Hydraulic Fracturing in Pennsylvania: A Policy Analysis

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Hydraulic Fracturing and PFAS chemicals in Pennsylvania: A Policy Analysis

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Abstract

PFAS (polyfluoroalkyl and perfluoroalkyl substances) chemicals and hydraulic fracturing have significant impact on the health and well-being of communities as well as the environment. PFAS chemicals, also known as "forever chemicals," do not break down naturally in the environment and have the high potential of leaking into soil and water. Contamination of soil and water via hydraulic fracturing is becoming more common. Many health risks and conditions are associated with exposure to PFAS chemicals. This policy analysis discusses how the guidelines distributed by the Environmental Protection Agency (EPA) influence policy in Pennsylvania, explores how weak policy making on hydraulic fracturing and PFAS chemicals puts communities at risk, and examines the Biden Administration's stance on hydraulic fracturing and PFAS contamination. The policies implemented by the EPA and the Pennsylvania Department of Environmental Protection were analyzed in detail as they pertain to hydraulic fracturing and exposure to PFAS chemicals. An environmental scan was then conducted to report on a widely-used database to record chemicals used in hydraulic fracturing, EPA approval of certain PFAS chemicals, and Marcellus Shale impact on unconventional drilling. The Biden Administration was discussed with respect to the steady emergence of reports on PFAS chemicals and their influence on the intersection of environmental health of the US population and policy making. This analysis concludes with recommendations to prioritize environmental health policy and implement

chemical testing strategies across the country with a focus on areas of high risk such as hydraulic fracturing sites.

Table of Contents

List of Tables

List of Figures

1.0 Introduction

Unconventional shale gas reservoirs, such as the Marcellus Formation in Pennsylvania, are a large source of natural gas reserves for the United States. To access the natural gas, a process known as hydraulic fracturing or "fracking" is utilized to increase gas flow and enhance permeability of shale formations (Department of Environmental Protection, n.d.). Essentially, this process of extracting gas produces fractures in rock formations to stimulate the flow of gas or oil. Per the Environmental Protection Agency, "Fractures are created by pumping large quantities of fluids at high pressure down a wellbore and into the target rock formation. Hydraulic fracturing fluid commonly consists of water, proppant and chemical additives that open and enlarge fractures within the rock formation." (EPA, 2021).

Fracking requires the use of chemical additives to keep fractures open for the steady flow of gas or oil. Many chemicals used by oil and drilling companies break down into toxic substances known as PFAS. PFAS chemicals, polyfluoroalkyl and perfluoroalkyl substances, have been used since the 1940s due to their many uses in manufacturing (Environmental Protection Agency, 2021, December 21). PFAS are characterized by their tendency to break down very slowly and build up in humans, animals, and the environment over time. Health effects associated with PFAS exposure are difficult to quantify due to the large number of PFAS chemicals and the differences in frequency and amount of exposure (EPA, 2021, December 21). PFAS chemicals or those that eventually break down into such toxic substances have the potential to seep into public water systems and contaminate drinking water.

According to a report on exposure of PFAS from drinking water, "[PFAS] contaminate the drinking water of as many as 80 million Americans." (Andrews, 2020). In 2019, the EPA

announced the first comprehensive nation-wide PFAS Action plan after increased attention from researchers, government agencies, and communities worldwide, all of whom expressed concern about PFAS contamination in food, soil, and water. In 2020, the EPA began to develop more guidelines on the process of setting regulatory limits on certain PFAS. States, including Pennsylvania, began to develop their own policies on PFAS regulation in response.

In September 2018, Governor Wolf signed Executive Order 2018-08 establishing the PFAS Action Team to begin sampling areas across the state that represent potential sources of PFAS contamination (Commonwealth of Pennsylvania Governor's Office, 2021). The policies and guidelines set forth by the EPA and state of Pennsylvania will be discussed below.

1.1 Essay Objectives

This essay will analyze the policies and guidelines created by the EPA and their impact on Pennsylvania's regulation of PFAS chemicals and hydraulic fracturing. The policy analysis will focus on EPA and Pennsylvania interventions to reduce exposure of PFAS chemicals and community risk of water contamination from runoff and wastewater resulting from hydraulic fracturing. Findings from the policy analysis and environmental scan will be used to discuss the actions of the Biden Administration and its influence on policymaking. To conclude, recommendations will be made based on these findings to improve policies that uphold the interest of public health in communities and prevent exposure to toxic chemicals.

2.0 Methods

This paper reviewed the PFAS regulation and hydraulic fracturing policies of the EPA and Commonwealth of Pennsylvania. As policies and recommendations trickle down from the national level to state-wide policymaking, both national and state regulations were examined. All risks inclusive of health and environmental impact from PFAS and the potential of contamination of drinking water from hydraulic fracturing were taken into consideration to illustrate the wide-spread importance of regulation of potential exposure. Next, an environmental scan was conducted on Pennsylvania policy interventions based on EPA guidelines and reports, PFAS sampling and testing, and Marcellus Shale operations. Finally, the stance taken by the current presidential administration in the realm of environmental health policy and protection of the US population against toxic chemical exposure was targeted to illustrate the federal government's influence on environmental health policy. To conclude, these topics were discussed to identify areas of improvement in the section on recommendations for the future of the intersection of environmental health and policy.

3.0 EPA Policy and Guidelines

The EPA has many regulations regarding the process of hydraulic fracturing as it pertains to water contamination. It also sets guidelines for chemical usage across the industry to regulate human, animal, and environment exposure to toxic substances. This section will discuss the Safe Drinking Water Act and Clean Water Act implemented by the EPA to protect human consumption of water.

3.1 Safe Drinking Water Act

In 1974, the Safe Drinking Water Act (SDWA) was enacted to protect the nation's public drinking water supply from the source to the tap. Over the years, it was amended to not only focus on water treatment, but also to take significant steps to "regulate source water protection, operator training, funding for water system improvements, and public information as important components of safe drinking water" (EPA, 2004). The SDWA sets national standards for drinking water that include requirements for water testing to detect contaminants and enforces maximum contaminant levels in drinking water or requires protocols to treat water to remove contaminant. The EPA also oversees state drinking water programs, such as that in Pennsylvania, to ensure that recommendations and guidelines are being enforced to protect water quality in communities. Drinking water standards are created through a three-step process:

1. Identify contaminants that occur in drinking water that pose a threat to public health and conduct further study to determine necessity of regulation.

2. Determine maximum contaminant level for regulated contaminants for which there is no risk to health to allow for margin of safety.
3. Specify maximum permitted level of contamination in drinking water delivered to the public, keeping feasibility in mind. Feasibility is measured via the best technology, treatment techniques, efficiency under field conditions and cost to implement. If not economically or technically feasible to set a maximum level, a required Treatment Technique which specifies a way to treat the water to remove contaminants is created. (EPA, 2004).

An EPA report concluded that there is scientific evidence that hydraulic fracturing activities can impact drinking water in the US (EPA Releases Final Report, 2016). The hydraulic fracturing process has five stages illustrated by the graphic seen in Appendix A. The stages include Water Acquisition, Chemical Mixing, Well Injection, Produced Water Handling, and Wastewater Disposal and Reuse. Water can become contaminated with toxic chemicals at any stage of this process via spills during the management fracking fluids and chemicals or high concentrations of chemicals reaching that may contaminate groundwater resources. Contamination can also occur via "injection of hydraulic fracturing fluids into wells with inadequate mechanical integrity, allowing gases or liquids to move to groundwater resources or injection of hydraulic fracturing fluids directly into groundwater resources" (EPA Releases Final Report, 2016).

National drinking water standards can be legally enforced by the EPA or states. If hydraulic fracturing by oil and drill companies contaminate drinking water, the EPA and US states have the authority to issue administrative controls via fines or legal action. Hydraulic fracturing is not directly regulated under this act. Many environmental statutes have exemptions for oil and gas production companies despite the proven risk of exposure to chemicals in drinking water. In a

report produced by the National Resources Defense Council it is stated, “Fracking is exempted from the Safe Drinking Water Act pollution control measures unless diesel is used in the fracking process” (National Resources Defense Council, 2013). This is supported by EPA’s SDWA’s Underground Injection Control program (UIC). The UIC establishes regulations for six classes of wells to prevent injection wells from contaminating underground sources of drinking water. The six classes of wells are composed of the following:

1. Class I: Industrial and Municipal Waste Disposal Wells
2. Class II: Oil and Gas Related Injection Wells
3. Class III: Injection Wells for Solution Mining
4. Class IV: Shallow Hazardous and Radioactive Injection Wells
5. Class V: Wells for Injection of Non-Hazardous Fluids into or Above Underground Sources of Drinking Water
6. Class VI: Wells Used for Geological Sequestration of CO2

Under these regulations, the UIC regulates the construction, operation, and closure of wells. (Underground Injection Control Regulations, 2021). Regulations include minimum requirement for state-implemented UIC programs under SDWA and procedures for the EPA to approve, change, or withdraw those programs. The regulations also include provisions for technical standards of injection wells and hazardous waste restrictions. Each class of injection well is regulated with its own standards and provisions based on state requirements to control contamination of underground drinking water sources via enforcement, funding, and monitoring activities.

