THE THIRST OF FRACKING: REGULATING TO PROTECT THE LINCHPIN OF THE NATURAL GAS BOOM

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The natural gas boom sweeping the United States has many enthusiastic about the production of domestic energy and the accompanying economic opportunities, but often taken for granted is another valuable resource that is essential to the extraction process: water.[1] The natural gas boom was ignited by the development of high-volume hydraulic fracturing (fracking) with horizontal drilling, which has enabled oil and gas companies to extract oil and gas from a significantly larger underground area through a single well.[2] The fracking process, however, requires huge amounts of water, in essence trading one resource for another.[3]

In order to break up the shale and release the oil or gas, millions of gallons of water are mixed with sand and chemicals and injected

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[1] *See* Peter J. Kiernan, *An Analysis of Hydrofracturing Gubernatorial Decision Making*, 5 ALB. GOV'T L. REV. 769, 770 (2012) ("Hydrofracturing employs huge amounts of fresh water, sometimes millions of gallons per drill.").

[2] *See generally* N.Y. ST. DEP'T OF ENVTL. CONSERV., REVISED DRAFT: SUPPLEMENTAL GENERIC ENVIRONMENTAL IMPACT STATEMENT ON THE OIL, GAS AND SOLUTION MINING REGULATORY PROGRAM §§ 1.1, 5.4 (Sept. 7, 2011), http://www.dec.ny.gov/data/dmn/rdsgeisfull0911.pdf [hereinafter RDSGEIS] (explaining the hydraulic fracturing process and listing the components of the fracking fluid).

[3] *See, e.g.*, Kate Galbraith, *As Fracking Increases, So Do Fears About Water Supply*, N.Y. TIMES, Mar. 8, 2013, at A21 ("In 2011, Texas used a greater number of barrels of water for oil and natural gas fracking (about 632 million) than the number of barrels of oil it produced (about 441 million), according to figures from the Texas Water Development Board and the Railroad Commission of Texas, the state's oil and gas regulator.").

into the well at high pressure.[4] Wells are drilled thousands of feet deep and then angled horizontally to access the shale, potentially stretching for thousands of feet.[5] The discovery of this new drilling technology in the last decade has opened up massive reserves of shale to oil and gas development in the United States.[6] Fracking was first employed in the Texas portion of the Barnett Shale in the 1990s, and came to eastern states in 2003 when the first horizontal well tapped the Marcellus Shale in Pennsylvania.[7] The boom ensued.[8] In August 2011, the Secretary of Energy Advisory Board reported that, "Owing to breakthroughs in technology, production from shale formations has gone from a negligible amount just a few years ago to being almost 30 percent of total U.S. natural gas production."[9] Even with low natural gas prices, some state and local economies are still booming from natural gas operations.[10] Certain communities across the U.S. that host oil and natural gas activities are seeing increases in jobs, tax revenues, incomes, economic activity, housing prices, and even zero vacancy rates.[11]

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[4] *See* RDSGEIS, *supra* note 2, §§ 1.1, 5.3, 5.4.

[5] *See* OHIO ENVTL. PROT. AGENCY, DRILLING FOR NATURAL GAS IN THE MARCELLUS AND UTICA SHALES: ENVIRONMENTAL REGULATORY BASICS 1 (Jan. 2014), http://www.epa.ohio.gov/portals/0/general%20pdfs/generalshale711.pdf [hereinafter ENVIRONMENTAL REGULATORY BASICS].

[6] *See* Emily C. Powers, Note, *Fracking and Federalism: Support for an Adaptive Approach That Avoids the Tragedy of the Regulatory Commons*, 19. J.L. & POL'Y 913, 922 (2011) ("Prior to the development of hydrofracking and horizontal drilling methods, gas extraction in New York State was on the decline due to the inability of producers to access gas trapped in shale.").

[7] *Id.* at 919; *see also* RDSGEIS, *supra* note 2, § 5.4.3 ("Barnett Shale is considered to be the first instance of extensive high-volume hydraulic fracturing technology use.").

[8] *See* Kiernan, *supra* note 1, at 773–74 (describing the "rush" in Pennsylvania following the issuance of permits to hydrofracture the Marcellus Shale).

[9] SEC'Y OF ENERGY ADVISORY BD., U.S. DEP'T OF ENERGY, SHALE GAS PRODUCTION SUBCOMMITTEE 90-DAY REPORT 1 (Aug. 18, 2011), http://energy.gov/sites/prod/files/Final_90_day_Report.pdf.

[10] *See id.* at 7; *see also* Jim Efstathiou Jr., *Fracking Boom Seen Raising Household Incomes by $1,200*, BLOOMBERG (Sept. 4, 2013), http://www.bloomberg.com/news/2013-09-04/fracking-boom-seen-raising-household-incomes-by-1-200.html.

