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FRACKING WITH "FOREVER CHEMICALS" IN OHIO

Evidence Shows Oil and Gas Companies Have Used PFAS in Ohio Wells; 'Trade Secret' Laws Limit Public's Ability to Know Full Extent of Use

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Cover photo: Jefferson County, Ohio/USA-March 7, 2019: Oil and gas well on a ridgetop in Eastern Ohio. These wells engage in the controversial practice called fracking to extract oil and natural gas. © iStock 2022

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EXECUTIVE SUMMARY

Previously unpublicized information unearthed by Physicians for Social Responsibility (PSR) shows that a class of extremely toxic and persistent chemicals known as PFAS has been used in Ohio's oil and gas wells since at least 2013. However, gaps in Ohio's disclosure rules prevent the public from knowing how widely PFAS – or other toxic chemicals – have been used in oil and gas drilling and extraction. These findings raise concerns that Ohioans may unknowingly be exposed to highly hazardous substances.

PSR analyzed industry data recorded in FracFocus, one of two official repositories for Ohio's required disclosure of chemicals used in hydraulic fracturing ("fracking") and found that PFAS have been used in Ohio wells for fracking. The affected wells are located in eight Ohio counties: Belmont, Carroll, Columbiana, Guernsey, Harrison, Jefferson, Monroe, and Washington.

In addition, Ohioans could be exposed to PFAS through billions of gallons of wastewater from oil and gas wells in Ohio, Pennsylvania, and West Virginia that have been injected into Ohio's 245 underground injection disposal wells, taken to centralized waste treatment facilities, or spread on roads for de-icing or dust suppression. Pennsylvania records show that between 2012 and 2022, eight wells in that state that had been fracked with PFAS sent their drilling and fracking wastewater to a centralized waste treatment facility in Warren and to injection disposal wells located in 18 other Ohio towns.

However, the number of definitively identified cases of PFAS use may significantly underrepresent the use and presence of PFAS in the state associated with oil and gas operations. That is in large part because Ohio law allows oil and gas companies to withhold fracking chemical identities from the public and regulators by claiming them as a "trade secret." Between 2013 and 2022, companies claimed trade secret privileges in 2,164 wells across 17 Ohio counties. Furthermore, while Ohio is one of two states that require oil and gas companies to publicly disclose at least some of the chemicals used in drilling that precedes fracking, Ohio also allows the companies to withhold these drilling chemical identities from the public and regulators by claiming them as a "trade secret." Records show that oil and gas companies in Ohio have used this provision to conceal such identities.

By shielding from public view the chemicals injected into oil and gas wells, these disclosure gaps raise the potential that Ohioans may be exposed to PFAS and other toxic chemicals from hundreds or even thousands of oil and gas production wells.

Among our key findings are:

- PFAS have been used in oil and gas extraction in Ohio over the past decade.

- Trade secrets make it extremely difficult to determine how extensively PFAS (and other highly toxic chemicals) have been used in Ohio. PSR's analysis of industry data analysis revealed that, between 2013 and 2022, Ohio well operators claimed at least one fracking chemical as a trade secret in 2,164 oil and gas wells located across 17 counties totaling 162 million pounds.

- It is likely that there is more PFAS use than has been reported. A peer-reviewed oil and gas industry journal said in 2008 that a type of PFAS known as fluorosurfactants had been used for oil and gas extraction "for four decades." In 2020, a scientific paper indicated that fluorosurfactants have been used in oil and gas extraction globally since 1956. In a report PSR published in 2021, we found that between 2012 and 2020, oil and gas companies had used PFAS or PFAS precursors, most of them fluorosurfactants, for fracking in more than 1,200 wells in six states. Yet, in examining records for the similar period 2013 to 2022, we found no reports of the use of fluorosurfactants in Ohio. This improbable absence may reflect oil and gas companies' extensive use of trade secret confidentiality claims.

- Of the Ohio wells for which oil and gas firms withheld chemical identities as trade secrets over the past decade, almost 700 had been injected with chemicals identified

as "surfactants" totaling almost 21 million pounds. Some of these may be fluorosurfactants.

- PFAS pollution of groundwater, surface water and air in Ohio is possible wherever these substances have been used at oil and gas wells and wherever oil and gas wastewater containing PFAS has been disposed of. This includes disposal in injection wells, shipment to wastewater treatment plants, and spreading on roads.

- This variety of potential pathways to exposure raises concerns that PFAS could endanger the environment and people's health.

In light of these findings, PSR recommends the following:

• Halt PFAS use in oil and gas extraction. Ohio should follow the lead of Colorado, a major oil- and gas-producing state which took this action through legislation passed in June 2022. Furthermore, Ohio and the U.S. Environmental Protection Agency (EPA) should prohibit PFAS from being used, manufactured, or imported for oil and gas extraction. Many PFAS are immediately replaceable with less persistent and less toxic substances, including in the oil and gas industry.

• Expand public disclosure. Ohio should greatly expand its requirements for public disclosure of oil and gas chemicals. The state could again follow the example offered by Colorado by requiring disclosure of all individual chemicals used in oil and gas wells without exceptions for trade secrets while requiring disclosure on the part of chemical manufacturers, who best know what chemicals are being used. Ohio should also require fracking chemical disclosure prior to fracking, as have several states including California, West Virginia, and Wyoming.

• Increase testing and tracking. Ohio and/or the U.S. EPA should determine where PFAS have been used in oil and gas operations in the state and where related wastes have been deposited and should test nearby water, soil, flora, and fauna for PFAS.

• Require funding and cleanup. Oil and gas and chemical firms should be required to fund environmental testing and evaluation in their areas of operation where these are needed, and should PFAS be found, be required to fund cleanup. If water cleanup is impossible, the companies responsible for the use of PFAS should pay for alternative sources of water for drinking and agriculture, as needed.

• Reform Ohio's regulations for underground injection disposal wells to prohibit wells close to underground sources of drinking water, to require groundwater monitoring for contaminants near the wells, and to require full public disclosure of the chemicals in the wastewater.

• Limit or ban drilling and fracking. Given the use of highly toxic chemicals, including but not limited to PFAS, in oil and gas extraction, Ohio should prohibit drilling, fracking, and disposal of related wastes in areas relatively unimpacted by oil and gas pollution and should increase protections in already-impacted regions. The state should empower local governments to take such action, too. When doubt exists as to the existence or danger of contamination, the rule of thumb should be, "First, do no harm."

CH. 1 PFAS: A MAN-MADE THREAT TO HEALTH AND THE ENVIRONMENT

a. Man-made and Dangerous

Physicians for Social Responsibility (PSR) has identified evidence from industry sources that a highly dangerous class of chemicals, known as per- and polyfluoroalkyl substances (PFAS), has been used in Ohio oil and gas wells* for hydraulic fracturing ("fracking"). The wells definitively known to have been injected with PFAS between 2013 and 2022 are located in eight Ohio counties: Belmont, Carroll, Columbiana, Guernsey, Harrison, Jefferson, Monroe, and Washington. However, the wells PSR was able to identify may significantly underrepresent the extent of PFAS use in the state.

PFAS are a class of thousands of man-made chemicals known for having properties that are valuable in multiple contexts, including being slippery, oil- and water-repellant, and able to serve as dispersants or foaming agents.[1] PFAS have been called "perfluorinated chemicals" and "polyfluorinated compounds," or PFCs, though the term currently preferred by EPA is PFAS.[2]

The first PFAS to be sold commercially was created by a chemist at Dupont and was patented as Teflon. Since 1949, it has been used in thousands of products, from nonstick cookware to waterproof clothing to plastics to dental floss.[3] Other PFAS chemicals, the most prominent of which are known as PFOA and PFOS, have been used in food packaging, fire-fighting foam, and in 3M's widely used fabric protector, Scotchgard.[4] The U.S. Environmental Protection Agency (EPA) reports that there are currently about 650 types of PFAS in commerce.[5] Weak chemical disclosure laws make it difficult for the Agency to identify which PFAS chemicals are used, and where.

