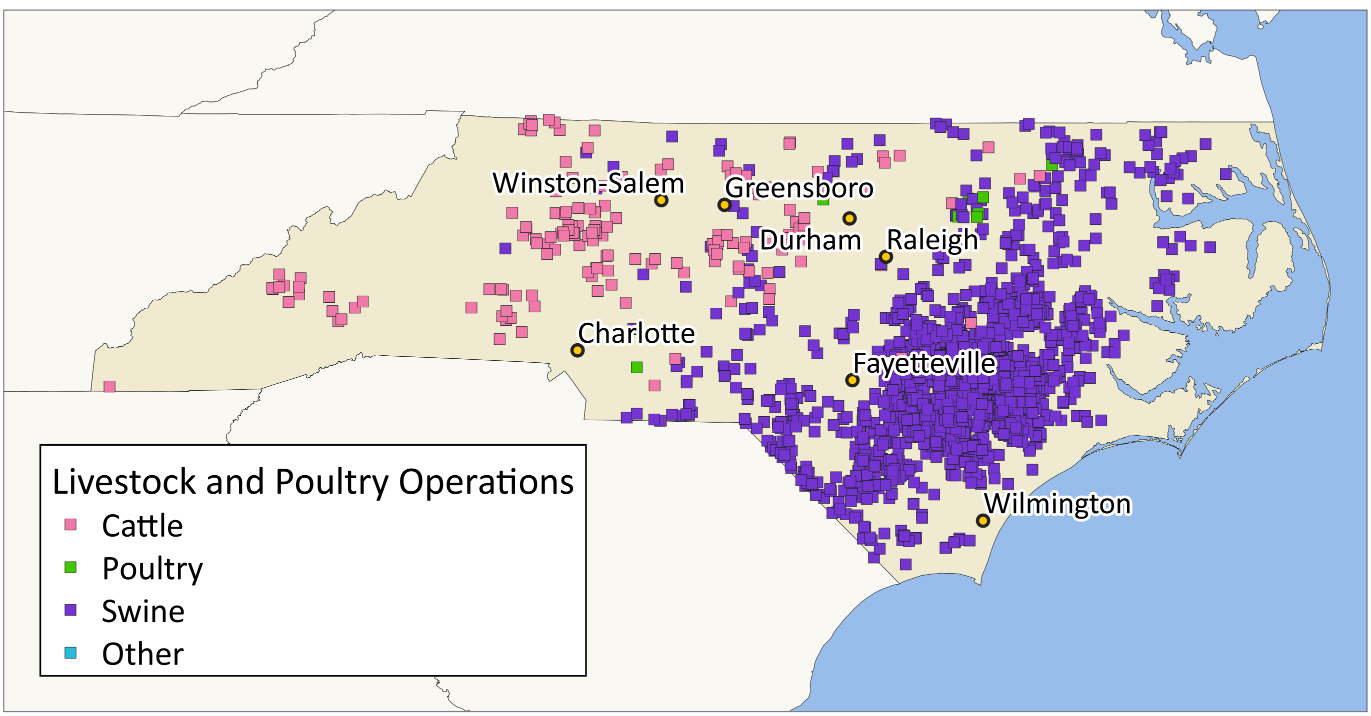
EWG/Waterkeeper's analysis of satellite imagery in North Carolina found 4,145 waste lagoons in the state, covering nearly 7,000 acres.[147] The analysis found that 170 of those waste lagoons were within a 100-year floodplain (from the North Carolina Flood Risk Information System), while 136 lagoons were within a half-mile of a public water well.

Deteriorating Coal Ash Pits Lie on the Banks of Major Rivers

When coal is burned, it leaves behind waste called coal combustion residuals, more commonly referred to as ash. In 2016, coal plants produced 107 million tons of ash, of which nearly half (47 million tons) was left over as waste and not used for other industrial processes.[149]

According to data from the U.S. Energy Information Administration, nearly 90 percent of coal plants have a coal ash pit on site (other coal plants store ash in dry landfills).[150] In a coal ash pit, which is often dug into the land surrounding the coal plant, ash is mixed with water for storage. The ash eventually settles out of the water and is deposited at the bottom of the pit.[151] The ash can then be collected and recycled in industrial or construction projects. As of 2012, there were at least 735 coal ash pits, located at 169 coal plants.[152]

Figure 7. Livestock and Poultry Operations in North Carolina[148]



Often, coal ash pits are separated from water by only a thin retaining wall, as was the case for a pit at the Kingston Fossil Plant in Tennessee, the site of one major spill. Image: Skytruth via Flickr (CC BY-NC-SA 2.0)

Coal Ash Pits Are Inherently Risky

Coal ash pits pose a great risk to waterways because coal ash is highly toxic, the pits are often located near waterways, and coal ash pits are susceptible to failure.