[11] *See, e.g.*, AUDREY PUTZ ET AL., SUSTAINABILITY IN NATURAL RESOURCE-DEPENDENT REGIONS THAT EXPERIENCED BOOM-BUST-RECOVERY CYCLES: LESSONS LEARNED FROM A REVIEW OF THE LITERATURE 15 (2011), http://www.ag.ndsu.edu/ccv/documents/sustainability-report (explaining that due to a natural gas boom between 2003 and 2007, Sublette County, Wyoming had a 28% increase in population, a 20% decrease in available housing, and an annual increase of $21,207 in housing prices); *see also* Brian Louis, *Fracking in Ohio Sparks Real Estate Rebound: Mortgages*, BLOOMBERG (June 11, 2012), http://www.bloomberg.com/news/2012-06-11/fracking-in-ohio-sparks-real-estate-rebound-mortgages.html; SEC'Y OF ENERGY ADVISORY BD., U.S. DEP'T OF ENERGY, *supra* note 9, at 7 ("[W]ell over 200,000 of [sic] jobs (direct, indirect, and induced) have been created over the

Such economic growth is in stark contrast to much of the rest of the country, as it wades through a lingering recession.[12]

Despite the booms and often-cited economic potential for gas drilling in the United States, a critical, inescapable fact is that significant amounts of water are needed for drilling operations.[13] Given the two to five million gallons of water used to frack a horizontal shale gas well and extract gas, the natural gas industry's expansion throughout the U.S. has raised water supply concerns.[14] The Colorado Oil and Gas Conservation Commission (COGCC) estimates that almost 17,800 acre-feet of water (one acre-foot equals about 326,000 gallons) will be used for fracking in Colorado in 2014 and almost 19,000 acre-feet will be used in 2015.[15] The New York Department of Environmental Conservation's Revised Draft Supplemental Generic Environmental Impact Statement (RDSGEIS) estimates that "average water use per well in New York could be 3.6 million gallons."[16] Such large-scale water withdrawals for fracking could impact water supplies, and other industries and uses as well as ecosystems may find themselves competing with the gas industry.[17]

Much of the water used in fracking remains trapped deep underground.[18] The U.S. Environmental Protection Agency (EPA) estimates that anywhere from 15% to 80% of the water is pushed

last several years by the development of domestic production of shale gas, and tens of thousands more will be created in the future.").

[12] *See* Michael A. Fletcher, *Four Years After End of Recession, Incomes Remain Depressed*, WASH. POST, Aug. 22, 2013, at A11 (noting that inflation-adjusted median household income declined 4.4% since June 2009 to $52,098, and Americans' average income remains 6.1% below December 2007 pre-recession levels); *see also* Press Release, Sentier Research, Household Income Down by 4.4 Percent Overall Post Recession—Many Groups with Larger Income Declines 1 (2013), *available at* http://www.sentierresearch.com/pressreleases/Sentier_PressRelease_PostRecessionaryHouseholdIncomeChange_June2009toJune2013_08_21_13.pdf.

[13] OFFICE OF RESEARCH AND DEV., U.S. ENVTL. PROT. AGENCY, HYDRAULIC FRACTURING RESEARCH STUDY 2 (2010), http://www.epa.gov/safewater/uic/pdfs/hfresearchstudyfs.pdf.

[14] *See id.* ("[T]wo to five million gallons of water may be necessary to fracture one horizontal well in a shale formation."); ENVIRONMENTAL REGULATORY BASICS, *supra* note 5, at 2 ("It can take up to four million gallons of fresh water to fracture a single well."); RDSGEIS, *supra* note 2, § 5.7.

[15] COGCC ET AL., WATER SOURCES AND DEMAND FOR THE HYDRAULIC FRACTURING OF OIL AND GAS WELLS IN COLORADO FROM 2010 THROUGH 2015, http://cogcc.state.co.us/Library/Oil_and_Gas_Water_Sources_Fact_Sheet.pdf.

[16] RDSGEIS, *supra* note 2, § 5.7.

[17] *See id.* § 6.1.1.

[18] ENVIRONMENTAL REGULATORY BASICS, *supra* note 5, at 2.

back up to the surface.[19] This water, called "flowback," may contain elements of the chemicals added to the fracking fluid or hazardous chemicals from below the earth's surface.[20] This water cannot be adequately treated by typical municipal water treatment plants, so it must either be stored—such as by being injected into an underground disposal well—or transported to a facility capable of processing chemical wastes.[21] Thus, the fracking process raises issues of water quantity and water quality, presenting regulators with complex challenges regarding how to properly and adequately regulate fracking in order to preserve water supplies and protect the quality of those supplies.[22]

This article examines water resources concerns raised by natural gas development and regulatory approaches to addressing those issues. Part I of this article provides a brief overview of how the oil and gas industry is regulated. Part II identifies water supply and use issues, such as sources of the water used for fracking and impacts on competing uses, and specific regulatory approaches to address those concerns. Part III discusses water quality concerns, including disclosure of the chemicals used, setback requirements, and disposing or reusing flowback, and gives examples of regulations that address these issues. Finally, Part IV identifies key regulatory challenges for adequately regulating the oil and gas industry in light of the industry's complex and quickly changing technology. This part further examines the appropriate regulatory scale for addressing these water resources concerns, as well as the difficulty of implementing and maintaining regulations that effectively regulate an industry that is rapidly changing—with regard to the best available technology for drilling and extracting the resource, and the technology that can most effectively protect water resources, including treating flowback.

I. REGULATION OF FRACKING IN A NUTSHELL

The regulation of the oil and gas industry has traditionally been left to the states, and fracking itself is currently exempt from the

[19] *See* OFFICE OF RESEARCH AND DEV., U.S. ENVTL. PROT. AGENCY, *supra* note 13, at 2.

[20] ENVIRONMENTAL REGULATORY BASICS, *supra* note 5, at 3.

