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Zoning in the Marcellus Shale Formation

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A Method for Balancing Resident and Land Protection Against Economic Opportunity

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I. Introduction

In the world today, we are under a constant barrage of information relative to the environment and economics. On one side, we have the Al Gores of the world, pointing to melting ice caps and rising carbon dioxide levels as conclusive evidence that global warming is occurring. On the other side are the sometimes equally persuasive arguments that nothing is wrong, and attempts to administratively control pollution will only serve to further slow and cripple an already weak American economy. Though neither side may ultimately be proven entirely correct, the seemingly constant head-butting between the two underscores the difficulty in any matters involving both environmental and economic concerns.

At this point, nearly everyone is aware of the significance of the significance of natural gas-rich shale formations across the United States, including the massive formation stretching from Ohio and Virginia to New York, known as the Marcellus Shale. This porous formation supposedly contains enough trapped natural gas to supply the country's heat and electricity rates for more than 15 years at current consumption rates.[2] Drilling companies were issued approximately 3,300 Marcellus gas-well permits in 2010.[3] In areas such as western Pennsylvania, where the local economy still feels the effects of the collapse of the coal and steel industries, many residents regard the burgeoning natural gas industry as a boon, both for the workforce and for landowners eager to share in the profits. Others are reminded of the embarrassing cloud of smog and soot that enveloped Pittsburgh and other local towns during the steel industry's heyday.

The area has steady experience with oil and gas drilling in general. The first natural gas well in the country was drilled in western New York in 1821, and in 1859, Drake's Well in Titusville, Pennsylvania, became the first commercial oil well.[4] In total, over 350,000 oil and gas wells have been drilled in Pennsylvania alone.[5] Despite the history, the relatively new and highly technical method of extracting the natural gas enclosed in the Marcellus Shale has many residents in the dark as to what the process entails. The problem of the lack of knowledge is

compounded by holes in industry regulation that leave many unwittingly unprotected. While some drillers can and have mitigated the potential for harm, local agencies are in need of a method for appropriately balancing the protection of their residents and land against the potential for economic growth.

II. The Drilling Process: Hydraulic Fracturing

Though shale formations can contain massive quantities of natural gas, the value of the shale varies, depending on the concentration of gas and the rate at which the gas is able to flow from the shale into the production well.[6] A now-common method of improving the rate of production is to create fractures in the shale formation to provide space for the gas to flow through into the well.[7] Extractors drill down to the depth of the shale formation, eventually turning the well sideways to maximize the number of fractures that can be made and increase productivity. Water is then injected into the well at high pressures to break apart the rock or widen already existing gaps, along with "proppants" (sand or other minerals), which serve to hold open the cracks.[8] This process, known as "hydraulic fracturing," "hydrofracking," or simply "fracking," allows the natural gas to flow out of the rock and into the wellbore more freely.

The composition of the fluids used varies, but it usually consists primarily of water and sand, along with a small percentage of chemicals that help facilitate the fracking process.[9] Such chemicals can include dangerous substances such as hydrochloric acid and lead, among others.[10] The chemicals typically comprise roughly 0.5%[11] of the 4 million to 5 million gallons of fluid used per well. [12] Most of the fracking water is pumped into tanker trucks from local rivers and streams, and then trucked to the well site, although some companies are able to recycle a portion of the water recovered from past wells and reuse it. [13] The volume of water necessary requires as many as 1000 tanker truckloads.[14] Once injected, roughly 35 percent or more of the water may return to the surface along with the recoverable natural gas and other naturally occurring substances underground.[15] In Pennsylvania, this recovered fluid, known as

"flowback," "brine," or "waste" water is considered "residual waste," and drillers must control its storage, treatment, and disposal under state law.[16]

Needless to say, there are numerous environmental concerns raised by the hydraulic fracturing process. Unfortunately, the already murky waters surrounding this industry have been further muddied by often conflicting evidence as to the seriousness of the issues.

III. Is Hydraulic Fracturing Really So Bad?

While the concerns surrounding hydraulic fracturing are often loudly expressed and the evidence can be compelling, industry officials and supporters are fairly united in their insistence that reported incidents of environmental damage have been blown out of proportion. It is also possible that the potential economic benefits of drilling outweigh the environmental risks.

According to the Aubrey McClendon, CEO of Chesapeake Energy, there has been no lasting environmental damage from hydraulic fracturing drilling.[17] McClendon claims that all past incidents of water contamination are due to Pennsylvania's unusual geology, and further that they have not and likely will not be seen elsewhere. McClendon further maintains that the groundwater issues particular to Pennsylvania have been solved, due to Pennsylvania's recently increased well casing and cementing standards. The industry seems united on this front, as Range Resources senior vice president and general counsel David P. Poole recently said, "'it is physically impossible for you to frack a Marcellus Shale well [...] and have any impact on groundwater.'" McClendon also points to the Groundwater Protection Council and the Interstate Oil and Gas Commerce Commission, which will soon debut an online registry where drillers may voluntarily submit lists of chemicals used on a well-by-well basis. Such lists may be comforting to local residents whose knowledge on the subject is lacking, but critics argue that the data collected is often vague and incomplete.[18]

Despite their claims, the industry has heretofore been unable to identify the exact cause of continued groundwater contamination in the Marcellus Shale and other shale plays in the

United States. Poole admits that the drillers cannot maintain complete innocence until they have proof that they are not the cause of the pollution. Still, the industry clings to the economic benefits of natural gas drilling as a way to rationalize the effects that they may have on the environment. As McClendon claims, fracking has had a huge impact on the price of gas, approximately slicing the cost of natural gas in half over the last several years.[19]