The EPA released a statement in 2014 describing the regulations of the UIC Program, “In the 2005 Energy Policy Act, Congress revised the SDWA definition of “underground injection”

to specifically exclude hydraulic fracturing fluids from UIC regulation except where diesel fuels are used (SDWA Section 1421(d)(1)(B)). UIC regulations prohibit any underground injection except as authorized by rule or by permit" (EPA Fact Sheet, 2014). The report went on to say that oil and gas companies may still inject diesel fuels for hydraulic fracturing if they obtain a permit before the start of injection. The regulation focuses solely on the chemicals within diesel fuels and makes no mention of other chemicals used in the fracking process such as PFAS or the chemicals that break down into PFAS. At the writing of this document, the regulation has not changed despite multiple reports of the harms of PFAS and risk from fracking.

3.2 Clean Water Act

The Federal Water Pollution Control Act was enacted in 1948 as the first major US Law to address water pollution. It was expanded in 1972 and became commonly known as the Clean Water Act (CWA) creating a standard structure to regulate pollutant discharges into water. (Friis, 2019). Under the CWA, the EPA has the authority to develop pollution control programs such as setting standards for wastewater used in industry. This act was also adapted to maintain requirements for setting water quality standards of surface waters. Surface waters refer to lakes, rivers, ponds, reservoirs, and oceans as opposed to groundwater which is contained in interconnected pores in aquifers.

The EPA has a permit program to control discharges of pollutants into navigable waters. Under this program, it is required that industrial and municipal facilities obtain permits if their discharges go directly to surface waters (Environmental Protection Agency, October 2021). This is enforced via the Clean Water Act Compliance Monitoring Program and general Water

Enforcement made through partnerships between the EPA and federal, state, and tribal regulatory partners. The states are largely responsible for ensuring compliance with CWA from wastewater and stormwater to surface water. However, there are exemptions provided to certain industries.

Per the NDRC, "Oil and gas operations are exempt from important permitting and pollution control requirements of the Clean Water Act, including the stormwater runoff permit requirement" (National Resources Defense Council, 2013). Additionally, certain wastewater produced by hydraulic fracturing of oil and gas companies can be discharged into surface waters, as hydraulic fracturing activities are not strictly regulated and held to the same standards as other activities under the CWA. As such, states are not required to regulate these companies and their fracking practices.

3.3 EPA PFAS Regulation

Regulations on PFAS by the EPA are a relatively new development in environmental health policy. Only within the last five years has extensive research been conducted to learn more about the risks of PFAS chemicals. Thus, new regulations, guidelines, and strategies have been created and are in the process of being implemented by the EPA and enforced by state governments.

In 2018, the EPA published a new method to update guidelines on detecting PFAS in drinking water. Known as Method 537.1, it is used to collect national occurrence data on PFAS and is used in laboratories to quantitate PFAS in drinking water (Shoemaker, 2018). Method 537.1, which detects 18 PFAS, replaced a previous method that detected only six. States across the nation began transitioning to this new method to detect PFAS in their drinking water in forthcoming

years. A description of how the Commonwealth of Pennsylvania adopted this new method and policy guidelines will be discussed in a later section.

In 2019, the EPA announced its EPA PFAS Action Plan, detailing its commitment to protect human health and limit exposure to harmful levels of PFAS (EPA's PFAS Action Plan, 2019). Policy actions described in this document include the following:

1. Initiating steps to evaluate the need for a maximum contaminant level (MCL) for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS)
2. Beginning the necessary steps to propose designating PFOA and PFOS as "hazardous substances" through one of the available federal statutory mechanisms
3. Developing groundwater cleanup recommendations for PFOA and PFOS at contaminated sites

The action plan set forth concerns and challenges to be addressed with regulatory standards with a timeline spanning to 2022. Many are listed as "ongoing" or have not been completed despite certain timeline endpoints.

In February 2021, the EPA released two actions to address PFAS: "reproposing the Fifth Unregulated Contaminant Monitoring Rule (UCMR 5) to collect new data on PFAS in drinking water and … reissuing final regulatory determinations for perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) under the Safe Drinking Water Act (SDWA)" (Environmental Protection Agency, February 2021). Per the Regulatory Determinations set forth by these actions, the EPA planned to implement the national primary drinking water regulation development process for the two PFAS mentioned in the release. They also announced that they would consider evaluating other PFAS chemicals to understand the frequency that PFAS appear in drinking water at certain levels.

In April 2021, the EPA announced that a new regulatory body within the agency would continue to build on existing initiatives to better understand and reduce risks associated with PFAS exposure (Office of the Administrator, April 2021). The ultimate goal of this regulatory body is to fulfill the agenda set forth by the Action Plan.

In June 2021, the EPA proposed expansions to the Significant New Use Rules (SNURs) to require reporting of PFAS manufactured in the US. The SNURs require, "anyone intending to use [the] chemicals under certain conditions of use to submit a significant new use notice (SNUN) that EPA would review to make a TSCA [Toxic Substances Control Act] section 5 finding for the significant new use." (Environmental Protection Agency, January 2022). The expansion rule requires "all manufacturers (including importers) of PFAS in any year since 2011 to report information related to chemical identity, categories of use, volumes manufactured and processed, byproducts, environmental and health effects, worker exposure, and disposal" (Environmental Protection Agency, June 2021). This rule represents the first targeted effort to compile a comprehensive dataset on PFAS and collect information on PFAS manufacturing under the Toxic Substances Control Act. In addition to this, three new PFAS were incorporated into the Toxics Release Inventory, as they became subject to the SNUR under the Toxic Substances Control Act.

Also in June 2021, the EPA restarted the process to designate PFOA and PFOS as hazardous substances, although they have not officially been added to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substance list as of February 2022. CERCLA provides a federal Superfund to clean up uncontrolled or abandoned hazardous-waste sites and contaminants in the environment. Under CERCLA, the EPA has the authority to require that companies and agencies responsible for any release of hazardous waste must cooperate in cleanup efforts. As PFAS are not considered hazardous waste yet under

CERCLA, oil and gas companies that produce PFAS are exempt from provisions that govern the assessment control and clean-up of hazardous waste (National Resources Defense Council, 2013).

The EPA announced the development of a National PFAS Testing Strategy in October 2021 with a multi-phase implementation separated by human-health related data and ecologically-related data. As there are hundreds of PFAS chemicals and toxicity data on them is minimal or non-existent, the goal of this strategy is to address this gap in data. Through data collection, the EPA can identify and select PFAS that require testing through the Toxic Substances Control Act (National PFAS Testing Strategy, 2021). By the end of 2021, the EPA plan encompassed issuing test orders on selected PFAS with additional phases to follow in 2022.

The timeline below illustrates a more concise display of the EPA Action Plan for reference:

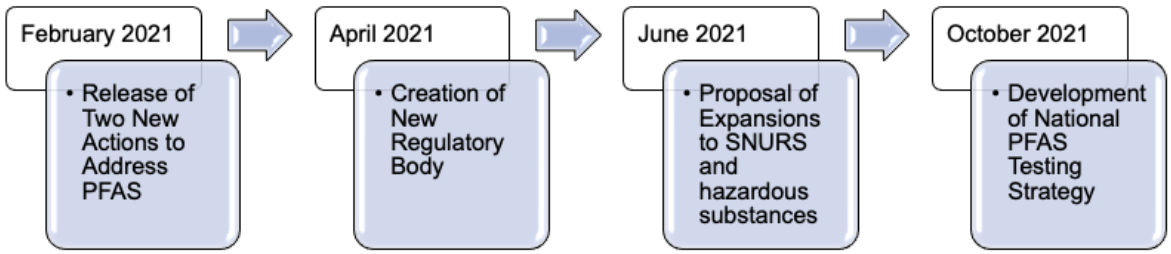


Figure 1

Throughout this period of PFAS regulation (2018-2021), there was no mention of hydraulic fracturing being a risk factor. Sites of oil and gas drilling were never mentioned as areas of concern for PFAS testing, despite significant risk for drinking water contamination. This could be for a few reasons. Drill sites are regulated through permitting and must comply with safety standards. However, there are gaps in this regulation that do not specifically address relevant certain chemical

exposures as seen with evidence of water contamination from drill sites with proper permitting. Additionally, lack of regulation including drill sites as possible areas of contamination may be due to relatively new guidance on PFAS chemicals. There is a possibility that eventually regulation will stretch to these sites; however, they have not yet expanded into the oil and gas drilling market. But, with significant risk of exposure to chemicals and other harmful substances via runoff and underground water contamination, regulation should hold oil and gas companies responsible for safe handling of chemicals and restrict usage of PFAS in their activities.

4.0 Commonwealth of Pennsylvania Policy and Guidelines

Pennsylvania's Department of Environmental Protection (DEP) regulates hydraulic fracturing based on national guidelines and policies set forth by the EPA. Oil and gas drilling is also regulated by state oil and gas laws as pertains to unconventional wells. They are also regulated by environmental protection laws including water treatment and wastewater management laws. The following sections analyze a few of these laws and policies regarding hydraulic fracturing and steps taken to address PFAS chemicals.