[21] *Id.*

[22] *See* Powers, *supra* note 6, at 944 (noting concerns with regulation process of the Department of Environmental Conservation (DEC)).

principal federal environmental laws.[23] Notably, fracking is exempt from the Safe Drinking Water Act's underground injection control program, unless diesel fuel is used.[24] The U.S. Bureau of Land Management (BLM) regulates the permitting of fracking on federal lands, and is currently in the process of proposing regulations for gas drilling activities.[25] Otherwise, fracking is generally regulated at the state level.[26] States typically implement regulations of the oil and gas activities, including standards and the permitting process for well construction and regulation of environmental impacts.[27]

The EPA, however, has been revisiting its role.[28] It is currently investigating the impacts of fracking on drinking water.[29] In addition, legislation has been proposed in recent years to revise the exemptions of fracking from federal regulation.[30] The Fracturing Responsibility and Awareness of Chemicals Act, the so-called "FRAC Act," was re-proposed in 2013,[31] which would require operators to disclose the chemicals used in fracking and would allow the EPA to regulate fracking under the Safe Drinking Water Act.[32]

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[23] *Id.* at 913–14; *see also id.* at 914 n.4 (listing federal laws that exempt fracking).

[24] 42 U.S.C. § 300h(d)(1)(B) (2012) ("The term 'underground injection' . . . excludes . . . the underground injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations."). On February 11, 2014, the U.S. Environmental Protection Agency issued final permitting guidance on fracking when the injected fluid contains diesel fuel. U.S. ENVTL. PROT. AGENCY, PERMITTING GUIDANCE FOR OIL AND GAS HYDRAULIC FRACTURING ACTIVITIES USING DIESEL FUELS: UNDERGROUND INJECTION CONTROL PROGRAM (Feb. 2014), http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/upload/epa816r14001.pdf.

[25] *See* Oil and Gas; Well Stimulation, Including Hydraulic Fracturing, on Federal and Indian Lands, 77 Fed. Reg. 27691, 27691 (proposed May 11, 2012).

[26] William Yukstas, Note, *Managing Fractions: The Role of Local Government in Regulating Unconventional Natural Gas Resources—Recommendations for New York*, 11 CARDOZO PUB. L. POL'Y & ETHICS J. 563, 583 (2013).

[27] Sorell E. Negro, *Fracking Wars: Federal, State and Local Conflicts Over the Regulation of Natural Gas Activities*, 35 ZONING & PLAN. L. REP., Feb. 2012, at 3–4, *available at* http://www.rc.com/documents/Negro_FrackingWars_2012.pdf.

[28] *Id.* at 3.

[29] *EPA's Study of Hydraulic Fracturing and Its Potential Impact on Drinking Water Resources*, U.S. ENVTL. PROT. AGENCY, http://www2.epa.gov/hfstudy (last updated Dec. 19, 2013).

[30] *See* S. 1135, 113th Cong. § 1 (2013); S. 587, 112th Cong. § 2 (2011); H.R. 1084, 112th Cong. § 2 (2011).

[31] S. 1135.

[32] *Id.* On the other hand, in July 2013, the House Natural Resources Committee proposed a bill that would prevent the Department of the Interior from regulating fracking, instead seeking to defer to state regulations. *See* H.R. 2728, 113th Cong. § 2 (2013).

While similar FRAC Act bills have not gone very far in the past,[33] should the federal government take a larger role in regulating fracking, the natural gas operations in the states that currently support natural gas activities, and the regulatory agencies of those states, would undergo significant change.[34]

State law determines the extent to which a local government may enact regulations that impact natural gas development.[35] States vary with regard to how much authority is granted to local governments to enact regulations that may affect the oil and gas industry.[36] Some states grant significant authority to municipalities.[37] Often states authorize municipalities to enact general land use ordinances that specify where certain industrial development may occur, such as high-impact industry,[38] or ordinances addressing nuisances, public safety, or traffic concerns,[39] but will less likely allow local governments to determine how the industry can operate or what environmental or technical standards must be applied to the industry.[40] For example, the Railroad Commission of Texas regulates the oil and gas industry, including production and delivery of the natural resources, but municipalities in Texas may regulate where drilling occurs within their borders through such tools as zoning ordinances and land use permitting requirements.[41] For a more specific example, Coppell, Texas, allows

[33] Negro, *supra* note 27, at 2–3; *see* S. 587; H.R. 1084.

[34] Negro, *supra* note 27, at 10.

[35] *See* Hunter v. City of Pittsburgh, 207 U.S. 161, 178 (1907) ("Municipal corporations are political subdivisions of the State, created as convenient agencies for exercising such of the governmental powers of the State as may be entrusted to them.").

[36] *See* Negro, *supra* note 27, at 4; *see also* Yukstas, *supra* note 26, at 594 tbl.2 (comparing the authority granted to local governments in Pennsylvania and New York to regulate hydraulic fracturing).

[37] *See* Cooperstown Holstein Corp. v. Town of Middlefield, 106 A.D.3d 1170, 1171 (App. Div. 3d Dep't 2013) ("[T]he [New York Oil, Gas, and Solution Mining Law does not] preempt[] a municipality's authority to enact local land use laws prohibiting oil, gas and solution mining or drilling activities within its borders."), *leave to appeal granted*, 995 N.E.2d 851 (N.Y. 2013); Anschutz Exploration Corp. v. Town of Dryden, 940 N.Y.S.2d 458, 472 (Sup. Ct. Tompkins County 2012) ("[New York's Oil, Gas, and Solution Mining Law] does not preempt a municipality's authority—through the exercise of its zoning power—to completely ban operations related to oil and gas production within its borders."), *aff'd sub nom.* Norse Energy Corp. USA v. Town of Dryden, 964 N.Y.S.2d 714 (App. Div. 3d Dep't 2013), *leave to appeal granted*, 995 N.E.2d 851 (N.Y. 2013).