EPA and other regulators have identified PFAS as a serious threat to health and the environment.[6] As early as the 1960s and 1970s, researchers inside Dupont and 3M became aware that the PFAS they were manufacturing or using were associated with health problems including cancers and birth defects, had accumulated in virtually every human being, and persisted in the environment.[7] Many of these facts, kept internal by the companies, came to light after attorney Rob Bilott filed lawsuits in 1999 and 2001 accusing Dupont of causing pollution in and around Parkersburg, West Virginia with PFOA, a type of PFAS used in making Teflon.[8] In December 2011, as part of Dupont's settlement of the 2001 lawsuit, a team of epidemiologists completed a study of the blood of 70,000 West Virginians and found a probable link between PFOA and kidney cancer, testicular cancer, thyroid disease (over- or under-production of hormones by the thyroid gland), high cholesterol, pre-eclampsia (a potentially dangerous complication during pregnancy characterized by high blood pressure and signs of damage to other organ systems, most often the liver and kidneys), and ulcerative colitis (a disease causing inflammation and ulcers in the large intestine or colon).[9]

PFAS are also extremely mobile in water,[10] and in October 2021, EPA announced a "strategic roadmap" for regulating PFAS that encompasses a goal to set federal drinking water standards for PFOA and PFOS by 2023.[11] In June 2022, reflecting the growing concern about PFAS, EPA significantly lowered its health advisory level for PFOA and PFOS in drinking water. Previously, in 2016, EPA had set the combined health advisory level for these chemicals at 70 parts per trillion.[12] "The new published peer-reviewed data and draft EPA analyses…" EPA wrote in June 2022, "indicate that the levels at which negative health outcomes could occur are much lower than previously understood."[13] EPA set its new interim health advisory level for PFOA in drinking water to 0.004 parts per trillion and its interim health advisory level for PFOS to 0.02 parts per trillion.[14] EPA also set new final health advisory levels for two other PFAS known as Gen X (10 parts per trillion) and PFBS (2,000 parts per trillion).[15] EPA said that its interim health advisory levels are intended to provide guidance until enforceable drinking water regulations for PFAS take effect.[16]

EPA's new health advisory levels mean that the toxicity of PFOA is almost beyond comprehension. Under EPA's levels,

* Gas, the principal component of which is methane, is also known as "natural" gas, "fossil" gas and "fracked" gas.

five measuring cups of PFOA could contaminate about 140 trillion gallons of water, more than the estimated 128 trillion gallons of water in Lake Erie[17] or the amount of water that New York City would use during 107,500 days at its current consumption rate of 1.3 billion gallons per day.[18]

b. Persistent and Widespread in the Environment

PFAS are not only highly toxic; they also demonstrate extreme persistence in the environment. PFAS' nickname "forever chemicals" reflects their chemistry – created by chemical manufacturers – that features a bond between fluorine and carbon atoms that is among the strongest in chemistry and rarely if ever exists in nature. The result: chemicals that are extremely resistant to breaking down in the environment.[19]

Evidence has mounted over the years of cases of PFAS pollution from a variety of sources, including in Ohio. Under the state's PFAS Action Plan launched in 2019, the Ohio EPA has coordinated water sampling for six types of PFAS in almost 1,550 public water systems.[20] The state used as its action levels the EPA health advisory levels for PFOA and PFOS set in 2016 and the state's own levels for four other types of PFAS.[21] The testing found detectable levels of PFAS in 106 public drinking water systems, two of which, in Aullwood and Bridgeport, exceeded the state's action levels.[22] However, in many of the cases that did not exceed the state's action levels, the detected levels of PFOA and PFOS greatly exceeded the new interim health advisory levels set by EPA in June 2022.[23] Also in June 2022, the Ohio River Valley Water Sanitation Commission, an interstate commission representing Ohio, seven other states and the federal government, released results of a study on PFAS levels in the Ohio River, which borders Ohio for hundreds of miles. In the study, scientists sampled water from 20 locations on the Ohio River, including nine that bordered Ohio, as well as water from locations in two tributaries. The scientists found multiple PFAS at each testing site. At 19 sites they found PFOA with concentrations ranging from 4.88 parts per trillion to 12.90 parts per trillion[24] – at least 1,220 times EPA's interim safe level.

While these levels of PFOA in the Ohio River are cause for concern, they do not necessarily mean that drinking water will be contaminated, thanks to the potential removal of the contaminants during treatment.[25] However, Louisville radio station WFPL reported that at least on the Kentucky side of the Ohio River, some public drinking water providers did not have the ability to remove PFAS from drinking water.[26] On a webpage dated 2022, the Greater Cincinnati Water Works reported that PFOA and three other types of PFAS were "not detected" in drinking water from the Ohio River. However, some earlier test results on the website, including one from earlier in 2022, appear to show levels of detected PFOA and PFOS that are higher than EPA's new interim health advisory levels.[27] A representative of Greater Cincinnati Water Works said in an email in August 2022 that the detection levels of PFOA and PFOS were correct and that the agency would correct its erroneous statement that these forms of PFAS were "not detected."[28]

EPA's new advisory levels are non-binding, but concern over PFAS pollution has led eight states, though not Ohio, to develop enforceable standards for concentrations of several types of PFAS in drinking water.[29] One of the most recent to act is Michigan, which set standards in 2020 for limiting PFAS in drinking water and for removing PFAS from groundwater. The standards apply to PFOA and six other forms of PFAS. Michigan's maximum allowable level is no more than eight parts per trillion for PFOA,[30] a standard that is one of the lowest among states but is now much more permissive than EPA's health advisory. Even Michigan's standard, however, shows how toxic PFAS can be. By extrapolation, Michigan's standards suggest that five measuring cups of PFOA could contaminate more than 70 billion gallons of water – the amount of water needed to fill more than 106,000 Olympic-sized swimming pools at about 660,000 gallons per pool.[31] The extreme potency of PFOA, as with other PFAS, indicates why health experts are concerned about even minute quantities of these chemicals.

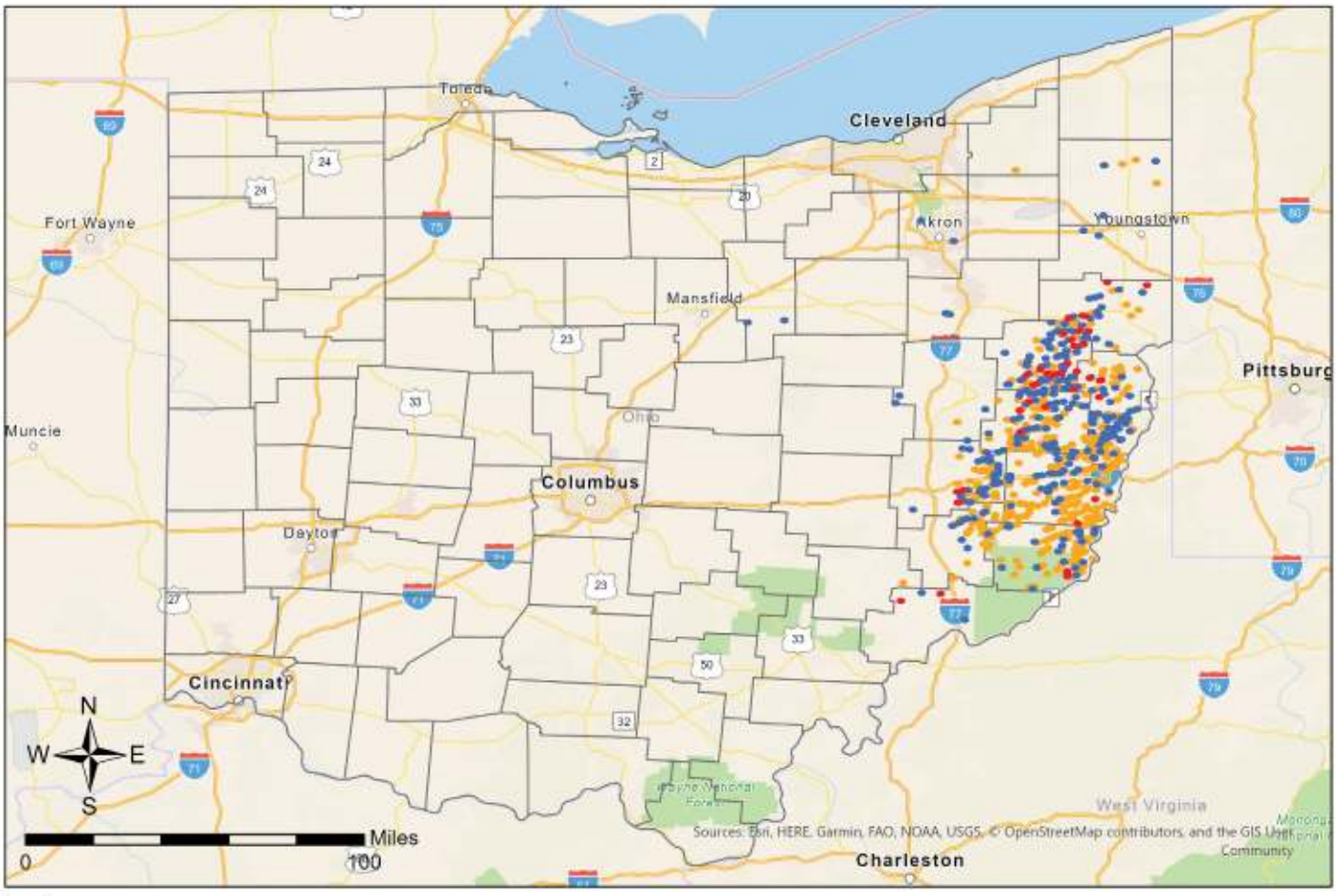
CH. 2 OIL AND GAS COMPANIES USED PFAS IN OHIO

a.Industry Data Reveal Use of PTFE, a PFAS Fluoropolymer

PFAS contamination has been associated with manufacturing facilities, airports, and military bases where firefighting foams and other industrial chemicals that contain the chemicals have been used, according to Wright State University Professor of Earth and Environmental Sciences Abinash Agrawal, who spoke with the Dayton Daily News in 2021 in response to Ohio's PFAS testing program.[32] However, oil and gas operations in the state may be an additional source of contamination.