4.1 Wastewater Treatment Requirements

Section § 95.10 of the Pennsylvania Code, Treatment requirements for new and expanding mass loadings of Total Dissolved Solids (TDS), describes the requirements regarding operations with wastewater resulting from hydraulic fracturing, production, field exploration, drilling or completion of natural gas wells. The regulation states, "there may be no discharge of wastewater into waters of this Commonwealth from any source associated with fracturing, production, field exploration, drilling or well completion of natural gas wells." However, there is an exception, as discharges of wastewater resulting from fracking activities may be authorized if oil and gas companies fulfill requirements in National Pollutant Discharge Elimination System permitting, monitoring and compliance.

4.2 Pennsylvania Safe Drinking Water Act

The PA SDWA sets forth many of the same requirements as the Federal SDWA. Special sections in the act are specifically related to contaminants which are defined as "Any physical, chemical, biological or radiological substance or matter in water" (Pennsylvania Safe Drinking Water, 1984). The state assumes primary enforcement of all regulations in the PA SDWA and develops procedures to enforce compliance including but not limited to monitoring and inspection, maintaining an inventory of public water systems, developing a program to conduct sanitary surveys, and establish certification processes for laboratories conducting analyses of drinking water samples. The law does not specifically state where such contaminants may originate from but is clear in that maintenance of drinking water systems are conducted to identify possible contaminant consumption risks.

4.3 The Clean Streams Law of 1937

The Clean Streams Law, last amended in 2006, was created protect public health via preservation and purification of waters in Pennsylvania. It is composed of regulations that provide strategies to avoid pollution, protect PA's water supply and water quality, and regulate discharges of industrial wastes. Like EPA regulation, the Clean Streams Law does not permit industrial waste discharges into water supplies of the Commonwealth unless approved for a permit under an Environmental Hearing Board. Any discharge of industrial waste without a legal permit is considered to be a nuisance and may result in a mandatory preliminary or special injunction in cases where public health is endangered (Pennsylvania Clean Streams Law, 2006). Again, this

policy falls short of complete regulation of hydraulic fracturing as PFAS are not yet considered hazardous waste and cannot be regulated and enforced under Pennsylvania law.

4.4 Unconventional Well Law

Section 78a.54 of the Pennsylvania Code, which describes the general requirements under the Environmental Protection Performance Standards for unconventional shale wells, states clearly, “The well operator shall control and dispose of fluids, residual waste and drill cuttings, including tophole water, brines, drilling fluids, drilling muds, stimulation fluids, well servicing fluids, oil, production fluids and drill cuttings, in a manner that prevents pollution of the waters of the Commonwealth.” Additionally, Section 78a.60 of the Pennsylvania Code states, “The owner and operator may not cause or allow a discharge of a substance, fill or dredged material to the waters of the Commonwealth unless the discharge complies with The Clean Streams Law.” Companies engaging in hydraulic fracturing under PA law and in accordance with EPA policy may not release discharge that will contaminate drinking water to protect both ecological interest and public health.

4.5 Wolf Administration Response to PFAS

In September 2018, Pennsylvania Governor Tom Wolf signed Executive Order 2018-08 to address PFAS in drinking water by creating the PFAS Action Team. The PFAS Action Team began a statewide sampling plan in June 2019 to better understand the presence of PFAS in PA

and develop a metric to protect public water systems. Originally, samples collected by the DEP were analyzed for the presence of six PFAS chemicals (Commonwealth of Pennsylvania Governor's Office, 2021). Unfortunately, due to the COVID-19 pandemic, sampling was halted from March 2020 to July 2020; the analysis shifted to adopt EPA Method 537.1 in August 2020. As stated above, this new method can detect 18 PFAS. New samples were collected and repeat samples were taken at all the sites from the 2019 sampling. The DEP chose their sampling sites based on location criteria. Sites were selected if they met criteria as a potential source of PFAS contamination or were located within half a mile of such a source like military bases, fire training sites or landfills (Commonwealth of Pennsylvania Governor's Office, 2021). Not a single hydraulic fracturing site met the criteria as a possible PFAS contamination site despite being known to have high potential to contaminate drinking water via runoff and wastewater exposure.

The sampling results found that PFOS and PFOA were most commonly detected at 103 and 112 sites respectively. Additionally, eight PFAS were detected at all sites with detections. Two of these detected results were above the US EPA Health Advisory Level (Commonwealth of Pennsylvania Governor's Office, 2021). Based on these findings the DEP took the following actions to address PFAS contamination in Pennsylvania:

1. Begin the process of setting a Maximum Contaminant Level (MCL) for PFAS after the EPA did not do so in February 2019
2. Develop a cleanup standard for PFAS soil contamination
3. Develop uniform, science-based operating procedures to guide the identification and assessment of commercial and industrial properties that have contaminated private and/or public drinking water sources

5.0 PFAS Public Health Impact

PFAS can be found in our drinking water, soil and water near landfills and hazardous waste sites, and in biosolids used in water treatment plants. It can be found in workplaces and even homes from drinking water to household products and dust. Because there are so many avenues of exposure, humans can be exposed to PFAS in many ways. From drinking water contaminated with PFAS, to working in occupations such as chemicals manufacturing and processing, the risk of PFAS exposure is vast.

While research is still ongoing to determine the health effects of PFAS exposure, research suggests that exposure to high levels of PFAS can lead to adverse health outcomes (Environmental Protection Agency, December 2021). Data from the EPA suggests that exposure to certain levels of PFAS may contribute to the following:

1. Reproductive effects such as decreased fertility or increased high blood pressure in pregnant women
2. Developmental effects or delays in children
3. Increased risk of some cancers
4. Reduced ability of the body's immune system to fight infections, including reduced vaccine response
5. Interference with the body's natural hormones
6. Increased cholesterol levels and/or risk of obesity.

PFAS are also known to build up in the environment over time and are known as “forever chemicals” because they do not break down naturally. This affects water and soil composition and can increase exposure in animals as well.

6.0 Environmental Scan

To perform an analysis of PFAS chemical use in hydraulic fracturing, a scan of recent environmental reports was conducted. It offered insight into fracking in Pennsylvania and unconventional well-drilling on Marcellus Shale. An explanation of FracFocus, a chemical disclosure registry that lists all chemicals used by fracking sites, is provided to explain its use in recent reports of PFAS in hydraulic fracturing. This section will also briefly discuss the list of approved chemicals produced by the EPA for use in hydraulic fracturing.

6.1 FracFocus Database

FracFocus is a natural hydraulic fracturing chemical disclosure registry. Its purpose is to provide a database of chemicals used in hydraulic fracturing sites organized by location. The registry "receives reports from more than 1,100 companies reporting chemicals for more than 138,000 hydraulic fracturing operations nationwide. Because of the system's success from both operator and consumer perspectives, 27 states now either require or allow companies to disclose chemical data via FracFocus" (About FracFocus, n.d.). All chemicals that are used to hydraulically fracture a well are reported in this database except those that are withheld by companies as trade secrets. Pennsylvania is included in one of the 27 states disclosing chemical data. In addition to chemical data, the database website also contains links to all 50 states and their oil and gas regulations. Pennsylvania's link navigates to the Department of Environmental Protection Oil and

Gas Surface Regulations, and lists Oil and Natural Gas Representatives at the Pennsylvania Bureau of Oil and Gas Management.

Appendix B contains screenshots of FracFocus illustrating the wells and chemicals used for fracking of Marcellus Shale in Mercer County Pennsylvania. Mercer County was arbitrarily chosen to show an example of fracking of Marcellus Shale in PA.

6.2 EPA Permitting Use of PFAS

In July 2021, a group of physicians released a report presenting evidence that oil and gas companies have used potential PFAS and/or chemicals that eventually degrade into PFAS chemicals in their hydraulic fracturing activities between 2012 and 2020. The report, "Fracking with Forever Chemicals," was released by Physicians for Social Responsibility (PSR) and documents that the EPA approved three chemicals for use in hydraulic fracturing despite knowledge that these chemicals could degrade into substances like PFOA. (PSR, 2021). The three chemicals mentioned were approved by the EPA in 2010 for use in oil and gas drilling and fracking. But, per documents gathered under the Freedom of Information Act, PSR noted that EPA regulators were concerned that the chemicals could degrade into substances like PFOA and could be associated with severe health effects. According to the report, more than 1,200 wells in the US used potential PFAS chemicals in hydraulic fracturing activities as late as 2018, and due to a lack of disclosure of such chemicals by the EPA, it is likely that PFAS may have been used more frequently in any of the stages of the hydraulic fracturing process.

To determine if one of the chemicals (fluorinated acrylic alkylamino copolymer) approved by the EPA had been used in oil and gas wells, PSR used the FracFocus database to search for the

chemical under its generic name. PSR did not find any uses of the chemical under its generic name but found chemicals with related names reported in more than 1,200 wells. Evidence suggests that these chemicals could be PFAS, or precursors to PFAS. It should be noted that it is difficult to identify chemicals in the FracFocus database that could be fluorinated acrylic alkylamino copolymer because a chemical can have many trade or industry names. Without knowing the CAS number (a unique identifier assigned to chemicals by the American Chemical Society), it would be impossible to know exactly what the chemical is in the database. Thus, there is a strong possibility that this chemical could already be listed as a PFAS under a different name.