Coal ash contains dangerous substances such as arsenic, lead, mercury, cadmium, chromium and selenium, which threaten human health and wildlife.[153] These pollutants can damage the circulatory, respiratory and digestive systems and lead to neurological and reproductive problems. Additionally, arsenic and cadmium are known carcinogens.[154] These pollutants can also cause long-term damage to the environment. For example, the chemical element selenium can bioaccumulate, or build up in concentration, as it moves up the aquatic food chain, eventually becoming toxic to animals including fish and aquatic invertebrates.[155] Selenium is fatal to fish at high doses, and at lower doses it can lead to decreased growth, weight changes, deformities, and reproductive problems.[156] Because coal can contain trace amounts of uranium and thorium, coal ash is also often radioactive.[157] In combustion waste, these elements can reach 10 times their original concentration in unburned coal.[158]

In addition to the toxicity of coal ash, coal ash spills can also physically degrade the environment. Coal ash deposited after a spill can blanket and smother riverbeds and wildlife.[159] This physical degradation is particularly damaging to animals that live in the riverbed, including mussels, clams and insects.[160]

Coal ash pits are often located on the edges of waterways in order to access water for filling the pit and because coal plants tend to be located next to water for cooling.[161] Sometimes they are separated from waterways by only a thin retaining wall, as was the case for a pit at the Kingston Fossil Plant in Tennessee, the site of one major spill. Coal ash pits are also large, averaging over 50 acres in area with depths of 20 feet, on average able to hold the equivalent of almost 500 Olympic swimming pools' worth of wastewater.[162]

Coal ash pits are susceptible to spills. During floods or heavy rains, uncovered coal ash pits can overflow and spill into nearby waterways.[163] For example, in 2018, floodwaters from Hurricane Florence inundated a coal ash pond at the Sutton Plant in North Carolina, sending toxic ash waste into a nearby lake and the Cape Fear River.[164]

The biggest spills have occurred because of retaining wall failures.[165] The hazard is increased for aging or poorly constructed pits. In the case of the Kingston Fossil plant spill that resulted from a collapsed ash pit, the pit was more than 20 years old and the retaining wall had been built on a layer of "slimes" consisting of old ash, river silt and clay runoff.[166] When the slimes liquefied after a heavy rain, the wall collapsed.[167]

Many coal ash pits are deteriorating or in poor condition, according to a February 2014 EPA assessment of 559 coal ash pits.[168] Of these, one in five were rated in poor condition, and more than half were rated as being in either fair or poor condition. The assessment also included an analysis of the level of hazard presented by each site, based on the potential for economic loss, environmental damage, or damage to infrastructure if the site fails. Of the sites assessed, 81 were found to have a "high" hazard level and another 250 presented "significant" hazard.[169]

Coal Ash Pits Are Poorly Regulated

Despite the many risks associated with coal ash pits, they are poorly regulated.

Coal ash itself is not listed as a hazardous substance by the EPA.[170] Rather, it is categorized as "solid waste," meaning it is regulated similarly to household garbage.[171] And while some states regulate coal ash pits to some degree, for example by requiring pit liners, many unlined pits remain as a result of grandfather clauses.[172]

Coal Ash Leaks and Spills Are Common

Coal ash pits frequently spill and leak, often resulting in severe damage to bodies of water. Damage can occur, however, even in the absence of a major spill.

Coal ash sites frequently contaminate groundwater. An analysis of electric utility reporting by Earthjustice in December 2018 found evidence of harmful groundwater contamination in 22 states at 67 different coal plants.[173] Contamination was from chemicals including arsenic, chromium, lead and selenium. The utility reports were published as the result of a U.S. EPA requirement that coal plant owners monitor groundwater and disclose when contamination exceeds federal limits. A separate 2014 analysis by Earthjustice found evidence of 208 sites where coal ash pits and landfills polluted waterways or groundwater, from either single spills or long-term leakage.[174]

Coal ash groundwater contamination poses a threat to drinking water. In a lawsuit against the Tennessee Valley Authority, the Southern Environmental Law

Coal ash spill into the Dan River in North Carolina, 2014. Image: Waterkeeper Alliance/Rick Dove on Flickr (CC BY-NC 2.0)

Center (SELC) presented evidence that unlined coal ash pits were hydrologically linked to – and therefore likely responsible for contamination of – the Cumberland River, which provides drinking water to one million Tennessee residents.[175] That study helped convince a federal judge to rule that the Tennessee Valley Authority's storage of coal ash waste in unlined pits violated the Clean Water Act.[176]

When major spills do occur, damage to nearby waterways can be catastrophic.

In February 2014, 39,000 tons of coal ash and 27 million gallons of coal ash pit water spilled into the Dan River in Eden, North Carolina, after a pipe burst at Duke Energy's Dan River Steam Station, located at the river's edge.[177] Although the plant had recently transitioned from coal to natural gas, the plant still stored more than one million tons of coal ash waste in pits that were separated from the river by an earthen dam.[178] The coal ash contained arsenic, cadmium, chromium, mercury, selenium and other toxic substances.[179] The Dan River is home to two endangered species (the Roanoke logperch and the James spinymussel), is used for livestock watering and crop irrigation, and is a source of drinking water for residents in North Carolina and Virginia. In the wake of the spill, dead turtles were found onshore.[180] In an interview with the local Fox television affiliate, Jenny Edwards of the Dan River Basin Association said "[t]urtles should be hibernating this time of year. It's cold. They hibernate down in the mud. The fact that they're crawling up on the bank and dying, even if it's not in mass numbers... It's highly unusual."[181] After the spill, indications of coal ash contamination were also detected in nearby wells.[182]