Drillers also claim to be moving toward more "green" methods of hydraulic fracturing, including reducing the number of chemical additives and recycling wastewater.[20] These changes are driven by economics as much as environmental concerns, as companies seeking ways to alleviate the cost of water disposal are finding that the treatment of flowback water is a significant cost. Recycling has some other benefits; some drillers actually prefer to use recycled wastewater on new wells because the mineral-filled mixture is denser and more effectively fractures the shale. According to Range resources, the company recycled 90% of their wastewater in 2010, with a 100% recycling rate goal for 2011. Companies are also finding that the amount of chemicals used in the fracturing process is an expense that can be lessened. Range claims to have reduced the percentage of chemical parts in its fracking fluid from 0.5% to 0.1%.[21]

Still, in an industry where an average of 4 million to 5 million gallons of the water-based fracking fluid are used per well[22], even 0.1% amounts to 4000 to 5000 gallons of potentially dangerous chemicals that are being pumped into the ground at each site. Additionally, reports of increased efforts to recycle wastewater seem to skim over the fact that approximately 65% of the water used never comes out of the well.[23]

The industry as a whole remains adamant that hydraulic fracturing is not nearly as dangerous as public perception would indicate. Excessive water migration into a hydraulic fracturing well can effectively "kill" the economics of the well, so drillers have heavy incentives to avoid water contamination not only due to safety, but to protect the profitability of the well. [24] Despite well-publicized reports of spills and contamination, Environmental Protection Agency

("EPA") officials have downplayed the environmental impact of the spills.[25] Cabot Oil and Gas Corporation spilled 8000 gallons of fracturing fluid containing the chemical LGC-35 CBM into a creek near Dimock, Pennsylvania, on September 16, 2009, when transport pipe connections failed.[26] Although LGC-35 CBM is a potentially carcinogenic chemical lubricant, the EPA determined that there was no evidence of groundwater contamination relative to the spills.[27] Fortunately, the chemical was additionally found to be too diluted to be harmful.[28]

The "company line" seems to be that drillers are so careful that there is no cause for concern relative to their operations. Drillers design their operations based on data on the specific formation being drilled, and rely on past experience to prevent potential issues.[29] Needless to say, not all drillers active in the Marcellus Shale Formation share the same amount of past experience on which to rely. However, those companies with the resources to do so spend large amounts of time and money to determine the optimal size and location of the potential fractures.[30] Drillers are motivated to do this because fractures extending outside the formation will reduce the productivity of the well.[31]

The typical response to citizens concerned with groundwater contamination seems to be something along the lines of "the fracturing operations are far too deep underground to have any possibility of aquifer contamination." Indeed, the Marcellus shale formation sits approximately 4000 to 8500 feet below ground level, while the aquifer in the area is approximately 850 feet deep.[32] Apart from the general location of the shale in comparison to the aquifer, drillers have the further incentive of ensuring that they avoid contact with water because a flooded well becomes uneconomical to produce gas from.[33]

To avoid groundwater contamination, drillers engage in a series of steps, including "drilling the well, logging the hole, running casing, cementing the casing, logging the well, perforating the well, and monitoring well performance and integrity."[34] Casing (heavy steel pipe) is added to the well in stages to seal off the drilling, prevent formation fluids from migrating, and keep the wellbore from caving in.[35] The casing is of critical importance, as it ensures that the

well is able to withstand various pressures, in addition to preventing fluids and gases from entering and exiting the well underground.[36]

As mentioned above, another common industry statement regarding groundwater contamination is that the chemicals used in the fracking process represent only a very small percentage of the fracking fluid. Typically, the chemicals represent only about 0.5% of the fracking fluid mixture.[37] The exact amount of any particular chemical used in the fracking fluid differs widely depending on the formation and the proprietary formulas of a particular drilling company.[38]

Apparently, some of these chemicals are often found in ordinary household items that are ingested or used on the face.[39] Typically not mentioned in the same breath is the existence of other significantly dangerous chemicals in the fluid. Additionally, toxic substances such as arsenic and radioactive material like radium can be churned up and released along with flowback water. Even if there weren't additional chemicals underground, some of the chemicals mentioned that exist in everyday household products, such as bleaching agents, biocide, and diluted acid,[40] remain unsafe for ingestion despite their relatively common nature.

The obvious opposing argument is that even the dangerous chemicals used, such as hydrochloric acid, are so diluted that potential harm is greatly mitigated. The chemicals are further diluted when added to the sand and water in the fracturing fluid, and diluted still further through the fracturing process. The chemicals in the fracturing fluid that are unable to be recovered after the fracking process are typically stranded in pore formations or fractures that shut with the release of well pressure. The groundwater is allegedly protected from this unrecovered fluid by the vertical distance between the shale formation and the aquifer, as well as geological formations in the intervening area.[41] The fluid that is recovered is typically then recycled, which further dilutes the chemicals,[42] or disposed of into an EPA classified Underground Injection Control Well.[43]

The control wells are theoretically a safe means of handling the chemicals remaining in

the fracturing fluid. This raises an important question -- who is handling the fluid?