Finally, the FracFocus database reported that more than 130 oil and gas companies used chemicals that are or could be PFAS substances or precursors to PFAS according to the EPA's list of PFAS (PSR, 2021). These companies include major producers including XTO Energy Inc., a subsidiary of ExxonMobil, and Chevron Corp.

Prior to this report by PSR, it was not publicly known that the three chemicals mentioned were approved by the EPA and the records obtained by PSR represent "the first public indications that PFAS, long-lasting compounds also known as 'forever chemicals,' may be present in the fluids used during drilling and hydraulic fracturing, or fracking" (Tabuchi, 2021).Notably, PFAS were found in four wells in Washington County, PA, an area where no sampling was conducted to identify PFAS in Pennsylvania water sources per the Governor's executive order to crack down on PFAS exposure.

6.3 Marcellus Shale and Unconventional Drilling

The Marcellus Shale is a rock formation holding trillions of cubic feet of natural gas under two-thirds of Pennsylvania (Department of Environmental Protection, 2020). Prior to 15 years ago, access of this natural gas was considered too expensive. With the advent of advanced drilling technologies, "directional drilling increased from 6% of new hydraulically fractured wells drilled in the US in 2000 to 42% of new wells drilled in 2014" (Haley, 2016). It is now projected that natural gas developed via hydraulic fracturing "will rise to more than 75% of the domestic supply by 2035" (Haley, 2016).

The first commercial oil well used to drill Marcellus Shale was developed in 1859 by Colonel Edwin Drake in Titusville, PA and since then it is suggested that between 300,000 and 760,00 oil and gas wells have been drilled (Department of Environmental Protection, 2020). DEP and the Office of Oil and Gas Management are responsible for the regulation of safe exploration and recovery of natural gas via unconventional drilling. They are responsible for upholding public health and safety in Pennsylvania. As with any fracking site, large volumes of water are used for drilling and large volumes of wastewater are produced at Pennsylvania fracking sites on Marcellus Shale. In Pennsylvania, "A person may not withdraw or use water from water sources within this commonwealth for drilling or hydraulic fracture stimulation of any unconventional well except in accordance with a Water Management Plan (WMP) approved by DEP" (Department of Environmental Protection, 2020). A WMP as approved by the DEP includes where a person or company plans to obtain, store, and treat water and explains how they will ensure that withdrawal water will not affect quality nor quantity of water sources in the Commonwealth.

The DEP monitors the locations of wells of Marcellus Shale and ensures that fracking sites are not too close together. Additionally, they regulate the review and issue of drilling permits as

well as the inspection of drilling operations and water quality complaints. The Marcellus Shale Act (Act 13) developed stricter standards for wastewater treatment and construction of unconventional wells. It was signed into law in 2012 and institutes an impact fee on drillers in Pennsylvania. Goldstein states in his article on unconventional shale gas development, "In Pennsylvania, the new Marcellus Shale Act (Act 13) increases the likelihood that industry will obtain baseline water quality data through holding companies liable for any nearby water quality problems unless it can show that the problems were pre-existing" (Goldstein, 2013).

Hydraulic fracturing of Marcellus Shale wells in Pennsylvania uses a water-based fluid called "slickwater" frac (Department of Environmental Protection, n.d.). Slickwater fracs are water pumped at high pressure containing sand and concentrations of additives and chemicals designed to increase the production of gas from the reservoir. Slickwater refers to friction-reducing agents/chemicals that are added to water that is pumped into the wells to reduce pressure and access fluid in the well. Appendix C lists chemicals by oil and gas companies in Pennsylvania for hydraulic fracturing.

7.0 Biden Administration

In October 2021, the Biden Administration announced new efforts to stop PFAS from polluting the air, drinking water, and food supply. It also released actions to expand clean-up efforts to remove the PFAS contamination in systems across the country. The efforts were announced as a partnership between eight US agencies in a government-wide campaign to rid the American people of chemicals and pollutants that put the health and safety of the nation at risk. These agencies include the EPA, the Department of Defense, the Food and Drug Administration, the Department of Agriculture, the Department of Homeland Security, the Federal Emergency Management Agency, the Department of Health and Human Services, and the White House Council on Environmental Quality. As discussed earlier, the EPA announced its new strategy during this time to control PFAS at the source, increase accountability of polluters and focus on science-based decision making to address negative impacts on the disadvantaged (Dennis, 2021). The Biden Administration plans to work closely with the EPA to support its new strategy and ensure the correct steps are taken to reduce PFAS exposure. Additionally, "The Administration is also continuing work to pass President Biden's Bipartisan Infrastructure Deal and Build Back Better Agenda," both of which include setting funding aside to address PFAS contamination in the country's drinking water. Biden's Build Back Better Agenda also includes "investments for EPA to conduct monitoring across the country for 29 PFAS compounds in drinking water through the Unregulated Contaminant Monitoring Rule program" (The White House, 2021).

Coupled with the EPA's strategy to bolster PFAS testing and designate certain PFAS as hazardous substances under CERCLA, the Biden Administration is also supporting the Department of Defense (DOD) and their initiative to complete PFAS cleanup at about 700 DOD

and National Guard locations where PFAS may have been used or released. The EPA also committed to work with the DOD to expand their testing in soil and groundwater and increase their ability to detect PFAS in environmental media.

President Biden also incorporated the Food and Drug Administration (FDA) in his action plan. The FDA already began a testing campaign to detect potential PFAS in processed foods. At the time of the White House press release, the FDA was committed to expand its food supply testing and PFAS analysis method development. The Department of Agriculture (USDA) also declared that they would take strict steps to investigate the causes and sources of PFAS in our nation's food system by developing and implementing analytical testing methods for PFAS levels in meat and poultry.

The Department of Homeland Security (DHS) promised to take a very active role to not only develop and maintain initiatives to address PFAS, but also to protect first responders. "DHS conducted the first-ever inventory of PFAS use and prior releases from its facilities, including uses in firefighting foams and other PFAS-containing materials, and possible water source contamination" while implementing a Policy Directive to establish procedures to conduct investigations and testing (The White House, 2021).

Finally, the Biden Administration released its goal to utilize the Department of Health and Human Services to continue its review of the research and science on PFAS and their effects on human health and safety. They announced their CDC and Agency for Toxic Substances and Disease Registry study in eight states to provide information about adverse health effects related to PFAS exposure.

In conclusion, the Biden Administration has taken a very aggressive stance against PFAS and their potential to negatively affect the health of the American people. As a final initiative to

illustrate the Administration's commitment to coordinate PFAS activities and interventions across the government sectors involved, the White House developed a new Council on Environmental Quality (CEQ). Their goal is to continue to facilitate and develop new strategies to further research and removal of PFAS in communities.

8.0 Discussion

The EPA has many policies focused on access to clean drinking water and maintaining water quality. The Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA) are two laws designed to protect the public from consuming water containing contaminants and pollutants. The SDWA provides standards that include testing requirements, maximum contaminant levels, and treatment procedures and guidelines to remove those contaminants. Through the SDWA, the EPA also exercises oversight for many state drinking water programs and policies to enforce the guidelines and requirements for safe water systems. The CWA is specifically related to regulating pollutant discharges in water sources. Under the CWA, the EPA has the authority to develop pollution control programs and set standards for wastewater discharges from industrial practices. Any company or person who wishes to discharge wastewater into water sources or surface water areas must obtain a permit under the CWA. Both policies specify guidelines to protect public health and safety via safe drinking water; however, as outlined above, they do not protect public health from hazards related to hydraulic fracturing.

Per the EPA, hydraulic fracturing is known to have negative impacts on drinking water. Each stage of the hydraulic fracturing process has the potential to contaminate groundwater, surface water, water systems, or drinking water sources. Yet, regulations developed by the EPA for national enforcement have exemptions for hydraulic fracturing services. Oil and drilling companies are exempt from the SDWA unless they employ the use of diesel fuel in their activities despite the many other potentially harmful chemicals used in fracking. These companies are permitted to discharge wastewater into surface waters. Even if a company uses diesel fuel, they can still take part in underground injection practices with a permit. Additionally, under the CWA,

oil and drilling companies are also exempt from many of the standards required of other industrial practices and companies. They do not have to abide by many of the pollution control regulations and stormwater permitting. While there is scientific evidence produced by the EPA that hydraulic fracturing can contaminate water sources, there is still a lack of regulation around the industry.

Regulations on PFAS by the EPA are also lacking. Only recently have stricter policies been developed to take a more active role in regulating PFAS chemicals. The EPA created an Action Plan to combat PFAS exposure and protect the public against their many health risks. With the implementation of the Action Plan, steps will be taken to establish a maximum contaminant level and develop groundwater cleanup regulations for water sources that were already contaminated. Many PFAS, potential PFAS, and chemicals that breakdown into PFAS-like substances are not categorized as hazardous waste. This is another step the EPA will attempt to correct via their new strategies. With the support of the Biden Administration and many governmental agencies, a vast and comprehensive testing program will be created to better understand PFAS, reduce exposure, and complete a more robust categorization of potential PFAS.

