FRACKING FOLLY: REGULATORY ALTERNATIVES TO A HIGH-STAKES RACE TO THE BOTTOM

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**The editorial team at the *Willamette University Environmental Law Journal* is proud to present this inaugural Issue. Many months have passed since we first advertised and promised this Issue. As with all new ventures, many unexpected complications, in addition to the usual ones, delayed us. As a result, some of this Issue's articles were authored in the fall 2011 and spring 2012. I nonetheless believe this Issue's articles remain highly relevant and further the mission of this Journal—*viz*: to encourage those interested in environmental law issues to publish the results of their research, express their ideas, and stimulate ongoing discussion and research. We hope that you find this Issue of the Environmental Law Journal a valuable legal resource.

I. INTRODUCTION

Domestic energy policy forms at the confluence of environmental regulation and economic theory. Modern energy policy is extremely politicized—environmental agencies regularly advocate for more comprehensive federal regulation of energy production, while industry-leaning elected officials and state agencies call for deregulation to remove disincentives for capital investment and industrial advancement. Throughout our nation's history, the petroleum industry has taken center stage as this political dichotomy unfolds.

While Americans expressed outrage over the impact of the Deepwater Horizon catastrophe in 2010, another political conflagration raged in Pennsylvania and other northeastern states. The controversy surrounds the natural gas industry's most utilized gas extraction method—hydraulic fracturing. An increasing body of scientific evidence now confirms decades of complaints from landowners about extensive groundwater contamination during and after hydraulic fracturing. The so-called "Halliburton Loophole"—an exemption from federal regulation created in 2005—has garnered increasing skepticism as Congress debates the proper role of the federal government in regulating hydraulic fracturing. The FRAC Act, now before both chambers of Congress as companion bills, would allow the Environmental Protection Agency ("EPA") to reregulate hydraulic fracturing by closing the Halliburton Loophole. Passage of the FRAC Act is essential to protect groundwater resources for current and future generations.

The ensuing four parts of this Article provide support and analysis of the points

briefly discussed in the foregoing Introduction. Part I of the Article provides necessary background information about hydraulic fracturing and the correlation between falling gas prices and technological advances in the drilling industry. Part II discusses the severe environmental impacts from hydraulic fracturing. Part III briefly describes the history of federal regulation in this area, and contemplates the problems associated with state regulation of the petroleum industry. Part IV concludes the Article with an argument in support of the FRAC Act and offers specific proposals for federal oversight of hydraulic fracturing process as implemented by the natural gas industry.

II. BACKGROUND

A. High-Volume Hydraulic Fracturing

Oil and gas companies continuously seek to increase the economically viable recovery of oil and gas at each well to boost productivity. Hydraulic fracturing is a decades-old gas extraction method used in the petroleum industry. Recent advances in drilling technology allow gas companies to cheaply drill horizontal wells, increasing the effectiveness of hydraulic fracturing. This modern method, known as High-Volume Hydraulic Fracturing ("HVHF"), involves drilling a horizontal well at the base of a vertical well, followed by injection of a highly pressurized mix of water, proppant, and chemical additives.[1] Injection of this highly pressurized "fracking fluid" causes fractures and fissures deep within tight shale formations. The proppant (usually sand or ceramic beads) remains in the fissures "propping" them open for many years. HVHF is an

[1] High-volume hydraulic fracturing is referred to as "HVHF," "hydraulic fracturing," "fracking," "fracing," or "slickwater fracturing." These terms are used interchangeably throughout the industry and this Article.

effective extraction method because it releases large quantities of gas that were previously trapped in tight shale formations. Upon its release, the gas travels through the fissures and up the vertical well to the surface.

During the drilling process, workers inject concrete into the well around steel casing. This concrete and casing form the only barrier between the well and drinking water aquifers near the surface. As discussed in Part IV of this Article, there is no federal regulation of well construction and state regulators inspect well construction to varying degrees. According to the American Petroleum Institute, the industry's best practices, together with state regulation, "effectively protect underground sources of drinking water," and "contemporary well design practices [. . .] ensure multiple levels of protection."[2] However, community members, environmentalists, scientists, elected officials, and many others completely disagree with the industry's position.

Following the drilling and construction of the casing, the well is "fracked." Each fracked well requires approximately one to seven million gallons of water, depending on the well depth and the number of times the well is fracked.[3] Companies add proppant and a mixture of chemicals to the water to create the desired "fracking fluid." The drilling industry has proposed the use of 322 chemicals for HVHF operations in New York, including mercury, benzene, lead, diesel fuel, methanol, kerosene, formaldehyde,

[2] *Industry Practices Relating to Hydraulic Fracturing*, AM. PETROLEUM INST., http://www.api.org/policy-and-issues/policy-items/exploration/industry_practices_relating_to_hydraulic_fracturing.aspx (last visited June 18, 2012); *see Hydraulic Fracturing Operations—Well Construction and Integrity Guidelines*, AM. PETROLEUM INST. (Oct. 2009), http://www.shalegas.energy.gov/resources/HF1.pdf.

[3] *Supplemental Generic Environmental Impact Statement On The Oil, Gas and Solution Mining Regulatory Program,* N.Y. STATE DEP'T OF ENVTL. CONSERVATION, Executive Summary 8 (2011), http://www.dec.ny.gov/data/dmn/rdsgeisfull0911.pdf [hereinafter N.Y. ENVIRONMENTAL IMPACT STUDY].

ethylene, glycol, glycol ethers, hydrochloric acid, and sodium hydroxide.[4] These chemicals serve a variety of purposes in the fracking process and provoke intense debate about the environmental impact of fracking.[5] Most of the fracking fluid is removed from the well following the fracking process, but a portion of the fracking fluid remains underground and is never removed. Gas company representatives and environmental groups disagree about the percentage of the fracking fluid that is typically recovered from the average well.[6]

The fracking fluid returns to the surface after mixing with salts, metals, chlorides, sulfates, and other subterranean substances.[7] Each well produces over a million of gallons of briny "flowback" waste that is even more toxic than the original fracking fluid.[8] The flowback, along with the drilling "cuttings," are usually stored close to the

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[4] *Id.* at 22.