IV. Water Quality: Cause for Concern

On Thursday, March 17, 2011, Robert Allen Shipman was charged with illegally dumping millions of gallons of wastewater in holes, mineshafts, and waterways across six counties from 2003 to 2009.[44] Shipman's disposal company, Allan's Waste Water Service Inc., did have an EPA permit to dispose of drilling wastewater into an abandoned coal mine. However, Shipman's company allegedly "cocktailed" different types of wastes together, and dumped these mixtures into virtually any hole they could find, sometimes under cover of dark or during heavy rains. Notable among the alleged illegal dump sites was a floor drain that eventually empties into Dunkard Creek, the site of a massive fish kill in 2009. Authorities have had difficulty establishing the exact effect of Shipman's activities in relation to the amount of fish that were killed at Dunkard Creek, but say they are certain that it was a contributing factor. Shipman allegedly earned up to $7 million per year during the six year dumping period.[45]

Even when properly disposed of, environmental concerns about wastewater remain. Often it is collected and treated at municipal wastewater treatment plants, then discharged into streams[46], but reports of increased total dissolved solids and chlorides in river systems have raised concerns about the effectiveness of traditional waste treatment plants for frack water.[47] In a 2009 study, an EPA consultant concluded that some sewage treatment plants were incapable of removing some water contaminants, and were likely violating the law.[48]

Additionally, EPA documents indicate that the wastewater contains radioactivity levels too high for treatment plants to handle. Sewage treatment plant operators admit that they cannot remove enough radioactivity to meet federal drinking water standards.[49] This, combined with other EPA studies that reveal the radioactivity in the waste cannot be fully diluted in rivers and other waterways, reveals a frightening picture, especially for residents in Pittsburgh whose drinking water is partly culled from the Monongahela River, one of the primary recipients of

wastewater discharge in western Pennsylvania. Industry representatives hold that the radioactivity is sufficiently diluted to avoid any potential health risks, but of over 179 wells that have produced highly radioactive wastewater, at least 116 reported levels over 100 times higher than federal drinking water standards, with at least fifteen wells creating wastewater 1000 times more radioactive than accepted levels. The radioactive material in the wastewater, including high levels of radium, is not necessarily dangerous in terms of physical proximity to people, but many federal studies have shown that radium can cause cancer once it enters the body by eating, drinking, or breathing.[50]

The Pennsylvania Department of Environmental Protection ("DEP") additionally recently stepped into action on this issue, asking companies to stop taking wastewater to 15 treatment plants by May 19, 2011. The DEP cited in its reasoning heightened levels of the salt Bromide, a chemical present in wastewater. Bromide reacts with chlorine disinfectants used by drinking water systems to create trihalomethanes, a chemical that is harmful to people who drink water with heightened levels of it over a long period of time.[51] It is unclear whether or not Pennsylvania will follow the seemingly wise policy of Oklahoma, which completely bars fracking waste from being processed at treatment plants.[52]

Hydraulic fracturing is also not exempt from the possibility of blowouts, like the infamous explosion at BP's Macondo oil well in the Gulf of Mexico in 2010. On April 19, 2011, workers at a Chesapeake Energy fracking operation in Bradford County, Pennsylvania, lost control of a shale well, which sent thousands of gallons of drilling fluid into the environment.[53] The well was brought under control within a few days, but the scare prompted Chesapeake to suspend all hydraulic fracturing operations as it worked to plug the well. The Pennsylvania DEP was unsure of the exact cause of the leak as of April 21, 2011.[54]

Due to the relative youth of the process of fracking in shale formations compared to fracking in coal seams, comprehensive environmental research as to the risks of underground contamination of aquifers and private wells due to defective production well casings and

unintended fissures is not yet available. There have, however, been numerous reports & allegations of contamination due to shale drilling in the last few years. Residents in Texas and Wyoming, two areas with shale formations similar to the Marcellus Shale in Pennsylvania, have reported incidents of suspected groundwater contamination.[55] These reports are sometimes met with little or no response at all from drilling companies and state authorities.[56] Perhaps unsurprisingly, complaints of drinking water contamination are now popping up in Pennsylvania.

In Dimock Township, Pennsylvania, residents claim that shortly after drilling activities began in the area, their water suddenly became "cloudy, foamy and discolored, and smelled and tasted foul."[57] After one residents well exploded on New Years Day in 2009, a state investigation found that Cabot Oil & Gas Corp. had allowed flammable gas to escape the production well and enter groundwater supplies. A private consulting firm found that almost every sample taken from Dimock Township water wells contained industrial solvents, including ethylbenzene, a chemical which may cause cancer. This report came on the heels of a $240,000 fine levied against Cabot by the Pennsylvania DEP when the agency found that defective casings on at least three Cabot wells allowed gas to pollute groundwater. Allegedly, the DEP was so concerned that the entire aquifer was polluted, the only solution for the affected residents was to connect to a municipal water supply in Montrose—six miles away. According to Daniel Farnham, an environmental engineer who has tested water on behalf of both gas interests and local residents, the effects of drilling on groundwater are obvious:[58]

> "It doesn't take me or any scientist to see some of the impacts on the drinking water," he said. "Your drinking water goes from clear and fine, to a week later being yellow-colored, sediment on the bottom, foam on the top and an oily smell to it. It's not a figment of anybody's imagination."[59]

The problems posed by drinking water contamination, pushed to the extreme, consist of quite a bit more than property injuries such as those in Dimock Township. Some of the more serious possible health effects can be seen in reports apparently arising from hydraulic fracturing for

coalbed methane across the United States. Though shale plays typically lay much deeper underground than coal seams, fissures from hydraulic fractures have been known to extend as far as 3000 feet,[60] and defective well casings are an issue regardless of the formation being drilled. Therefore the reports of negative health effects allegedly attributable to coalbed methane fracking operations are important in evaluating the potential risks of shale fracking in Pennsylvania.