Pennsylvania policies on hydraulic fracturing and PFAS are similar from a regulatory standpoint. While oil and gas drilling is more regulated by the oil and gas laws in Pennsylvania, the laws are more geared toward conservation of oil and gas rather than regulating hydraulic fracturing processes. For example, under the Wastewater Treatment Requirements, oil and gas companies drilling on Marcellus Shale cannot discharge wastewater into "waters of the Commonwealth." That is, unless proper permitting and compliance is fulfilled under the National Pollutant Discharge Elimination System. Again, there is another exception for oil and gas drilling companies.

The Pennsylvania Safe Drinking Water Act, similar in many ways to the federal SDWA, regulates water contaminants. Pennsylvania enforces monitoring, permitting, and compliance in sanitary surveys of public water systems. The PA SDWA establishes guidelines for certified laboratory testing of contaminated water systems.

The Clean Streams Act is related to preventing pollution, maintaining water quality and regulating industrial waste discharges. Similar to EPA regulation and the Unconventional Well Law, the Clean Streams Act does not permit industrial discharges into water supplies of the Commonwealth unless a permit is obtained. Enforcement of this act is through the state and the threat of legal injunction should there be a discharge of wastewater without proper permitting or in any area not approved by the permit.

Each of these policies, while regulatory in some manner towards hydraulic fracturing, lack awareness of an important fact: he EPA has not approved many PFAS and PFAS-like chemicals to be categorized as hazardous waste. Even though a permit may be obtained legally through the proper state and national channels, those permits are obtained with chemicals in mind that are not regulated. The risk of contaminating all sources of water due to the use of chemicals in hydraulic fracturing is very high based on an absence of PFAS policymaking.

With the aggressive stance of the Biden Administration on combatting the dangers of PFAS, there may soon be significant change for PFAS policy. Through a multidisciplinary approach of utilizing many different departments of government, stricter regulation of PFAS may be enforced.

8.1 Environmental Justice and Health Equity

The discussion of the significance of PFAS exposure and the impact of hydraulic fracturing is closely tied to issues of environmental justice and health equity. Many unconventional wells and drilling sites are in rural areas of lower income. This could be because rural areas have more land to conducting drilling activities and poorer individuals are more likely to allow hydraulic fracturing on their land in return for compensation, whereas the wealthy are less likely to give up their mineral rights (NPR, 2018). A study conducted by Kirk Jalbert for the FracTracker Alliance, which uses data analysis to monitor the risks associated with hydraulic fracturing, concluded that of 779 wells located in three counties around Pittsburgh, 777 wells were in areas where the median home value was under $200,000 (NPR, 2018).

Additionally, another study conducted by Clark University reported that the rural poor in Pennsylvania are unequally exposed to pollution and the negative impacts of hydraulic fracturing. There is a strong correlation between fracking wells and poverty levels not only in Pennsylvania, but across Marcellus Shale in Ohio and West Virginia. The Clark University researchers mapped 6,000 wells in these states and used Geographical Information Systems (GIS) to look at demographics in the areas surrounding drilling sites. The results were the same across the board: communities closer to drilling sites were below poverty level. Results indicated that "environmental injustice occurs in areas with unconventional wells…in all three states: Pennsylvania (for poverty and elderly population), West Virginia (for poverty, elderly population, and education level) and Ohio (for children)" (Ogneva-Himmelberger, 2015).

Another item of interest in the realm of hydraulic fracturing regulation relates to private vs. public wells. All the policies guidelines reviewed in the policy analysis section regulate only public drinking water sources. They do not consider the environmental impact on owners of private

wells, which are predominate in rural areas that depend on private wells as their primary source of drinking water. In essence, oil and drilling companies can target rural land, purchasing it from poorer rural communities for great economic benefit. However, those communities suffer through decreased access to safe drinking water which is not protected by the federal and state policies discussed in this paper.

Communities in rural areas are at a disadvantage when it comes to hydraulic fracturing and activities and the potential for contamination of drinking water sources. This is an environmental justice and health equity issue as these communities are at the mercy of oil and drilling companies. These communities are more likely to be exposed to pollutants and experience adverse health effects not only from potential water contamination, but also through air and soil pollution in areas surrounding drilling sites. The protection and provision of clean water for the public has become a major talking point in public health. However, individuals and families using private wells in rural areas are consistently left out of the conversation and are not provided with equitable resources to obtain safe drinking water.

9.0 Options

The process of enacting laws that regulate PFAS chemicals and hydraulic fracturing is a lengthy one. There are currently no laws that specifically regulate PFAS chemicals as related to hydraulic fracturing, so it would be a novel process to develop such a law. Some options for final recommendations include the increased management and control of PFAS, the restriction of drilling companies, and the expansion of sampling areas of possible PFAS exposure. It is important that testing strategies nationally and at the state level are continuously updated to account for new PFAS chemicals and are expanded to include a registry of all known and possible PFAS.

Another option for decreasing exposure to PFAS is to educate communities not only on risk of contamination, but also how to reduce exposure. Health departments can distribute materials to communities in areas of high risk of possible PFAS contamination and encourage populations to learn more about how they can get their water tested, who they can contact if they have concerns about contamination, and learn more about what is regarded as a safe level of exposure. With knowledge of PFAS exposure being limited at the present time, it can only serve to promote the health and safety of populations to address lack of education regarding all possible avenues of contamination including water, soil, cosmetics, and food products.

To expand on the community level of preventing exposure to toxic chemicals, regulations can also be amended to consider private drinking water wells. The majority of oil and drilling sites of unconventional wells exist in rural communities where groundwater aquifers are at an increased risk of contamination. Individuals and families living close to hydraulic fracturing sites and using private wells are more prone to contamination via pollutants from fracking activities. As these communities are usually of lower income and are virtually unprotected by federal and state

legislation on hydraulic fracturing, regulations may be created to ensure equity and justice in environmental health policy for these areas.

10.0 Recommendations

The best way to ensure that PFAS chemicals do not contaminate the nation's water sources is to classify them as hazardous waste. By doing this, they would be strictly regulated by CERCLA and the Toxic Substances Act and it would be more difficult for industrial waste to be discharged into surface waters and pollute water systems. However, none of the action plans laid out by the Biden Administration, the EPA, or the Pennsylvania DEP mention another law that could potentially be beneficial in reducing harm from PFAS. The Resource Conservation and Recovery Act (RCRA) gives the EPA the authority to control hazardous waste from cradle-to-grave (RCRA Overview, 2021). Under RCRA, the generation, transportation, treatment, storage, and disposal of hazardous waste is monitored to control the management and cleanup of solid and hazardous waste. There are also regulations under RCRA that regulate solid non-hazardous waste. Per the law, "States play the lead role in implementing non-hazardous waste programs under Subtitle D. EPA has developed regulations to set minimum national technical standards for how disposal facilities should be designed and operated. States issue permits to ensure compliance with EPA and state regulations" (RCRA Overview, 2021). Essentially, even if PFAS could not officially be considered hazardous waste, they could still be regulated under congressional law if RCRA were to be amended to cover PFAS chemicals.

Another recommendation to curb the exposure of PFAS and pollutants from hydraulic fracturing is to further restrict oil and drilling companies. There are many exemptions from safe drinking water laws for these companies that enable them to potentially expose the public's water systems to harmful contaminants. While permitting and monitoring compliance is a beneficial way to protect drinking water in communities, more can be done to regulate oil and drilling companies.

As even diesel-utilizing oil and gas companies may receive an exemption, removing such exemptions for these companies would protect more of the public and enforce compliance to prevent discharge of damaging discharge water. This not only safeguards public health, but also preserves the environment.

In Pennsylvania, it is recommended that sampling of areas that may be polluted with PFAS continue. However, it must continue in more areas that are of higher risk of contamination by including hydraulic fracturing sites. There is scientific evidence to support that hydraulic fracturing activities can contaminate the soil and water supplies around the sites. Runoff from wastewater discharges and contaminants from injection drilling can seriously impact the level of potential PFAS exposure.