[5] *See id.* at 5-50. Table 5.6—*Types and Purposes of Additives Proposed for Use in New York State*—identifies 13 distinct chemical additives proposed for use in New York state, each with a specific purpose: (1) *Acid* (i.e. hydrochloric acid) "[r]emoves cement and drilling mud from casing perforations prior to fracturing fluid injection"; (2) *Breaker* (i.e. peroxydisulfates) "[r]educes the viscosity of the fluid in order to release proppant into fractures and enhance the recovery of the fracturing fluid"; (3) *Bactericide/Biocide* (i.e. gluteraldehyde; 2,2-dibromo-3-nitrilopropionamide) [p]revents growth of organisms and bacteria; (4) *Buffer* (i.e. sodium or potassium carbonate; acetic acid) "[a]djusts and controls the pH of the fluid in order to maximize the effectiveness of other additives such as crosslinkers"; (5) *Clay Stabilizer* (i.e. salts) "[p]revents swelling and migration of formation clays which could block pore spaces"; (6) *Corrosion Inhibitor* (i.e. methanol; ammonium bisulfate) "[r]educes rust formation on steel tubing, well casings, tools, and tanks"; (7) *Crosslinker* (i.e. potassium hydroxide; borate salts) "[i]ncreases fluid viscosity . . . allow[ing] the fluid to carry more proppant into the fractures"; (8) *Friction Reducer* (i.e. sodium acrylate-acrylamide) "[a]llows fracture fluids to be injected at optimum rates and pressures by minimizing friction"; (9) *Gelling Agent* (i.e. petroleum distillates) "[i]ncreases fracturing fluid viscosity, allowing the fluid to carry more proppant into the fractures"; (10) *Iron Control* (i.e. citric acid) "[p]revents the precipitation of metal oxides which could plug off the formation"; (11) *Scale Inhibitor* (i.e. ammonium chloride; ethylene glycol) "[p]revents the precipitation of carbonates and sulfates . . . which could plug off the formation"; (12) *Solvent* (i.e. aromatic hydrocarbons) "control[s] the wettability of contact surfaces or to prevent or break emulsions"; (13) *Surfactant* (i.e. methanol; isopropanol; ethoxylated alcohol) "[r]educes fracturing fluid surface tension thereby aiding fluid recovery."

[6] Abraham Lustgarten, *In New Gas Wells, More Drilling Chemicals Remain Underground*, PROPUBLICA (Dec. 27, 2009), http://www.propublica.org/article/new-gas-wells-leave-more-chemicals-in-ground-hydraulic-fracturing.

[7] Ian Urbina, *Regulation Lax as Gas Wells' Tainted Water Hits Rivers*, N.Y. TIMES (Feb. 26, 2011), http://www.nytimes.com/2011/02/27/us/27gas.html.

[8] *Id.*

well site in large waste pits lined with tarp barriers as to prevent seepage of waste into the underlying soil.[9] A portion of this waste is treated at the well site and then reused or reinjected into the ground.[10] Trucks ship the remainder to state and private water treatment facilities. As discussed below in detail, there is currently no federal regulation of the treatment of the wastewater produced throughout the fracking process.

B. Capture, Leaseholds, and Subterranean Trespass

Gas companies obtain surface and mineral rights through lease agreements with state and private property owners. Longstanding property law principles of capture hold that the owner of the surface owns all that is underneath.[11] Oil and gas "belong to the owner of the land, and are part of it…and are subject to [the owner's] control; but when they escape, and go into other land, or come under another's control, the title of the former owner is gone."[12] The rise of horizontal drilling as used in hydraulic fracturing, however, has increasingly led to claims of "subsurface trespass."[13] The theory of hydraulic trespassing, difficulties of proof, and general litigation trends, however, are beyond the scope of this Article.[14]

C. Natural Gas Today

HVHF and America's ever-increasing appetite for cheaper, cleaner energy has led

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[9] N.Y. ENVIRONMENTAL IMPACT STUDY, *supra* note 3, at 5-37.

[10] *Id.* at 5-118.

[11] Westmoreland & Cambria Nat. Gas Co. v. De Witt, 130 Pa. 235, 249 (1889).

[12] *Id.*

[13] Patrick Byrd, Meghan Dawson & Bill Kroger, *Shale Play Litigation: A Study of the Various Risks*, 238 PIPELINE & GAS J., 5 (2011) (discussing the effect of hydraulic fracturing on the development of subsurface trespass law in Texas, Louisiana, Arkansas, and Oklahoma), http://www.pgjonline.com/shale-play-litigation-study-various-risks.

[14] For a critical review of this theory, *see* Owen L. Anderson, *Subsurface "Trespass": A Man's Subsurface is Not His Castle,* 49 WASHBURN L.J. 247 (2010).

to a "gas rush" in states with large shale gas reserves including Texas, Arkansas, Pennsylvania, West Virginia, and New York. The Marcellus Shale Formation, which lies beneath southwestern New York, western Pennsylvania, eastern Ohio, and most of West Virginia, is believed to hold 168 trillion to 516 trillion cubic feet of natural gas.[15] Gas companies drilled 1,121 wells in West Virginia and Pennsylvania in 2009 alone.[16] The same companies have applied for thousands of drilling permits in New York, but a current moratorium on drilling has stalled the gas rush there. Pennsylvania and New York are expected to be the leaders in the growth of natural gas production in the northeast.[17]

Increased production made possible by new fracking technologies appears to have a led a dramatic decline in gas prices.[18] The wellhead price for natural gas throughout the 1980s and 1990s was about $2.00 per million British thermal units ("MMBtu").[19] Prices increased dramatically in the early 2000s, and by 2008 the price for gas had quadrupled to nearly $8.00/MMBtu.[20] The 2009 fracking boom in Pennsylvania coincided with a dramatic drop from those all-time highs. Since 2009, the average price of gas per

[15] John S. Gray, *The Marcellus Shale: Regulation, Litigation, and Legislation* in *Navigating Legal Issues Around the Marcellus Shale*, 61, 63 ASPATORE SPECIAL REP. 5 (Melanie Zimmerman ed., 2011).

[16] Timothy J. Considine, Ph.D., *The Economic Impacts of the Marcellus Shale: Implications for New York, Pennsylvania, and West Virginia—A Report to the American Petroleum Institute,* NATURAL RESOURCE ECONOMICS, INC., ii (2010), http://www.scribd.com/doc/34656839/The-Economic-Impacts-of-the-Marcellus-Shale-Implications-for-New-York-Pennsylvania-West-Virginia.

[17] *Pennsylvania Drives Northeast Natural Gas Production Growth,* U.S. ENERGY INFO. ADMIN. (Aug. 30, 2011), http://www.eia.gov/todayinenergy/detail.cfm?id=2870.

[18] The foregoing monetary values are expressed in United States dollars ("USD").

[19] *U.S. Natural Gas Wellhead Price*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/naturalgas/data.cfm (follow "prices" hyperlink; follow "prices" hyperlink again; then follow "Wellhead Price—View History: 1973-2012" hyperlink) (updated monthly).