In a congressional hearing in 2007, Steve Mobaldi testified to health effects suffered by himself and his wife after a company began fracking on a piece of property located approximately 3000 feet away from his ten-acre ranch in Rifle, Colorado. Mobaldi testified that they first began to experience burning eyes and nosebleeds, then his wife "'began to experience fatigue, headaches, hand numbness, bloody stools, rashes, and welts on her skin. When she showered she would turn red, tiny blisters covered her entire body.'" Doctors diagnosed her with chemical exposure but were unable to determine what chemical was causing the symptons. Steve then "'began to experience rectal bleeding.'" Mobaldi further testified that after an oil and gas company began drilling across the street from his property, his wife "'lost her voice and got headaches, burning eyes,'" and that employees of the company instructed the couple to stop drinking their water, which began to fizz with bubbles and show the filmy evidence of oil contamination.[61]

Another incident with serious implications was reported by Newsweek in August 2008. Employees of a Colorado energy-services company who were allegedly "'caught in a 'fracturing fluid' spill'" went to the emergency room complaining of symptoms including nausea and headaches. Several days later, the treating nurse began experiencing symptoms such as yellow skin, vomiting, and retaining fluid. She, like the Mobaldi couple, was diagnosed with chemical poisoning, which she attributes to the fracking fluid she encountered while treating the energy company employees. The fracking fluid that was spilled contained methanol, a chemical that can cause "'kidney and liver damage, irritate lung tissue, decrease blood pressure, and result in

dizziness and vomiting,'" yet Newsweek reported that the companies never filed a single incident report with any government agency.[62]

Unfortunately, environmental concerns raised by the hydraulic fracturing process are not limited to water issues. Although other environmental issues are far less publicized, the importance of considering these other effects cannot be overlooked.

V. Other Environmental Concerns: Air Quality and …Earthquakes?

Natural gas companies have sometimes found themselves with unusual bedfellows. Some environmentalists cite natural gas, a fuel that burns cleaner than coal and oil, as a viable method of lessening the carbon footprint and greenhouse gas emissions of our daily activities. This viewpoint has come under fire recently with the increased scrutiny raised by the 2010 film Gasland and a recent study by Cornell University professors.

The Cornell study evaluates the greenhouse gas footprint of natural gas in shale fracking operations by primarily looking into fugitive methane emissions from natural gas wells.[63] According to the study:

> Natural gas is composed largely of methane, and 3.6% to 7.9% of the methane from shale-gas production escapes to the atmosphere in venting and leaks over the lifetime of a well. These methane emissions are at least 30% more than and perhaps more than twice as great as those from conventional gas. The higher emissions from shale gas occur at the time wells are hydraulically fractured—as methane escapes from flow-back return fluids—and during drill out following the fracturing. Methane is a powerful greenhouse gas, with a global warming potential that is far greater than that of carbon dioxide, particularly over the time horizon of the first few decades following emission. Methane contributes substantially to the greenhouse gas footprint of shale gas on shorter time scales, dominating it on a 20-year time horizon. The footprint for shale gas is greater than that for conventional gas or oil when viewed on any time horizon, but particularly so over 20 years. Compared to coal, the footprint of shale gas is at least 20% greater and perhaps more than twice as great on the 20-year horizon and is comparable when compared over 100 years.

The "20 year horizon" as compared with a 100 year period is significant. Though methane is a more potent contributor to greenhouse gases in the atmosphere than carbon dioxide, it is estimated to remain in the atmosphere only one tenth as long as carbon dioxide. Because

carbon-trading markets currently concentrate on a 100 year period to evaluate greenhouse gas impacts, the relatively higher immediate impact of methane emissions on the atmosphere is undervalued.[64]

The Cornell study has drawn immediate attention from news outlets and criticism from industry officials. According to a spokesperson at Energy in Depth, a coalition of independent oil and natural gas producers, the study relies on questionable data and assumptions, not to mention the author's personal bias against the hydraulic fracturing industry.[65] A Range Resources representative said that the volume of methane contemplated by the study could amount to as much as $6 billion in lost revenue for the industry.[66] According to a senior vice president at Range the volume of methane allegedly released just does not make sense in an industry where profits are made by capturing it.[67]

Still, the article has garnered respect from some experts in the field. David Hughes, a geoscientist and research fellow at the Post Carbon Instiute, used the Cornell study calculations in concluding that replacing coal with natural gas for base-load electricity generation would only make greenhouse gas emissions worse. David Hawkins, director of climate programs with the Natural Resources Defense Council, says that although the data used was less than ideal, the study provides vital insight and information in an industry where little is known about all of the potential environmental effects of the processes used. Although natural gas burns fairly clean compared to oil and coal, it is unclear how the fuel sources compare over their entire production cycles.[68]

Environmental concerns have also been raised about the possibility that the massive amount of pressurized water used in injection wells after the fracking process is completed could be behind recent swarms of earthquakes that have hit Texas and Arkansas, although such concerns have yet to be validated by the scientific community.[69] In August 2009, Chesapeake Energy Corp shut down two disposal wells for frack water from the Barnett Shale formation as a precautionary measure after nearly a dozen small earthquakes hit the Dallas-Fort Worth area.

Researchers at Southern Methodist University said preliminary results did not indicate a correlation between the earthquakes and the drilling itself, but that there was a possible correlation with a Chesapeake frack water disposal well that sits atop a fault line at Dallas-Fort Worth International Airport.[70]

Similarly, the Guy earthquake swarm, a series of over 30 small earthquakes that hit the Guy, Arkansas area in February 2011, has been attributed by some to drilling activity in the Fayetteville Shale formation.[71] Though there is no conclusive proof that the earthquakes are related to shale drilling activity, Scott Ausbrooks, geohazards supervisor for the Arkansas Geological Survey, said he would not rule out the possible impact of several disposal wells located near the earthquake area. The Arkansas Oil and Gas Commission placed a six-month moratorium on new disposal wells in the area in January 2011.[72]

The possible air and geological issues serve to further highlight the potential for harm to human populations located near fracking operations. They also beg a question—What are lawmakers doing to help diminish these dangers?

VI. Federal Regulation

The potential for environmental damage resultant from hydraulic fracturing stands as a stark contrast to the dearth of federal oversight over the practice. Though the EPA intervenes on a limited basis after spills or contamination is reported, most regulation of fracking is left to the individual states, resulting in patchwork legal standards.