After the previously mentioned Kingston Fossil Plant spill (see page 4), river water near the site tested positive for mercury and arsenic, and contained levels of lead and thallium in excess of safety limits.[183] Elevated levels of selenium and mercury were found in several fish species near the site, creating the potential for long-term bioaccumulation and ecosystem dam-

Overhead view of ash pits at the Dan River Steam Station. Image: ©2018 Google age.[184] Two years after the spill, only half of the spilled coal ash had been removed.[185] By 2018, ten years after the spill, more than 30 people who had worked to clean up the spill had died of illness.[186] Their survivors, along with sick workers, won a lawsuit in 2018 against the company that handled the cleanup, alleging that exposure to coal ash led to illness and death.[187] Following the completion of a seven-year, billion-dollar cleanup effort, more than 500,000 cubic yards of coal ash remained in the river.[188]

THREAT SPOTLIGHT:

Coal Ash Pits by Waterways and in Flood Zones

An analysis of coal plant location data finds that 181 coal plants with on-site coal ash pits lie within a quarter-mile of freshwater or ocean, and 26 coal plants with ash pits lie in FEMA 100-year flood zones.[189] While hundreds of coal plant sites across the country likely put water at risk, those with coal ash pits located in flood zones may pose an elevated threat, as being in a flood zone indicates both proximity to water and risk of flooding. (The estimate of coal plants in flood zones is likely conservative. See Methodology for details.)

The 181 plants within a quarter mile of water generate at least 50 million tons of coal ash each year.[190] They are also home to at least 326 coal ash pits, including 22 that were found to be in poor condition according to a 2014 U.S. Environmental Protection Agency (EPA) assessment. Seventy of the pits represented "high" or "significant" hazard potential in case of failure, indicating that impoundment failure would cause economic loss, environmental damage, or damage to infrastructure.[191]

Many of these plants sit along the Ohio River. The Ohio River runs 981 miles, beginning in Pittsburgh, traversing the Appalachian coal region and providing the borders of Ohio, West Virginia, Indiana, and Kentucky until it flows into the Mississippi River in Illinois. Along the way, it supplies drinking water for more than 3 million people.[194] It also sustains hundreds of

Figure 8. 181 U.S. Coal Plants with Coal Ash Pits Are within a Quarter Mile of Water; 26 Are in a 100-Year Flood Zone[192]

