Petrochemical Toxics in the Ohio River Watershed

Survey and Mapping of Permitted Toxic Discharges in Pennsylvania, Ohio and West Virginia

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EARTHWORKS

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AUTHORS:

Ryan Talbott with Erica Jackson/FracTracker

CONTRIBUTORS:

Alan Septoff

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Shell Petrochemical Complex (aka Ethane Cracker) under construction.
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Executive Summary

Context

On the banks of the Ohio River in southwestern Pennsylvania, one of world's largest fossil fuel companies, Royal Dutch Shell, is building a petrochemical complex that, if it becomes operational, will flood the world with 1.6 million tons of plastic each year. This toxic facility is just the first in a planned buildout that could turn the Ohio River valley into a petrochemical hub similar to what exists along the Mississippi River between Baton Rouge and New Orleans, known as "Cancer Alley." Such a buildout would have devastating consequences on the Ohio River and the millions of people that rely on it for drinking water. Before further expansion of the petrochemical industry occurs in the Ohio River Basin, it is important to understand the industry's current footprint and how much toxic pollution is currently discharged into the Basin's streams and rivers.

Methods

To understand the petrochemical industry's current footprint in the upper Ohio River Basin, we used public databases maintained by the Environmental Protection Agency (EPA) to search for petrochemical-related facilities that had National Pollutant Discharge and Elimination System (NPDES) permits. Once the NPDES permits were compiled, we reviewed each permit to find toxic chemicals that are permitted to be discharged into rivers and streams. Only those toxic chemicals that had mass-based numeric discharge limits (e.g., kg/d) were included in this analysis.

Of the permits reviewed containing mass-based discharge limitations, petrochemical facilities are permitted to annually discharge ***over 500,000 pounds of toxic pollutants into the Ohio River Basin within Ohio, Pennsylvania, and West Virginia.*** These toxic pollutants include known carcinogens like benzene, vinyl chloride, and trichloroethylene and over 100 other chemicals that can affect human health in a variety of ways, including birth defects, developmental disorders, and effects to the central nervous system and endocrine system.

Shell's ethane cracker will significantly increase the rate of permitted discharge of several toxics, including vinyl chloride (68% increase) and trichloroethylene (75% increase).

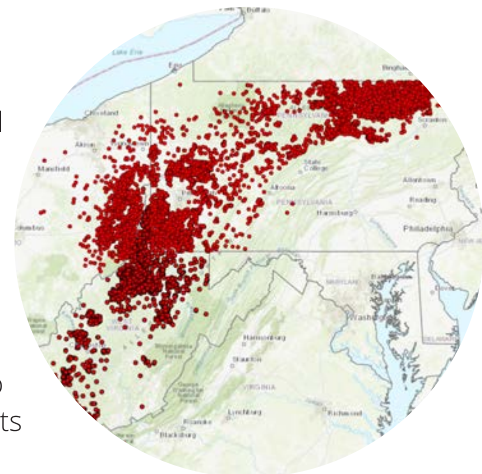
Shell's ethane cracker will increase the rate of permitted discharge of toxic vinyl chloride by 68% and trichloroethylene by 75%.

Takeaways

The Ohio River is already considered one of the most polluted rivers in the country and there are several petrochemical facilities within the watershed that are hazardous waste sites. The expansion of the petrochemical industry in the Ohio River Basin would exacerbate these impacts for the millions of people who live there and rely on the Ohio River for drinking water.

> **Regulatory agencies have also weakened standards meant to improve and protect water quality at the same time that the petrochemical industry targets the Ohio River Basin for expansion. If what's past is prologue, action must be taken now to prevent further expansion of this toxic industry.**

Introduction



In 2004, Range Resources fracked the first Marcellus shale gas well in southwestern Pennsylvania. Since then, thousands of new gas wells have been fracked in the Marcellus and Utica shale formations. In Pennsylvania alone, there are over 12,000 active shale gas wells[1] with thousands more in Ohio and West Virginia.[2] This fracking boom resulted in a massive expansion and reconfiguration of natural gas infrastructure across the country. Thousands of miles of new and reconfigured pipelines were constructed to transport fracked natural gas out of these three states to markets around and outside the country.

There are 12,000+ active shale gas wells in Pennsylvania, and thousands more in Ohio and West Virginia.

All of this came with significant social and environmental costs. Residents adjacent to fracking infrastructure have faced health impacts, and the chemicals released by the industry have been tied to impacts to the immune system, sensory organs, liver, and kidney, contributing to cancers, neurotoxicity, and reproductive and developmental toxicity.[3] Forests across these states have been fragmented with rampant construction of roads, well pads, pipelines, compressor stations, and other related infrastructure. Emissions of methane, a potent greenhouse gas, have skyrocketed at a time when we must be reducing greenhouse gas emissions to stave off the worst effects of climate change. While wealthier neighborhoods are less likely to face encroachments from the oil and gas industry,[4] many communities and landowners have suffered from increased industrialization of rural areas, contaminated water supplies, and loss of property through eminent domain.

Oil and gas infrastructure in Pennsylvania, Ohio and West Virginia has impacted residents' health in myriad ways.

Another impact of the fracking boom now looms on the horizon—turning the Ohio River Basin into a petrochemical hub for the plastics industry.

The Ohio River provides drinking water to over five million people.[5] For decades, the Ohio River "was virtually an open sewer used to dispose of untreated human waste and industrial process water."[6] Historically, Black communities in the Ohio River basin in places like Institute, West Virginia have long experienced the disproportionate health burdens of living in the chemical corridor of the Ohio River basin.[7] Since the 1950s, efforts to clean up the Ohio River have made some progress but it still remains one of the most polluted rivers in the United States, routinely topping that list over the last decade.[8]

The Ohio River provides drinking water to over five million people. It remains one of the most polluted rivers in the United States, routinely topping that list over the last decade.

The buildout of the petrochemical industry threatens to keep the Ohio River at the top of the most polluted river list.

- This report finds the petrochemical buildout would substantially increase the amount of toxic discharges into the basin's rivers and streams.
- It will also result in massive amounts of air pollution, both from the facilities that process natural gas and manufacture plastic as well as the emissions from the continued fracking that will be required to keep these facilities in operation.[9]
- In essence the buildout would be a perpetual pollution machine: oil and gas companies want to lock in long term oil and gas demand just as the end is in sight for fossil fuels as the primary energy source for heating and transportation.

Turning the Rust Belt into the Plastic Belt

When natural gas wells are fracked and drilled, they can produce both dry gas and wet gas. Dry gas is essentially methane: after processing, what some power plants and stoves burn. Wet gas, or "natural gas liquids" (NGLs), include ethane, propane, and butane. Ethane is the most prolific NGL by volume, making up around 10% of natural gas.