The Safe Drinking Water Act, enacted in 1974, gave the EPA the power to establish national standards for allowable contamination levels in public drinking water systems.[73] This Act does not preempt state regulation of allowable contamination levels, as states can take primary enforcement authority by adopting stricter regulations than those set forth by the EPA.[74] The Act also establishes controls for underground injection of fluids to protect the drinking water systems.[75] Pursuant to this power, the EPA is required to establish minimum

requirements for state underground injection control ("UIC") programs. Once approved by the EPA, states have authority to enforce their UIC programs.[76]

The definition of "underground injection" has been under particular scrutiny over the last several years because controversy exists as to whether the phrase should encompass hydraulic fracturing activities. In 1997, in a case known as *LEAF*, the EPA argued that UIC regulations did not apply to fracking because the UIC regulations apply only to wells whose primary function is to inject fluids in the ground, whereas the primary function of fracking wells is to produce oil and gas.[77] The court held that UIC regulations apply to any and all underground injection activities, which obviously includes hydraulic fracturing because the process involves forcing high volumes of water into rock formations.[78]

After LEAF, the EPA began to closely evaluate and attempt to determine its proper role in regulating hydraulic fracturing.[79] In 2003, the EPA entered into an agreement with three energy companies. Under the agreement, the companies agreed to cease using diesel fuel in fracking fluid, a chemical that was under particular criticism due to potential adverse health effects in the event of drinking water contamination. The agreement, however, was limited to coalbed methane production, and did not apply to shale fracturing operations.[80]

The 2003 agreement was followed by an EPA study in 2004, focused on the potential for contamination of drinking water systems due to hydraulic fracturing in coalbed methane wells.[81] The EPA concluded that fracking in coalbed methane seams posed little or no threat to drinking water, although it did identify several contaminants of "particular concern."[82] However, the EPA went on to state that the threat posed by these chemicals is reduced significantly by the process of removing large quantities of groundwater and fracturing fluids after the coalbed methane wells are fractured.[83]

The 2004 EPA study has drawn heavy criticism, including other studies showing that the EPA study was remarkably lackadaisical considering the environmental issues at stake and the inadequate UIC programs at the state level.[84] Critics complained that the EPA did nothing more

than review data compiled by state agency reports created in response to complaints from areas near coalbed methane production wells. The EPA countered that the state reports contained no conclusive evidence of groundwater contamination as a direct result of fracking operations.[85]

Shortly after the 2004 EPA study, the Energy Policy Act of 2005 was introduced to the House of Representatives. The Act, which would later become known as the "Halliburton Loophole," amended the definition of "underground injection" under the Safe Drinking Water Act to exclude "'the underground injection of natural gas for purposes of storage; and the underground injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations related to oil, gas, or geothermal production activities.'"[86] Despite public pressure from states where fracking operations take place, the EPA has continually declined to regulate fracking.[87] Nonetheless, some congress members are now pushing for repeal of the Energy Policy Act of 2005, and congress further directed the EPA to conduct further investigations of the relationship between fracking and drinking water in the appropriations bill funding the EPA for the 2010 fiscal year[88]

In June 2009, Congress introduced for the first time the Fracturing Responsibility and Awareness of Chemicals Act ("FRAC Act"), which would remove the Halliburton Loophole and explicitly put hydraulic fracturing under the jurisdiction of the EPA[89] Supporters of the FRAC Act claim that it will provide protection to people who live in close proximity to drilling operations, but the industry and its supporters see it as an unnecessary addition to an industry already adequately regulated at the state and local level. Many in the industry also strongly oppose the mandatory disclosure of the chemical constituents in their fracking fluids that the Safe Drinking Water Act would impose.

In accordance with the recent direction from Congress, the EPA has undertaken a new study to comprehensively research and investigate the potential adverse impacts of hydraulic fracturing on water quality and public health, including potential impacts on underground and surface water sources.[90] Even this study has been met with some objection; on September 9,

2010, the EPA sent requests to nine major energy companies seeking information on the chemicals used in the fracking process.[91] Halliburton refused to cooperate, so the EPA issued a subpoena under authority granted by the Toxic Substances Control Act.[92] The defensive posturing by companies such as Halliburton undoubtedly raises eyebrows among many environmentalists, who note such refusals as equivalent to admissions that energy companies are hiding a dirty secret. On the other hand, drilling companies view their fracking fluid mixture as proprietary information. Although the process is widely known, the ideal mixture of chemicals for a particular formation is regarded as a trade secret. Companies that have a superior mixture will likely have lower costs and higher production rates.[93] Courts have not yet addressed whether fracking fluid mixtures are trade secrets, but at least one court has held that other performance improving formulas in the petroleum industry had potential trade secret qualities or patentable status.[94]

As to whether federal regulations will be changed to add additional requirements for fracking operations, the answer likely depends on the results of the EPA study, which are anticipated sometime after 2011. Until that time, hydraulic fracturing operations will likely continue to be regulated mostly at the state level.

VII. Pennsylvania Regulation

Until the EPA decides or is ordered to begin regulating hydraulic fracturing, this regulation is left to the individual states. Because Pennsylvania is currently experiencing massive growth in the industry, this section will focus on current and potential future Pennsylvania regulation on hydraulic fracturing.