[38] Negro, *supra* note 27, at 4.

[39] *Id.* at 8.

[40] *Id.* at 10 (noting that some attempts by local governments to ban fracking are being challenged in court).

[41] *See* R.R. COMM'N OF TEX., EAGLE FORD SHALE TASK FORCE REPORT 54, 102 (2013),

drilling only in areas zoned "Light Industrial" or "Agricultural," and operators must obtain a permit.[42]

Some states are facing these questions for the first time, and it might be unclear in a given state how much authority municipalities have in this area. Pennsylvania has been in a notorious state of flux in this respect. In 2012, the Pennsylvania General Assembly passed Act 13, which was intended to "preempt[] and supersede[] the local regulation of oil and gas operations regulated by the [state's] environmental acts . . . ."[43] A provision of Act 13, section 3304, required municipalities to allow natural gas development in all zones, including residential,[44] and another provision, section 3125(b)(4), conferred significant authority on the state Department of Environmental Protection to waive setback requirements for wells.[45] In 2013, these provisions were overturned by a trial court in *Robinson Township v. Commonwealth of Pennsylvania*[46] on constitutional grounds, and this decision was appealed to state's Supreme Court. The lower court held that the provision requiring fracking in all land use zones violated the substantive due process provision of the state's constitution, which authorizes municipalities to regulate to protect the public safety and welfare.[47] By forcing municipalities to allow for drilling in all zones without limitation, the court found that the statute forced irrational zoning.[48] In addition, the provision allowing the state to waive setback requirements was struck down because the statute provided insufficient guidance as to when setbacks could be waived, in violation of the state's non-delegation doctrine.[49]

On appeal, the Pennsylvania Supreme Court held that the provisions of Act 13 discussed above are unconstitutional because

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http://www.rrc.state.tx.us/commissioners/porter/reports/Eagle_Ford_Task_Force_Report-0313.pdf.

[42] COPPELL, TEX., ORDINANCE NO. 2009-1228, § 9-26-7(A)(1), (5) (2009), *available at* http://weblink.coppelltx.gov/WebLink8/DocView.aspx?id=28698&dbid=0.

[43] 58 PA. CONS. STAT. § 3303 (2013)

[44] *Id.* § 3304(b).

[45] *Id.* § 3215(b)(4) ("The department shall waive the distance restrictions upon submission of a plan identifying additional measures, facilities or practices to be employed during well site construction, drilling and operations necessary to protect the waters of this Commonwealth. . . .").

[46] Robinson Twp. v. Commonwealth of Pa., 52 A.3d 463 (Pa. Commw. Ct. 2012).

[47] *Id.* at 485, 493.

[48] *Id.* at 484.

[49] *Id.* at 493.

they violate the Environmental Rights Amendment of the State Constitution, article I, section 27, which obligates the Commonwealth to "conserve and maintain" the public natural resources, including clean air and water, "for the benefit of all the people."[50] The court found that natural gas development in Pennsylvania "will produce a detrimental effect on the environment," and through Act 13, the citizens' "fundamental constitutional rights" to a clean environment were "compromised by a legislative determination that violates the public trust."[51]

Thus, state and municipal authority to enact regulations related to natural gas development depends on the particular state's constitution as well as its statutory scheme, and the contours of such authority will be fleshed out by the courts.

II. REGULATING WATER SUPPLY AND USE ISSUES

The fracking process requires a significant amount of water. As explained above, each well requires two to five million gallons of water.[52] While this amount of water might not be a large percentage of overall water usage for a given state or region,[53] this can be an enormous amount for certain arid communities, particularly in times of drought. Recent reports from Ceres, a nonprofit organization in the field of water scarcity and climate

[50] PA. CONST. art. I, § 27; Robinson Twp. v. Commonwealth of Pa., 83 A.3d 901, 1000 (Pa. 2013).

[51] *Robinson Twp.*, 83 A.3d at 976. Three of the justices in the plurality opinion held that the Act's provision preempting local environmental legislation related to oil and gas operations violated art. I, § 27 by mandating that municipalities ignore their obligations under art. I, § 27 and undo existing local environmental protections. *Id.* at 977–89. The Act's provision requiring that municipalities allow oil and gas operations in all zoning districts also violated art. I, § 27 because it exposed otherwise protected areas to environmental degradation, displaced local regulatory structures that protect public resources, and provided no environmental protections. *Id.* One justice in the plurality opinion affirmed the lower court's invalidation of certain of Act 13's provisions on substantive due process grounds. *Id.* at 1001 (Baer, J., concurring). The Supreme Court remanded to the commonwealth court the consideration of certain other claims. *Id.* at 989 (majority opinion).

[52] *See* OFFICE OF RESEARCH AND DEV., U.S. ENVTL. PROT. AGENCY, *supra* note 13, at 2; ENVIRONMENTAL REGULATORY BASICS, *supra* note 5, at 2.