However, ethane does not have market value without additional processing. In order to turn ethane into ethylene, a key precursor to many plastic products, it must first be "cracked" by manufacturing plants called "crackers." This process is both energy and water intensive, resulting in the production of large amounts of heavily contaminated wastewater that is eventually discharged into streams and rivers. And while there may be systems in place to treat the wastewater before discharge, the permits these facilities operate under nevertheless allow these companies every year to dump huge quantities of toxics into watersheds including the Ohio River Basin.

In 2016, Shell began construction of the first ethane cracker that is part of the petrochemical industry's plans for the Ohio River Basin. The state of Pennsylvania granted Shell a $1.6 billion tax break to locate this facility along the banks of the Ohio River about 25 miles northwest of Pittsburgh.[10] When completed and in operation, this petrochemical complex will require 1,000 new wells to be fracked every three to five years.[11]

Unfortunately for communities, the agencies that are charged with protecting our water are in some cases weakening standards; the result is that it is easier for facilities like Shell's ethane cracker to operate with repeated violations. For example, in 2019, the Ohio River Valley Water Sanitation Commission (ORSANCO), a multi-state commission charged with protecting the Ohio River from industrial

Shell Petrochemicals Complex (aka Ethane Cracker) under construction.

Photos: Below, Digitalwhiz / Adobe Stock. Right, Ted Auch, FracTracker Alliance, 2021. Aerial support provided by LightHawk.

pollution[12], eliminated the requirement for its member states to comply with its water quality standards. Until 2019, ORSANCO required "specific wastewater discharge requirements" to be "incorporated into discharge permits."[13] In 2019, however, ORSANCO eliminated that requirement, stating that its standards are now "advisable" rather than mandatory.[14]

ORSANCO also weakened its standards regarding "mixing zones" in the Ohio River. A mixing zone is an "area or volume of water where initial dilution of a discharge takes place and where certain numeric water quality criteria may be exceeded."[15] In other words, mixing zones are parts of a river where regulators allow permit holders to exceed the limits set in their permits.

Regulators have weakened standards to allow industry to exceed the limits set in their discharge permits.

When ORSANCO revised its pollution control standards in 2013, it imposed a sunset provision to eliminate mixing zones for bioaccumulative chemicals of concern (BCCs) "no later than October 16, 2015."[16] This prohibition applied "immediately" to discharges of BCCs that came into existence after October 16, 2003.[17] However, when it revised its standards again in 2019, ORSANCO removed that sunset provision, stating instead that mixing zones for BCCs should be eliminated "as soon as practicable."[18] Eliminating the requirement to ban mixing zones for BCCs by a certain date opens the door for more of these dangerous chemicals to be discharged into the Ohio River indefinitely.

The timing of ORSANCO's decision and the construction of Shell's ethane cracker can hardly be overlooked[19] and the message is clear: the Ohio River Basin's water supplies are increasingly at risk.

Methodology/Data Acquisition

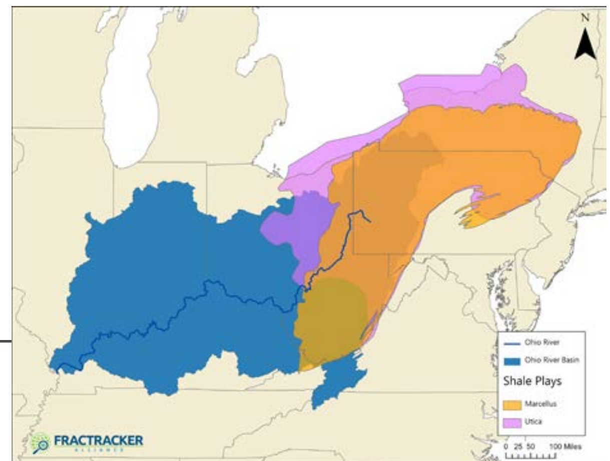
Under the Clean Water Act, the discharge of any pollutant into streams and rivers (waters of the United States) is unlawful unless the United States Environmental Protection Agency (EPA) or a delegated state agency issues a permit to allow it[20] via the National Pollutant Discharge Elimination System (NPDES).[21] Under the NPDES permitting process, permits are issued as either general or individual permits.[22] A general permit is not issued to any one specific facility but rather covers a class of facilities that have similar operations and discharges. An individual permit is tailored to a specific facility for activities that are not covered by a general permit.

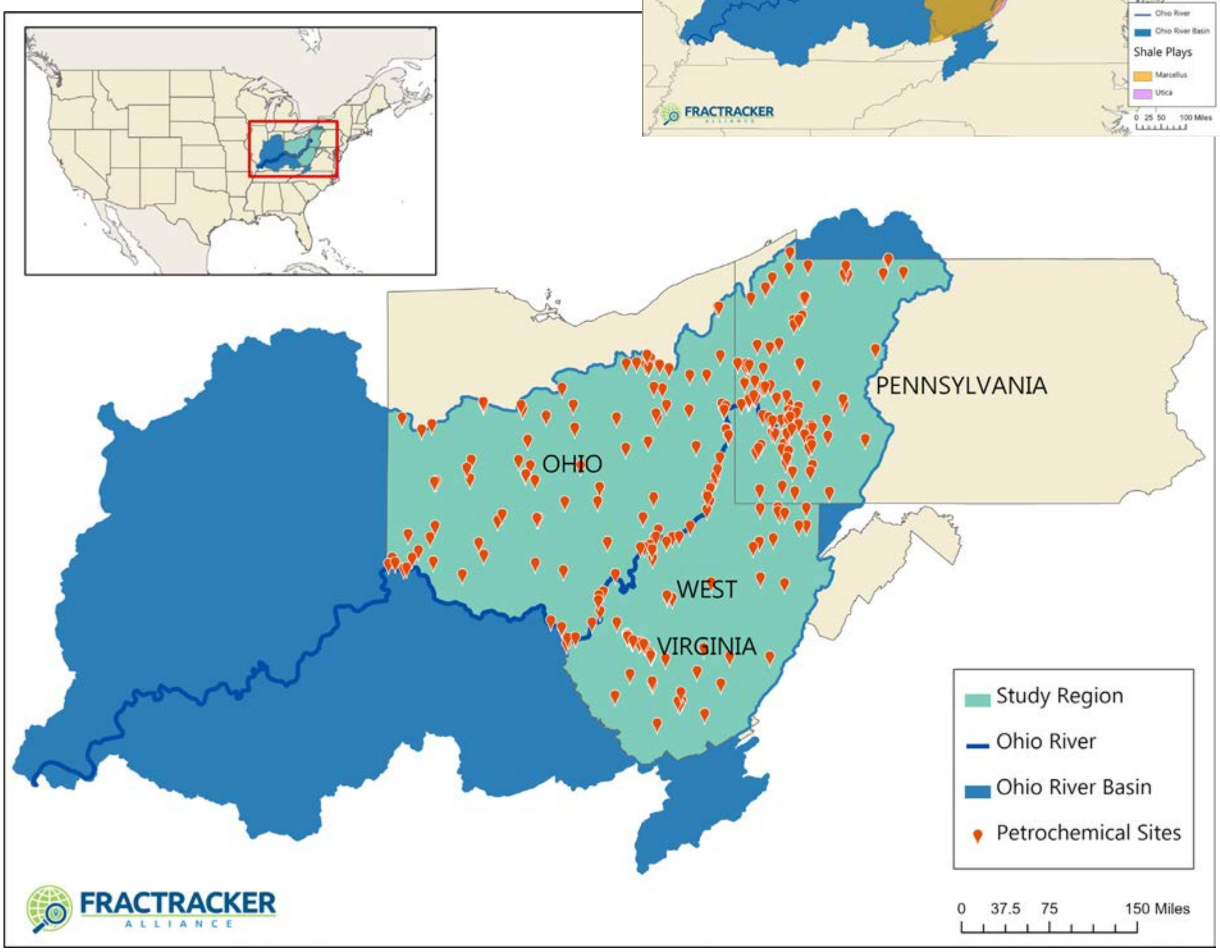
Facilities operating under individual permits are categorized as either "major" or "minor" facilities. For industrial dischargers, EPA classifies major facilities based on a point system using several criteria, including " toxic pollutant potential, flow volume, and water quality factors such as impairment of the receiving water or proximity of the discharge to coastal waters."[23] If the facility scores over a certain point threshold because it has a large discharge volume or is discharging a lot of toxic pollutants, then it is classified as a "major" facility. Facilities that do not exceed the point threshold are considered "minor" facilities.