Pennsylvania does have several regulations in place relating to fracking operations. In 2002, Pennsylvania enacted the Water Resources Planning Act, which requires entities who withdraw more than 300,000 gallons of water over a thirty day period to register such activity.[95] In response to increasing development in the Marcellus shale formation, the Pennsylvania

Bureau of Oil and Gas Management started requiring identification of the location and amount of water withdrawals to ensure that water quality standards are maintained and protected. The DEP follows guidance for water withdrawal provided by the Susquehanna River Basin Commission and the Delaware River Basin Commission.[96]

Under the Pennsylvania Oil and Gas Act, oil and gas drillers are presumed to be responsible for pollution of a water supply if it occurs within six months of the drilling and is within 1,000 feet of the well. Drillers can rebut this presumption by performing a pre-drilling survey that establishes that pollution levels were pre-existing.[97]

Pennsylvania regulations also require that drillers identify potential risks posed by their operations and plan for the possibility of accidents with a Prevention, Preparedness, and Contingency plan. This includes listing chemicals or additives utilized, as well as the different wastes generated during the fracking process. The plan must be available at the well site and submitted to the DEP upon request. A consolidated list of chemicals usedby the various companies is available at the Pennsylvania DEP website.[98] The plan is a prerequisite to permit issuance for hydraulic fracturing wells in Pennsylvania[99] The drilling permit prices were also raised in response to Marcellus shale development—from $100 in 2008 to over $5,000, with the exact price depending on the depth of the well.[100]

Pennsylvania also has requirements for waste water identification and tracking. The DEP Bureau of Waste Management uses a form for generators of waste hydraulic fluids to make annual reports. The form requires certain analytical parameters for the produced wastewater. It requires a chemical analysis that represents the volume of wastewater stored in impoundments or tanks, and a new chemical analysis when large amounts of waste fluid are added to the impoundment.[101] The waste reporting requirements also include information on the processing or disposal facilities that will accept the waste, and provide requirements for transportation, including “accident prevention and contingency planning, emergencies, wastes from accidents and spills, recordkeeping and reporting, and appropriate signage on vehicles.”[102] Waste haulers

have to have permits, and are subject to the program outlined above. The volume of waste delivered and the location of the intake facility or haulers are submitted annually to the Bureau of Oil and Gas Management.[103] On August 21, 2010, Pennsylvania began requiring that waste water from wells is treated to the federal Safe Drinking Water standard for total dissolved solids (500 milligrams per liter).[104]

Pennsylvania also recently responded to the Dimock Township gas contamination by establishing updated requirements for drilling, casing, cementing, testing, monitoring, and plugging of oil and gas wells. The new standards require increased well design and construction practices to prevent gas migration. These standards are in addition to a rule established in November 2010, requiring a 150 foot buffer between natural gas wells and approximately 20,000 miles of selected streams in the state.[105] Curiously, the requirement does not apply to all streams in the state, only the "most pristine and highest quality." Additionally, the current regulations as to buffer zones from stream and presumption against wells within 1,000 of water contamination areas only apply to the location the surface portion of the well. Given the fact that the wells are turned horizontal, it is interesting that there is not a similar presumption when the fracture area extends to within certain horizontal distance of such areas. Pennsylvania has a long history of fossil fuel extraction, and the DEP has also not provided regulations for fracking wells near active or abandoned wells that may serve as conduits for drilling fluid to reach and contaminate groundwater supplies.[106] Moreover, despite mandating and enforcing "strong blowout prevention policies," such policies do not prevent all contingencies, as displayed by the April 19, 2011 Chesapeake Energy blowout in Bradford County.[107]

Despite the proactive steps listed above, the DEP has recently drew criticism for a policy change requiring top agency officials to sign off on all violation notices issued to Marcellus Shale drillers.[108] The DEP contends that the new process is necessary to ensure consistent enforcement, thereby shielding inspectors from court challenges. Critics say the new process could slow down corrective actions and prevent inspectors from reporting certain problems that

they observe. The appropriate values of the fines for violations have also been under debate. Nearly half of the fines levied between 2005 and February 1, 2011 were for $7,000 or less, raising concerns that drillers see the fines as merely a cost of doing business.[109]

Though state regulations in Pennsylvania provide some protection to residents and environment there are undoubtedly a few troubling holes in the regulatory scheme. Without any promises of stricter regulations forthcoming, municipalities have taken action to protect their interests.

VIII. Range, Huntley, & Zoning

As drilling companies ramped up their efforts to secure mineral rights in the Marcellus shale formation, Pennsylvania municipalities began exploring zoning ordinances as a method of protecting their land and residents. These efforts were obviously met with some consternation among those in the industry. The industry push-back eventually culminated in a pair of cases before the Pennsylvania Supreme Court in 2009.[110]

In *Range Resources-Appalachia, LLC v. Salem Township*, Salem attempted to enact an ordinance regulating surface and land development, directed at oil and gas drilling operations.[111] Several drilling companies initiated a declaratory judgment action alleging, *inter alia*, that the ordinance did not comply with the Pennsylvania Oil and Gas Act. The Oil and Gas Act contains language stating, in relevant part:

> No ordinances or enactments adopted pursuant to the aforementioned acts shall contain provisions which impose conditions, requirements or limitations on the same features of oil and gas well operations regulated by this act or that accomplish the same purposes as set forth in this act. The Commonwealth, by this enactment, hereby preempts and supersedes the regulation of oil and gas wells as herein defined.[112]

The ordinances eventually enacted by Salem included substantive restrictions on oil and gas drilling operations, a fee for permit applications, and criminal penalties for failure to comply with the ordinance.[113]

Salem argued that local regulation of drilling activity should only be deemed preempted by the act where the activity: "(a) relates to the technical operations of the oil and gas industry, (b) flows directly from the operation of an oil or gas well, and (c) is unique to the oil and gas industry."[114] The drillers countered that "the Act preempts all local oil and gas regulations that either seek to accomplish the Act's purposes or overlap the Act's regulatory features. The drillers further argued that an ordinance such as the one in question, that specifically targets the oil and gas industry, incorporates the Act, and overlaps the Act "at nearly every turn," is clearly preempted by the Act.[115]