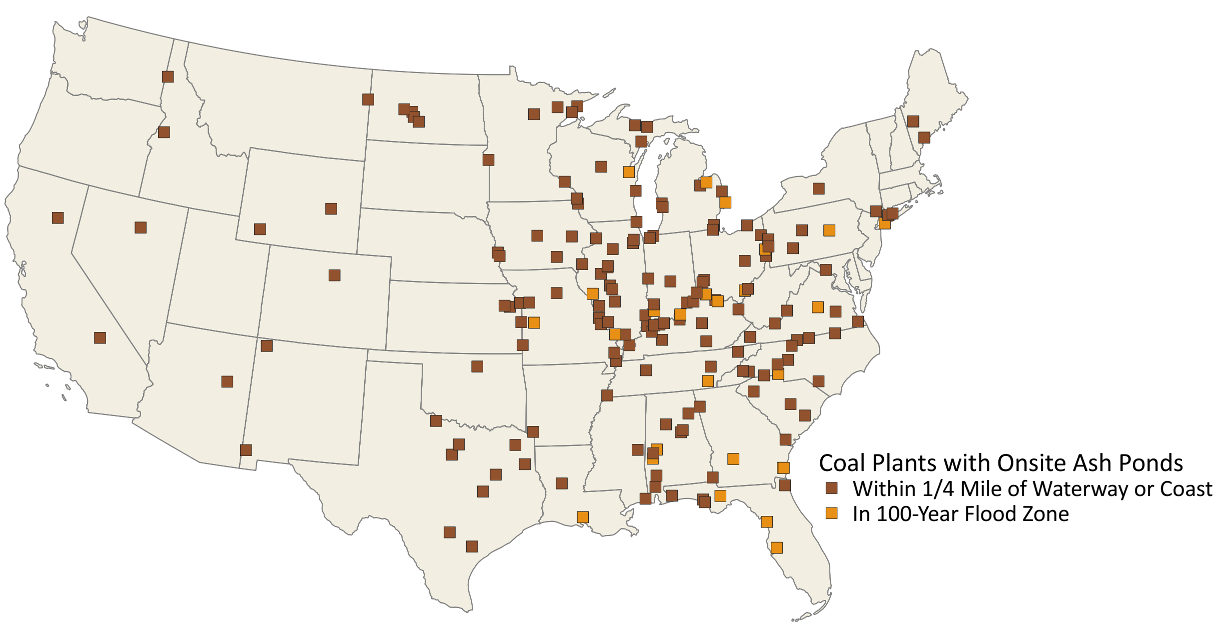
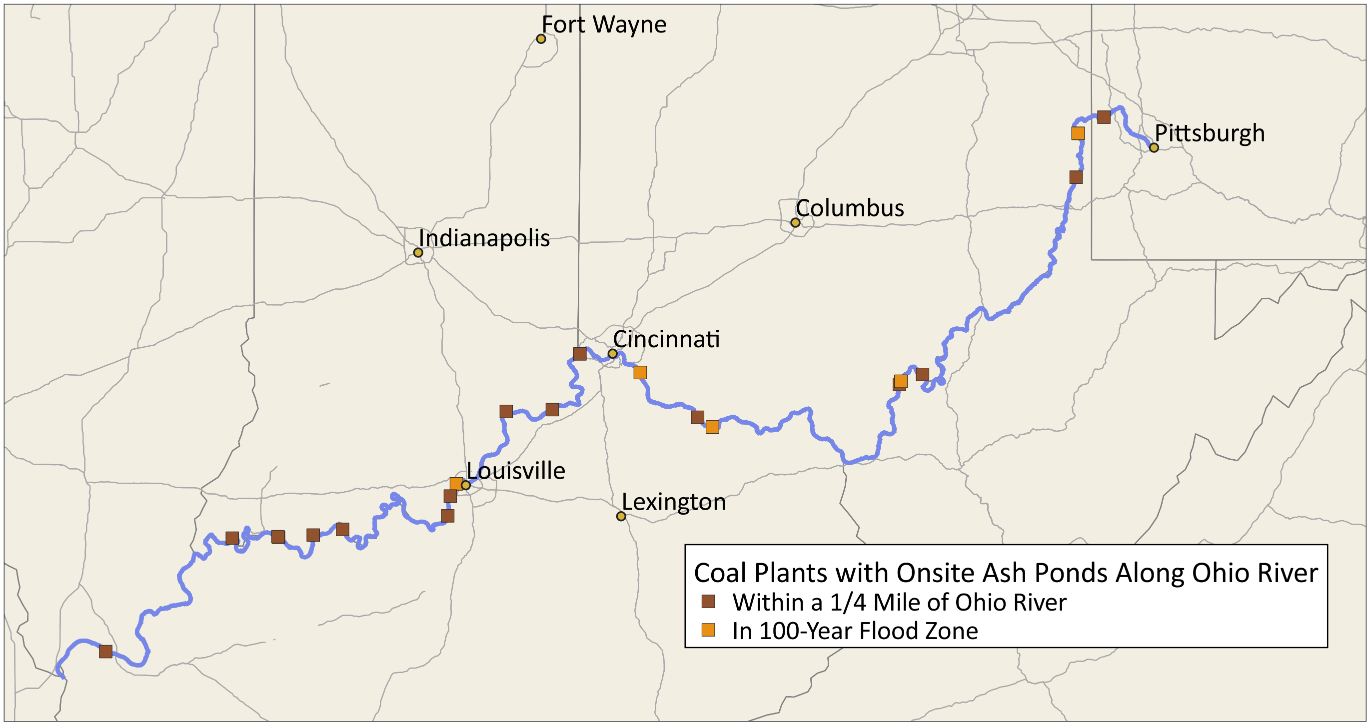


Figure 9. 21 Coal Plants with Ash Ponds Are within a Quarter Mile of the Ohio River, and Five Are in a 100-Year Flood Zone[193]



EPA-labeled aerial imagery of the J.M. Stuart coal plant on the Ohio River. Only one of the five coal ash pits assessed was in "satisfactory" condition.[197] Image: U.S. Environmental Protection Agency animal species, including 47 species of mussel (eight of which are endangered) and nearly 200 species of birds, and supports vibrant and unique riparian forests, including those of the Ohio River Islands National Wildlife Refuge.[195] The Ohio River also hosts more than 20 coal plants on its shores, which use the river's water for cooling – and to fill coal ash pits.

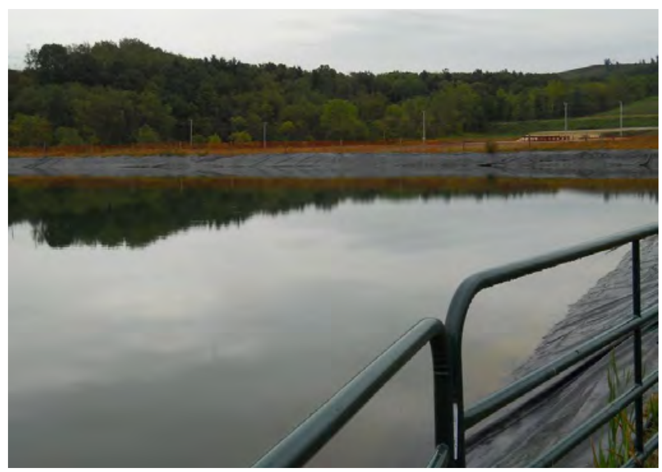
As of September 2018, 27 operable coal plants with onsite ash pits used the Ohio River as a water source. Of these, 21 are within a quarter mile of the river, and five of those plants are in a flood zone. The 21 plants produce more than 14 million tons of coal ash each year, and are home to at least 50 coal ash pits. Eighteen of the 21 plants were included in the EPA's 2014 coal ash assessment report. Of those, all but two had an onsite coal pit that posed either a "high" or "significant" hazard. The J.M. Stuart Station in Aberdeen, Ohio, had five coal ash pits assessed, three of which were in "poor" condition. In 2012, the J.M. Stuart plant generated 1.6 million tons of coal ash.[196]