[20] *Id.*

MMBtu fluctuates between $2.50 and $5.00.[21] The Henry Hub spot price for February 1, 2012 was $2.32; close to a 10-year low.[22] Future gas prices are likely to depend heavily on production trends, including production in the Marcellus Shale region.

Natural gas seems primed to play an important role as the nation's energy infrastructure transitions from fossil fuels to renewable and environmentally sensitive sources of energy. The gas industry has coined the phrase "bridge fuel" to describe the interim role natural gas is playing in the nation's energy transformation, emphasizing that natural gas is environmentally friendly compared to other fossil fuels, and is more affordable than other energy sources.[23] I criticize both of these conclusions throughout this Article.

III. ENVIRONMENTAL IMPACTS OF HYDRAULIC FRACTURING

Hydraulic fracturing leaves an enormous footprint. The environmental damage is a product of the process itself. Each time a well is fracked, literally tons of hazardous chemicals and sand are added to millions of gallons of water and then blasted deep into the earth. Gas companies do not retrieve all the used fracturing fluid, and much of the fluid stays deep within the ground. Data collected from hydraulic fracturing sites increasingly suggest some of this fracking fluid migrates from the closed drilling and fracturing systems into drinking water wells and aquifers. Furthermore, treatment of the toxic wastewater "flowback" remains inadequate. The millions of gallons of retrieved

[21] *U.S. Natural Gas Weekly Update,* U.S. ENERGY INFO. ADMIN. (Dec. 8, 2011), http://www.eia.gov/naturalgas/weekly/archive/2011/12_08/index.cfm.

[22] *U.S. Natural Gas Weekly Update*, U.S. ENERGY INFO. ADMIN. (Feb. 2, 2012), http://www.eia.gov/naturalgas/weekly/archive/2012/02_02/index.cfm#tabs-prices-2.

[23] John D. Podesta and Timothy E. Wirth, *Natural Gas, A Bridge Fuel for the 21st Century*, CENTER FOR AMERICAN PROGRESS (Aug. 10, 2009), http://www.americanprogress.org/wp-content/uploads/issues/2009/08/pdf/natural/gasmemo.pdf.

fracking waste—considered even more toxic than the original fluid—are overwhelming water treatment facilities and the untreated toxic wastewater is finding its way to steams and rivers[24]. Quite simply, hydraulic fracturing operations seriously threaten drinking water supplies for the millions of residents in New York and Pennsylvania, including New York City, Pittsburgh, and Philadelphia.

A. Groundwater Contamination From Fracturing Operations

The effect of HVHF on local groundwater supplies is the most hotly debated environmental impact of HVHF. Consumer groups, local landowners, and political leaders claim hydraulic fracturing contaminates groundwater in two ways: (1) natural gas trapped in the target formations migrates to subsurface soils and aquifers; and (2) chemically-laced HVHF fluids enter into subsurface soils and aquifers from the earth's surface.[25] The EPA began citing evidence of groundwater contamination caused by hydraulic fracturing as early as 1987.[26]

The natural gas industry disregarded the 1987 EPA study and steadfastly insists that it is inherently impossible for gas or fracturing fluids to penetrate layers of impermeable rock to reach local drinking water.[27] The industry relies on a 2004 EPA

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[24] Urbina, *supra* note 7.

[25] Accounts of water contamination received heightened public attention following the release and HBO broadcasting of the anti-fracking documentary, GASLAND (Josh Fox 2010), in which residents of a recently drilled Pennsylvania town describe the negative impact of HVHF on their drinking water. The movie depicts residents who are able to light their drinking water on fire as a result of contaminated groundwater.

[26] *See generally Management of Wastes from the Exploration, Development, and Production of Crude Oil, Natural Gas, and Geothermal Energy*: *Vol. 1 Oil and Gas,* U.S. ENVTL. PROTECTION AGENCY (Dec. 1987) (reporting to Congress that one effect of hydraulic fracturing is possible groundwater contamination), http://www.nytimes.com/interactive/us/drilling-down-documents-7.html.

[27] *See Hydraulic Fracturing at a Glance,* AM. PETROLEUM INST. (2008), http://www.api.org/policy/exploration/upload/hydraulic_fracturing_at_a_glance.pdf:

> Recent claims that hydraulic fracturing is a source of ground water contamination are unfounded. Current regulations covering well design requirements and hydraulic fracturing operations are

study that concluded hydraulic fracturing poses "little or no threat to [underground drinking water]."[28] However, the 2004 study was internally inconsistent and did not address the possibility of water contamination from hydraulic fracturing in shale formations.[29] The EPA also admitted in the report that "it had difficulty determining whether the environmental effects observed and discussed were caused by fracing, [or] other activities[…]."[30] The report was released during a period of widespread distrust of Bush Administration science policy.[31] One EPA member publically proclaimed that the

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> specifically intended to protect ground water. Recent studies by the GWPC and the EPA have clearly demonstrated the effectiveness of these regulations. No instances of ground water contamination from hydraulic fracturing were identified in either of these thorough studies.

See also N.Y. ENVIRONMENTAL IMPACT STUDY, *supra*, note 3 at 11-12 ("No significant adverse impact to water resources is likely to occur due to underground vertical migration of fracturing fluids through the shale formations. The developable shale formations are vertically separated from potential freshwater aquifers by at least 1,000 feet of sandstones and shales of moderate to low permeability." The study concludes that "there is no likelihood of significant adverse impacts from the underground migration of fracturing fluids." Although the study disclaims the possibility of migrating fracturing fluids, however, the study punts on the issue of gas migration, concluding: "[g]as migration is a result of poor well construction. [W]ell construction practices mandated in New York are designed to prevent gas migration.").

[28] *Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs Study*, U.S. ENVTL. PROT. AGENCY, 7-5–7-6 (June 2004), http://www.epa.gov/ogwdw/uic/pdfs/cbmstudy_attach_uic_ch07_conclusions.pdf, (claiming the EPA found "no confirmed cases that are linked to fracturing fluid injection into coalbed methane wells or subsequent underground movement of fracturing fluids").

[29] Hannah Wiseman, *Untested Waters: The Rise of Hydraulic Fracturing in Oil and Gas Production and the Need to Revisit Regulation*, 20 FORDHAM ENVTL. L. REV. 115, 133-134 (2009). Wiseman points to the fact the EPA's contradiction:

> [D]espite its earlier observations, in the same chapter, that "hydraulic fracturing fluids may contain constituents of potential concern," including "bactericides, acids, diesel fuel, solvents, and/or alcohols." The EPA apparently reconciled this finding with its conclusion that fracing posed little or no threat to drinking water by finding that "the largest portion of fracturing fluid constituents is nontoxic (>95% by volume)" and that "dilution and dispersion, adsorption, and potentially biodegradation, minimize the possibility that chemicals included in the fracturing fluids would adversely affect underground sources of drinking water."