The Court concluded that the ordinance, which included provisions for the location of access roads, treatment facilities, and transport lines, focused "not on zoning or the regulation of commercial or industrial development generally, but solely on regulating oil and gas development."[116] The court noted that although Salem may have had laudable goals in enacting the ordinance, the provisions included by the Township are addressed by the Act, and as such are preempted. Additionally, those provisions that were not specifically addressed by the Act were impermissible in the form of a regulation specifically directed to oil and gas well operations.[117]

In *Huntley & Huntley, Inc. v. Council of Oakmont*, the companion case to *Range*, the court ruled on a slightly different zoning ordinance. Huntley, a drilling company, sought to drill for natural gas on two parcels of residential property located in the Borough of Oakmont.[118] Both properties were located in a single family residential zoning district in the borough. Soon after Huntley obtained a DEP permit to drill, the borough issued a letter stating that mineral extraction is only allowed as a conditional use in the single family residential zone. Huntley was ordered to cease operations and submit a conditional use application. The application would be acted upon by the borough Council after a hearing, subject to conditions determined by the Council.[119] After the Council denied the conditional use application, Huntley commenced suit, averring in part that the Oil and Gas Act preempts local zoning regulations involving gas drilling

and production.[120]

After two appeals, three viewpoints on this issue were presented before the Pennsylvania Supreme Court. The Council argued that the purpose of the Oil and Gas Act was not "to preempt zoning ordinances to the extent they designate appropriate districts in which oil and gas operations may be located." Rather, the Act was designed to provide "a minimum level of protection for existing buildings, national landmarks, bodies of water, and other environmentally sensitive areas."[121] The DEP essentially agreed with the Council's argument, saying that the Act was intended "simply to foreclose municipalities from legislating on the technical aspects of well operations or enacting ordinances that purport to establish permitting, bonding, or registration requirements for oil or gas wells."[122] Huntley argued that the Act plainly preempts local zoning ordinances that attempt to regulate the location and operation of natural gas wells.[123]

The court held that "such ordinances are preempted to the extent that they either 'contain provisions which impose conditions, requirements or limitations on the same features of oil or gas well operations regulated by' the Act, or 'accomplish the same purposes as set forth in' the Act." These are two separate components, each of which must be given effect. As to the first component, the Court held that placement of a gas well in a certain location is not an operational feature preempted by the Act.[124] In considering the second inquiry, the Court noted that zoning controls are both broader and narrower in scope than the Act. They are narrower in that they pertain only to specific attributes and developmental objectives of the locality rather than matters of statewide concern. They are also broader in that they deal with all potential land uses and "generally incorporate an overall statement of community development objectives that is not limited solely to energy development." The Court noted that while oil and gas regulation in service of the Act's goals may require the knowledge and expertise of a state agency, the Municipality Planning Code recognizes the particular expertise than municipalities have designate where different uses should be permitted. Therefore, the Oil and Gas Act did not

preempt a restriction on the location of wells such as the one presented by the Council.[125]

Huntley was a step in the right direction for Pennsylvania in the development of a regulatory scheme. Unfortunately, *Huntley* and *Range* provide little insight into the types of zoning regulations that would be allowable, except that ordinances may not impose conditions on the features of "oil and gas well operations regulated by the Act."[126] This leaves municipalities in a difficult position, as they must attempt to guess which aspects of well operations they can regulate without falling under preemption under the Act.

IX. Belden & Blake; Fracking in Pennsylvania State Parks

One of the other several areas where landowners are inadequately protected in Pennsylvania is with regard to surface damages due to the actions of mineral rights owners on the property. Increasingly common are situations where the property has gone from traditional ownership of the land and subsurface, to split ownership of the surface of the land and the mineral rights below.[127] In most states, the subsurface rights owner has a right to use the surface on the land to the extent necessarily to develop and operate a well. This is often at conflict with the interests of the surface rights because it can involve such invasive and harmful activities as construction of the well and access roads, removal of tress, use of surface water, and damage to crops, not to mention the noise and smell attributable to the drilling activity. In some states, statutes provide for compensation to the landowner for use of his land in the well production. [128] In West Virginia, for instance, the driller must obtain the written consent of the surface owner "for valuable consideration" before the state will issue a permit.[129]

Pennsylvania has no such statutes for the protection of the surface rights owner, so courts are left to decide what constitutes a "reasonable use" of the surface property.[130] Since the 1800s, Pennsylvania courts have held that mineral owners have the right to use so much of the surface as is "reasonably necessary" to access the minerals. In a landmark 1980 decision, a Pennsylvania federal district court held that the subsurface owner had the right to occupy so

much of the surface as was necessary to operate the subsurface right, the subsurface owner must exercise its right with due regard to the surface owner.[131] If the mineral owner has more than one available method of extracting the minerals, and neither of them are detrimental to the mineral owner, the mineral owner must use the method least detrimental to the surface owner, which should be determined with input from the surface owner.[132] Furthermore, the Court stated that the mineral rights owner is not necessarily capable of making a unilateral decision as to whether its activities would unnecessarily impair the surface owner's use of the surface, the two parties should attempt to reach a reasonable accommodation so both can enjoy their respective rights.[133]

The determination of "reasonable use" of the surface becomes slightly more complicated when mineral rights beneath a state park have been severed from the surface rights. This situation came before the Pennsylvania Supreme Court in 2009 in the case *Belden & Blake Corp. v. DCNR*.[134] In that case, Belden owned mineral rights on 3 parcels of property in Oil Creek State Park. Between 2004 and 2005, Belden notified the Department of Conservation and Natural Resources ("DCNR") that it intended to develop natural gas wells on each of the three parcels. The DCNR attempted to restrict Belden's access to the land by requiring a performance bond for each well and stumpage fees for the amount of timber that Belden planned to remove. Belden petitioned for relief, claiming that the DCNR had no right to impose additional requirements on Belden after Belden provided several months notice and met with DCNR officials regarding potential alternatives.[135]

The DCNR contended that it had the right to impose additional requirements on Belden under the Pennsylvania Constitution[136] and § 303 of the Conservation and Natural Resources Act ("CNRA"). The CNRA provides, in part, that the DCNR has the power "[t]o supervise, maintain, improve, regulate, police and preserve all parks belonging to the Commonwealth."[137] Furthermore, the Statutory Construction Act provides "the General Assembly intends to favor the public interest as against any private interest."[138] DCNR argued that a surface use that has

been afforded special protection as a public natural resource requires additional protection.