To identify whether and where PFAS were used in Ohio, PSR analyzed self-reported industry data recorded in FracFocus, a database for the oil and gas industry[33] maintained by the Groundwater Protection Council,[34] a nonprofit comprised of regulators from state agencies. PSR used the open-source version of FracFocus, Open-FF, that is more accurate and informative than the original

Ohio Oil & Gas Wells Fracked with PTFE and Trade Secret Chemicals, 2013-2022



This map shows the location of oil and gas wells in Ohio known to have been fracked between 2013 – 2022 using PTFE, trade secret chemicals, and/or trade secret surfactants. An interactive version of the map is available at https://ft.maps.arcgis.com/apps/webappviewer/index.html?appid=4fe19ca9a17141a6a1f5ac35728ac0fa.

version of FracFocus.[35]

Our analysis of the industry's own entries shows that oil and gas companies used the PFAS polytetrafluoroethylene (PTFE) in 101 oil and gas wells in eight Ohio counties between 2013 and 2022. It is unclear for what purpose the PTFE was used; however, PTFE, which is marketed as Teflon, is known for its slipperiness, and fracking chemicals are sometimes used as friction reducers.[36] The locations of the wells where PTFE was used are indicated in the map on page 3 and tables on the pages 8 and 9.

PTFE is a fluoropolymer. Fluoropolymers are a type of plastic.[37] Scientists' and environmentalists' major concerns about PTFE and other fluoropolymers are not related so much to these substances themselves but rather the associated impacts of their production, use, and disposal, according to a 2020 scientific report.[38] The production of PTFE and other fluoropolymers relies on other, highly toxic PFAS that are used as production aids. As the paper noted, these other PFAS have included fluorosurfactants such as PFOA, whose risks are discussed in the previous chapter, and GenX, which is similarly harmful and has replaced PFOA in fluoropolymer production.[39] (PFOA has been phased out as a manufacturing aid in the U.S. but is still used in Asia.)[40] PTFE and other fluoropolymers can contain these more toxic PFAS fragments as impurities that can leach out of the PTFE during use.[41] PTFE may also generate other PFAS if the PTFE breaks down under heat.[42] The authors of the 2020 paper noted that

> The levels of leachables…in individual fluoropolymer substances and products depend on the production process and subsequent treatment processes; a comprehensive global overview is currently lacking.[43]

In addition, the authors noted that the persistence in the environment of PTFE and other fluoropolymers could pose problems during disposal. "Landfilling of fluoropolymers leads to contamination of leachates with PFAS and can contribute to release of plastics and microplastics," they wrote.[44] One of the authors added in an email to PSR that if PTFE were used in oil and gas wells that have especially high temperatures, it could undergo a process called "thermolysis" and generate toxic PFAS called perfluoroalkyl carboxylic acids (PFCAs). As a result, he wrote, "there could be some additional problems that need some investigation."[45] In 2021, a coalition of environmental groups including the Center for Environmental Health, Clean Water Action, Ecology Center, Environmental Working Group, Natural Resources Defense Council, Safer States, and the Sierra Club shared similar concerns, based on multiple scientific articles, regarding the risks of fluoropolymers such as PTFE. The groups also noted that fluoropolymers are manufactured with chemicals that have an outsized negative effect on climate change.[46] Disclosure gaps in Ohio law discussed below may prevent scientists and the public from knowing the extent of PTFE use in oil and gas operations.

b. Curiously Absent: Disclosure of PFAS Fluorosurfactants

PSR's findings of PFAS use in Ohio are based on oil and gas company operators' records in FracFocus, a database for the oil and gas industry.[47] Under Ohio law, operators must disclose in the FracFocus database the name of chemical products used in fracking and each individual component chemical used in each product.[48] They must also disclose each chemical's Chemical Abstracts Service (CAS) number, if available.[49] CAS numbers are unique numeric identifiers assigned to each chemical by the American Chemical Society. They are the most accurate way to identify chemicals, as a chemical can have multiple names or trade names but only one CAS number.[50]

Our analysis of FracFocus records also examined the use of fluorosurfactants, sometimes called fluorinated surfactants, in fracking in Ohio. Fluorosurfactants are part of a larger group of chemicals known as "surfactants" that are commonly used in fracking.[51] According to EPA, surfactants lower the surface tension of a liquid, the interaction at the surface between two liquids (called interfacial tension), or that between a liquid and a solid.[52] While surfactants are commonly used in fracking,[53] fluorosurfactants are said to be "superior in their aqueous surface tension reduction at very low concentrations and are useful as wetting and leveling agents, emulsifiers, foaming

agents, or dispersants."[54] Fluorosurfactants encompass the dangerous chemicals PFOA and PFOS, as well as hundreds of other less-studied replacement chemicals and mixtures.[55] Some are known to be extremely toxic to people,[56] could be harmful to animals,[57] and are expected to persist in the environment.[58] As indicated previously, fluorosurfactants are also used to manufacture PTFE and are of even greater concern than PTFE itself.

A variety of industry sources suggest that fluorosurfactants are commonly used in oil and gas extraction. In July 2021, PSR found that according to FracFocus data, between 2012 and 2020, oil and gas companies used PFAS or chemicals that could break down into PFAS in fracking in more than 1,200 wells in six states. Most were fluorosurfactants.[59] In 2020, an article published in *Environmental Science: Processes and Impacts* showed that since 1956, PFAS, including fluorosurfactants, had been used or proposed to be used globally in oil and gas extraction techniques including chemical-driven gas production, chemical flooding, fracking, and the drilling that precedes fracking and other oil and gas production techniques.[60] And in 2008, two authors, one of whom was identified as an employee at DuPont, wrote in the peer-reviewed *Open Petroleum Engineering Journal* that the use of fluorosurfactants was relatively common in the oil and gas industry and that their use was about to surge. They referred to fluorosurfactants as an "emerging technology" and stated,

> While fluorosurfactants have been used in gas and oil exploration for four decades, the increased demand for petroleum and the greater understanding of the benefits of fluorosurfactants have led to growing acceptance for fluorosurfactants throughout the petroleum industry.[61]

Yet despite evidence of widespread and longstanding use of fluorosurfactants in oil and gas extraction, PSR did not find evidence of their use in Ohio, either in Open-FF or in other online sources. This surprising lack of evidence, as is discussed below, may be due to the significant gaps in reporting requirements for the oil and gas industry in Ohio, rather than the lack of use fluorosurfactant chemicals.

c. PFAS Joins a Roster of Dangerous Chemicals Used in Fracking

For years, scientists, advocates and regulators in Ohio and other states have raised concerns about the hundreds of industrial chemicals used in fracking of oil and gas wells, including potential threats to water resources and health. In fracking, energy companies inject into oil and gas wells a mixture of up to tens of millions of gallons of water, sand, and chemicals at high pressure to fracture underground rock formations, unlocking trapped oil and gas. The chemicals serve a variety of purposes including killing bacteria inside the wellbore, reducing friction during high-pressure fracking, and as gelling agents to thicken the fluid so that the sand, suspended in the gelled fluid, can travel farther into underground formations.[62] In 2016, EPA published a study that identified 1,606 chemicals used in fracking fluid and/or found in fracking wastewater. While the agency found high-quality information on health effects for only 173 of these chemicals, that information was troubling. EPA found that health effects associated with chronic oral exposure to these chemicals include carcinogenicity, neurotoxicity, immune system effects, changes in body weight, changes in blood chemistry, liver and kidney toxicity, and reproductive and developmental toxicity.[63]

Chemicals used in the drilling stage that precedes fracking can also pose health risks, including developmental toxicity and the formation of tumors, according to EPA regulators.[64] A disclosure form filed with the state of Ohio, shows that Statoil, Norway's state oil company (since renamed Equinor), has used a neurotoxic chemical, xylene, in drilling.[65]

PFAS has joined the roster of potentially dangerous chemicals used in fracking. The use of PFAS in oil and gas production in Ohio was exposed in 2021,[66] but PFAS may have been used more extensively than records indicate, both geographically and in additional methods or stages of oil and gas operations, such as drilling, that precede fracking and in other techniques known as enhanced oil recovery. PFAS used in these operations may add to the cumulative human exposure to PFAS from other sources.