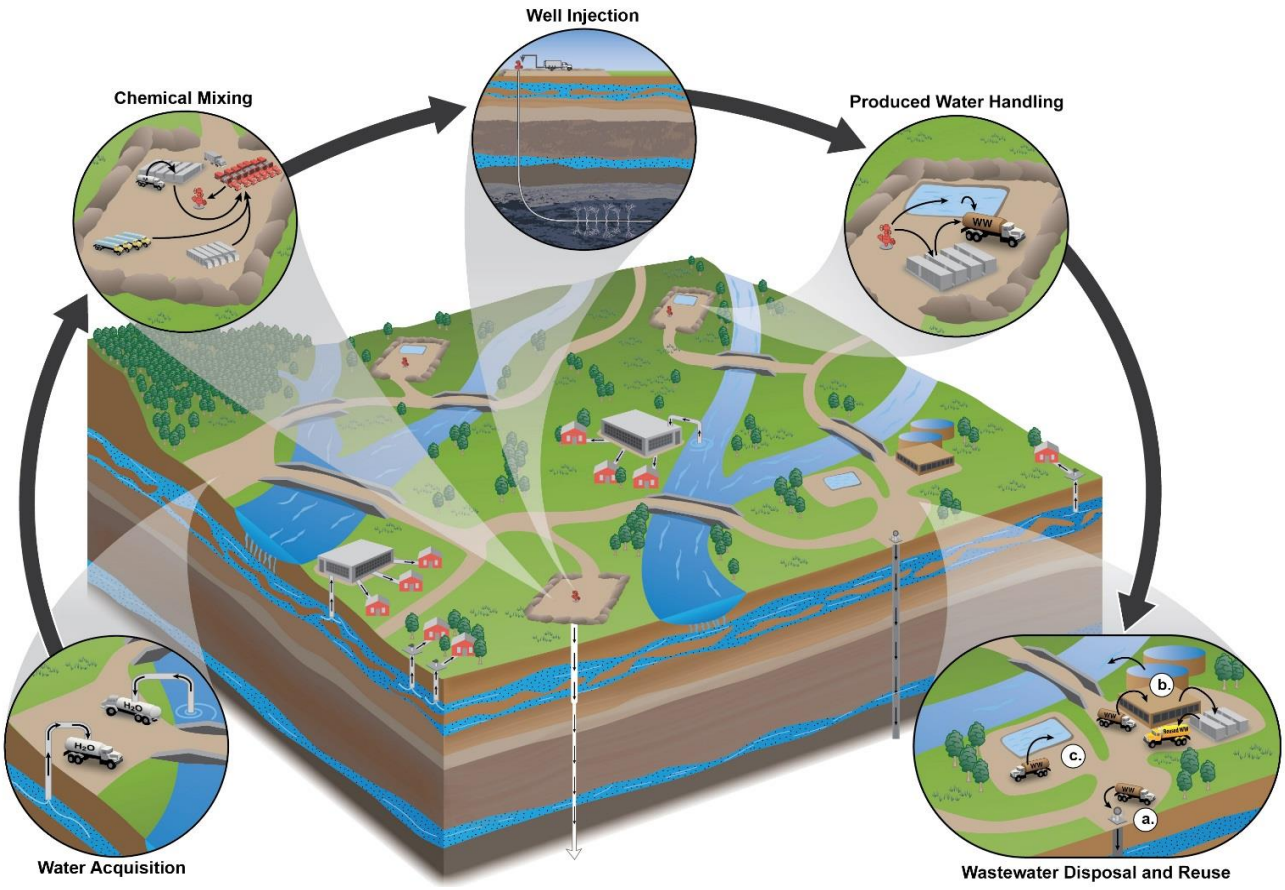
Finally, policy should be developed to restrict hydraulic fracturing in terms of PFAS. The Biden Administration's plan to further enforce PFAS regulation and create new policy is not sufficient to protect the population against the health risks associated with exposure to these harmful chemicals. Hydraulic fracturing activities are not mentioned in any of the plans and strategies set forth by the many government departments pledging to prevent PFAS contamination. It would be best practice for environmental health policymakers to take hydraulic fracturing into consideration when writing policy for PFAS.

11.0 Conclusion

As demonstrated in this policy analysis, it is critically important for the federal government as well as Pennsylvania to develop additional regulations and interventions to identify and reduce exposure to PFAS chemicals, particularly in the hydraulic fracturing industry. EPA and Pennsylvania DEP have lacked the sense of urgency necessary to include hydraulic fracturing activities in their sampling data. Moreover, many laws and policies created by these two agencies have exemptions for safe drinking water contamination specifically for companies involved in hydraulic fracturing despite known issues with runoff and discharge waters.

However, under the influence of the Biden Administration coupled with public outcry for further testing and research into PFAS chemicals and the dangers posed by hydraulic fracturing, the potential for more adaptive and encompassing policymaking has increased. The Action Plan set forth by the EPA to take a more aggressive stance against toxic PFAS chemicals is promising for environmental health policy strategies. The US may yet see an increase in environmental protection from harmful industrial production and activities. Recommendations to prioritize environmental health policies and implement wider testing strategies to promote accountability of the oil, gas, and manufacturing industries highlights the importance of public health intervention. It is crucial to recognize the significance of the intersection of environmental health and policymaking to promote public health.

Appendix A



Appendix Figure 1

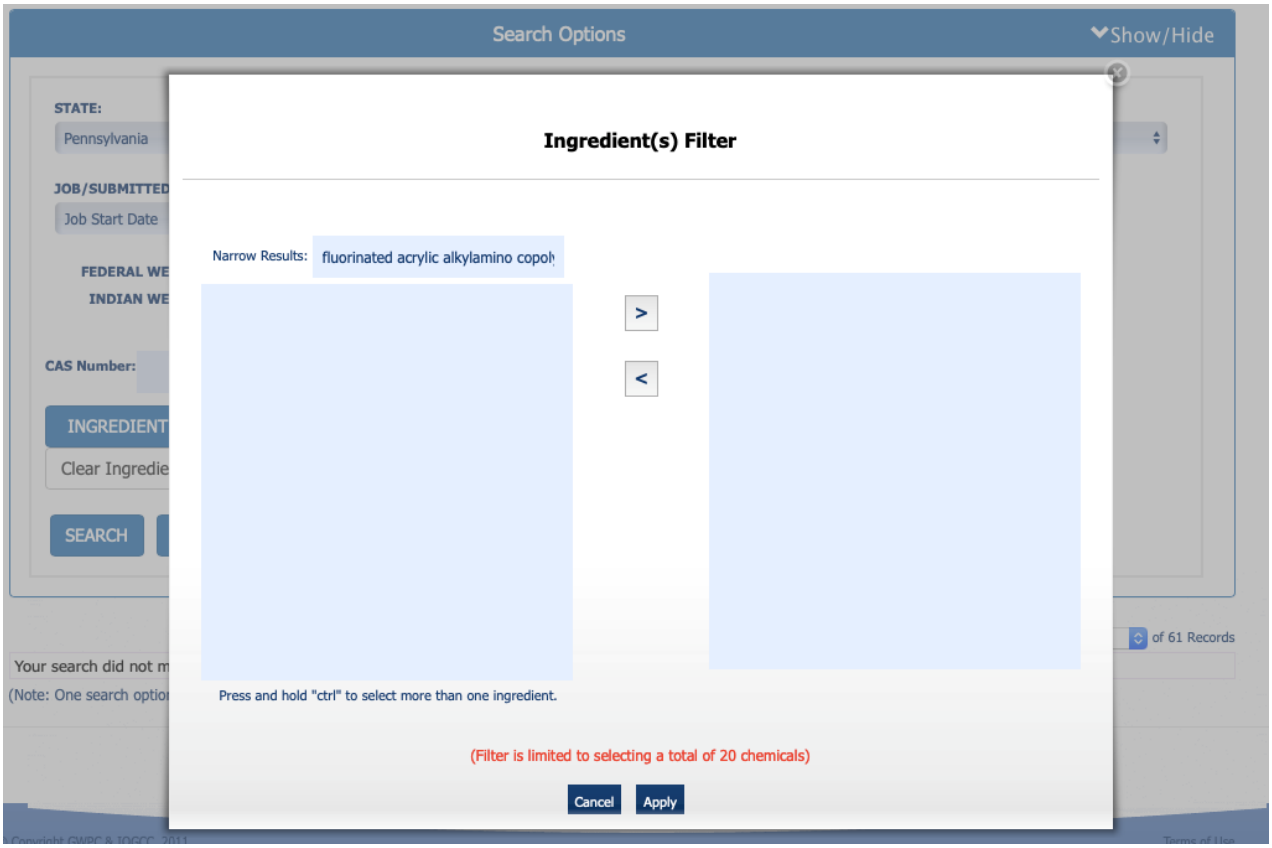
Appendix Table 1 – List of Wells in Mercer County