The Court refused to depart from established jurisprudence in Pennsylvania, which clearly places the burden on the surface owner to seek legal redress to prevent or restrain the subsurface owner's exercise of its rights. The Court also held that a subsurface owner's rights cannot be diminished because the surface comes to be owned by the government or any party with statutory obligations. The DCNR's statutory duties do not allow it to unilaterally impose additional conditions on a mineral rights owner any more than a normal surface owner would be able to do the same.[139]

The *Belden* decision was rendered in a four to two split. Justices Saylor filed a dissenting opinion, joined by Justice Todd, in which they question the majority's reasoning in denying the DCNR the ability to impose additional conditions necessary to ensure reasonable ingress to the property and prevent unreasonable activity. As Saylor points out, Commonwealth agencies such as the DCNR are vested with implied powers necessary to effectuate their statutory mandates.[140] The General Assembly intended that "DCNR, as the custodian and trustee of public property including 'some of our State's most precious and rare natural areas, have the ability to negotiate agreements with subsurface owners, and restrain unreasonable incursions onto the surface of Commonwealth lands.

Saylor also disagreed with the majority's assertion that giving the DCNR this authority results in the DCNR having a unilateral right to determine the rights of subsurface rights owners at parklands. Subsurface owners still have the right to seek redress in the courts, which is a preferable alternative to depriving the DCNR of a substantial means to guard and protect vital Commonwealth resources. Saylor cautions, however, that while mineral rights owners must act with due regard to public interests, the DCNR must also act with due regard to private interests. "If the DCNR misjudges the reasonableness of a subsurface owner's conduct and unduly restrains it, it is acting in derogation of substantial private rights and interests which are also protected by the Constitution, and which the courts are open and available to vindicate."

Therefore, in light of the statutory duties of DCNR, Saylor advocates a careful consideration of the reasonableness of both parties rather than a blanket rule denying DCNR the right to restrict mineral rights owners at state parks.[141]

Considering the potential for damage to the environment, it is a dangerous proposition to deny the DCNR statutory authority to protect important state lands in favor of economic development. Until all of the risks posed by hydraulic fracturing are fully understood, it is irresponsible to place public lands such as these in jeopardy.

X. Proposals for Change

Given the seriousness of the types of harm theoretically possible as a result of hydraulic fracturing, the process merits careful consideration by legislators. This need is exponentially increased by the lack of federal oversight and the current gaps in regulation at the state level in. Many of the laws in place simply were not designed with the particular risks of shale fracking in mind. Though there are many avenues that could be taken to rectify the situation, I propose two relatively simple ideas: (1) an amendment to the Pennsylvania Oil and Gas Act that will allow municipalities to effectively regulate the impact of the process on the environment and public health; and (2) an amendment to the CNRA specifically granting the DCNR the ability to make reasonable efforts to ensure that natural gas drilling does not damage state parks.

1. Amendment to the Oil and Gas Act

Effective on January 1, 2012, this act repeals 58 P.S. § 601.602.

§ 601.602 Local Ordinances

(a) Definitions

For purposes of this section:

"**well head**" means the portion of the oil or gas well that sits above the surface area of the land, including, but not limited to: platforms, towers, machinery, electronics, and piping.

"**technical aspects**" means aspects related to the efficiency, production, and safety of oil and gas operations, as well as permitting, bonding, or registration requirements. This definition does not include aspects of oil and gas operations relating to: (1) placement and height of the well head; (2) allowable proximity of underground portions of the well to residential zones or water sources; (3) setbacks; (4) ingress to and egress from the well; (5) noise levels; (6) size, lining, and covering requirements for wastewater pits; (7) site restoration standards; and (7) other provisions reasonably necessary to promote the safety, health, and morals of the community, to accomplish coordinated development, and to guide uses of land and structures.

(b) Except with respect to ordinances adopted pursuant to the act of July 31, 1968 (P.L. 805, No. 247), known as the Pennsylvania Municipalities Planning Code, and the act of October 4, 1978 (P.L. 851, No. 166), known as the Flood Plain Management Act, all local ordinances and enactments purporting to regulate the technical aspects of oil and gas operations are hereby preempted and superseded. Ordinances or enactments adopted pursuant to the aforementioned acts may not impose conditions, requirements, or limitations on the technical aspects of well functioning and matters ancillary thereto.

2. Amendment to the CNRA

Effective January 1, 2012, the following provision is added to 71 P.S. § 1340.303(a):

(12) Where mineral rights to oil and gas beneath state lands are not owned by the Commonwealth, the department may impose the following requirements on the holder of such mineral rights to the extent reasonably necessary to prevent unreasonable incursions:

(i) performance bond of up to $10,000 per well. All requirements under the bond shall be the same as set forth in 58 P.S. § 601.215.

(ii) damage and repair fees of up to double the total value of plant life, animal life, habitats, and scenic areas to be destroyed.

(iii) groundwater testing prior to the commencement of drilling

(iv) maximum noise levels

(v) department plans for access to proposed drilling areas

(vi) allowable proximity of underground portions of wells to water sources within the park

(vii) mandatory well shutdown and cleanup in the event of a leak, spill, or explosion. The well shall remain inactive until the cause is determined and fixed, and the mineral rights holder submits and adheres to a plan for avoiding future incidents of the same type.

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