CH. 3 OHIO'S CHEMICAL DISCLOSURE LAWS SHIELD CHEMICAL IDENTITIES

Fire at the Eisenbarth Well operated by Statoil in Monroe County, Ohio, June 28-29, 2014. Credit: U.S. Environmental Protection Agency.

a. Ohio's "Trade Secret" Law Shields Potentially Dangerous Substances, Including PFAS

The danger of exposure to unknown chemicals – PFAS and others – from oil and gas operations persists in Ohio. This is true, despite state rules enacted in 2010 and amended in 2012 that require public disclosure of fracking and drilling chemicals.[67] The rules require that within 60 days of completing an oil or gas well, well operators disclose their fracking chemicals either to the Ohio Department of Natural Resources or to both the department and FracFocus.[68] Our analysis showed that about 90 percent of disclosures are made to both. Similarly, within the same 60-day time frame, well owners must disclose to the Department of Natural Resources, though not to FracFocus, chemicals intentionally added during the initial phase of drilling that precedes fracking. The identities of these drilling chemicals must include CAS numbers.[69] This provision makes Ohio and Colorado[70] the only states to require disclosure of at least some chemicals used in drilling. EPA has indicated that any chemicals used during the first stage of the drilling process would be highly likely to leach into groundwater since during this stage, drilling passes directly through groundwater zones[71] before any casing or cement is placed in the well to seal it off from surrounding aquifers. The resulting potential for groundwater contamination makes public disclosure of chemicals used in drilling especially important.

On the face of it, these disclosure requirements sound effective; however, an important exception allows companies to avoid full and meaningful disclosure: The law allows chemical manufacturers, well operators and other companies in the chemical supply chain to withhold exact fracking and drilling fluid ingredient information if they deem it a "trade secret."[72] In place of specific fracking chemical identities, oil and gas companies often list generic chemical names such as "inorganic salt" and "proprietary surfactant."[73] Ohio's drilling chemical records show some similar uses of generic chemical names, such as "phosphates," "quaternary ammonium chloride," and "amine derivative."[74] Regrettably, the use of such vague descriptors can hide from public view the true identities of dangerous chemicals, including PFAS.

The use of trade secrets to conceal chemicals' specific identities effectively undermines the public health benefits of disclosure by preventing health professionals, state regulators and the public from knowing where PFAS — or other toxic chemicals — have been used in oil and gas wells. In addition to allowing trade secret exemptions for fracking and drilling chemicals, Ohio does not require public disclosure of chemicals used in enhanced oil recovery or in other extraction techniques that are distinct from fracking per se. These regulatory gaps increase the potential that Ohioans could unknowingly be exposed to PFAS and other chemicals used during multiple phases and methods of oil and gas extraction.[75]

An example of potential exposure to trade secret chemicals occurred in 2014, when a fire at an oil and gas well in Monroe County resulted in the release of unknown chemicals used in oil and gas extraction into a tributary of the Ohio River. State and EPA officials did not learn the chemicals' identities until five days later, after an estimated 70,000 fish in the tributary had died.[76] It is unclear whether firefighters who responded to the blaze ever learned the chemicals' identities. "Firefighters, you know, we have this tradition of running in where people are running out," retired Youngstown Fire Department Battalion Chief and hazardous materials expert Silverio Caggiano told Marketplace on NPR in 2017, commenting on the fire and the risks oil and gas chemicals pose to firefighters. "And without the knowledge of what's in there, running in there may be turning us into victims as well."[77]

According to an EPA report, trade secret chemicals spilled as a result of the fire, along with other chemicals. Fluids that may have contained the trade secret chemicals ran off the well pad into a tributary of the Ohio River, where an estimated 70,000 fish died.[78]

b. Extensive Use of 'Trade Secret' Claims Veils Actual Use

The lack of evidence of additional PFAS use in Ohio's oil and gas wells may reflect, at least in part, extensive application of the trade secret provisions in Ohio's chemical disclosure rules. PSR's data analysis revealed that, between 2013 and 2022, Ohio well operators claimed at least one fracking chemical as a trade secret in 2,164 oil and gas wells located across 17 counties. The trade secret chemicals used in Ohio over this roughly 10-year period totaled 162 million pounds.[79] (See Table 1, next page.) If even a small fraction of this weight were PFAS, that fraction could pose significant health and environmental risks.

In an effort to determine if any of these trade secret chemicals were PFAS, PSR examined whether any were listed as a surfactant. Surfactants, as noted above, encompass dangerous fluorosurfactants, some of which are extremely toxic to people[80] and persistent in the environment.[81] We found thousands of cases of oil and gas companies using at least one trade secret chemical that they described as a surfactant. These occurred in 688 wells, spread across 15 counties.[82] (See Table 1) Operators' names for these chemicals were vague, including "surfactant" and "surfactant blend." These trade secret surfactants totaled almost 21 million pounds. (See examples from individual wells in Table 2.) Should even a small percentage of them be fluorosurfactants, they could pose significant threats to human health and the environment.

Companies using trade secret surfactants include prominent oil and gas producers (see Table 3). Among them are Chesapeake Energy Corp., once the second-leading gas producer in the U.S., that recently emerged from a multi-billion-dollar bankruptcy;[83] Statoil, now called Equinor, the Norwegian state-run oil and gas company[84] whose well fire in Monroe County in 2014 appears in the photograph above; caused unknown chemicals to flow into a tributary of the Ohio River; and ExxonMobil, the nation's largest publicly traded oil and gas company.[85]

Table 1. Disclosed Use in Fracking of Trade Secret Chemicals and PFAS in Ohio Oil and Gas Wells, 2013-2022

County	Number of wells with at least one trade secret chemical	Weight of trade secret chemicals (lbs.)	Number of wells with at least one trade secret surfactant	Weight of trade secret surfactants (lbs.)	Number of wells with PTFE	Weight of PTFE (lbs.)
Ashland	2	5,880	2	4,140	0	0
Belmont	520	17,500,000	86	182,000	4	11
Carroll	295	58,200,000	172	12,700,000	46	263
Columbiana	45	7,480,000	19	1,190,000	12	58
Geauga	1	325	0	0	0	0
Guernsey	199	8,930,000	73	471,000	8	45
Harrison	398	41,100,000	139	4,660,000	18	101
Jefferson	277	15,100,000	94	1,140,000	6	58
Mahoning	2	9,010	2	322	0	0
Monroe	291	8,720,000	55	194,000	3	27
Morgan	2	97	0	0	0	0
Noble	111	4,280,000	30	125,000	0	0
Stark	3	1,880	3	1,100	0	0
Summit	2	1,130	2	663	0	0
Trumbull	7	185,000	4	3,750	0	0
Tuscarawas	6	667,000	4	162,000	0	0
Washington	3	180,000	3	65,800	4	23
Total	2,164	162,000,000	688	20,900,000	101	590

This table, based on FracFocus data, shows county-by-county the number of Ohio wells in which oil and gas companies injected at least one trade secret fracking chemical between 2013 and 2022, at least one trade secret surfactant, and/or PTFE. The total weight figures reflect the sum of all records for which we have enough information to calculate a chemical's weight. However, the total weight figures represent an undercount because many fracking chemical disclosures lack sufficient data to perform this calculation.

Table 2. Examples of Chemical Reporting on Individual Oil and Gas Wells in Ohio

Well Operator	Well Number	County	Year Fracking Completed	Chemical used in Well	CAS Number	Trade Name	Weight of Chemical (lbs.)
Chesapeake Operating, Inc.	3408120636	Jefferson	2016	PTFE	9002-84-0	not reported	21
XTO Energy/ExxonMobil	3401320790	Belmont	2018	PTFE	9002-84-0	not reported	6
Chesapeake Operating, Inc.	3406721356	Harrison	2015	proprietary surfactant	proprietary	report reflects a large set of products	250,244
Gulfport Energy Corporation	3411124769	Monroe	2021	surfactant	proprietary	not reported	13,114
Antero Resources Corporation	3411124413	Monroe	2014	alcohol ethoxylate surfactants	proprietary	Plexslick 953	5,192

This table shows a sample of specific wells injected with the types of fracking chemicals referenced in the larger table above, including trade secret surfactants such as the "alcohol ethoxylate surfactants" and "proprietary surfactant" as well as PTFE. The examples cover a range of years and represent wells fracked in several Ohio counties. Even the smallest mass shown for a proprietary chemical (5,192 pounds for a proprietary surfactant) would be a huge amount of PFAS if this proprietary chemical were PFAS.