Effluent limitations are set in NPDES permits for pollutants in terms of maximum pollutant load or concentration.[24] Once a facility obtains an NPDES permit, it is lawful for that facility to discharge the listed pollutants into streams and rivers up to the limits established in the permit.

The study area for this report is the Ohio River Basin within Ohio, Pennsylvania, and West Virginia (which are also the three states where the vast majority of fracking has occurred in the Marcellus and Utica shale formations).

The Ohio River Basin is heavily impacted by both the fracking and petrochemical industries in part because the Utica and Marcellus shale plays overlap within the basin.





To find petrochemical industry-related facilities, we first used the Watershed Statistics page on EPA's Enforcement and Compliance History Online (ECHO) database to get a list of all facilities with NPDES permits within the Ohio River Basin.[25] Next, we limited the results to the three-state study area and used the following NAICS and SIC codes[26] to narrow the facility list to petrochemical facilities.

TABLE 1: NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM (NAICS) CODES AND DESCRIPTIONS

NAICS Code	NAICS Description
324110	Petroleum Refineries
324191	Petroleum Lubricating Oil and Grease Manufacturing
324199	All Other Petroleum and Coal Products Manufacturing
325110	Petrochemical Manufacturing
325132	Synthetic Organic Dye and Pigment Manufacturing
325182	Carbon Black Manufacturing
325192	Cyclic Crude and Intermediate Manufacturing
325193	Ethyl Alcohol Manufacturing
325199	All Other Basic Organic Chemical Manufacturing
325211	Plastics Material and Resin Manufacturing
325212	Synthetic Rubber Manufacturing
325311	Nitrogenous Fertilizer Manufacturing
325510	Paint and Coating Manufacturing
325520	Adhesive Manufacturing
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing
326113	Unlaminated Plastics Film and Sheet (except Packaging) Manufacturing
326122	Plastics Pipe and Pipe Fitting Manufacturing
326130	Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing
326140	Polystyrene Foam Product Manufacturing
326150	Urethane and Other Foam Product (except Polystyrene) Manufacturing
326199	All Other Plastics Product Manufacturing
326211	Tire Manufacturing (except Retreading)
326291	Rubber Product Manufacturing for Mechanical Use
326299	All Other Rubber Product Manufacturing
339999	All Other Miscellaneous Manufacturing
424710	Petroleum Bulk Stations and Terminals

TABLE 2: STANDARD INDUSTRIAL CLASSIFICATION (SIC) CODES AND DESCRIPTIONS	
SIC Code	**SIC Description**
2911	Petroleum Refining
2992	Lubricating Oils and Greases
2999	Product of Petroleum and Coal, Not Elsewhere Classified
2869	Industrial Organic Chemicals, Not Elsewhere Classified
2895	Carbon Black
2865	Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments
2821	Plastics Materials, Synthetic Resins, and Nonvulcanizable Elastomers
2822	Synthetic Rubber (Unvulcanizable Elastomers)
3086	Plastic Foam Products
2873	Nitrogenous Fertilizers
2851	Paints, Varnishes, Lacquers, Enamels, and Allied Products
2891	Adhesives and Sealants
2899	Chemicals and Chemical Preparations, Not Elsewhere Classified
3081	Unsupported Plastics Film and Sheet
3084	Plastics Pipe
3089	Plastics Products, Not Elsewhere Classified
9999	Nonclassifiable Establishments
3011	Tires and Inner Tubes
3061	Molded, Extruded, and Lathe-Cut Mechanical Rubber Goods
3069	Fabricated Rubber Products, Not Elsewhere Classified
2879	Pesticides and Agricultural Chemicals, Not Elsewhere Classified
5171	Petroleum Bulk Stations and Terminals
1321	Natural Gas Liquids
3052	Rubber and Plastics Hose and Belting
3053	Gaskets, Packing, and Sealing Devices
3082	Unsupported Plastics Profile Shapes
3083	Laminated Plastics Plate, Sheet, and Profile Shapes
4932	Gas and Other Services Combined
5172	Petroleum and Petroleum Products Wholesalers, Except Bulk Stations and Terminals

After narrowing the selection by NAICS and SIC codes, we identified approximately 250 facilities with NPDES permits in the study area. We then used the Water Pollution Search[27] page on EPA's ECHO database to obtain the NPDES permit data for each facility. Of the approximately 250 total facilities, about 90 facilities are covered under general permits while the remaining facilities have individual permits.[28] Of the facilities covered by individual permits, 32 facilities are considered "major" facilities while the rest are considered minor (or non-major) facilities.