Sluice lines entering "Pond 5" at the J.M. Stuart Station, located in an Ohio River flood zone. Pond 5 was found by an EPA assessment to be in "poor" condition, and to pose a "significant" hazard to the surrounding area. Image: U.S. Environmental Protection Agency

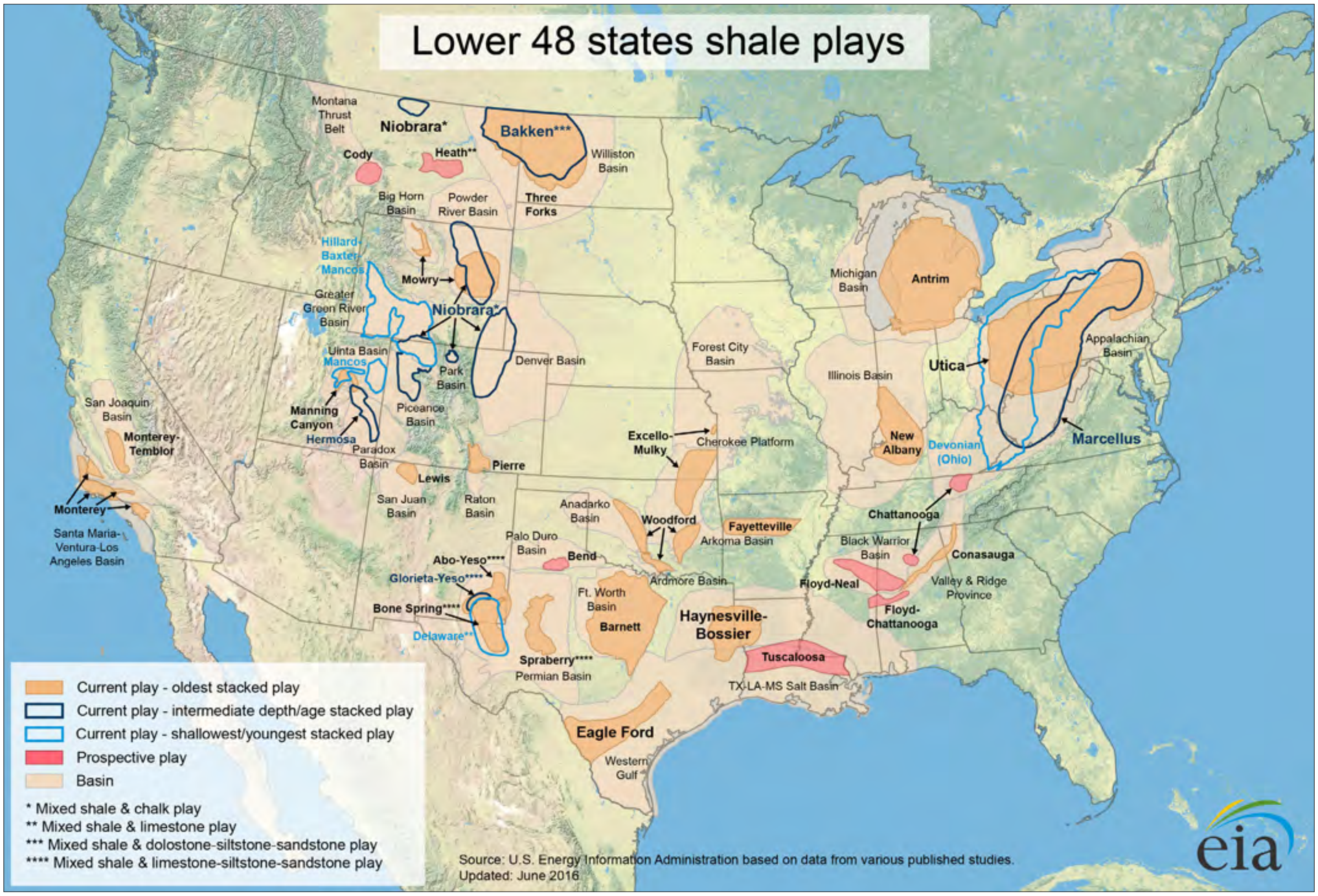
Fracking Wastewater Pits Threaten Toxic Spills

"Fracking" refers to the combination of two drilling techniques, hydraulic fracturing and horizontal drilling, to extract oil and gas from rock formations deep underground.[198] To frack a well, water mixed with a chemical cocktail – referred to as "fracking fluid" – and sand is pumped at high pressure into a shale oil or gas deposit, which fractures the rock, enabling gas and oil, along with a mixture of fracking fluid and brine from the rock layer itself, to flow to the surface.[199]