Table 3. Oil and Gas Companies that Fracked the Most Wells in Ohio Using Trade Secret Surfactants, 2013-2022

Well Operator	Number of wells with trade secret surfactants	Total weight of trade secret surfactants (lbs.)
Chesapeake Operating, Inc.	270	20,000,000
Ascent Resources - Utica, LLC	164	111,000
Antero Resources Corporation	33	155,000
EAP Ohio LLC	32	114,000
American Energy Utica	26	22,300
Hess Corporation	22	5,780
Eclipse Resources I, LP	22	25,300
Gulfport Energy Corporation	16	39,300
Rice Drilling B, LLC	14	2,340
EQT Production	11	166,000
Southwestern Energy	10	76,300
CONSOL Energy Inc.	10	31,800
PDC Energy	8	7,980
Statoil USA Onshore Properties Inc.	7	7,400
XTO Energy/ExxonMobil	7	15,600

This table shows the fifteen oil and gas companies that fracked the greatest number of oil and gas wells in Ohio with trade secret surfactants between 2013 and 2022. Surfactants may be PFAS, given the widespread use in oil and gas wells of PFAS or potential PFAS known as fluorosurfactants.

a. Multiple Potential Pathways to Exposure

The threats to health from chemicals used in oil and gas operations are well-documented. EPA in its 2016 national report on fracking and drinking water found that fracking-related pollution could follow a number of pathways. Even without examining water contamination impacts or risks from underground disposal wells,[86] the agency cited the following possible pathways to exposure:

• spills of fracking fluid that seep into groundwater;

• injection of fracking fluid into wells with cracks in the casing or cement, allowing the fluid to migrate into aquifers (much of the fracking fluid can remain underground);

• injection of fracking fluids directly into groundwater;

• underground migration of fracking fluids through fracking-related or natural fractures;

• intersection of fracking fluid with nearby oil and gas wells,

• spills of wastewater after the fracking process is completed, and

• inadequate treatment and discharge of fracking wastewater to surface water supplies.[87]

Where PFAS are among the chemicals used in oil and gas extraction, they too could enter water supplies through one or more of these pathways, thus placing drinking water and agricultural water sources at risk. That risk is substantial, given PFAS' characteristics: toxic in minuscule concentrations, linked to cancer, birth defects, pre-eclampsia, and other serious health effects, extremely mobile in water, and highly persistent in the environment.

In addition, toxicologist Dave Brown, former director of environmental epidemiology at the Connecticut Department of Health, noted in PSR's July 2021 report on PFAS that PFAS used in oil and gas wells could follow airborne exposure routes. He warned that if PFAS were to enter drinking water, it could subsequently volatilize or become airborne inside homes. Brown also added another potential pathway for airborne exposure: PFAS could become airborne when gas is burned off during flaring at the wellhead.[88]

b. Spills of Fluid, Disposal of Wastewater Raise Pollution Concerns

When PFAS are used at oil and gas well sites, there is a real risk of contamination and exposure due to spills and other accidents. Thousands of spills and accidents, and hundreds of cases of associated pollution, have been documented at oil and gas well sites.[89] In 2017, for example, the news outlet EnergyWire reported "at least 8,519 spills in 14 producing states" in 2016, with the number of reported spills in Ohio at 51 in 2012, 103 in 2013, 38 in 2014, 76 in 2015, and 53 in 2016.[90]

Another risk that is especially high in Ohio is that PFAS and other chemicals could pollute the environment through the disposal of fracking and/or drilling wastewater. Oil and gas wastewater can contain chemicals injected during the fracking process including trade secret chemicals[91] and thus, potentially, PFAS. It can also contain naturally occurring toxics found underground such as radium, a radioactive element and known human carcinogen.[92] The major destination for oil and gas wastewater in Ohio is underground injection disposal wells that are intended to hold the wastewater safely underground forever. According to an analysis of state data by FracTracker Alliance, Ohio has 245 of these wells that have become a major repository for wastewater not just from in-state oil and gas wells but also wells located in Pennsylvania and West Virginia.[93] The volume of wastewater pumped into Ohio's injection wells rose from 690 million gallons in 2013 to 12.7 billion gallons in 2020, according to a separate analysis of state data by FracTracker Alliance.[94] This is not surprising, given that wastewater volumes in Ohio average 2.3 million gallons per well.[95]

Meanwhile, researchers have known for decades that wastewater from disposal wells can migrate upward from

A Class II injection well in North Portage County, OH. April 2019. Credit: Ted Auch, FracTracker Alliance, 2019. Aerial support provided by LightHawk.

deep underground through nearby oil and gas wells that have ceased operating but have not been properly sealed off from the surrounding underground rock formation. This migrating wastewater can break out of the abandoned wells and contaminate groundwater located near the earth's surface.[96] Two different teams of researchers have estimated that Ohio has more than 150,000 abandoned oil and gas wells, only some of which have been plugged.[97] These wells could serve as conduits for wastewater injected underground to migrate upward, where it could break out of the old wells and seep into ground or surface water.[98] Ohio does not require groundwater monitoring near wastewater injection wells, so it could be difficult for people living near the injection wells to know if injected wastewater were migrating upward into groundwater.[99]

c. Evidence of Wastewater Underground Migration

The years 2020 and 2021 witnessed at least two apparent major underground migrations of fracking wastewater from Ohio injection disposal wells. Both impacted or endangered water supplies. In January 2021, more than 1.6 million gallons of what appeared to be fracking wastewater flowed for four days from an unplugged oil and gas well idle since 2012, in Noble County.[100] A nearby tributary, Taylor Fork, was impacted by the spill, resulting in a fish kill. The cause

of the spill was unclear, but there were six active fracking wastewater injection wells in Noble County including three within four miles of the leaking oil and gas well. Another example occurred in September 2020 in Washington County, when fracking wastewater migrated at least five miles from a disposal well to gas-producing wells, causing state officials to worry about possible groundwater contamination.[101]

Other, smaller incidents have also occurred. In August 2021, Veto Lake, located less than a mile from the same Washington County disposal well mentioned in the preceding paragraph, became contaminated with oil. State officials did not know whether the contamination was connected to the disposal well, but one expert said it was possible.[102] In November, the Parkersburg (WV) News & Sentinel indicated that the source of the oil was an abandoned oil and gas well in the lake that had been improperly plugged.[103] In addition to these incidents, the state of Ohio told the news outlet StateImpact that there had been 65 spills of oil and gas wastewater between 2018 and 2020.[104]

d. Inadequacy of Waste Treatment and Water Treatment Facilities

Wastewater taken to Centralized Waste Treatment (CWT) facilities can also pose risks. According to EPA, a CWT facility "is generally defined as one that accepts industrial materials (hazardous or non-hazardous, solid, or liquid) generated at another facility (off-site) for treatment or recovery."[105] In a 2018 review of the ability of CWT facilities to handle oil and gas (O&G) wastes, EPA found several causes for concern:

> Environmental and human exposure to pollutants in O&G wastewater can occur through multiple pathways related to treatment at CWT facilities. Environmental releases and human interactions with pollutants can occur from discharge of treated effluent to the environment, during transport to CWT treatment facilities, during CWT treatment itself, or through other waste streams such as sludge, spills, and fugitive emissions.[106]

EPA found that some facilities

> use treatment, such as chemical precipitation, that remove specific pollutants but provide little or no removal of the many other pollutants commonly found in these wastes. As a result, some facilities discharge much greater quantities of pollutants, such as total dissolved solids and chlorides, than others.[107]

One facility that appeared to fall in this category of inadequate wastewater treatment was a CWT unit in Warren, Ohio called Patriot Water Treatment, LLC. EPA found that "The facility does not have technologies for TDS [total dissolved solids] or chlorides removal."[108] Beginning in 2010, the Warren facility accepted oil and gas wastewater, primarily from Pennsylvania and West Virginia, partially treated it, and then paid the city of Warren to send it to the city's sewage treatment plant, where it was subsequently discharged into the Mahoning River.[109] In 2011, following an exposé by the New York Times about high levels of carcinogenic radium in fracking wastewater in Pennsylvania,[110] the Pennsylvania Department of Environmental Protection asked oil and gas companies to voluntarily stop sending wastewater to public sewage treatment plants and commercial waste facilities in the state.[111] However, the Warren plant continued to accept the wastewater from the Patriot CWT facility.[112]

In 2016, EPA prohibited publicly owned treatment works [POTWs] like Warren's sewage plant from accepting wastewater from onshore oil and gas production "from shale and/or tight geologic formations," the type of "unconventional oil and gas resources"[113] that are typically drilled in Ohio, Pennsylvania, and West Virginia.[114] EPA extended the deadline for compliance for some plants until 2019.[115] EPA acted in large part because wastewater from unconventional oil and gas extraction "can contain high concentrations of TDS [total dissolved solids], radioactive elements, metals, chlorides, sulfates, and other dissolved inorganic constituents that POTWs are not designed to remove" and these contaminants