Next, we used the permitted pollutant discharge data for each permit in ECHO to cross-reference for any toxic or hazardous pollutants that appear on any of the following lists:

TABLE 3: TOXIC AND HAZARDOUS POLLUTION LISTS	
Toxic / Hazardous List	**Statutory / Regulatory Source**
Toxic Release Inventory	Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA)
Toxic Pollutants	40 C.F.R. § 401.15
Toxic Characteristics	40 C.F.R. § 261.24
Hazardous Waste	40 C.F.R. §§ 261.31 and 261.32
Discarded Commercial Chemical Products	40 C.F.R. § 261.33

Finally, we added the estimated permitted annual discharge for each toxic or hazardous pollutant across all facilities for those permits containing mass-based effluent limitations.

Results

Of the permits reviewed containing mass-based effluent limitations, petrochemical facilities are permitted to annually discharge over 500,000 pounds of toxic pollutants into the Ohio River Basin within Ohio, Pennsylvania, and West Virginia.

As part of this research FracTracker created an interactive map visualizing petrochemical sites and the toxics they are permitted to discharge in three states of the Ohio River Basin (Ohio, West Virginia, and Pennsylvania).

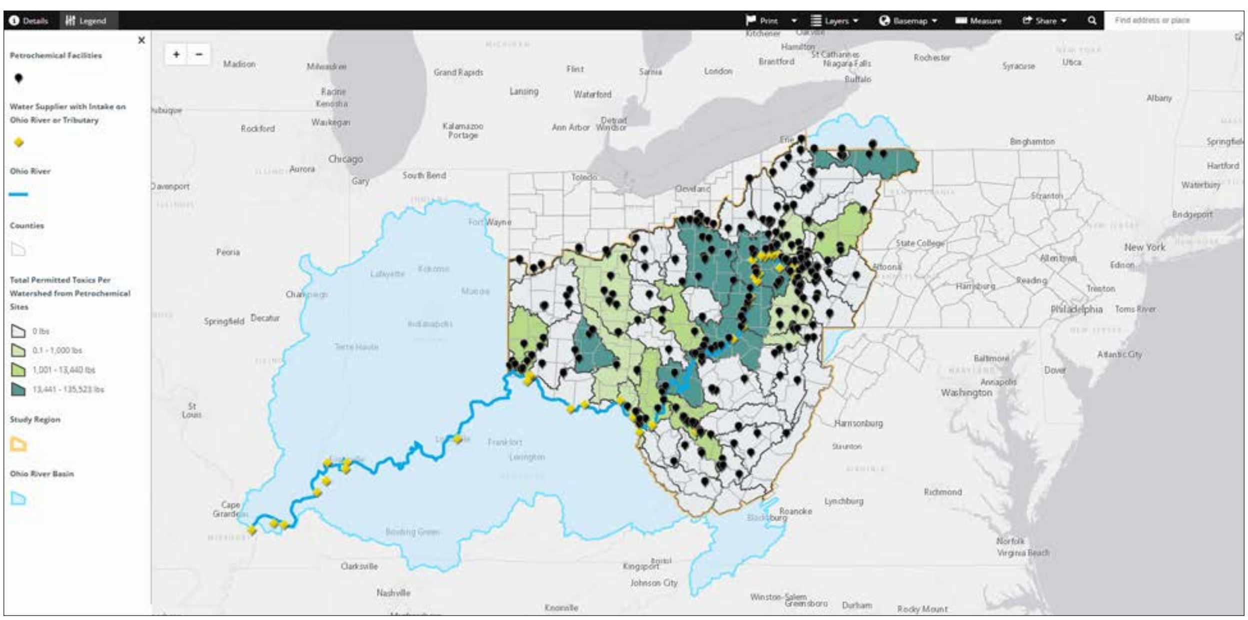


TABLE 4: ANNUAL PERMITTED DISCHARGE LIMITS OF TOXIC POLLUTANTS (LBS/YEAR)		
Chemical Classification[29]	**Toxic Pollutant**	**Permitted Annual Discharge (lbs) Facility Total**
Volatile Organic Compounds—(VOC)	1,1-Dichloroethane	733.92
	1,1-Dichloroethylene	446.19
	1,1,1-Trichloroethane	6,058.24
	1,1,2-Trichloroethane	2,084.50
	1,2-Dichlorobenzene	2,533.51
	1,2-Dichloroethane	2,802.64
	1,2-Dichloropropane	4,586.54
	1,2,4-Trichlorobenzene	5,630.88
	1,3-Dichlorobenzene	849.49
	1,3-Dichloropropene	567.97
	1,4-Dichlorobenzene	409.17
	2,4-Dinitrotoluene	3,090.93
	2,6-Dinitrotoluene	7,152.16
	Acrolein	28.49
	Acrylonitrile	3,375.60
	Benzene	1,564.02
Volatile Organic Compounds—(VOC)	Carbon tetrachloride	506.80
	Chlorobenzene	497.14
	Chloroethane	3,808.11
	Chloroform	1,880.07
	Dichlorobromomethane	116.78
	Ethylbenzene	2,064.54
	Hexachlorobenzene	76.70
	Hexachlorobutadiene	372.79
	Hexachloroethane	475.65
	Methyl chloride (Chloromethane)	4,424.36
	Methylene chloride	1,949.29
	Nitrobenzene	737.78
	Styrene	13.76
	Tetrachloroethylene (PERC)	686.84
Volatile Organic Compounds—(VOC)	Toluene	1,528.77
	trans-1,2-Dichloroethylene	520.24
	Trichloroethylene	1,651.66
	Vinyl chloride	9,671.10
VOC TOTAL		**72,896.63 lbs/year**

Table continued next page

TABLE 4: ANNUAL PERMITTED DISCHARGE LIMITS OF TOXIC POLLUTANTS (LBS/YEAR)		
Chemical Classification[29]	**Toxic Pollutant**	**Permitted Annual Discharge (lbs) Facility Total**
Phthalates	Dibutyl phthalate	1,134.88
	Di[2-ethylhexyl] phthalate (DEHP)	5,032.49
	Diethyl phthalate	2,731.50
	Dimethyl phthalate	532.15
PHTHALATES TOTAL		**9,431.02 lbs/year**
Phenols	2-Chlorophenol	711.22
	2-Nitrophenol	951.46
	2,4-Dichlorophenol	896.17
	2,4-Dimethylphenol	520.00
	2,4-Dinitrophenol	1,652.47
	4-Nitrophenol	1,671.62
	4,6-Dinitro-o-cresol	1,762.00
	Phenol	586.32
	Total Phenols[30]	2,791.94
PHENOLS TOTAL		**11,543.20 lbs/year**
Polycyclic Aromatic Hydrocarbons (PAH)	Acenaphthene	614.64
	Acenaphthylene	608.77
	Anthracene	298.93
	Benz[a]anthracene	504.63
	Benzo[a]pyrene	552.83
	Benzo[b]fluoranthene	504.28
	Benzo[k]fluoranthene	521.77
	Chrysene	527.64
	Fluoranthene	572.23
	Fluorene	619.72
	Naphthalene	654.48
	Phenanthrene	564.91
	Pyrene	690.38
PAH TOTAL		**7,235.21 lbs/year**