[53] *See* COGCC ET AL., *supra* note 15 (noting that in 2010, hydraulic fracturing used 13,900 acre-feet in Colorado, which constituted 0.08% of the state's total water usage, while agriculture used 85.5% of the state's total water usage); David Blackmon, *Water For Fracking, In Context*, FORBES (July 1, 2013, 11:34 AM), http://www.forbes.com/sites/davidblackmon/2013/07/01/water-for-fracking-in-context/ ("[S]tatewide in 2011, Texans consumed [eighteen] times more water in keeping their grass green than the industry used in frac jobs.").

change, show that almost half of fracking wells in the United States are located in water basins with high to extreme water stress.[54] Ceres characterized areas as under "extreme water stress" where over 80% of available water is used for municipal, industrial, and agricultural purposes, and "high water stress" regions as those where 40–80% of available water is already allocated.[55] Ceres also concluded that 56% of hydraulically fractured wells are in areas facing drought conditions.[56] Accordingly, the amount of water needed for fracking can be extremely significant at the local scale. Thus, while the COGCC notes that in 2010, fracking only used 0.08% of Colorado's water, Ceres concluded that in that state, "97 percent of wells are being developed in regions of high or extremely high water stress."[57] Moreover, although some of the water comes back out of the well as flowback, and in some cases can be recycled and reused for fracking, much of the water is not reused, nor is the water returned to its source.[58] Accordingly, the use of water in fracking is considered "consumptive in nature."[59]

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[54] MONIKA FREYMAN, HYDRAULIC FRACTURING & WATER STRESS: WATER DEMAND BY THE NUMBERS 6 (Feb. 2014), https://www.ceres.org/resources/reports/hydraulic-fracturing-water-stress-water-demand-by-the-numbers [hereinafter WATER STRESS 2014]; MONIKA FREYMAN & RYAN SALMON, HYDRAULIC FRACTURING & WATER STRESS: GROWING COMPETITIVE PRESSURES FOR WATER 5 (May 2013), http://lawreview.richmond.edu/wp/wp-content/uploads/2013/04/Ceres_FrackWater_060313.pdf [hereinafter WATER STRESS 2013].

[55] WATER STRESS 2014, *supra* note 54, at 21.

[56] *Id*. at 24.

[57] *Id.* at 21; WATER STRESS 2013, *supra* note 54, at 6; COGCC ET AL., *supra* note 15.

[58] U.S. GOV'T ACCOUNTABILITY OFFICE, ENERGY-WATER NEXUS: INFORMATION ON THE QUANTITY, QUALITY, AND MANAGEMENT OF WATER PRODUCED DURING OIL AND GAS PRODUCTION 14 (2012) (noting that a limited amount of the flowback water is reused); Brian G. Rahm & Susan J. Riha, *Toward Strategic Management of Shale Gas Development: Regional, Collective Impacts on Water Resources*, 17 ENVTL. SCI. & POL'Y 12, 13 (2012) (noting that flowback water is sometimes treated and reused but other times the flowback water must be disposed of safely).

[59] Del. River Basin Comm'n, Natural Gas Development Regulations, § 7.3(a)(2)(i) (proposed Nov. 8, 2011), *available at* http://www.state.nj.us/drbc/library/documents/naturalgas-REVISEDdraftregs110811.pdf. Notably, regarding natural gas activities in the Delaware River Basin:

> Estimates of the quantity of water needed to develop these wells and perform hydraulic fracturing range from [three] to [five] million gallons per well. The Commission has determined that the water uses associated with natural gas development are almost entirely consumptive in nature. Although some of the water used to hydraulically fracture a natural gas well will be recovered and reused to hydraulically fracture other natural gas wells in the basin, much of the water used at each well will come from other water sources identified in Sections 7.4(a) and (b) and will not be returned to the source water near the point of withdrawal.

Id.

The Ceres reports have been criticized for not taking into account availability of brackish water in determining which areas are in water stress, which is significant because brackish water is increasingly used in fracking,[60] as discussed in greater detail below. Reports differ as to the extent of the impacts of fracking on water supplies, including how much water is used in a given state or watershed, and how much water remains in the ground after fracking, versus how much comes out as flowback.[61] Regulators have also been criticized for not providing accurate information on how much water is used.[62] At the very least, further studies and a better understanding of impacts on water supplies are needed.

In some places, there simply may not be enough water, or the community may not want to use its limited water for natural gas development. In 2013, Mora County, New Mexico became the first county in the United States to ban fracking out of concern for its water resources.[63] All five-thousand residents of Mora County get their drinking water from wells, and their groundwater is noticeably limited.[64] Thus, although Mora County is one of the most economically depressed counties in New Mexico, it was not willing to risk impacts to its groundwater for job opportunities.[65] Other communities in dry western states that have fracking operations are seeing water shortages and are questioning whether there is enough to sustain the natural gas activities, such as Dimmit

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[60] *See* David Blackmon, *Ceres' Focus on Fracking Misses the Point, Probably Intentionally*, FORBES (Feb. 10, 2014, 6:24 PM), http://www.forbes.com/sites/davidblackmon/2014/02/10/ceres-focus-on-fracking-misses-the-point-probably-intentionally; Blackmon, *supra* note 53.

[61] HEATHER COOLEY & KRISTINA DONNELLY, HYDRAULIC FRACTURING AND WATER RESOURCES: SEPARATING THE FRACK FROM THE FICTION 15 (2012), http://www.pacinst.org/reports/fracking/full_report.pdf; WATER STRESS 2013, *supra* note 54, at 10.