> can be discharged, untreated, from the POTW to the receiving stream; can disrupt the operation of the POTW (*e.g.,* by inhibiting biological treatment); can accumulate

> in biosolids (sewage sludge), limiting their beneficial use; and can facilitate the formation of harmful DBPs [disinfection byproducts].[116]

Indeed, environmental advocates uncovered emails showing that a Warren official believed that the wastewater from Patriot was so high in TDS and salts that it was compromising Warren's ability to treat its waste.[117] In 2017, Warren stopped accepting oil and gas wastewater from Patriot, following a lawsuit by the Freshwater Accountability Project alleging that the plant was violating its discharge permits under the Clean Water Act.[118] Under EPA's rule, drilling companies can still send wastewater from unconventional wells to CWT facilities like Patriot, but the water cannot be sent on to POTWs.[119]

e. Wells Fracked with PFAS in Pennsylvania Sent Wastes to Ohio

Prior to 2017, Patriot Water Treatment, LLC and multiple injection wells in Ohio received wastewater from unconventional gas wells in Pennsylvania hydraulically fractured with PFAS. Patriot and several landfills also received thousands of tons of drill cuttings – rock fragments or ground-up rock produced during the drilling process – from the wells. The wastewater and drill cuttings could contain not only PTFE and any other PFAS associated with it, but also naturally occurring radium and other toxic chemicals, including additional undisclosed PFAS, as Pennsylvania law allows well owners to use fracking chemicals with identities shielded from the public as trade secrets.[120] The law also explicitly exempts chemical manufacturers from having to disclose chemicals in their fracking chemical products to the well operators, who must ultimately disclose fracking chemicals to the public.[121] Evidence shows that in at least some cases, chemical manufacturers have not disclosed all of the chemicals to well operators who, in turn, are unable to disclose these chemicals publicly.[122] As a result, the identities of many chemicals used in fracking fluid in Pennsylvania, and present in fracking wastewater and drill cuttings from Pennsylvania that are shipped to Ohio, may be unknown.

FracFocus records show that between 2012 and 2014, oil and gas well operators fracked eight wells in Western Pennsylvania with PTFE/Teflon.[123] Records with the Pennsylvania Department of Environmental Protection show that millions of gallons of drilling fluid, fracking fluid and wastewater from these wells were shipped to more than 20 injection wells and to the Patriot CWT facility. Drill cuttings were also sent to four different Ohio-based landfills and to Patriot.[124] In some cases, these practices continued well into 2022.

Gas wells in Pennsylvania sent waste fluids to injection disposal wells in the following towns in Ohio: Atwater, Barnesville, Cambridge, Coolville, Coshocton, Dennison, Dexter City, Fowler, Garrettsville, Hartville, Hiram, Kent, Marietta, Nashport, Newton, Norwich, Rootstown, and Stockport. And they sent thousands of tons of drill cuttings to landfills in Amsterdam, Lowellville, New Spirit, New Springfield, Waynesburg, as well as to Patriot Water Treatment in Warren.[125]

Landfills produce wastewater known as "leachate" when water percolates through the contents of the landfill.[126] In 2019, local prosecutors asked the Pennsylvania Attorney General's office to investigate after leachate from a landfill that had accepted drill cuttings was taken to a wastewater treatment plant and apparently caused the plant's discharge of treated water to exceed state and federal pollution standards. The plant discharged into the Monongahela River, a major source of drinking water for Western Pennsylvania.[127] Given that landfills in Ohio have also received drill cuttings that could contain PFAS, radium, and other contaminants and could have sent their leachate to wastewater treatment plants, the danger exists that other waterways could have been subject to similar incidents.

f. Wastewater Dumping and Spreading in Ohio

Other potential pathways for exposure to PFAS-tainted fracking wastewater in Ohio include intentional dumping of wastewater and the spreading of wastewater on roads for de-icing and dust suppression. In 2014, the owner of a Youngstown-based company, Hardrock Excavating LLC, was

A brine hauler in Malaga, OH, May 2017. The briny wastewater that comes out of fracking wells is sometimes spread on roads for dust suppression or as a de-icer. It carries a host of unidentified chemicals. Credit: Ted Auch, FracTracker Alliance, 2017

sentenced to more than two years in prison for directing his employees to illegally discharge oil and gas wastewater that Hardrock Excavating was storing for oil and gas companies. Over the course of two years, the owner directed his employees to wait until after dark and then secretly use a hose to empty some of the wastewater into a wastewater drain. The drain flowed into a tributary of the Mahoning River which flowed into the river itself. According to the U.S. Department of Justice, tests of some of the wastewater showed that it contained "several hazardous pollutants, including benzene and toluene."[128] EPA has classified benzene as a known human carcinogen for all routes of exposure[129] and notes that toluene exposure can affect the central nervous system.[130] It is unclear if the wastewater was ever tested for PFAS.

As for spreading wastewater on roads, Ohio law allows local governments to engage in this practice for dust suppression or de-icing, with certain limitations. These limitations include a prohibition on the use of wastewater from horizontal wells and prohibitions on the use of fluids associated with drilling the well, the initial production of wastewater known as "flowback" that contains the fracking fluid, or other fluids "used to treat a well."[131] In theory, these prohibitions would limit the wastewater to that which occurred naturally in underground formations and would prevent the use of

wastewater containing PFAS, as PFAS would likely be found in oil and gas wells only if it were added to the well. However, Caggiano, the retired Battalion Chief of the Youngstown Fire Department, believes that these rules might be violated in practice, whether intentionally or unintentionally. He cited the potential for tanker trucks hauling waste for spreading on roads to be cross-contaminated with flowback or drilling fluids, and the possibility of bad actors to illegally spread fracking or drilling wastewater that might contain PFAS. "I would not be surprised if drilling fluid or fracking fluid ended up on roads," he said.[132]

Even if the wastewater spread on roads were only from underground formations, it could contain dangerous naturally occurring toxics such as carcinogenic radium. In 2017, the Ohio Department of Natural Resources tested AquaSalina, a product used for deicing roads that is naturally occurring formation water from vertical oil and gas wells. The department found that one sample of AquaSalina contained 9,602 picocuries per liter of combined amounts of radium-226 and radium-228. This level exceeded Ohio's legal limit for radium in oil and gas waste allowed in landfills (0.005 picocuries per liter) by a factor of almost two million. Ohio's Department of Transportation had been purchasing AquaSalina for deicing since 2013-2014 but announced in August 2021 that it planned to stop buying the fluid without explaining why. The state still had more than 227,000 gallons of the fluid available for use.[133]

g. PFAS Use Could Compound Health Harms from Other Oil and Gas Chemicals

PFAS is by no means the only chemical associated with oil and gas extraction that could cause harm to health. Deeper investigation of PFAS use in oil and gas operations is especially important because exposure to PFAS may be additional to, and could impact or intensify health effects from, those other chemicals. It is unknown if any of the problems associated with fracking chemicals, some of which are referenced below, are linked to or aggravated by PFAS used in oil and gas operations, but researchers should investigate.

Peer-reviewed studies of people living near oil and gas operations have found that proximity to active well sites correlates with a variety of diseases and other health effects. A 2018 study of 66 households in Belmont County, Ohio found that prevalence of contaminants in drinking water, including toluene, bromoform, and dichlorobromomethane, was higher in homes closer to unconventional oil and gas wells. The study also found that people living closer to multiple wells were more likely to report health issues including wheezing, stress, fatigue, and headache.[134] A 2019 study in the journal *Environment International* examined 3,324 babies born in Colorado between 2005 and 2011 and found that, compared with control groups, congenital heart defects were 1.4 and 1.7 times more likely in babies born to mothers in areas of medium and high unconventional gas drilling, respectively.[135] A 2017 study in *PLOS One* of Coloradans between birth and 24 years old diagnosed with cancer between 2000 and 2013 found that those between the ages of five and 24 were more than four times more likely to live in areas of heavy oil and gas drilling, compared to controls.[136]

On a national scale, PSR and Concerned Health Professionals of New York have collaborated to compile and summarize the substantial and growing number of scientific studies that have found serious health effects associated with oil and gas drilling. In the eighth edition (2022) of our report, we wrote,

> Public health problems associated with fracking include prenatal harm, respiratory impacts, cancer, heart disease, mental health problems, and premature death..... Poor birth outcomes have been linked to fracking activities in multiple studies in multiple locations using a variety of methods. Studies of mothers living near oil and gas extraction operations consistently find impaired infant health, especially elevated risks for low birth weight and preterm birth. As we go to press, a new study in Pennsylvania finds "consistent and robust evidence that drilling shale gas wells negatively impacts both drinking water and quality of infant health."[137]

Low birthweight is a leading contributor to infant death in the United States.[138] The Southwest Pennsylvania Environmental

Health Project[139] and the Pennsylvania-based FracTracker Alliance[140] have also examined studies of health impacts of unconventional oil and gas development and reached similar conclusions. In addition to the findings in peer-reviewed studies, residents living near oil and gas operations have anecdotally reported experiencing illnesses that they believe are related to chemical exposures.