Table continued next page

TABLE 4: ANNUAL PERMITTED DISCHARGE LIMITS OF TOXIC POLLUTANTS (LBS/YEAR)		
Chemical Classification[29]	**Toxic Pollutant**	**Permitted Annual Discharge (lbs) Facility Total**
Pesticides	4,4′-DDD	0.16
	4,4′-DDE	0.08
	4,4′-DDT	0.08
	Aldrin	0.35
	Alpha-BHC	1.93
	Dieldrin	0.02
	Endrin	0.80
	Heptachlor	0.56
PESTICIDES TOTAL		**3.98 lbs/year**
Metals	Aluminum	1,358.95
	Barium	507.04
	Chromium	10,575.40
	Chromium, Hexavalent	201.61
	Copper	23,561.41
	Iron	27,082.36
	Lead	2,632.58
	Manganese	2,293.75
	Mercury	1.72
	Nickel	19,951.61
	Phosphorus	16,359.52
	Selenium	16.10
	Sulfide	3,091.57
	Zinc	21,426.86
METALS TOTAL		**129,060.48 lbs/year**
Inorganic Substances	Ammonia as N	212,180.38
	Cyanide	8,264.75
	Fluoride	7,645.84
INORGANIC SUBSTANCES TOTAL		**228,090.97 lbs/year**
Radionuclides	Strontium	48,530.95
Dioxins, Furans, PCBs	PCBs	0.02
GRAND TOTAL		**506,792.46 lbs/year**

Nearly 80% of the total annual toxic discharge that is permitted comes from about two dozen major facilities.

TABLE 5: MAJOR FACILITIES WITH TOXIC DISCHARGES IN THE OHIO RIVER BASIN WITHIN OHIO, PENNSYLVANIA, AND WEST VIRGINIA[31]		
Major Facilities	**NPDES Permit ID**	**Estimated Permitted Facility Discharge Limit (lbs/year)**
Solvay Specialty Polymers USA	OH0003905	14,655.08
Marathon Petroleum Canton Refinery	OH0005657	19,605.54
Durez Corporation	OH0006769	758.08
Kraton Polymers Belpre Plant	OH0007030	9,092.11
Arizona Chemical Company	OH0007196	18,652.66
Dover Chemical Corp.	OH0007269	607.72
INEOS ABS (USA) Corporation	OH0009946	8,200.39
Dow Chemical Company	OH0099309	0.01
Eastman Chemical Company	PA0000507	47.24
Calumet Karns City Refining	PA0002135	5,909.75
Shell Chemical Appalachia[32]	PA0002208	28,339.18
Sonneborn	PA0002666	7,533.49
American Refining Group	PA0002674	1,641.52
United Refining Company	PA0005304	133,705.58
Nova Chemicals Incorporated	PA0006254	29,954.30
Union Carbide Institute Plant	WV0000086	8,759.39
MPM Silicones	WV0000094	43,542.24
APG Polytech	WV0000132	1,091.10
Braskem America Neal Plant	WV0001112	1,000.72
Chemours – Belle Plant	WV0002399	5,648.66
ICL-IP America Inc.	WV0002496	689.82
Koppers Follansbee Tar Plant	WV0004588	390.82
Ergon West Virginia Inc.	WV0004626	56,942.82
Chemtura North and South Plants	WV0004740 WV0022047	256.90
Bayer MaterialScience	WV0005169	4,757.96
TOTAL		**401,783.08 lbs/year**

Environmental Injustice

Many of the major facilities in Table 5 have long records of significant contamination of the land, air, and water around them. For example, six facilities have been subject to corrective actions pursuant to EPA's authority under the Resource Conservation and Recovery Act (RCRA), as shown in Table 6.

These six facilities are all located in West Virginia, a state with a long and checkered history of sacrificing frontline communities' health in service of corporate polluters, including the 2014 Elk River chemical spill that deprived Charleston-area resident of drinking water and the 1985 Union Carbide toxic leak that led to the passage of the Emergency Planning and Community Right-to-Know Act.

TABLE 6: MAJOR FACILITIES SUBJECT TO EPA'S CORRECTIVE ACTION PROGRAM UNDER RCRA

Facility (location)	Contaminants	Permitted Discharge (lbs/y)
Bayer Material Science (New Martinsville, WV)[33]	1,2-Dichlorobenzene, DEHP, phenol, 2,4-Dinitrotoluene, 2,4-Tolunediamine, aniline, and nickel	4,757.96
Chemtura (Morgantown, WV)[34]	1,2-Dichloroethane, trichloroethane, trichloroethene, perchloroethylene, and arsenic (North Plant); perchloroethylene, trichloroethene, and polyaromatic hydrocarbon compounds (PACs) (South Plant)	148.57
Chemours Belle Plant (Belle, WV)[35]	Acetone, benzene, 2-butanone, phenol, toluene, xylene	5,648.66
MPM Silicones (Friendly, WV)[36]	Benzene, monochlorobenzene, 1,2-Dichlorethylene, Toluene, and 1,1- Dichloroethane	43,542.24
Union Carbide Institute Plant (Institute, WV)[37]	Benzene, chlorobenzene, chloroform, carbon tetrachloride, and tetrachloroethene	8,759.39
Koppers Follansbee Tar Plant (Follansbee, WV)[38]	Naphthalene, phenol, volatile organics (benzene, xylene, toluene, ethylbenzene, trichloroethene and trichlorobenzene), polycyclic aromatics, cyanide, and metals	390.82
TOTAL		**63,247.64 lbs/year**

West Virginia's Kanawha River Valley has one of the highest concentrations of chemical facilities in the country, earning it the nickname, "Chemical Valley." These facilities produce explosives, antifreeze, solvents, pesticides, per- and polyfluoroalkyl substances (PFAS), chlorine, and other chemical products.