Displaying 50 of 61 Records

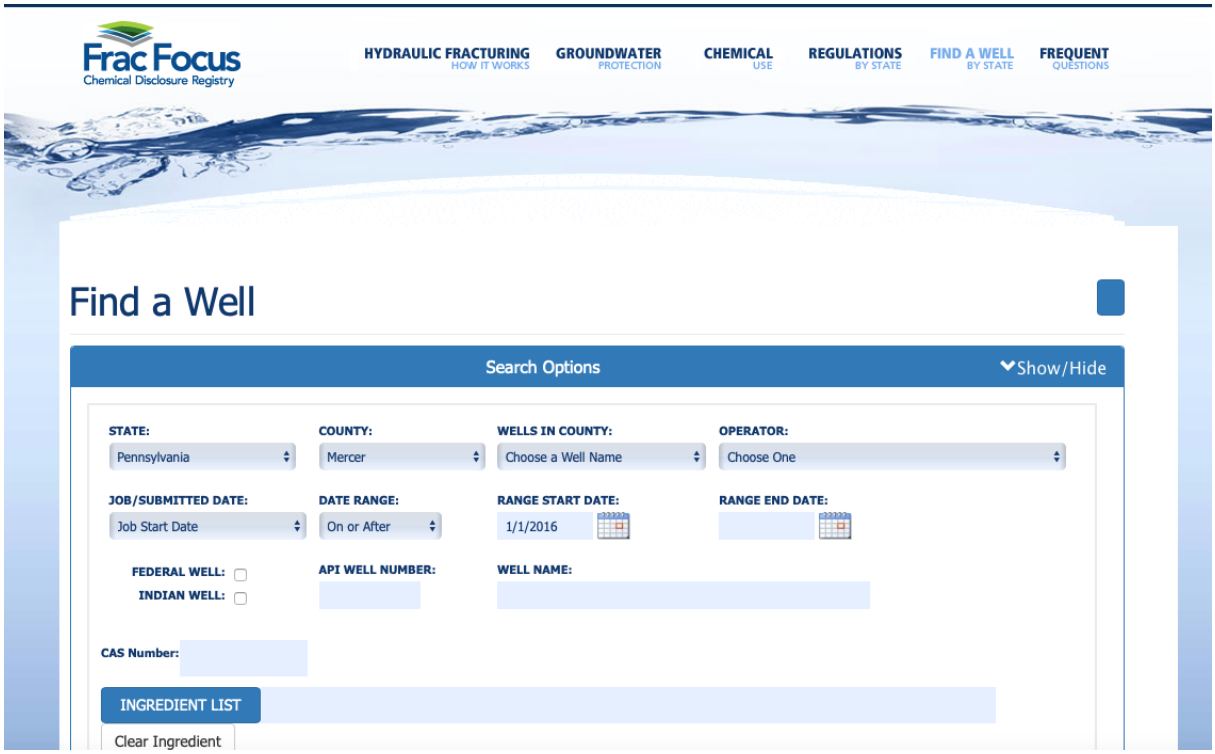
Next Page

Page 1 of 2 Go

API No.	Job Start Dt	Job End Dt	State	County	Operator	WellName
37-085-24656-00-00	1/15/2013	2/1/2013	Pennsylvania	Mercer	Halcon Resources Corpor...	Phillips 1H
37-085-24632-00-00	1/17/2013	1/17/2013	Pennsylvania	Mercer	Halcon Resources Corpor...	Phillips 1H
37-085-24631-00-00	3/20/2013	3/21/2013	Pennsylvania	Mercer	Halcon Resources Corpor...	Yoder 2H
37-085-24631-00-00	3/24/2013	3/24/2013	Pennsylvania	Mercer	Halcon Resources Corpor...	Yoder 2H
37-085-24637-00-00	3/29/2013	3/29/2013	Pennsylvania	Mercer	Chevron USA Inc.	Hurtt Unit 3H
37-085-24638-00-00	3/29/2013	3/29/2013	Pennsylvania	Mercer	Chevron USA Inc.	Hurtt Unit 4H
37-085-24643-01-00	5/21/2013	5/27/2013	Pennsylvania	Mercer	Hilcorp Energy Company	Lackwannock James #1H
37-085-24656-00-00	5/28/2013	6/12/2013	Pennsylvania	Mercer	Halcon Resources Corpor...	Pilgrim 2-3H
37-085-24642-01-00	11/23/2013	12/3/2013	Pennsylvania	Mercer	Shell Oil Company affiliate	Palmer 2082-5HD
37-085-24674-00-00	5/8/2014	5/16/2014	Pennsylvania	Mercer	Hilcorp Energy Company	Shenango Radkowski #11H
37-085-24673-00-00	5/8/2014	6/5/2014	Pennsylvania	Mercer	Hilcorp Energy Company	Shenango Radkowski #9H
37-085-24671-00-00	5/17/2014	5/26/2014	Pennsylvania	Mercer	Hilcorp Energy Company	Shenango Radkowski #5H
37-085-24663-00-00	5/18/2014	5/26/2014	Pennsylvania	Mercer	Hilcorp Energy Company	Shenango Radkowski 3H
37-085-24676-00-00	5/29/2014	6/5/2014	Pennsylvania	Mercer	Hilcorp Energy Company	Shenango Radkowski #10H
37-085-24670-00-00	5/29/2014	6/21/2014	Pennsylvania	Mercer	Hilcorp Energy Company	Shenango Radkowski #4H
37-085-24675-00-00	6/6/2014	6/11/2014	Pennsylvania	Mercer	Hilcorp Energy Company	Shenango Radkowski #12H
37-085-24672-00-00	6/6/2014	6/22/2014	Pennsylvania	Mercer	Hilcorp Energy Company	Shenango Radkowski #6H
37-085-24680-00-00	7/5/2014	7/16/2014	Pennsylvania	Mercer	Hilcorp Energy Company	Jefferson McGhee #5H
37-085-24677-00-00	7/5/2014	7/16/2014	Pennsylvania	Mercer	Hilcorp Energy Company	Jefferson McGhee #6H



Appendix Figure 2 Screenshot Showing Filter by Chemical



Appendix Figure 3 Search Options for FracFocus Database

Appendix B

Chemicals Used by Hydraulic Fracturing Companies in Pennsylvania
For Surface and Hydraulic Fracturing Activities
Prepared by the Department of Environmental Protection
Bureau of Oil and Gas Management
Compiled from Material Safety Data Sheets obtained from Industry

1,2,4-Trimethylbenzene	Glycol Ethers (includes 2BE)
1,3,5 Trimethylbenzene	Guar gum
2,2-Dibromo-3-Nitrilopropionamide	Hemicellulase Enzyme
2.2-Dibromo-3-Nitrilopropionamide	Hydrochloric Acid
2-butoxyethanol	Hydrotreated light distillate
2-Ethylhexanol	Hydrotreated Light Distilled
2-methyl-4-isothiazolin-3-one	Iron Oxide
5-chloro-2-methyl-4-isothiazotin-3-one	Isopropanol
Acetic Acid	Isopropyl Alcohol
Acetic Anhydride	Kerosine
Acie Pensurf	Magnesium Nitrate
Alchohol Ethoxylated	Mesh Sand (Crystalline Silica)
Alphatic Acid	Methanol
Alphatic Alcohol Polyglycol Ether	Mineral Spirits
Aluminum Oxide	Monoethanolamine
Ammonia Bifluoride	Naphthalene
Ammonia Bisulfite	Nitrilotriacetamide
Ammonium chloride	Oil Mist
Ammonium Salt	Petroleum Distallate Blend
Ammonia Persulfate	Petroleum Distillates
Aromatic Hydrocarbon	Petroleum Naphtha
Aromatic Ketones	Polyethoxylated Alkanol (1)
Boric Acid	Polyethoxylated Alkanol (2)
Boric Oxide	Polyethylene Glycol Mixture
Butan-1-01	Polysaccharide
Citric Acid	Potassium Carbonate
Crystalline Silica: Cristobalite	Potassium Chloride
Crystalline Silica: Quartz	Potassium Hydroxide
Dazomet	Prop-2-yn-1-01
Diatomaceus Earth	Propan-2-01
Diesel (use discontinued)	Propargyl Alcohol
Diethylbenzene	Propylene
Doclecylbenzene Sulfonic Acid	Sodium Ash
E B Butyl Cellosolve	Sodium Bicarbonate
Ethane-1,2-diol	Sodium Chloride
Ethoxlated Alcohol	Sodium Hydroxide
Ethoxylated Alcohol	Sucrose
Ethoxylated Octylphenol	Tetramethylammonium Chloride
Ethylbenzene	Titaniaum Oxide
Ethylene Glycol	Toluene
Ethylhexanol	Xylene
Ferrous Sulfate Heptahydrate	
Formaldehyde	
Glutaraldehyde	

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Appendix C

The following are tables of all exemptions for oil and gas drilling companies under the policies and laws discussed in this paper.

Appendix Table 2 – Table of Exemptions: Federal

	Safe Drinking Water Act	Clean Water Act	PFAS Regulation
Exemptions	Oil and gas companies are exempt from pollution control measures unless diesel fuel is involved in fracking process	Oil and gas operations are exempt from permitting and pollution control requirements including the stormwater runoff permit requirement	Sites of oil and gas drilling are never mentioned as areas of concern for PFAS testing, despite significant risk for drinking water contamination
	Hydraulic fracturing fluids are excluded in definition of "underground injection" activities except where diesel fuel is used	Certain wastewater produced by hydraulic fracturing of oil and gas companies can be discharged into surface waters, as hydraulic fracturing activities are not strictly regulated and held to the same standards as other activities under the CWA	Gaps in regulation do not specifically address relevant certain chemical exposures as seen with evidence of water contamination from drill sites with proper permitting
	Oil and gas companies can inject diesel fuel in hydraulic fracturing activities if they obtain a permit	States are not required to regulate oil and gas companies and their fracking practices	Oil and gas companies are not held responsible for safe handling of chemicals and usage of PFAS in their activities

Appendix Table 3 – Table of Exemptions: Pennsylvania

	Wastewater Treatment Requirements	PA Safe Drinking Water Act	The Clean Streams Law	Wolf Response to PFAS
Exemptions	Discharges of wastewater resulting from fracking activities may be authorized if oil and gas companies fulfill requirements in National Pollutant Discharge Elimination System permitting, monitoring and compliance	The law does not specifically state where contaminants may originate from leaving oil and gas companies exempt from the enforcement compliance including monitoring and inspection of contaminants	Permits industrial waste discharges into water supplies of the Commonwealth of approved for a permit under an Environmental Hearing Board	No hydraulic fracturing site met criteria as a possible PFAS contamination and sampling site despite being known to have high potential to contaminate drinking water via runoff and wastewater exposure
				PFAS are not yet considered hazardous waste and cannot be regulated and enforced under Pennsylvania law if used in oil and gas drilling activities

Bibliography

About Fracfocus. FracFocus. (n.d.). Retrieved January 30, 2022, from https://www.fracfocus.org/learn/about-fracfocus

Andrews, D., & Naidenko, O. (2020, October 14). *Population-wide exposure to per- and polyfluoroalkyl substances from drinking water in the United States*. ACS Publications. Retrieved January 29, 2022, from https://pubs.acs.org/doi/10.1021/acs.estlett.0c00713

Commonwealth of Pennsylvania Governor's Office. (2021, June 3). Wolf Administration Announces Final PFAS Statewide Sampling Results. *DEP News Room*. Retrieved December 1, 2021, from https://www.ahs.dep.pa.gov/NewsRoomPublic/articleviewer.aspx?id=21961&typeid=1.