Quoting Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs Study, U.S. ENVTL. PROT. AGENCY, EPA 816R04003 at 7-5–7-6 (June 2004), http://www.epa.gov/ogwdw/uic/pdfs/cbmstudy_attach_uic_ch07_conclusions.pdf.

[30] Wiseman, *supra* note 29, at 136.

[31] Adam Orford, *Fractured: The Road to the New EPA "Fracking" Study*, 267 ENVTL. COUNS. 4, (Sept. 17, 2010), http://www.martenlaw.com/newsletter/20100917-new-epa-fracking-study.

report was "scientifically unsound."[32] EPA whistleblowers insist that numerous documented cases of tainted groundwater exist but are sealed due to settlements between landowners and gas companies.[33] Furthermore, recent EPA testing more clearly demonstrates a link between hydraulic fracturing and contaminated groundwater.[34] The industry, however, continues to claim that HVHF is safe.

The gas industry cannot possibly deny the well-documented contamination of the aquifer that once supplied water to Dimock, Pennsylvania, "where more than 60 gas wells were drilled in a nine-square-mile area."[35] Cabot Oil & Gas was fined $360,000 by the Pennsylvania Department of Environmental Protection after contaminating Dimock's groundwater aquifer.[36] Over a dozen families from Dimock are suing Cabot for "negligence, breach of contract, and fraudulent misrepresentation, among other charges."[37] Two of the plaintiffs were evacuated from their houses by Cabot employees due to high concentrations of methane gas.[38] Another plaintiff alleges that the well that provides water for her house actually exploded.[39] Yet another plaintiff reportedly

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[32] *Id.*

[33] *See* Ian Urbina, *A Tainted Water Well, and Concern There May Be More*, N.Y. TIMES (Aug. 3, 2011), http://www.nytimes.com/2011/08/04/us/04natgas.html.

[34] *See* Kirk Johnson, *E.P.A. Links Tainted Water in Wyoming to Hydraulic Fracturing for Natural Gas*, N.Y. TIMES (Dec. 8, 2011), http://www.nytimes.com/2011/12/09/us/epa-says-hydraulic-fracturing-likely-marred-wyoming-water.html; *see also* Abrahm Lustgarten, *EPA Finds Compound Used in Fracking in Wyoming Aquifer,* PROBPUBLICA (Nov. 10, 2011), http://www.propublica.org/article/epa-finds-fracking-compound-in-wyoming-aquifer, (stating the EPA test wells in drinking water aquifers "contained benzene at 50 times the level that is considered safe for people, as well as phenols—another dangerous human carcinogen—acetone, toluene, naphthalene and traces of diesel fuel," all of which are commonly used in hydraulic fracturing).

[35] Christopher Bateman, *A Colossal Fracking Mess: The Dirty Truth Behind the New Natural Gas*, VANITY FAIR (June 21, 2010), *available at* http://www.vanityfair.com/business/features/2010/06/fracking-in-pennsylvania-201006.

[36] *Id.*

[37] *Id*.

[38] *Id.*

[39] *See* complaint, Fiorentino v. Cabot Oil & Gas Corp.*,* (M.D. Pa., Nov. 19, 2009) (No. 3:02-cv-02284).

photographed a creek that "turned red with diesel fuel."[40] Similar cases have been filed by landowners against gas companies in Arkansas, Colorado, Louisiana, New York, Pennsylvania, Texas, and West Virginia.[41]

Environmental groups have prepared numerous reports about the adverse impacts of hydraulic fracturing on groundwater. In 2002, the Natural Resources Defense Council summarized complaints from citizens in Alabama, Virginia, Colorado, Wyoming, and Montana, and found the fracturing fluids used there were "likely to contain toxic and carcinogenic chemicals."[42] In 2005, the Earthworks Oil and Gas Accountability Project critiqued the 2004 EPA study and concluded that fracking fluids migrate into underground drinking water.[43]

Perhaps the most compelling study to date was published in 2011 by researchers from Duke University.[44] The researchers collected 68 drinking-water samples in

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[40] Bateman, *supra* note 35.

[41] *See e.g.* complaint, Ginardi v. Frontier Gas Servs*., LLC,* (E.D. Ark. May 17, 2011) (No. 4-11-cv-0420-BRW); complaint, Tucker v. S.W. Energy Co*.,* (E.D. Ark. May 17, 2011) (No. 1:11-cv-0044-DPM); complaint, Strudley v. Antero Res. Corp*.,* (Denver Cnty. Dist. Ct. Mar. 23, 2011) (No. 11-cv-2218); complaint, Andre v. EXCO Res., Inc*.,* (W.D. La. Apr. 15, 2011) (No. 5:11-cv-00610-TS-MLH); Baker v. Anschutz Exploration Corp., (N.Y. Sup. Ct., Feb. 11, 2011) (No. 2011-1168); complaint, Zimmermann v. Atlas Am., LLC, (Pa. Ct. Com. Pl., Sept. 21, 2009) (No. 2009-7564); Berish v. S.W. Energy Prod. Co., 763 F. Supp. 2d 702, 704 (M.D. Pa. 2011); complaint, Scoma v. Chesapeake Energy Corp., (N.D. Tex., July 15, 2010) (No. 3:10-cv-01385); complaint, Hagy v. Equitable Prod. Co., (S.D.W. Va., Dec. 10, 2010) (No. 2:10-cv-01372). For a brief synopsis of the litigation in each state, *see generally* Barclay Nicholson and Kadian Blanson, *Tracking Fracking Case Law: Hydraulic Fracturing Litigation*, 26 FALL NAT. RESOURCES & ENV'T, Fall 2011, at 25.

[42] Wiseman, *supra* note 29, at 137.

[43] *Hydraulic Fracturing 101*, EARTHWORKS.COM, http://www.earthworksaction.org/issues/detail/hydraulic_fracturing_101, concluding that:

> [F]racing fluids are a threat to human health even when diluted, that many fluids are injected directly into underground sources of drinking water or migrate to nearby underground water, and that some fracing fluids are left "stranded" in fraced formations, meaning they could contaminate groundwater far into the future as the water table rises.