Two of the sites from Table 6 are along the Kanawha River: the Chemours Plant and the Union Carbide Institute Plant. The Union Carbide Institute Plant is located in the town of Institute, a historically Black community that has faced decades of environmental racism from the chemical industry. Union Carbide used to produce and store the lethal chemical methyl isocyanate in Institute, the same chemical that leaked from a Union Carbide plant in Bhopal, India in 1984, killing thousands of people. Thanks in part to community organizing efforts, the West Virginia plant no longer produces this chemical. However, chemical plants in and around Institute continue to impact residents' health, and air emissions here drive elevated cancer risks from air toxics.[39]

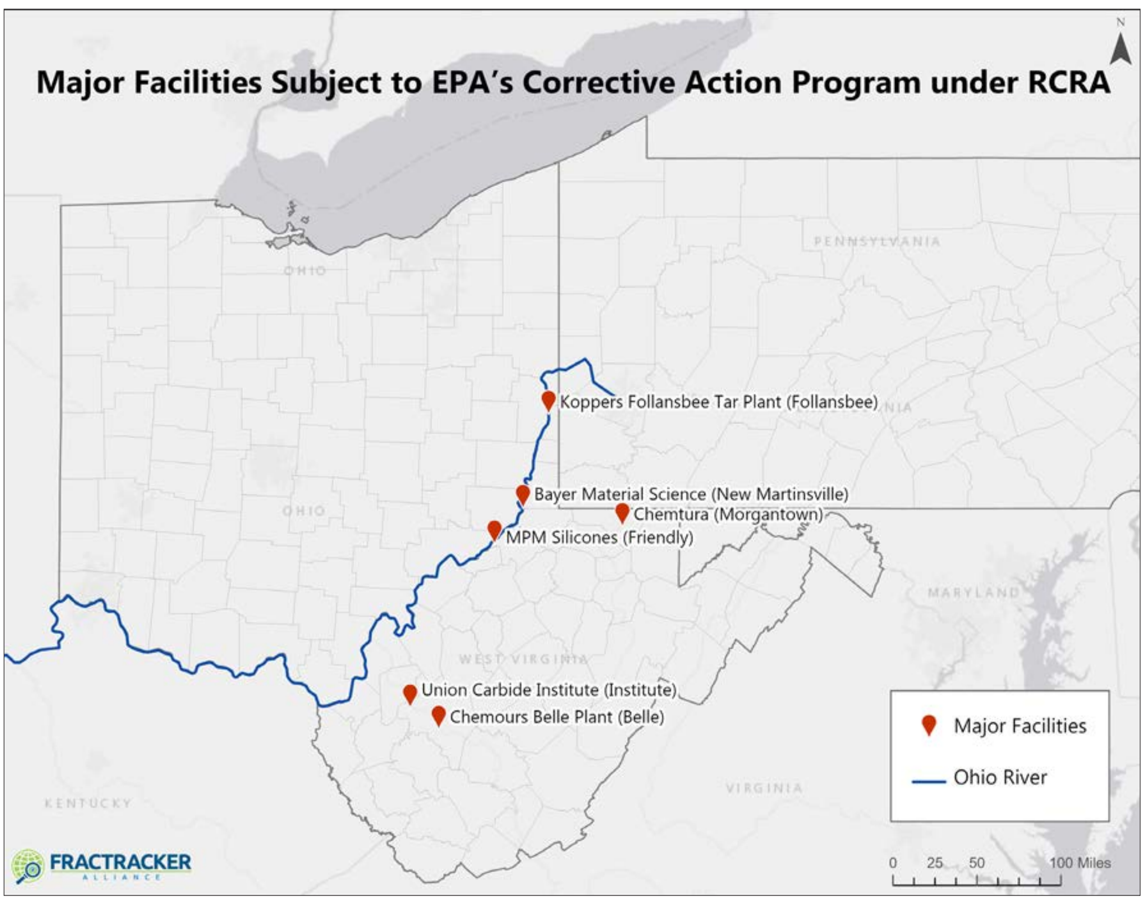
This analysis found 20 sites located in the Upper and Lower Kanawha Watersheds along the Kanawha River, in and around the city of Charleston, which contained the 9th and 11th highest concentrations of toxic pollutants per watershed in this study.

Facilities that are subject to EPA's Corrective Action authority under RCRA have "risks comparable to Superfund Sites" and include current and former chemical manufacturing plants, oil refineries, lead smelters, wood preservers, steel mills, and commercial landfills.[40] Some of the sites listed above have been subject to corrective action for years.

For example, EPA initiated corrective action against the Chemours plant in Belle, West Virginia, in 1998.[41] In 2015, nearly twenty years later, EPA and the facility owner were still analyzing data to determine how to clean up the toxic contaminants at this site.[42] In other words, once these facilities contaminate the soil and water underneath and around them, it can take years, if not decades, to simply develop a cleanup plan, let alone actually removing the contaminants.

And the toxics contaminating these facilities include known carcinogens like benzene and trichloroethylene. Benzene has been linked to increased incidence of leukemia in occupational exposure in humans as well as developmental effects in animals such as low birth weight, delayed bone formation, and bone marrow damage.[43] Exposure to trichloroethylene has been associated with cancers of the kidney, liver, cervix, and lymphatic system (with the strongest support for kidney cancer).[44] And because of trichloroethylene's moderate water solubility, it has the potential to migrate into groundwater and, in fact, is frequently detected in groundwater.[45] This is of particular concern as there may be a link between the occurrence of congenital heart defects in children and drinking water contaminated with trichloroethylene.[46]

Petrochemical hazardous waste sites in West Virginia's Ohio River basin identified by the U.S. EPA for corrective action under RCRA.



The Petrochemical Buildout Will Substantially Increase the Toxic Discharges that are Permitted in the Ohio River Basin

Based on a review of the collected NPDES permits, the petrochemical buildout that is planned for the Ohio River Basin will substantially increase the permitted amount of toxic pollutant discharge. As Table 5 above shows, the Shell ethane cracker alone will increase the amount of permitted discharge by over 28,000 lbs/year, a 7 percent increase for those pollutants with mass-based effluent limits. Considering Shell's ethane cracker is just one of the nearly 130 petrochemical facilities[47] that are part of the petrochemical buildout in the Ohio River Basin (existing or planned), it makes clear that additional petrochemical infrastructure will only exacerbate the toxic discharges into the basin's streams and rivers.

And when looking at some of the pollutants individually, Shell's ethane cracker will be the largest discharger by far of certain toxic pollutants, VOCs in particular. In fact, of the more than thirty VOCs that are permitted for discharge from Shell's ethane cracker, there are six in which the permitted discharge is higher than all other facilities combined based on those facilities with mass-based discharge limits in their permits. This includes 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, 1,2,4-Trichlorobenzene, Hexachlorobenzene, Trichloroethylene, and Vinyl Chloride.

As discussed above, trichloroethylene has been linked to multiple cancers and is a frequent water contaminant. Trichloroethylene could also be connected to congenital heart defects in children who drink water contaminated with it. Increases in other contaminants is equally concerning, as Table 7 shows.

Permitted discharges for six VOCs in the Ohio River Basin (Pennsylvania, Ohio, West Virginia), comparing the combined total permitted for all other facilities vs Shell Petrochemical Complex.