[62] Forrest Wilder, Observer *Analysis Finds Fracking Water Use Underestimated in Eagle Ford Shale*, TEXAS OBSERVER (June 24, 2013, 1:25 PM), http://www.texasobserver.org/observer-analysis-finds-fracking-water-use-underestimated-in-eagle-ford-shale/ ("Texas authorities haven't done much to study the impact of fracking on water supplies. Some of the few official estimates they have done are suspiciously optimistic.").

[63] Julie Cart, *In New Mexico, County Leads the Charge Against Fracking*, L.A. TIMES, May 29, 2013, at A1.

[64] *See id.*

[65] Staci Matlock, *Law Center to Help Mora County Uphold Fracking Ban*, SANTA FE NEW MEXICAN (July 26, 2013, 6:30 PM), http://www.santafenewmexican.com/news/local_news/article_e48adf5f-b2df-5f6a-ae9f-7855a524de52.html.

County, Texas.[66] In Dimmit County, a study by the local groundwater district found that in the five-county area that includes Dimmit, fracking reduces water levels of the Carrizo-Wilcox Aquifer by one-third of the aquifer's recharge.[67]

Where fracking is permitted, water supply issues include identifying where the water that will be used for fracking will come from,[68] how much water is needed and projected to be needed for natural gas operations in a particular state or watershed,[69] how this will affect competing uses,[70] and what will happen to the water after it is used.[71] Some states have taken steps toward monitoring or regulating the amount of water to be used in gas drilling.[72] For example, in 2011, Michigan's Department of Environmental Quality began requiring gas companies to provide a proposed total volume of water needed for fracking operations, complete an online water withdrawal evaluation, and explain the source of their water before beginning extraction.[73] This will hopefully enable the State to better understand and mitigate the impact of drilling on its water resources.[74] Companies must also disclose the amount of water pumped out following the fracturing process.[75]

The water supply issue is of particular concern to water scarce regions in the southern and western United States.[76] However, even in relatively water-rich eastern states where one might not expect water supplies to be an issue, there is a need to effectively

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66 Galbraith, *supra* note 3.

67 *Id.*

68 *See* COOLEY & DONNELLY, *supra* note 61, at 14, 16.

69 *Id.* at 15; WATER STRESS 2013*, supra* note 54, at 10.

70 COOLEY & DONNELLY, *supra* note 61, at 16.

71 *Id.* at 25; Rahm & Riha, *supra* note 58, at 13.

72 *See* MICH. DEP'T OF ENVTL. QUALITY, SUPERVISOR OF WELLS INSTRUCTION 1-2011: HIGH VOLUME HYDRAULIC FRACTURING WELL COMPLETIONS 2 (2011), http://www.michigan.gov/documents/deq/Supervisor_of_Wells_Insruction_1-2011_428260_7.pdf.

73 *Id.*

74 *See id.*

75 *Id.* at 3.

76 *E.g.*, Kent Holsinger & Peter Lemke, *Water, Oil, and Gas: A Legal and Technical Framework*, 16 U. DENV. WATER L. REV. 1, 24 (2012) (describing the scarcity and unpredictability of water in the western United States); Jason Schumacher & Jennifer Morrissey, *The Legal Landscape of "Fracking": The Oil and Gas Industry's Game-Changing Technique Is Its Biggest Hurdle*, 17 TEX. REV. L. & POL. 239, 251 (2013) (noting the scarcity of water in some locales); Taelor A. Allen, Comment, *The South Texas Drought and the Future of Groundwater Use For Hydraulic Fracturing in the Eagle Ford Shale*, 44 ST. MARY'S L.J. 487, 488–89 (2013) (describing the historical scarcity of water in Texas and how it impacts hydraulic fracturing operations).

control and monitor water withdrawals in order to avoid unsustainable and dangerous low flows of streams.[77] In an effort to manage its water resources, for example, West Virginia requires that gas operators report the estimated volume of water they will use for fracking.[78] If an operator anticipates using more than two-hundred and ten thousand gallons of fresh water in a month, it must submit a water management plan.[79] This plan must include anticipated sources of water, the months when water withdrawals will be made, the additives used in the water, water uses, and planned disposition of wastewater.[80]

III. REGULATING WATER QUALITY ISSUES

The natural gas industry's high-profile growth has been met with staunch opposition from many communities where the drilling occurs or would occur if permitted, environmental activists, and others concerned about possible environmental impacts, particularly contamination of water supplies.[81] Opponents argue that insufficiently cased wells or the drilling process itself can lead to contamination of water resources.[82]

Elevated levels of methane found in drinking water near Dimock, Pennsylvania, and Pavillion, Wyoming, raised concerns at the local and federal levels.[83] The EPA released a preliminary study on the cause of the contamination found in Pavillion, and concluded that it likely was due to gas drilling.[84] The oil and gas industry sharply criticized this study,[85] however, and in response, the EPA backed

[77] *See* Holsinger & Lemke, *supra* note 76, at 24 (comparing the western United States' use of diversion, storage, and irrigation to manage water storage with the eastern United States, which rarely employs such techniques); *see also* Hannah J. Wiseman, *Risk and Response in Fracturing Policy*, 84 U. COLO. L. REV. 729, 775–78 (2013) (describing the various harmful effects of the large water withdrawals associated with fracking, and the regulations implemented by various states to minimize those effects).

[78] W. VA. CODE R. § 35-8-5.6.a (2013).

[79] *Id.*

[80] *Id.* §§ 35-8-5.6.b–35-8-5.6.b.5.

[81] *See* Wiseman, *supra* note 77, at 732–36.

[82] *Id.* at 738–39, 741, 780–81.