[44] Stephen G. Osborn, Avner Vengosh, Nathaniel R. Warner and Robert B. Jackson, *Methane Contamination of Drinking Water Accompanying Gas-well Drilling and Hydraulic Fracturing*, DUKE UNIVERSITY CENTER ON GLOBAL CHANGE, NICHOLAS SCHOOL OF THE ENVIRONMENT, DIVISION OF EARTH AND OCEAN

Pennsylvania and New York from bedrock aquifers that overlie hydraulic fracturing operations and tested for methane levels.[45] The report concluded "[m]ethane concentrations were 17-times higher on average . . . in shallow wells from active drilling and extraction areas than in wells from nonactive areas. The *average* methane concentration in shallow ground-water areas fell within the defined action level . . . for hazard mitigation recommended by the U.S. Office of the Interior[…]"[46] However, the report found "no evidence for contamination of the shallow wells near active drilling sites from deep brines and/or fracturing fluids."[47] Additionally, the report suggested that the methane contamination is more likely to be caused by ruptured drilling casings than by migration deep underground.[48] Nonetheless, the report concluded that both migration scenarios are possible.

Groundwater contamination occurs, not only by subsurface migration of HVHF fluids into underground aquifers, but also from industrial accidents at the earth's surface. Spills of wastewater during transportation, reservoir overflows, well or tank ruptures, ground fires, or equipment failure all lead to contamination entering groundwater.[49] For example, in September of 2009, up to 8,000 gallons of fracking fluid leaked into streams in Dimock, Pennsylvania.[50] "The spills were not immediately reported to families whose

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SCIENCES, AND BIOLOGY DEPARTMENT (May 10, 2011), http://www.nicholas.duke.edu/hydrofracking/Osborn%20et%20al%20%20Hydrofracking%202011.pdf.

[45] *Id*. at 5.
[46] *Id.* at 2.
[47] *Id.* at 4.
[48] *Id.*
[49] N.Y. ENVIRONMENTAL IMPACT STUDY, *supra* note 3, at 10.
[50] Bateman, *supra* note 35.

children played in and around the contaminated stream."[51] In April of 2009, also in Dimock, a truck overturned, spilling 800 gallons of diesel fuel.[52] On April 21, 2011, thousands of gallons of fracking waste were spilled into local waterways near Canton, Pennsylvania after a well casing failed.[53]

Flooding of drilling sites is yet another way bulk additives and wastewater could accidentally enter the environment in large quantities.[54] "Accordingly, construction of drill pads within flood plains raises serious and "significant adverse impacts."[55] Construction and maintenance of fracking fluid waste pits next to drilling sites create the potential for adverse impacts during heavy rain and snow melt.[56]

Although the Duke study clearly shows a correlation between HVHF and groundwater contamination, it is by no means a comprehensive study with a definitive answer. No current study provides a conclusive analysis that accounts for differences in each well site's underlying rock formations and differences in each well's chemical mix. There is simply not enough "hard" data to form rational and definitive conclusions about the overall effect of HVHF operations on groundwater. There is, however, a steady flow of news and opinion on both sides of this increasingly contentious debate. In October of 2009, Congress urged the EPA to:

> [C]arry out a study on the relationship between hydraulic fracturing and drinking water, using a credible approach that relies on the best available science, as well as independent sources of information . . . to be conducted

[51] Gray, *supra* note 15, at 6.
[52] *Id.*
[53] *See Chesapeake Energy will Investigate Pennsylvania Gas-drilling Spill,* ASSOCIATED PRESS (Apr. 26, 2011), http://www.usatoday.com/money/industries/energy/2011-04-22-chesapeake-energy-gas-drilling-spill_n.htm.
[54] N.Y. ENVIRONMENTAL IMPACT STUDY, *supra* note 3, at 10.
[55] *Id*. at 7-76.
[56] *Id*. at 10.

> through a transparent, peer-reviewed process that will ensure the validity and accuracy of the data.[57]

The forthcoming EPA study essentially reopens the much-refuted and scientifically-discredited 2004 EPA study. The EPA's findings will undoubtedly provide the scientific foundation for future federal regulation of HVHF. The report, however, is not expected until late 2012.

B. Groundwater Contamination From Untreated Waste

Fracking waste is treated off-site at both public and private wastewater treatment facilities. Evidence suggests that Pennsylvania facilities were overrun with fracking wastewater during the HVHF boom.[58] According to Earthjustice attorney Deborah Goldberg, "[t]he nation is in the midst of a fracking-fueled gas rush which is generating toxic wastewater faster than treatment plants can handle it."[59] Treatment plants are ill-equipped to remove all the contaminants in HVHF waste water, and will only partially remove contaminates before dumping the water into streams and rivers.[60]

C. Depletion of Water Resources

Studies suggest the increased consumption of local water during the fracking process might threaten local water supplies in certain circumstances, although the increased demand is usually insignificant. For example, New York residents currently withdraw approximately 3.8 trillion gallons of freshwater statewide each year.[61]

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[57] Orford, *supra* note 31, at 5.

[58] Michael Rubinkam, *EPA to Regulate Drilling Frackwater Disposal*, ASSOCIATED PRESS (Oct. 21, 2011), http://thetimes-tribune.com/news/gas-drilling/epa-to-regulate-drilling-frackwater-disposal-1.1221456#axzz1tr1iLg8K.

[59] *Id.*

[60] *Id.*

[61] N.Y. ENVIRONMENTAL IMPACT STUDY, *supra* note 3, at 9.

According to the New York Environmental Impact Study, proposed HVHF operations would use about 9 *billion* gallons of fresh water each year during peak operations, resulting in an increased demand for fresh water of approximately 0.24%.[62] The study concludes that, although this is a small percentage, "the cumulative impact of water withdrawals, if such withdrawals were temporally proximate and from the same water resource, could potentially be significant."[63]

D. Impact on Ecosystems

HVHF operations severely impact ecosystems and wildlife by fragmenting wild habitats, transferring invasive species, and threatening endangered species.[64] Potential impacts to wetlands include interruption of natural drainage, flooding, erosion and sedimentation, brush disposal, and increased access due to pit location.[65]

E. Greenhouse Gas Emissions and Exposure to Radioactive Materials

Wastewater produced by the fracking process is often stored in benzene-emitting containers known as "glycol dehydrators."[66] The waste is also stored in off-site compressor stations that produce formaldehyde emissions.[67] The waste may also contain elevated amounts of naturally-occurring radioactive materials ("NORM"). "The buildup of NORM in pipes and equipment [. . .] has the potential to cause a significant adverse

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[62] *Id.*

[63] *Id.* at 9-10.

[64] *Id*. at 13-14.

[65] *Id.* at 6-66.

[66] *Guidance for 40 CFR 63 Subpart HH Oil and Natural Gas Production MACT Standard*, JMC ENVTL. CONSULTING, 1, 19 (July 15, 1999), *available at* http://www.cde.state.co.us/artemis/hemonos/he17102m2519992internet/he17102m251999201internet.pdf.