Many residents have also expressed frustration over the secrecy surrounding chemicals used by the oil and gas industry.[141] In 2020, Pennsylvania's Attorney General issued a report based on a criminal grand jury investigation of oil and gas drilling pollution in the Keystone State. In that state, drilling for gas in shale formations has surged over the past 15 years,[142] vaulting Pennsylvania into the number two spot among gas-producing states (Texas is number one)[143] and bringing many more Pennsylvanians into contact with gas drilling and its impacts. Based on testimony from over 70 households, the attorney general compiled evidence of serious health impacts, finding that

> Many of those living in close proximity to a well pad began to become chronically, and inexplicably, sick. Pets died; farm animals that lived outside started miscarrying, or giving birth to deformed offspring. But the worst was the children, who were most susceptible to the effects. Families went to their doctors for answers, but the doctors didn't know what to do. The unconventional oil and gas companies would not even identify the chemicals they were using, so that they could be studied; the companies said the compounds were "trade secrets" and "proprietary information." The absence of information created roadblocks to effective medical treatment. One family was told that doctors would discuss their hypotheses, but only if the information never left the room.[144]

Study of the link between PFAS and other chemicals used in fracking would have been unlikely until 2021 because virtually no one knew that PFAS were used in oil and gas extraction until PSR published our report on the topic in July of that year. Now that we know PFAS have been used in oil and gas operations for years, scientists should determine whether there are connections between this use and health effects, for PFAS chemicals individually and as a compounding factor in conjunction with exposure to other fracking chemicals.

h. Fracking and Chemical Exposure as an Environmental Justice Issue

"Fenceline" communities – people living very close to oil and gas operations – often bear a disproportionate risk of exposure to toxic chemicals and may be particularly at risk from PFAS used in oil and gas extraction. Although drilling and fracking take place in the majority of U.S. states, not everyone shares in that risk equally. Rather, oil and gas infrastructure and associated chemicals are frequently located in or adjacent to poor, underserved, and marginalized communities, Indigenous communities, and other communities of color. For example, a 2018 study of the location of oil and gas wastewater disposal wells in Ohio showed that the wells were disproportionately located in lower-income, rural communities.[145] A 2019 analysis conducted in Colorado, Oklahoma, Pennsylvania, and Texas found strong evidence that people of color disproportionately lived near fracking wells.[146] Where a pattern of risks affects people of color and/or lower-income people disproportionately, fracking should be viewed as an Environmental Justice issue – and so too should any resultant exposure to PFAS.

CH. 5 POLICY CAN HELP PROTECT BUCKEYES FROM PFAS IN FRACKING

a. Lax EPA Regulation of PFAS

Ohio and other state governments will likely have to take the lead in addressing PFAS pollution, from oil and gas operations as from other sources. State action will be necessary because EPA has taken only modest steps to protect the public. To make matters worse, Congress and the executive branch have exempted the oil and gas industry from major provisions of multiple federal environmental laws. For example, oil and gas waste is exempted from the hazardous waste rules that require cradle-to-grave tracking and safe handling of hazardous substances under the Resource Conservation and Recovery Act. These exemptions increase the burden on state governments to address any PFAS pollution associated with oil and gas extraction.[147]

EPA has taken some steps to protect the public from dangerous PFAS. In 2005, EPA reached a then-record $16.5 million settlement with chemical manufacturer Dupont after accusing the company of violating the federal Toxic Substances Control Act (TSCA) by failing to disclose information about PFOA's toxicity and presence in the environment.[148] In 2006, EPA invited Dupont, 3M and six other companies to join a "stewardship" program in which the companies promised to achieve a 95 percent reduction of emissions of PFOA and related chemicals by 2010, compared to a year 2000 baseline. The agreement also required the companies to eliminate such emissions and use of these chemicals by 2015.[149] In 2022, EPA says on its website that the companies reported that they had accomplished those goals either by exiting the PFAS industry or by transitioning to alternative chemicals.[150] However, since the announcement of its PFAS stewardship program in 2006, EPA has allowed nearly unlimited use of closely related "replacement" chemicals in dozens of industries.[151] In response, in 2015 a group of more than 200 scientists raised health and environmental concerns that the new PFAS designed to replace PFOA and PFOS may not be safer for health or the environment.[152]

In October 2021, EPA announced its "strategic roadmap" for regulating PFAS. This plan encompasses a goal of setting federal drinking water standards for several PFAS chemicals by 2023, as well as commitments to "use all available regulatory and permitting authorities to limit emissions and discharges from industrial facilities" and "hold polluters accountable."[153] The plan does not, however, include an examination of PFAS use in the oil and gas industry. (Later that month, 15 members of the U.S. House of Representatives asked EPA to examine this topic.[154] The month before, PSR asked EPA to collect data on PFAS use in oil and gas extraction, utilizing its authority under TSCA.[155]) As previously stated, in June 2022, EPA announced new health advisory levels for several types of PFAS. Unfortunately, these standards are advisory and not legally enforceable.[156]

b. Ohio Disclosure Rules: In Need of Sweeping Reform

EPA's record of lax regulation suggests that at least in the short term, state and local governments will have to play leading roles to protect the public from these dangerous chemicals. In Ohio, multiple reforms are needed in the state's disclosure rules to lift the veil of secrecy that oil and gas companies have used to conceal the use of PFAS and other potentially dangerous chemicals. One such change should be tighter limits on the use of trade secret provisions.

Oil and gas companies have argued that chemical trade secrets are necessary to protect their intellectual property from competitors. However, this interest does not have to mean a complete lack of information on chemical identities for scientists, regulators, and the public. In 2015, California, a major oil-producing state,[157] began requiring full disclosure of chemicals used for well stimulation, including fracking. The policy did away with trade secret exemptions for the individual chemicals used in fracking products.[158] In June 2022, Colorado, a major producer of oil and gas,[159] followed in California's footsteps but extended the requirements for chemical disclosure to all chemicals used in oil and gas wells, not just fracking or stimulation chemicals.[160]

The methodology utilized in California and Colorado is consistent with a recommendation issued in 2014 by an advisory panel to the U.S. Department of Energy:[161] that

companies reveal the fracking chemicals injected into each well, providing that information in a list in which the chemicals are disassociated from the trade name of the commercial products they are part of. This form of disclosure enables the public to know all the chemicals used in fracking without disclosing to rival chemical manufacturers the exact components of any proprietary formulas.[162] California also has a process where state regulators review secrecy requests from chemical companies to determine whether the information must be kept proprietary.[163] Health and safety data related to fracking fluids are not allowed to be hidden from the public.[164] California requires disclosure of the chemicals used prior to fracking[165] as do West Virginia[166] and Wyoming.[167]

There is another step Ohio should take to ensure that full chemical disclosure is required from all of the companies in the chemical supply chain. Currently, Ohio rules require chemical disclosure only from companies farther down the supply chain, such as well operators, service providers, and vendors.[168] Chemical manufacturers are implicitly exempted, despite being the only entity that always knows the precise contents of the chemicals they produce. Evidence suggests that chemical manufacturers do not always tell companies farther down the supply chain the full contents of the chemical products they are using; rather, they provide these companies with vague descriptions, generic chemical family names, or Material Safety Data Sheets with an incomplete list of chemicals.[169] In such cases, the end users may legitimately be unable to disclose all the identities of chemicals used at a particular well – including PFAS – whether under trade secret protection or not. They simply would not have the information. Requiring disclosure of oil and gas chemicals from chemical manufacturers would avoid this problem. Colorado took this step in its June 2022 legislation.

These eminently reasonable and feasible reforms are valuable steps to protect the health of people who may be exposed to PFAS and other dangerous oil and gas chemicals, be they industry workers, residents living near wellsites, or first responders called to the scene of an accident. They can improve health and potentially even save lives. Additional steps to reduce the harms caused by oil and gas extraction are outlined in the following section including a ban on the use of PFAS in oil and gas operations, an action taken in 2022 by Colorado.[170] Among the evidence supporting this measure is a peer-reviewed analysis published in 2021 showing that many PFAS are immediately replaceable with less persistent and less toxic substances, including in the oil and gas industry.[171]

RECOMMENDATIONS

In light of the findings shared in this report, PSR recommends the following:

• **Halt PFAS use in oil and gas extraction.** Ohio should follow the lead of Colorado, a major oil- and gas-producing state which took this action through legislation passed in June 2022. Furthermore, Ohio and the U.S. Environmental Protection Agency (EPA) should prohibit PFAS from being used, manufactured, or imported for oil and gas extraction. Many PFAS are immediately replaceable with less persistent and less toxic substances, including in the oil and gas industry.