Fracking a single well can require millions of gallons of fracking fluid, and the wastewater that flows back to the surface from the well must be stored, transported and ultimately disposed of somewhere.[200] This fluid is often stored in aboveground pits where it may either be left to evaporate or transported to underground storage sites.[201]



A fracking waste pit at a natural gas drilling site in the Marcellus Shale in Pennsylvania. Image: United States Geological Survey



Shale oil and gas reserves can be found across the U.S. Image: U.S. Energy Information Administration

Although data on the precise number of fracking wastewater pits is not available, extensive fracking has taken place across the country since the early 2000s. From 2005 to 2016, at least 137,000 wells were drilled in the United States. In 2014, these wells produced at least 14 billion gallons of wastewater, not counting wastewater produced in some major fracking states where wastewater data is not available.[202]

Waste pits pose extensive risks to waterways, because fracking wastewater is highly toxic, and because pits are often located near water, are likely to spill, and are poorly regulated.

Fracking wastewater contains fracking fluid and naturally occurring substances picked up underground, both of which include highly toxic substances that can persist in the environment for many years.[203] More than 1,000 different chemicals have been used in fracking fluid, many toxic.[204] In one analysis of fracking fluid chemicals, 157 were found to be linked to reproductive or developmental health problems, and toxicity information was lacking for hundreds of others.[205] Naturally occurring underground chemicals include oil byproducts, which can cause kidney and liver damage and reproductive problems, and radioactive materials, which can cause lung and bone cancer, lymphoma and leukemia.[206]

In part because of their enormous water demands, fracking operations and their accompanying wastewater pits are often located near bodies of water.[207] One journalist documenting fracking along the Colorado River wrote of paddling under pipelines and alongside drilling operations during a trip down the river.[208]

Wastewater pits present overflow and leak hazards. A frequent cause is rain or other flooding, which can overflow pits and cause spillage into nearby waterways.[209] Wastewater pits can contaminate nearby water and groundwater even without overflowing through seepage and liner failure.[210] Spills can also occur during transportation of wastewater to storage sites. For example, a broken wastewater pipeline in North Dakota spilled 3 million gallons of fracking wastewater in 2015.[211]

Despite the risks they present, fracking wastewater pits are poorly regulated. Fracking waste is exempt from our nation's hazardous waste law, the Resource Conservation Recovery Act (RCRA), as well as the Safe Drinking Water Act (except in cases where diesel fuel is used).[212] According to the EPA, for surface storage of wastewater in pits, "[s]tates, tribes, and some local governments have primary responsibility for adopting and implementing programs to ensure proper management of these wastes."[213] A 2013 policy survey by Resources for the Future found that state regulation of wastewater varies wildly, with variation in how states regulate storage methods, use of pit liners, and the allowable distance from wastewater to the top of the pit.[214] This variation in regulation does not even consider enforcement, a critical component of effective regulation.[215] An investigation in Kern County, California, found more than 300 unlined wastewater pits that had been illegally dug without permits.[216]

Fracking Wastewater Spills Are Common

Although data on fracking wastewater pit spills is scarce – a problem compounded by inconsistent and inadequate reporting requirements in different states – evidence suggests that they occur often. A 2017 study in *Environmental Science & Technology* found 6,648 reported fracking spills in Colorado, New Mexico, North Dakota and Pennsylvania between 2005 and 2014, of which more than 400 were likely wastewater pit spills.[217] A second paper drawn from the same data reported that 47 percent of all fracking spills took place within 750 feet of water, and 7 percent within 100 feet.[218]

In 2007, a fracking waste pit overflowed into Acorn Fork Creek, Kentucky.[219] The river is an important habitat for the Blackside Dace, a federally protected threatened fish species. In the aftermath of the spill, river water became acidic, and its pH dropped from 7.5 to 5.6 (about the same pH as black coffee).[220] In the area of the spill, the fracking waste killed virtually all visible life, with Blackside Dace developing gill lesions and suffering liver and spleen damage. According to the U.S. Fish and Wildlife Service, the spill "killed virtually all aquatic wildlife in a significant portion of the fork, including fish and invertebrates."[221] Despite the mandate that spills like this be reported by fracking companies, U.S. Geological Service scientists found out about the spill only because a local resident reported it.