[67] West Virginia Department of Environmental Protection, Division of Air Quality, *Fact Sheet for General Permit Registration Under 45CSR30 and Title V of the Clean Air Act*, p. 2, (Oct. 24, 2007), http://www.dep.wv.gov/daq/permitting/titlevpermits/Documents/CGTC/Kenova%20FS.pdf.

impact" on gas industry workers.[68] Several industry workers have brought tort actions against their employers for exposure to radioactive material. More testing is needed to determine whether the fracking wastewater that is being released into streams and rivers from treatment facilities contains elevated levels of NORM.

IV. REGULATION

A. Federal Regulation

Congress enacted the Safe Water Drinking Act of 1974 ("SWDA").[69] The SWDA prohibited any underground injection that endangered drinking water sources, defined as any injection that:

> Result[s] in the presence in underground water which supplies or can reasonably be expected to supply any public water system of any contaminant, and if the presence of such contaminant . . . adversely affects the health of persons.[70]

However, the EPA determined that HVHF does not qualify as an "underground injection" "because the principal function of [hydraulic fracturing] wells is not the underground emplacement of fluids; their principal function is methane gas production."[71] Although the EPA's interpretation seems counterintuitive, it was not immediately challenged, and states were not required to regulate hydraulic fracturing until 1997.[72] In 1997, the Eleventh Circuit overruled the EPA's position on the applicability of the SWDA to hydraulic fracturing in *Legal Envtl. Assistance Found. v. EPA* ("*LEAF*") and held "hydraulic fracturing activities constitute 'underground injection' under Part C of the

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[68] N.Y. ENVIRONMENTAL IMPACT STUDY, *supra* note 3, at 19.
[69] 42 U.S.C. §§ 300(f)-(j)(26).
[70] 42 U.S.C. § 300h(d)(2).
[71] Legal Envtl. Assistance Found. v. U.S. Envtl. Prot. Agency, 118 F.3d 1467, 1471 (11th Cir. 1997).
[72] Orford, *supra* note 31, at 3.

SDWA."[73] The *LEAF* decision required the EPA to regulate hydraulic fracturing for the first time since the initial introduction of HVHF as a natural gas extraction method.

In 2001, President George W. Bush convened the Energy Task Force, lead by Vice President Dick Cheney.[74] Before his terms as Vice President, Dick Cheney was the chairman and chief executive officer of Halliburton Company from 1995 to 2000.[75] Halliburton is one of the world's largest drilling machinery manufacturers.[76] The Energy Task Force released a report in May 2001 that "portrayed hydraulic fracturing as essential to energy development, and recommended that fracking be exempted from the SDWA."[77] The highly-criticized EPA report was released in 2004, during the end of a long political debate in Congress about exempting fracking from federal regulation.[78] The EPA report seemingly solidified the industry's position and in 2005, Congress amended SDWA by exempting "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."[79] The exemption is commonly known as the "Halliburton Loophole" due to former Vice President Cheney's undeniable influence over the political process.[80] Federal regulation of fracking ceased and states were once again allowed to regulate, or deregulate, as they pleased.

B. State Regulation: A Race to the Bottom?

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[73] Legal Envtl. Assistance Found., at 1471, *supra* note 72.
[74] Orford, *supra* note 31 at 3.
[75] *Dick Cheney*, NNDB.COM, http://www.nndb.com/people/598/000022532 (last visited June 18, 2012).
[76] *See* http://www.halliburton.com for company information.
[77] Orford, *supra* note 31 at pg. 3.
[78] *Id.*
[79] 42 U.S.C. § 300h(d)(1)(B)(ii).
[80] *Halliburton Loophole*, EARTHWORKSACTION.COM, http://www.earthworksaction.org/halliburton.cfm (last visited June 18, 2012).

Twenty-seven states account for 99.9% of all oil and natural gas production in the United States.[81] All 27 states regulate natural gas exploration and production, although the scope and specificity of the regulations vary.[82] Common regulatory requirements include well permitting, well construction, and wastewater handling.[83] State legislatures generally delegate authority to issue permits "to an oil and gas division, commission or board."[84] The issuance of such permits typically requires the gas company to submit location and geological information of the proposed site to the state-permitting agency.[85] Only a few states require a permit for construction of the well pad or waste pits.[86]

Methods and materials of well construction are largely unregulated. Rather, the industry follows its own internal guidelines.[87] Cement is often used to form a barrier around steel well casing and is crucial in sealing the spaces between steel well casing joints. Proper cement sealing creates a hydraulic barrier to both vertical and horizontal fluid migration, but the cementing circulation process is expensive, and economic

[81] The 27 states include Alabama, Alaska, Arkansas, California, Colorado, Florida, Illinois, Indiana, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Montana, Nebraska, New Mexico, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas, Utah, Virginia, West Virginia, Wyoming. *State Oil and Natural Gas Regulations Designed to Protect Water Resources*, U.S. DEP'T OF ENERGY, OFFICE OF FOSSIL ENERGY 9 (May 2009), *available at* http://www.energyindepth.org/wp-content/uploads/2009/03/oil-and-gas-regulation-report-final-with-cover-5-27-20091.pdf, [hereinafter 2009 GWPC REPORT].

[82] *Id.*

[83] William J. Brady, *Hydraulic Fracturing Regulation in the United States: The Laissez-Faire Approach of the Federal Government and Varying State Regulations*, UNIVERSITY OF DENVER, STURM COLLEGE OF LAW, GRIMSHAW & HARRING, P.C., 10-17, http://law.du.edu/documents/faculty-highlights/Intersol-2012-HydroFracking.pdf. (summarizing state regulations of fracking operations in Colorado, New York, Pennsylvania, Texas, Louisiana, and Wyoming).

[84] 2009 GWPC REPORT*, supra* note 82, at 17.

[85] *Id*.

[86] *Id.*

[87] *Id.* at 18. The American Petroleum Institute established its own "standards," which are really just recommended practices.

incentives encourage gas companies to avoid cement circulation whenever possible.[88] Although most states require cement on surface casing, many do not require cement circulation across deeper groundwater zones.[89]

Recent highly publicized incidents of groundwater contamination in the Marcellus Shale region have led to increased political pressure for tougher state regulation of fracking operations. There is currently a moratorium on drilling in New York, but Governor Andrew Cuomo is advocating to lift the moratorium and allow drilling operations to begin there immediately.[90] After detecting high levels of toxic bromide in Pennsylvania streams, the Pennsylvania Department of Environmental Protection mandated that no wastewater treatment facilities may accept fracking waste water after May 19, 2011.[91] On July 12, 2011, Governor Earl Ray Tomblin of West Virginia issued an emergency executive order increasing the requirements in the permitting process for drilling in his state.[92] The basic requirements in this executive order evidence the lax nature of the current West Virginia permitting process.[93]

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[88] *Id*. at 20.