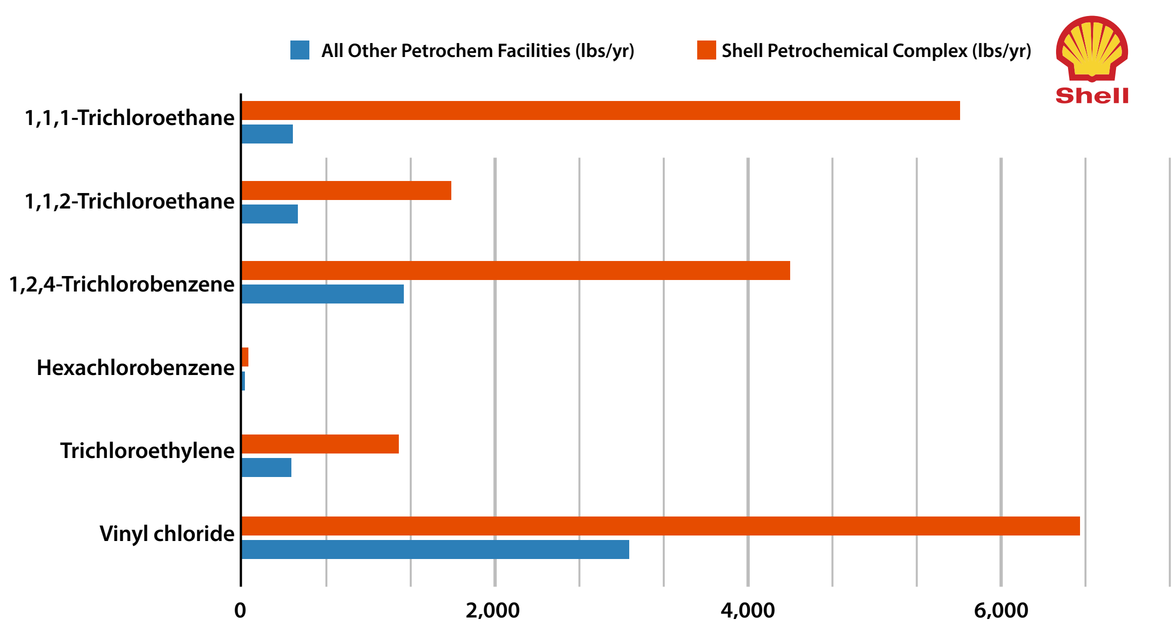


TABLE 7: HEALTH EFFECTS OF 1,1,1-TRICHLOROETHANE, 1,1,2-TRICHLOROETHANE, 1,2,4-TRICHLOROBENZENE,HEXACHLOROBENZENE, TRICHLOROETHYLENE, AND VINYL CHLORIDE				
Pollutant	**Acute Effects**	**Chronic Effects**	**Cancer**	**Reproductive /Developmental**
1,1,1-Trichloroethane[48]	Skin irritation	Liver damage and neurological effects to low levels	Not classified	No data
1,1,2-Trichloroethane[49]	Skin irritation. Animal studies report effects on liver, kidneys, and central nervous system	Animal studies report effects on liver and immune system; one study reported liver tumors and adrenal tumors	Possible human carcinogen	No data
1,2,4-Trichlorobenzene[50]	Oral animal studies produced alterations of liver and kidneys	Oral animal studies produced alterations of liver and kidneys	Not classified[51]	Little data but it has been found in human breast milk
Hexachlorobenzene[52]	No data in humans	Animal studies report effects on liver, skin, immune system, kidneys, and blood from oral exposure	Probable human carcinogen	Decreased survival rates of newborn animals; crosses the placenta and accumulates in fetal tissue of several animal species Neurological, teratogenic, liver, and immune system effects in offspring of animals orally exposed while pregnant
Trichloroethylene[53]	Effects to central nervous system, liver, kidneys, gastrointestinal system, and skin	Effects to liver, kidney, and immune and endocrine systems	Carcinogenic	Association between occurrence of congenital heart disease in children and a drinking water supply contaminated with TCE
Vinyl Chloride[54]	Effects to central nervous system, loss of consciousness, lung and kidney irritation, and inhibition of blood clotting in humans	Liver damage, effects to central nervous system	Carcinogenic	Association between vinyl chloride exposure in pregnant women and increased incidence of birth defects

Once some of these chemicals are discharged, they do not easily break down. For example, EPA has classified hexachlorobenzene as a persistent bioaccumulative toxic (PBT) chemical with a reporting threshold of 10 pounds.[55] EPA has also listed hexachlorobenzene as a pollutant of concern to EPA's Great Waters Program due to its "persistence in the environment, potential to bioaccumulate, and toxicity to humans and the environment."[56] The amount of hexachlorobenzene permitted to be discharged at Shell's ethane cracker is 2.5 times the reporting threshold.

In addition, several other toxics that are permitted for discharge from Shell's ethane cracker are included on a list of "high-priority" chemicals that EPA recently selected to determine whether they pose an unreasonable risk to human health.[57] In fact, nearly half of the twenty chemicals EPA selected to undergo this risk analysis are permitted for discharge at Shell's ethane cracker in Table 8.

TABLE 8: EPA'S "HIGH-PRIORITY" CHEMICALS UNDERGOING RISK ANALYSIS	
"High-Priority" Chemical	**Shell's Annual Permitted Discharge (lbs/year)**
p-Dichlorobenzene	58.43
1,1-Dichloroethane	85.80
1,2-Dichloroethane	265.02
trans-1,2-Dichloroethylene	81.76
o-Dichlorobenzene	300.03
1,1,2-Trichloroethane	1,641.84
1,2-Dichloropropane	594.93
Dibutyl phthalate	105.11
Di-ethylhexyl pthalate	401.53
Total	**3,534.45 lbs/year**

Key Takeaways

This report provides a snapshot of the existing permitted toxic discharges in the Ohio River Basin to understand how the petrochemical buildout that is planned across this region will exacerbate toxic loading in a river that is all-too-often considered one of the most polluted in the nation.

Of the NPDES permits that were reviewed, permit holders are allowed to discharge over 500,000 lbs/year of toxic pollutants into the Ohio River Basin's streams and rivers. This amount is what is legally permitted under the Clean Water Act. What they actually release might exceed these limits.

These toxic pollutants include known and probable carcinogens, endocrine disruptors, and PBTs.

Importantly, this is almost certainly a conservative estimate because this report only included those permits that contained mass-based (kg/d) effluent limitations. A broader look at permits containing both mass-based and concentration-based limits would likely reveal that the permitted discharge of toxic pollutants is higher than 500,000 lbs/y.