[83] *See* Mark Drajem, *EPA Official's Report Links Fracking to Methane in Pa. Town's Water*, WASH. POST, July 30, 2013, at A11; Kirk Johnson, *E.P.A. Links Tainted Water in Wyoming to Hydraulic Fracturing for Natural Gas*, N.Y. TIMES, Dec. 9, 2011, at A23.

[84] Johnson, *supra* note 83 ("Chemicals used to hydraulically fracture rocks in drilling for natural gas in a remote valley in central Wyoming are the likely cause of contaminated local water supplies, [according to] federal regulators.").

[85] *See id.*

down from pursuing its study and turned the reins over to the State.[86] A recently released report from an EPA official concluded, after preliminary findings, that natural gas drilling in Dimock contaminated drinking water wells with methane.[87] EPA has officially stated that further study is needed.[88] Ultimately, the impacts of fracking on water quality are hotly debated and not yet well understood, and further studies are needed. In 2013, a study of one-hundred drinking water wells in the Barnett Shale in Texas was published in *Environmental Science and Technology* and showed that wells within three kilometers of natural gas activities were more likely to contain contaminants—specifically selenium, arsenic, strontium, and total dissolved solids.[89] Pursuant to Congress's request, the EPA is undergoing a study on impacts of fracking on drinking water and expects to release a draft report in 2014,[90] and expects to finalize the report in 2016.[91]

Certain states are not waiting for agreed upon, or at least persuasive, studies to be done on fracking's impacts on water quality.[92] Instead, some states are putting the onus on the operators to demonstrate that the natural gas activities do not cause contamination.[93] Specifically, some states require operators to sample water wells prior to drilling to have a baseline for which to assess contaminants found in water after drilling has occurred.[94]

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[86] *See* Bridget DiCosmo, *As EPA Slows Studies, Environmentalists Seek Stricter Local Fracking Rules*, INSIDEEPA.COM (July 1, 2013), http://insideepa.com/201307012439345/EPA-Daily-News/Daily-News/as-epa-slows-studies-environmentalists-seek-stricter-local-fracking-rules/menu-id-95.html.

[87] *See* Drajem, *supra* note 83.

[88] *Id.*

[89] Brian E. Fontenot et al., *An Evaluation of Water Quality in Private Drinking Water Wells Near Natural Gas Extraction Sites in the Barnett Shale Formation*, ENVTL. SCI. & TECH. 10032, 10032 (2013).

[90] Press Release, U.S. Environmental Protection Agency, EPA Releases Update on Ongoing Hydraulic Fracturing Study (Dec. 21, 2012), *available at* http://yosemite.epa.gov/opa/admpress.nsf/0/4AF0024955D936EF85257ADB0058AA29.

[91] *See* DiCosmo, *supra* note 86. In 2013, a bill called the Hydraulic Fracturing Study Improvement Act, H.R. 2850, was proposed, which would require that the EPA complete its study on fracking's impacts on drinking water supplies by September 30, 2016. CONG. BUDGET OFFICE, H.R. 2850: EPA HYDRAULIC FRACTURING STUDY IMPROVEMENT ACT OF 2013 1 (Aug. 2013), http://www.cbo.gov/sites/default/files/cbofiles/attachments/hr2850.pdf.

[92] *See* Keith B. Hall, *Hydraulic Fracturing Contamination Claims: Problems of Proof*, 74 OHIO ST. L.J. FURTHERMORE 71, 76–77 (2013), http://moritzlaw.osu.edu/students/groups/oslj/files/2013/06/Furthermore.Hall_.pdf (discussing Colorado, Ohio, and Pennsylvania regulations on fracking).

[93] *Id.*

[94] *Id.*

Ohio requires well owners to "sample all water wells within three-hundred feet of the proposed well location in urbanized areas prior to drilling under the guidelines provided in the division's best management practices (BMPs)."[95] In contrast, Pennsylvania does not unequivocally require operators to conduct pre-drilling sampling of water supplies, but state regulations say that in order to preserve a defense that pollution of a water supply existed before the drilling occurred, the operator must conduct a pre-drilling survey.[96] Thus, while additional studies and investigation are needed on the potential impacts of fracking on water resources, such regulations can be put in place before such studies are available to monitor water supplies and allocate liabilities. Moreover, such monitoring and information gathering may also serve to increase regulators' and the public's understanding of feared impacts of natural gas activities on water resources.

A. Disclosure of Chemicals Used in Fracking

States are increasingly requiring public disclosure of the chemicals used by operators in fracking.[97] State regulators are seeking to balance the public's right to know this information with the companies' rights to protect trade secrets, into which category the operators typically claim at least some of the chemicals used in fracking fluid fall.[98] Many states require the disclosure of the chemicals used in fracking unless a component is a protected trade secret, including Alabama, Arkansas, Colorado, Indiana, Louisiana, Michigan, Montana, New Mexico, North Dakota, Ohio, Pennsylvania, Texas, West Virginia, and Wyoming.[99] In 2010, Wyoming became the first state to pass regulations requiring disclosure of chemicals used in fracking fluids, and companies must also file for trade secret approval in Wyoming.[100] In 2011, Texas

[95] OHIO ADMIN. CODE 1501:9-1-02(F) (2013).

[96] 25 PA. CODE § 78.52(a) (2013).

[97] *See* Negro, *supra* note 27, at 6 (noting a trend among states regarding disclosure of chemicals in fracking).