[89] *Id*.

[90] Cuomo has come under fire for his efforts to fast track hydraulic fracturing operations in New York. *See* Alison Rose Levy, *Will New Yorkers Veto Cuomo's Fracking Guidelines?,* THE HUFFINGTON POST (Dec. 2, 2011), http://www.huffingtonpost.com/alison-rose-levy/what-do-new-yorks-frackin_b_1124556.html.

[91] David Wagner, *Pennsylvania Department of Environmental Protection Calls on Marcellus Shale Drillers to Stop Taking Wastewater to Treatment Plants*, ENVIRONMENTAL LAW RESOURCE (Apr. 26, 2011), http://www.environmentallawresource.com/2011/04/articles/marcellus-shale-1/pennsylvania-department-of-environmental-protection-calls-on-marcellus-shale-drillers-to-stop-taking-wastewater-to-treatment-plants/.

[92] W.Va. Exec. Order No. 4-11 (July 12, 2011), *available at* http://www.governor.wv.gov/Documents/20110713150559476.pdf.

[93] *Id.* The Executive Order issued by West Virginia Governor Tomblin mandated that: (1) Marcellus Shale drilling applicants file a public notice of intent to drill; (2) any activity disturbing three or more acres of surface land be done in accordance with a plan certified by a registered professional engineer, which plan is to encompass erosion mitigation and sediment control measures; (3) any company expecting to use more than 210,000 gallons of water a month have on file with the WVDEP, and thereafter comply with, a formal water management plan; (4) a complete list of chemicals or other additives used in the fracking process be provided prior to the start of any

When states are left to regulate industry on their own, a battle between industry and public interests inevitably ensues. The desire for state regulators to create jobs and tax revenue by encouraging economic development in their state often overrides concerns for the health and welfare of the state's citizens. When states compete for industrial investment, a "race to the bottom" often develops as each state lowers the regulatory threshold to encourage business development.[94] Since the exemption of fracking operations from the SDWA in 2005, some states have leaned towards gas industry interests by keeping regulation to a minimum. However, recent public outrage over fracking has led to increased political pressure on states to increase regulation of fracking operations. Despite this increase in political pressure, some states remain reluctant to regulate for fear that they will drive off business and kill jobs.

C. The FRAC Act

The Fracturing Responsibility and Awareness of Chemicals Act ("FRAC Act") was introduced to both chambers of Congress in 2009 and reintroduced in 2011.[95] The Senate version, Senate Bill 587, sponsored by Senator Robert Casey of Pennsylvania,

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drilling; (5) that a company detail existing uses of stream water for any public stream from which the company expects to withdraw water; (6) well site safety be a priority; and (7) a previously instituted moratorium on the discharge of gas well return fluids into public wastewater treatment facilities remain in effect.

[94] Richard B. Stewart, *Pyramids of Sacrifice? Problems of Federalism in Mandating State Implementation of National Environmental Policy*, 86 YALE L.J. 1196, 1212 (1977) (recognizing that "any individual state or community may rationally decline unilaterally to adopt high environmental standards that entail substantial costs for industry and obstacles to economic development for fear that the resulting environmental gains will be more than offset by movement of capital to other areas with lower standards"); *see generally* Kirsten H. Engel, *State Environmental Standard-Setting: Is There a "Race" and is it "to the Bottom*"?, 48 HASTINGS L.J. 271 (1997) (concluding that empirical data suggests excessive market power held by states and industrial firms leads to market failure, and ultimately a race to the bottom scenario much like a classic prisoner's dilemma, the result of which is a reduction in overall social welfare).

[95] Abraham Lustgarten, *FRAC Act-Congress Introduces Twin Bills to Control Drilling and Protect Drinking Water*, PROPUBLICA (June 9, 2009), http://www.propublica.org/article/frac-act-congress-introduces-bills-to-control-drilling-609; Fracturing Responsibilities and Awareness of Chemicals Act, S. 1215, H.R. 1084, 112th Cong. (March 15, 2011), http://www.govtrack.us/congress/billtext.xpd?bill=s112-587.

was referred to the Environment and Public Works Committee on April 12, 2011.[96] The House version, House Bill 1084, sponsored by Representative Diana DeGetee of Colorado, was referred to the Committee on Energy and Commerce and the Subcommittee on Environment and the Economy on March 21, 2011.[97]

The companion bills would amend the SDWA to repeal the "Halliburton Loophole" and allow the EPA to reregulate hydraulic fracturing.[98] The FRAC Act would also require disclosure of all non-proprietary chemicals used at each well site, and disclosure of all chemicals, including proprietary chemicals, in the case of a medical emergency.[99] If passed, the bill would specifically require the disclosure of chemicals, and would further enable the EPA to set industry-specific minimum standards for safe hydraulic fracturing operations. States would be able to set stricter standards, but would be required to at least meet the EPA's minimum standards. In support of the FRAC Act, Senator Casey stated:

> Drilling for natural gas in the Marcellus Shale across much of Pennsylvania is part of our future. I believe that we have an obligation to develop that natural gas responsibly to safeguard the drinking water wells used by 3 million Pennsylvanians. We already have private wells contaminated by gas and fluids used in hydraulic fracturing. We need to make sure that this doesn't become a state-wide problem over the next few decades as we extract natural gas.[100]

Not all senators agree with Mr. Casey. Texas Senator John Cornyn believes that

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[96] Congressional Research Service, *S. 587: FRAC Act*, LIBRARY OF CONGRESS, (March 15, 2011), http://www.govtrack.us/congress/bill.xpd?bill=s112-587.

[97] Congressional Research Service, *H.R. 1084: FRAC Act*, LIBRARY OF CONGRESS (March 15, 2011), http://www.govtrack.us/congress/bills/112/hr1084/text.

[98] *Id*. at § 2(a).

[99] *Id*. at § 2(b)(i)-(iii).

[100] Senator Robert P. Casey Jr., *Casey, House Members Introduce Companion Bills To Protect Drinking Water from Natural Gas Fracking*, PRESS RELEASE (Jan. 9, 2009), http://casey.senate.gov/newsroom/press/release/?id=3d78271c-e412-4b63-95b8-419e75ce2bb6.

current state regulations are sufficient to address the concerns over hydraulic fracturing.[101] According to Cornyn, "[a]dditional regulations would take with them jobs and local, state and federal revenue."[102] The political debate over the FRAC Act remains highly partisan, as is common with energy policy. The FRAC Act's ultimate fate may hinge on the outcome of the 2012 elections.[103]

V. CONCLUSION AND RECOMMENDATIONS

An increasing body of research proves hydraulic fracturing operations are contaminating groundwater in rural communities across the country. An evaluation of the likelihood that fracking will contaminate urban drinking water supplies downstream from waste treatment plants requires further testing. Most notably, watersheds serving New York City, Pittsburgh, Pennsylvania, and Dallas, Texas may be at risk. Perhaps most importantly, large quantities of fracking fluid that remain underground could contaminate water resources for many future generations.