Much of the Ohio River Basin has been affected by polluting industries over the last century. Many plant locations along the Ohio, Monongahela, Allegheny, and Kanawha Rivers are considered hazardous waste sites and are subject to EPA's Corrective Action authority under RCRA. This requires the plant owners to work with EPA to develop and implement a site cleanup plan. However, it can take years, if not decades, to simply develop a site cleanup plan and actually cleaning up the site could be even further away.

One problem encountered in researching EPA's ECHO database is that many NPDES permits were listed as expired. However, upon following up with state regulators, many of these permits were in various stages of renewal. While the renewal process moved forward, the "expired" permit was "administratively continued," allowing the facility to continue operating.[58] This process of "administratively continuing" expired permits can drag on for years, even for facilities that may have significant toxic discharges.

One such site is Aquatech's wastewater treatment plant along the Allegheny River in Franklin, PA. Aquatech's NPDES permit allowed it to discharge over 77 million pounds of chloride each year.[59] According to EPA, this high amount was because Aquatech did not incorporate available pollutant removal technologies that other similar facilities utilized.[60] Although the permit expired in 2014, the facility continued operating for several years under an administratively continued permit.[61] In 2018, Aquatech and PADEP entered into a consent agreement based, in part, on Aquatech installing the necessary treatment equipment.[62]

ORSANCO's decision to eliminate the requirement for member states to comply with its water quality standards and to eliminate its ban on BCCs by a certain date are further signs that regulators are too often willing to cater to oil and gas interests at the expense of water quality. These requirements were in place to set a minimum benchmark for states to meet water quality standards and to eliminate the discharge of dangerous chemicals that bioacummulate. Eliminating these requirements is likely to worsen the cumulative effects to the Ohio River from petrochemical and other industrial dischargers.

For example, even though ORSANCO still bans mixing zones for BCCs for discharges that came into existence after October 16, 2003[63], that requirement likely will not apply to Shell's ethane cracker because PADEP allowed Shell to be grandfathered in under the prior permit holder, which dates to 2001.[64] Without the ban on BCC discharges for older facilities, Shell will have no obligation to eliminate BCC discharges for the foreseeable future. And we know that Shell is permitted to discharge at least one BCC, hexachlorobenzene, which accounts for over 75% of that pollutant's permitted annual discharge of the facilities reviewed with mass-based discharge limits.

The combined factors of governments luring petrochemical facilities to locate in the Ohio River Basin with billions of dollars in tax breaks while regulators weaken water pollution control standards does not bode well for a river that already tops the list of most polluted rivers in the country.

The combined factors of governments luring petrochemical facilities to locate in the Ohio River Basin with billions of dollars in tax breaks while regulators weaken water pollution control standards does not bode well for a river that already tops the list of most polluted rivers in the country. But the Ohio River does not have to be at the top of that dubious list. Turning this part of Appalachia into a toxic petrochemical hub is not a foregone conclusion.

Regulators and public officials must not continue repeating the mistakes of the past that have resulted in numerous locations in the Ohio River Basin being declared hazardous waste sites. The Ohio River Basin does not need another wave of industrial development that will not only pollute our land, air, and water, but will pollute the world with more plastic.

Rick Lohre / Adobe Stock

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20 33 U.S.C. § 1341(a)(1). Here, EPA has delegated authority to Ohio, Pennsylvania, and West Virginia to carry out the NPDES permitting program.

21 See 33 U.S.C. § 1342.

22 U.S. Environmental Protection Agency, About NPDES, https://www.epa.gov/npdes/about-npdes.

23 See EPA, NPDES Permit Writers' Manual, 2-17 (Sept. 2010), https://www3.epa.gov/npdes/pubs/pwm_2010.pdf.

24 Effluent limitations can be based on mass loading (kg/d) or concentration (mg/L). For purposes of this report, only the pollutants containing mass-based effluent limits are included. Many of the permits that were reviewed also contain concentration-based limits for other pollutants so the results in this report are a conservative estimate of how much toxic pollution is being discharged in the Ohio River Basin within Ohio, Pennsylvania, and West Virginia.

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26 NAICS Association, https://www.naics.com/search/

27 U.S. Environmental Protection Agency, Water Pollution Search, https://echo.epa.gov/trends/loading-tool/water-pollution-search/. We used the NPDES permit number to search under the "Facility ID" search function

28 Some facilities with individual permits also had general permits covering things like stormwater discharge.

29 We used the chemical classification system from the Agency for Toxic Substances and Disease Registry (ATSDR) to categorize the list of toxic pollutants. See ATSDR, Chemical Classifications, https://wwwn.cdc.gov/TSP/substances/ToxChemicalClasses.aspx. In some instances, chemicals were designated under more than one category. For example, copper is listed under both inorganic substances and metals. In such cases, we selected just one category.

30 In some of the NPDES permits, the specific phenolic chemicals were identified (e.g., 4-Nitrophenol). However, in four of the permits, the permit writer just listed "total phenols" instead of specifying which ones. So the "Total Phenols" in Table 4 reflects the total from those four permits while the "Phenols Total" reflects the combined total for the overall phenols category (i.e., the ones that list out the phenolic chemicals individually and the ones that just used "total phenols").

31 For the permits that had mass-based effluent limits in EPA's ECHO database, that data is provided in kg/d. We used the monthly average to estimate the annual permitted discharge in kilograms and then converted to pounds per year (lbs/y). 1 kg = 2.205 lbs

32 This is Shell's proposed ethane cracker that is currently under construction along the banks of the Ohio River in Beaver County, Pennsylvania. Although it is not in operation yet, the Pennsylvania Department of Environmental Protection (PADEP) has issued an NPDES permit for the petrochemical complex and it is included here. Note that EPA has Shell's current permit in its ECHO database but it is still listed under the site's former owner (Horsehead Corp Monaca Smelter).

33 EPA, Hazardous Waste Cleanup: Covestro LLC (Formerly: Bayer Material Science LLC) in New Martinsville, West Virginia, https://www.epa.gov/hwcorrectiveactionsites/hazardous-waste-cleanup-covestro-llc-formerly-bayer-material-science-llc-new.

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35 EPA, Hazardous Waste Cleanup: Chemours Belle Plant (Formerly: DuPont) in Belle, West Virginia, https://www.epa.gov/hwcorrectiveactionsites/hazardous-waste-cleanup-chemours-belle-plant-formerly-dupont-belle-west.

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37 EPA, Hazardous Waste Cleanup: Union Carbide Corporation – Institute Operations (Formerly: Bayer Cropscience LP) in Institute, West Virginia, https://www.epa.gov/hwcorrectiveactionsites/hazardous-waste-cleanup-union-carbide-corporation-institute-operations.

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46 Ibid.

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