• **Expand public disclosure.** Ohio should greatly expand its requirements for public disclosure of oil and gas chemicals. The state could again follow the example offered by Colorado by requiring disclosure of all individual chemicals used in oil and gas wells without exceptions for trade secrets while requiring disclosure on the part of chemical manufacturers, who best know what chemicals are being used. Ohio should also require fracking chemical disclosure prior to fracking, as have several states including California, West Virginia, and Wyoming.

• **Increase testing and tracking.** Ohio and/or the U.S. EPA should determine where PFAS have been used in oil and gas operations in the state and where related wastes have been deposited and should test nearby water, soil, flora, and fauna for PFAS.

• **Require funding and cleanup.** Oil and gas and chemical firms should be required to fund environmental testing and evaluation in their areas of operation where these are needed, and should PFAS be found, be required to fund cleanup. If water cleanup is impossible, the companies responsible for the use of PFAS should pay for alternative sources of water for drinking and agriculture, as needed.

• **Reform Ohio's regulations for underground injection disposal wells** to prohibit wells close to underground sources of drinking water, to require groundwater monitoring for contaminants near the wells, and to require full public disclosure of the chemicals in the wastewater.

• **Limit or ban drilling and fracking.** Given the use of highly toxic chemicals, including but not limited to PFAS, in oil and gas extraction, Ohio should prohibit drilling, fracking, and disposal of related wastes in areas relatively unimpacted by oil and gas pollution and should increase protections in already-impacted regions. The state should empower local governments to take such action, too. When doubt exists as to the existence or danger of contamination, the rule of thumb should be, "First, do no harm."

ENDNOTES

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[17] PSR calculated the amount of PFOA that would contaminate the estimated volume of water contained in Lake Erie using the following data: EPA's interim health advisory level for PFOA is 0.004 parts per trillion. U.S. Environmental Protection Agency. Technical Fact Sheet: Drinking Water Health Advisories for Four PFAS (PFOA, PFOS, GenX chemicals, and PFBS). June 2022, at 4. Accessed Sept. 20, 2022, at https://www.epa.gov/system/files/documents/2022-06/technical-factsheet-four-PFAS.pdf. Parts per trillion refers to milligrams per one million liters of water. U.S. Environmental Protection Agency. Environmental Science and Technology Briefs for Citizens. Center for Hazardous Substance Research. Understanding Units of Measurement. Accessed Sept. 20, 2022 at https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.files/fileid/14285. One measuring cup contains approximately 237 milliliters. Exploratorium. Cooking Equivalents and Measures. Accessed September 20, 2022 at https://www.exploratorium.edu/food/measurements. The density of PFOA is 1.8 grams per milliliter. National Institutes of Health. National Library of Medicine. National Center for Biotechnology Information. PubChem. Perfluorooctanoic Acid. Density. Accessed September 20, 2022 at https://pubchem.ncbi.nlm.nih.gov/compound/Perfluorooctanoic-acid. Therefore, the mass of one measuring cup of PFOA is 426.6 grams or 426,600 milligrams. This mass of PFOA is 106,650,000 times greater than 0.004 milligrams (EPA's interim health advisory level per million liters). In order to dilute the mass of the PFOA in an equivalent volume of water, we multiplied 106,650,000 by 1,000,000. The result is 106,650,000,000,000 liters of water. There are 3.785 liters of water per gallon. U.S. Environmental Protection Agency. EPA ExpoBox Unit Conversion Table. Accessed September 20, 2022 at https://www.epa.gov/expobox/epa-expobox-unit-conversion-table. Therefore, 106,650,000,000,000 liters of water is equal to a bit more than 28 trillion gallons of water – the amount of water that could be contaminated to EPA's interim health advisory level by one measuring cup of PFOA. Lake Erie contains an estimated 128 trillion gallons of water. Ohio Department of Natural Resources. Ohio Coastal Atlas, Chapter 2: Lake Erie Watershed (2018), at 35. Accessed Sept. 5, 2022, at https://ohiodnr.gov/static/documents/coastal/ohio-coastal-atlas/CH02_LakeErieWatershed.pdf. Therefore, five measuring cups of PFOA would be more than enough to contaminate the entire volume of water.

[18] PSR calculated this figure by starting with 28 trillion gallons, the amount of water that could be contaminated under EPA's interim health advisory level by one measuring cup of PFOA (see endnote 17) and dividing it by New York City's daily consumption of 1.3 billion gallons of water. New York City. Environmental Protection. History of New York City Drinking Water (2021). Accessed Sept. 5, 2022, at https://www1.nyc.gov/site/dep/water/history-of-new-york-citys-drinking-water.page. The result is that one measuring cup of PFOA could contaminate a volume of water equivalent to what New York City would use over more than 21,500 days. Therefore, five measuring cups of PFOA could contaminate the amount of water equivalent to what New York City would use over 107,500 days.

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[158] Cal. Public Resources. § 3160 (j)(2)(A) (providing that "Notwithstanding any other law or regulation, none of the following information shall be protected as a trade secret…The identities of the chemical constituents of additives [in well stimulation treatment fluids], including CAS identification numbers."

[159] U.S. Department of Energy. Secretary of Energy Advisory Board Task Force Report on FracFocus 2.0 (Mar. 28, 2014). Accessed Sept. 9, 2022, at https://www.energy.gov/sites/default/files/2014/04/f14/20140328_SEAB_TF_FracFocus2_Report_Final.pdf. U.S. Department of Energy. Secretary of Energy Advisory Board Task Force Report on FracFocus 2.0 (Mar. 28, 2014). Accessed Sept 9, 2022, at https://www.energy.gov/sites/default/files/2014/04/f14/20140328_SEAB_TF_FracFocus2_Report_Final.pdf.

[160] Colorado General Assembly. HB22-1348. Senate Amended 3rd Reading (May 11, 2022). Accessed Sept. 9, 2022, at https://leg.colorado.gov/sites/default/files/documents/2022A/bills/2022a_1348_rer.pdf.

[161] U.S. Department of Energy. Secretary of Energy Advisory Board Task Force Report on FracFocus 2.0 (Mar. 28, 2014). Accessed Sept. 9, 2022, at https://www.energy.gov/sites/default/files/2014/04/f14/20140328_SEAB_TF_FracFocus2_Report_Final.pdf.

[162] U.S. Department of Energy. Secretary of Energy Advisory Board Task Force Report on FracFocus 2.0 (Mar. 28, 2014). Accessed Sept. 9, 2022, at https://www.energy.gov/sites/default/files/2014/04/f14/20140328_SEAB_TF_FracFocus2_Report_Final.pdf.

[163] Cal. Public Resources. § 3160 (j)(5-7).

[164] Cal. Public Resources § 3160 (j)(2).

[165] Cal. Public Resources. § 3160(d)(6).

[166] W. Va. Code §§ 22-6A-7(e)(5), 22-6A-10(b).

[167] Wyoming Admin. Code Ch. 3 § 45(a).

[168] Ohio Rev. Code § 1509.10(A)(10)(a-b), (F-G).

[169] For example, in 2014, four attorneys with years of experience litigating oil and gas-related cases in Pennsylvania filed a petition with the state Commonwealth Court suggesting manufacturers often withhold chemical identities from other companies in the supply chain. See Petitioners' pleading filed in Robinson Twp. v. Commonwealth, Docket No. 284 MD 2012 (June 9, 2014), at 13 FN5 (on file with PSR). The attorneys provided as support a record filed in a separate case by well operator Range Resources in which Range suggested that it was relying on Material Safety Data Sheets from manufacturers to reply to a request for the chemicals used to fracture or stimulate its wells. "The MSDS are often useful for developing some understanding of what is in a particular chemical or product," Range wrote. "However, they vary widely in terms of usefulness. Some manufacturers include very little information about the actual components of a particular product. As a result, Range is currently in the process of seeking additional information from manufacturers that have failed to provide enough information about their products in the MSDS." See Kiskadden v. Department of Environmental Protection v. Range Resources – Appalachia, LLC. Docket No. 2011-149-R. Permittee Range Resources – Appalachia, LLC's Amended Responses and Objections to Appellant's Request for Production of Documents and Request for Admission. Filed with Commonwealth of Pennsylvania Environmental Hearing Board (April 24, 2013) (on file with PSR).

[170] Colorado House Bill 22-1348 (enacted June 8, 2022). Accessed Sept. 8, 2022, at https://leg.colorado.gov/sites/default/files/2022a_1348_signed.pdf.

[171] Julianne Glüge et al. Information Requirements under the Essential-Use Concept: PFAS Case Studies. Environmental Science & Technology (Oct. 5, 2021). Accessed Sept 9, 2022, at https://pubs.acs.org/doi/10.1021/acs.est.1c03732.

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