Labeling natural gas as a "clean-burning" fuel is misleading. Every time a well is fracked, thousands of diesel-burning transport trucks haul the fracking fluid waste off-site to be processed. Wastewater evaporators at, or near, the drill sites emit unknown amounts of greenhouse gases into the air long before the natural gas being produced is

[101] Heather Caygle, *Senator John Cornyn Cautions Against Additional Drilling Regulations*, CHRON (Apr. 13, 2011), http://blog.chron.com/txpotomac/2011/04/sen-john-cornyn-cautions-against-additional-drilling-regulations.

[102] *Id.*

[103] President Barack Obama announced plans to allow hydraulic fracturing on federal public lands in exchange for the full disclosure by gas companies of the chemicals used in the process. Obama, B. *Remarks by the President in State of Union Address* THE WHITE HOUSE, OFFICE OF THE PRESS SECRETARY (Jan. 24, 2012), *available at* http://www.whitehouse.gov/the-press-office/2012/01/24/remarks-president-state-union-address.

ever consumed. Even though natural gas is generally regarded as cleaner than burning coal, the air pollution caused by the extraction and production of natural gas may very well make natural gas consumption equally harmful to Earth's atmosphere.

HVHF allows gas companies to dramatically increase production, but the industry fails to include the cost of negative externalities in the price of natural gas. This leads to inadequate price signals as gas consumers are not paying for the true cost of natural gas. Compliance with new federal minimum standards authorized by the FRAC Act will likely increase the cost of production for gas drilling companies. The increased cost will, as a result, be passed onto consumers. Therefore, federal minimum standards are the necessary mechanisms to force the industry to account for the negative externalities associated with fracking.

The Energy Policy Act of 2005 authorized the Federal Energy Regulatory Commission ("FERC") to impose penalties on entities that manipulate the natural gas market,[104] and to establish rules to ensure price transparency.[105] Under careful oversight by FERC, wellhead gas prices could possibly double if federal regulation resumes. These prices will remain well below the 2008 highs, but will accurately reflect the true cost of natural gas production, unlike current prices, which are artificially low.

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[104] 15 U.S.C. § 717(c)(1) states that:

> It shall be unlawful for any entity, directly or indirectly, to use or employ, in connection with the purchase or sale of natural gas or the purchase or sale of transportation services subject to the jurisdiction of the Commission, any manipulative or deceptive device or contrivance [. . .] in contravention of such rules and regulations as the Commission may prescribe as necessary in the public interest or for the protection of natural gas ratepayers.

[105] 15 U.S.C. § 717(t)(2)(a)(1) ("The Commission is directed to facilitate price transparency in markets for the sale or transportation of physical natural gas in interstate commerce, having due regard for the public interest, the integrity of those markets, fair competition, and the protection of consumers.").

While many politicians insist that state laws are sufficient to regulate drilling operations, the unfortunate reality is that too many of our political leaders are overly focused on job creation and their states' economies to take any meaningful stance against the oil and gas lobby. The reinstatement of federal regulation in this area is the only way to avoid a race to the bottom scenario among state regulatory commissions.

If authorized by Congress, the EPA will be able to protect our domestic water supply by enforcing appropriate minimum standards on the gas drilling industry. Specifically, the EPA minimum requirements should (1) protect surface aquifers by enacting and enforcing strict standards for well construction and contamination containment, (2) ban specific chemicals known to be harmful to humans and ecosystems, (3) ban reinjectment of untreated HVHF waste, (4) require full treatment of all HVHF waste water by private waste treatment facilities at or near the well sites, (5) require all or most HVHF waste be removed from wells before the production phase, (6) establish standards for the construction of on-site waste pits, (7) establish protocols for the storage and movement of HVHF chemicals, (8) establish regular monitoring and testing of aquifers and private well water surrounding HVHF operations, and (9) establish fines and penalties for failure to comply with the minimum standards.

Well construction standards should require cement circulation around all vertical well casing segments, and drilling companies should be required to use high-quality cement. The required thickness of the cement barriers should be established after evaluating current industry standards. The EPA should also require mandatory well integrity tests before the fracking phase begins, and should institute random well

inspections during and after HFHV operations.

If gas companies insist on pumping thousands of gallons of dangerous chemicals into the ground, they must bear the full cleanup cost. The EPA should carefully analyze the chemicals currently being used in the fracking process to differentiate between highly toxic chemicals that should be banned from underground injection, and less harmful chemicals that are necessary for effective fracking. Specifically, the EPA should ban the underground injection of mercury, benzene, lead, diesel fuel, methanol, kerosene, formaldehyde, ethylene, glycol, glycol ethers, hydrochloric acid, and sodium hydroxide, all of which are used in HVHF fluid today.[106]

The EPA must be allowed to develop minimum standards for disposal of harmful HVHF waste. Treatment of HVHF waste will likely be the heaviest cost burden on gas companies. The EPA should establish a commission to evaluate options and propose solutions to mitigate the cost of water treatment. The commission, together with state regulatory agencies, should evaluate whether current private treatment plants can be improved or retooled to adequately accept a high volume of HVHF waste. This evaluation must be made on a location-by-location basis. If current facilities in a given location are inadequate, the gas industry must be required to construct their own treatment facilities there. On-site waste pits should also be subject to stricter minimum standards. Instead of tarp-lined pits, the EPA should require pits to have hard liners made of plastic or another impenetrable material to prevent seepage. The tops of the waste pits should extend no less than seven feet above the surface in areas identified as flood plains.

[106] N.Y. ENVIRONMENTAL IMPACT STUDY, *supra* note 3 at 22.

Perhaps most importantly, the EPA will need to establish minimum requirements for testing groundwater around HVHF sites and similar standards for testing treated water released from waste treatment plants. There should be contamination thresholds and any drilling site that exceeds the contamination threshold should be shut down or subject to severe monetary penalties that make such events cost prohibitive.

While it is important to keep costs low for natural gas consumers, it is equally important to safeguard against the potentially devastating environmental impact. The current price for natural gas is artificially low because the gas industry refuses to pay for the cost of its production. Externalities must be brought back into the equation through federal regulation so that correct pricing signals are sent to consumers. Congress should pass the FRAC Act and insist on stricter EPA standards before it is too late to reverse the damage.