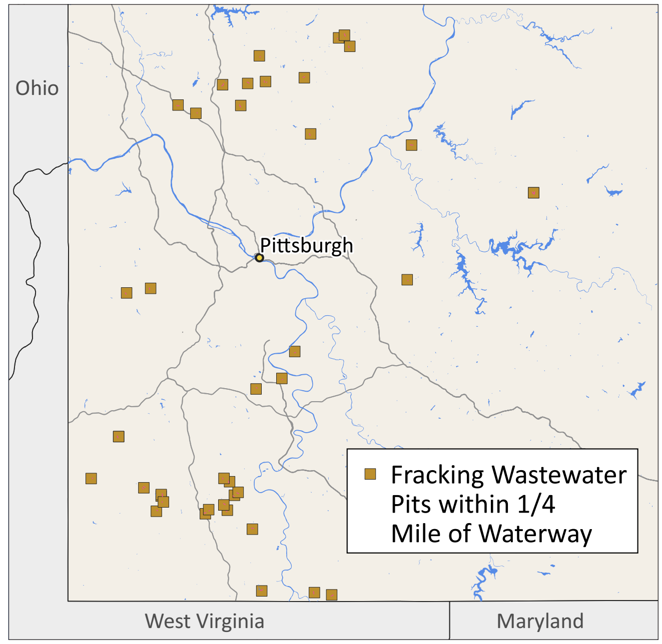
In late 2015, a pipe carrying fracking wastewater to a disposal site ruptured, spilling 3 million gallons of wastewater into the Blacktail Creek north of Williston, North Dakota. Residents noticed that something was wrong with the river when it failed to freeze at the usual time of the year.[222] Levels of benzene, thallium and barium exceeded water quality standards in sampled water.[223] In the spring, residents reported diminished wildlife in the area.[224] Spilled chemicals were detected almost as far downstream as the Missouri River.[225] One year later, traces of radium remained at the site.[226]

THREAT SPOTLIGHT:
Wastewater Pits in Pennsylvania

Data on fracking wastewater sites is very limited. The state with the most comprehensive wastewater pit information is Pennsylvania, thanks to satellite imagery analyses conducted over the last decade by the organization SkyTruth.[227] Although many of the pits identified in past years are no longer in use, their placement is likely illustrative of pits located elsewhere in the nation. In Pennsylvania, most wastewater pits were banned in October 2016, although some centralized waste pits are allowed to continue in use if they are permitted.[228]

Among 254 fracking wastewater pits identified by SkyTruth in 2015, more than one in four – 69 total – were located within a quarter-mile of a stream or river. The below image shows one such wastewater pit, located approximately 600 feet from the Loyalsock Creek by Montoursville. The pit and former well pad are also across the street from a residential community and down the street from Loyalsock Valley Elementary School.[229]

Figure 10. More than One in Four Pennsylvania Fracking Waste Pits Is within a Quarter Mile of a Stream or River, Including Many in Southeast Pennsylvania[230]



A fracking wastewater pit by Loyalsock Creek in Pennsylvania. Image: ©2019 Google[231]

Conclusion and Policy Recommendations

America's lakes, rivers and streams are an essential part of our country's landscape, and we depend on them for drinking water, recreation and the preservation of wildlife. Yet risky industrial and agricultural sites near our waterways threaten many of the places that are most important to American communities. Activities ranging from the storage of agricultural waste to the transportation of crude oil have resulted time and again in spills that have led to severe and long-lasting damage to our waterways. Many of these dangerous operations next to waterways are accidents waiting to happen.

Fortunately, policymakers can take action to prevent future damage. Doing so requires first acknowledging that activities once seen as essential or beneficial – like burning coal for electricity, concentrating industry along riverbanks, and encouraging giant agricultural operations – are either no longer necessary or not worth their consequences.

To protect water from toxic spills and accidents, policymakers should:

Limit or end operations that pose severe threats to water.

The best way to prevent toxic spills and accidents is to limit activities that create the potential for spills in the first place. Policymakers should work to reduce risky activities in general, including by:

- Requiring industry to use safer alternatives to toxic chemicals.
- Placing a moratorium on large-scale livestock operations, especially those with manure lagoons.
- Banning fracking waste pits, pipes and other oil and gas operations that put water at risk.
- Ramping up clean energy and energy efficiency to replace fossil fuels, which are responsible for the facilities and activities behind some of the worst water accidents, including coal ash pit ruptures, rail and pipeline oil transportation disasters, and fracking wastewater spills.

Keep risky facilities away from water.

As long as high-risk, waste-generating operations remain, policymakers should ensure that they are kept far enough from waterways to eliminate the risk of contamination. Policymakers can do so by:

- Using existing powers under the Safe Drinking Water Act, anti-degradation provisions of the Clean Water Act, and other laws to bar facilities or operations that put drinking water sources at risk from spills or other accidental releases of pollution. The EPA should require water utilities to implement robust source water protection plans with such policies.
- Entering into conservation easements with land owners, which are legally binding agreements to limit certain uses that pose environmental risks. (States can use funds from the Drinking Water State Revolving Loan Fund to provide loans to local water systems for both

creating buffer zones and entering into conservation easements.[232])

- Creating zoning laws, particularly at the local level, to bar facilities that generate or store vast quantities of chemicals or waste from being sited near waterways.

Set and enforce strict standards for existing risky facilities that already operate near waterways.

Strict standards should apply to any facilities that store or transport hazardous material near water. Policymakers can reduce the risk of damaging spills and accidents by:

- Creating strict laws regulating the storage of hazardous chemicals at sites that put freshwater at risk.
- Ensuring that facilities are regularly monitored for compliance with such laws, and enforcing penalties (especially financial penalties) for sites that violate the law.
- Requiring risky facilities to submit data on the storage of hazardous materials, and publishing data so that the public can assess risks to their community and environment.