Dennis, B., & Fears, D. (2021, October 18). Biden administration moves to curtail toxic 'forever chemicals'. *The Washington Post*. Retrieved December 1, 2021, from https://www.washingtonpost.com/climate-environment/2021/10/18/epa-regulate-forever-chemicals-pfas/.

Department of Environmental Protection, Marcellus Shale Fact Sheet (2020). Office of Oil and Gas Management. Retrieved December 1, 2021, from http://www.depgreenport.state.pa.us/elibrary/GetDocument?docId=1419062&DocName=MARCELLUS%20SHALE%20DEVELOPMENT.PDF%20%20%20%3cspan%20style%3D%22color:blue%3b%22%3e%3c/span%3e%201/17/2021.

Department of Environmental Protection, Department of Environmental Protection (n.d.). Office of Oil and Gas Management. Retrieved December 1, 2021, from https://files.dep.state.pa.us/OilGas/BOGM/BOGMPortalFiles/MarcellusShale/Frac%20list%206-30-2010.pdf.

Environmental Protection Agency. (2021, July 14). *Resource Conservation and Recovery Act (RCRA) Overview*. EPA. Retrieved April 13, 2022, from https://www.epa.gov/rcra/resource-conservation-and-recovery-act-rcra-overview

Environmental Protection Agency. (2021, January 4). *The Process of Unconventional Natural Gas Production*. EPA. Retrieved December 1, 2021, from https://www.epa.gov/uog/process-unconventional-natural-gas-production

Environmental Protection Agency. (2021, December 21). *Our Current Understanding of the Human Health and Environmental Risks of PFAS*. EPA. Retrieved January 29, 2022, from https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas

Environmental Protection Agency, Understanding the Safe Drinking Water Act (2004). Retrieved January 29, 2022, from https://www.epa.gov/sites/default/files/2015-04/documents/epa816f04030.pdf.

EPA Releases Final Report on Impacts from Hydraulic Fracturing Activities on Drinking Water. (2016, December 13). *News Releases from Headquarters*. Retrieved December 1, 2021, from https://archive.epa.gov/epa/newsreleases/epa-releases-final-report-impacts-hydraulic-fracturing-activities-drinking-water.html.

Environmental Protection Agency. (2021, December 13). *The Hydraulic Fracturing Water Cycle*. EPA. Retrieved January 29, 2022, from https://www.epa.gov/hfstudy/hydraulic-fracturing-water-cycle

Environmental Protection Agency, Fact Sheet: Implementation of the Safe Drinking Water Act's Existing Requirements for Oil and Gas Hydraulic Fracturing Activities Using Diesel Fuels (2014). Retrieved January 29, 2022, from https://www.epa.gov/sites/default/files/2015-05/documents/dfhf_guid_factsheet_epa816f14001.pdf.

Environmental Protection Agency. (2021, October 22). *Summary of the Clean Water Act*. EPA. Retrieved January 29, 2022, from https://www.epa.gov/laws-regulations/summary-clean-water-act

Environmental Protection Agency. (2021, February 22). EPA Takes Action to Address PFAS in Drinking Water. Retrieved December 1, 2021, from https://www.epa.gov/newsreleases/epa-takes-action-address-pfas-drinking-water.

Environmental Protection Agency, EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan (2019). Retrieved January 29, 2022, from https://www.epa.gov/sites/default/files/2019-02/documents/pfas_action_plan_021319_508compliant_1.pdf.

Environmental Protection Agency. (2021, June 10). EPA Continues to Take Action on PFAS to Protect the Public. Retrieved December 1, 2021, from https://www.epa.gov/newsreleases/epa-continues-take-action-pfas-protect-public.

Environmental Protection Agency, National PFAS Testing Strategy: Identification of Candidate Per- and Poly- fluoroalkyl Substances (PFAS) for Testing (2021). Retrieved January 29, 2022, from https://www.epa.gov/system/files/documents/2021-10/pfas-natl-test-strategy.pdf.

Environmental Protection Agency. (2021, March 4). *Underground Injection Control Regulations Underground Injection Control Regulations*. EPA. Retrieved March 10, 2022, from https://www.epa.gov/uic/underground-injection-control-regulations

Environmental Protection Agency. (2022, January 13). *Recent Activities for the New Chemicals Program under the Toxic Substances Control Act*. EPA. Retrieved March 10, 2022, from

https://www.epa.gov/reviewing-new-chemicals-under-toxic-substances-control-act-tsca/recent-activities-new-chemicals

Friis, R. H. (2019). Chapter 4: Environmental Health Policy and Regulation. In *Essentials of Environmental Health* (3rd ed., pp. 88–89). essay, Jones and Bartlett Learning.

Friis, R. H., & Friis, R. H. (2019). Chapter 7: Pesticides and Other Organic Materials. In *Essentials of Environmental Health* (3rd ed., pp. 154–157). essay, Jones and Bartlett Learning.

Goldstein, B. D., Ferrell Bjerke, E., & Kriesky, J. (2013). Challenges of Unconventional Shale Gas Development: So What's the Rush. *Notre Dame Journal of Law, Ethics and Public Policy*, *27*(1). https://scholarship.law.nd.edu/ndjlepp/vol27/iss1/7/

Haley, M., McCawley, M., Epstein, A. C., Arrington, B., & Bjerke, E. F. (2016). Adequacy of current state setbacks for directional high-volume hydraulic fracturing in the Marcellus, Barnett, and Niobrara Shale plays. *Environmental Health Perspectives*, *124*(9), 1323–1333. https://doi.org/10.1289/ehp.1510547

NPR. (2018, July 25). *Don't frack the rich? comment puts focus on environmental justice | Stateimpact Pennsylvania*. NPR. Retrieved April 10, 2022, from https://stateimpact.npr.org/pennsylvania/2016/06/06/dont-frack-the-rich-comment-puts-focus-on-environmental-justice/

National Resources Defense Council. (2013, February). *Fracking*. NRDC Policy Basics. Retrieved January 29, 2022, from https://www.nrdc.org/sites/default/files/policy-basics-fracking-FS.pdf

Ogneva-Himmelberger, Y., & Huang, L. (2015). Spatial distribution of unconventional gas wells and human populations in the Marcellus Shale in the United States: Vulnerability analysis. *Applied Geography*, *60*, 165–174. https://doi.org/10.1016/j.apgeog.2015.03.011

Office of the Administrator. (2021, April 27). EPA Administrator Regan Establishes New Council on PFAS. Retrieved January 29, 2022, from https://www.epa.gov/newsreleases/epa-administrator-regan-establishes-new-council-pfas.

Perkins, T. (2022, January 26). Nearly 75% of water-resistant products contain toxic PFAS, study finds. *The Guardian*. Retrieved January 26, 2022, from https://www.theguardian.com/environment/2022/jan/26/water-resistant-products-toxic-pfas-study.

Pennsylvania Safe Drinking Water Act, P.L 206, No. 43, Cl.35, (1984).

Pennsylvania Unconventional Well Law, Title 25, Chapter 78a, (2016).

Pennsylvania Clean Streams Law, P.L 1987, Act 394 of 1937, as amended (35 P.S. §§ 691.1), et seq, (2006).

Physicians for Social Responsibility. (2021). (rep.). *Fracking with Forever Chemicals*. Retrieved December 1, 2021, from https://www.psr.org/wp-content/uploads/2021/07/fracking-with-forever-chemicals.pdf.

Shoemaker, J. AND Dan Tettenhorst. Method 537.1: Determination of Selected Per- and Polyfluorinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS). U.S. Environmental Protection Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Washington, DC, 2018.

Tabuchi, H. (2021, July 12). *E.P.A. approved toxic chemicals for fracking a decade ago, new files show*. The New York Times. Retrieved December 1, 2021, from https://www.nytimes.com/2021/07/12/climate/epa-pfas-fracking-forever-chemicals.html

The Editorial Board. (2021, August 5). Fracking in Pennsylvania used toxic 'forever chemicals' as Pa. officials maintain willful ignorance. *The Philadelphia Inquirer.* Retrieved December 1, 2021, from https://www.inquirer.com/opinion/editorials/fracking-pennsylvania-pfas-toxic-chemicals-water-20210805.html.

The White House. (2021, October 18). FACT SHEET: Biden-Harris Administration Launches Plan to Combat PFAS Pollution. *Briefing Room*. Retrieved December 1, 2021, from https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/18/fact-sheet-biden-harris-administration-launches-plan-to-combat-pfas-pollution/.