Policymakers should also reject any efforts to weaken existing federal clean water protections – including current measures to undermine modest rules for coal ash and to strip Clean Water Act protections from thousands of streams and wetlands.

Methodology

Unless otherwise noted, geographic analyses used 100-year flood zone data from the Federal Emergency Management Agency (FEMA) and waterway data from the *1:100K National Hydrography Dataset*, created by the USGS and occasionally updated by the EPA.[233]

Industrial Sites

To find industrial or commercial facilities with on-site chemical storage in flood zones in New Jersey, facility locations were overlaid with flood map data. A database of facilities with chemicals on site was downloaded from the New Jersey Department of Environmental Protection's *Data Miner* tool.[234] Facilities' physical locations were largely available in the database as a street address, and converted to latitude and longitude using the Geocodio service.

Coal Ash

Coal plant locations were downloaded from the U.S. Energy Information Administration.[235] Coal plants assessed include all electricity generating facilities, including industrial power facilities, with a capacity of more than one megawatt.[236] Plants do not include coal-burning facilities that do not produce electricity (for example, coal furnaces that produce heat for industry).

For the analysis of coal plants within a quarter mile of waterways, certain water features from the National Hydrography Dataset were not included in the analysis: features with the feature type "SwampMarsh," "CanalDitch," "Submerged Stream" and "Wash." "Reservoir" and "LakePond" features with an area of less than one square mile were also not included, as many smaller pond and reservoir features represent coal ash ponds themselves.

The estimate of coal plants in flood zones is likely conservative. Coal plant location data were only available as single points representing each plant property. Many coal plants are both located near flood zones and also cover a large area (generally between 200 and 400 acres).[237] Therefore, some plants that this analysis determined were outside the limits of a flood zone may in fact overlap with a flood zone.

Oil Trains and Pipelines

To find the length of Bakken-Chicago oil rail line and Keystone Pipeline located within a flood zone, route geographies were overlaid with flood zone data from FEMA. Rail line geographic data was downloaded from the U.S. Department of Transportation.[238] The likely rail route was determined using the methodology described on page 13, using rail loading and unloading station data from Oil Change International.[239]

Keystone Pipeline geographic data was downloaded from the Keystone Mapping Project.[240] Pipeline waterway crossings by state were found using a path intersection analysis using QGIS software.

Fracking Wastewater

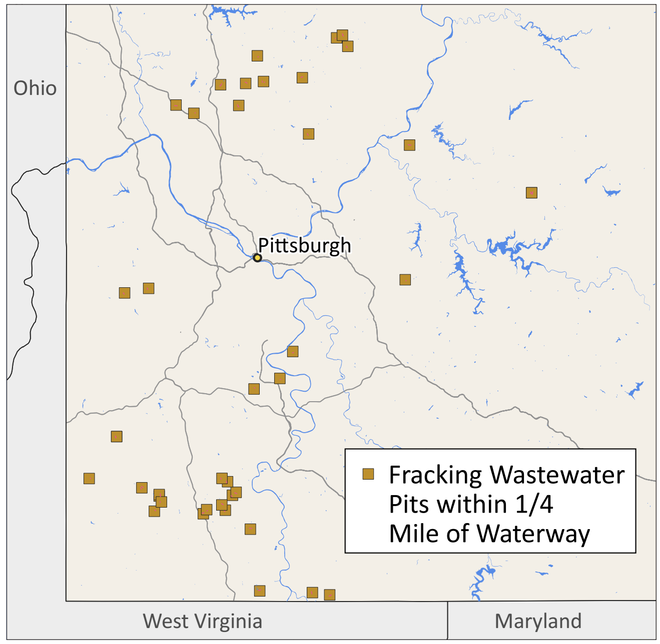
To find fracking wastewater pit sites within a quarter mile of waterways, wastewater site locations were overlaid with hydrographic data from the USGS. Fracking wastewater pit site location data were downloaded from SkyTruth.[241]

THREAT SPOTLIGHT:
Wastewater Pits in Pennsylvania

Data on fracking wastewater sites is very limited. The state with the most comprehensive wastewater pit information is Pennsylvania, thanks to satellite imagery analyses conducted over the last decade by the organization SkyTruth.[227] Although many of the pits identified in past years are no longer in use, their placement is likely illustrative of pits located elsewhere in the nation. In Pennsylvania, most wastewater pits were banned in October 2016, although some centralized waste pits are allowed to continue in use if they are permitted.[228]

Among 254 fracking wastewater pits identified by SkyTruth in 2015, more than one in four – 69 total – were located within a quarter-mile of a stream or river. The below image shows one such wastewater pit, located approximately 600 feet from the Loyalsock Creek by Montoursville. The pit and former well pad are also across the street from a residential community and down the street from Loyalsock Valley Elementary School.[229]

Figure 10. More than One in Four Pennsylvania Fracking Waste Pits Is within a Quarter Mile of a Stream or River, Including Many in Southwest Pennsylvania[230]



A fracking wastewater pit by Loyalsock Creek in Pennsylvania. Image: ©2019 Google[231]

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