[98] *See id.*

[99] Matthew McFeeley, *State Hydraulic Fracturing Disclosure Rules and Enforcement: A Comparison*, NRDC ISSUE BRIEF 7 (2012), http://www.ourenergypolicy.org/wp-content/uploads/2012/07/Fracking-Disclosure-IB.pdf.

[100] John D. Furlow & Corrine V. Snow, *In the Wake of the Shale Revolution: A Primer on Hydraulic Fracturing Fluid Chemical Disclosure*, 8 TEX. J. OIL GAS & ENERGY L. 249, 254 (2012–2013); *see also* McFeeley, *supra* note 99, at 12 (explaining that many states do not have

passed the first legislation mandating disclosure, requiring that companies report the total volume of water and chemicals used in fracking fluid, except for proprietary information, on FracFocus, an online chemical registry through which many operators voluntarily disclose information.[101] In December 2011, the COGCC passed new rules requiring companies to post information about the chemicals on FracFocus, including the concentrations of all chemicals used, except for proprietary information, following the trend.[102]

Many states that host natural gas activities do not have any disclosure requirements.[103] Among those that do, the states' disclosure requirements vary significantly.[104] Some do not require disclosure to the public before the fracking occurs.[105] Only a couple require that landowners be notified of fracking—Colorado and West Virginia.[106] Some states require the amounts of each chemical used be disclosed, but many do not.[107] Some states have a broad exception to the disclosure requirement for confidential or trade secret information, while other states like Arkansas and Wyoming require an applicant claiming a trade secret to show that the protection applies through an application process.[108] While states can look to each other to assess what types of disclosure requirements are common or seem to work, the states differ as to whether disclosure is required and, if so, what the disclosure looks like. The industry therefore must be aware of each state's requirements, keeping in mind that they are likely to evolve in the near future as public and political pressures for greater

requirements when a company claims disclosure exemptions because of trade secrets); Mark Jaffe, *Oil Industry and Environmentalists Spar Over Fracking Fluid Disclosure Rules*, DENV. POST (Dec. 5, 2011, 11:24 AM), http://tinyurl.com/d83cewu (discussing proposed changes to Colorado's disclosure rule based on parts of Wyoming's disclosure rule).

[101] Furlow & Snow, *supra* note 100, at 254–55 (citing TEX. NAT. RES. CODE ANN. § 91.851 (West 2013); *see* TEX. NAT. RES. CODE ANN. § 91.851 (placing requirements on well operators performing hydraulic fracturing treatment to disclose certain information).

[102] *See* P. Solomon Banda, *Colorado to Require Disclosure of Fracking Chemicals*, USA TODAY (Dec. 15, 2011, 3:44 PM), http://usatoday30.usatoday.com/money/industries/energy/story/2011-12-13/colorado-fracking-two/51882992/1.

[103] McFeeley, *supra* note 99, at 7.

[104] *Id.*

[105] *Id.* at 8.

[106] *See id.* at 8 & n.25 (explaining that even states such as West Virginia, which has disclosure requirements, only have requirements that apply to specific wells).

[107] *Id.* at 8.

[108] *See id.* at 12 (giving examples of states whose submissions require a showing that information is a trade secret and should be kept confidential).

transparency increase.[109]

B. Regulating Siting of Natural Gas Activities

States, and even local governments, are also regulating where natural gas activities can occur, such as where wells can be located and how far they must be from other uses, including water resources such as drinking wells and aquifers.[110] Setback regulations have sprung up as fracking increasingly occurs in more densely populated areas, as the recent developments in technology have led to the discovery of more oil and gas deposits in shale and have allowed a single well to extract gas from one to two miles away.[111] As a result, more people are impacted by the drilling activities.

While municipal setbacks typically apply to separating gas wells from sensitive uses, like day cares and residences,[112] state setbacks commonly apply to protect water resources. For example, New York's draft regulations allow for five-hundred foot setbacks from private water wells, unless waived by the landowner, and two-thousand foot setbacks from primary aquifers.[113] In Pennsylvania, wastewater can be discharged into a pit only if the pit is more than two-hundred feet from a water supply or one-hundred feet from a stream, body of water, or wetland, unless a waiver is obtained.[114] Recently, Illinois passed the Hydraulic Fracturing Regulatory Act, which prohibits a gas well from being located within five-hundred feet of a water well; within three-hundred feet of a perennial stream, river, lake, pond or reservoir; or within fifteen-hundred feet

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[109] *See, e.g.*, U.S. Bureau of Land Management, 43 C.F.R. § 3160.0-1 (2013) (proposing final rule regulating fracking on federal lands ensuring that certain best practices are followed, including disclosure of chemicals used in fracking on federal and Indian lands).

[110] *See generally* ARLINGTON, TEX., ORDINANCE NO. 11-068 (2012), *available at* http://www.arlingtontx.gov/planning/gas_drilling.html (highlighting Arlington Texas's local Ordinance that regulates natural gas activities).

[111] JACQUELYN PLESS, NATURAL GAS DEVELOPMENT AND HYDRAULIC FRACTURING 1, 2, 7 (2012).

[112] *See, e.g.*, ARLINGTON, TEX., ORDINANCE NO. 11-068, art. VII, § 7.01(B)(1)(a) (2012), *available at* http://www.arlingtontx.gov/planning/gas_drilling.html (noting that well pads must be six-hundred feet from parks and protected land uses); COLLIER TOWNSHIP, PA., ORDINANCE NO. 592, § 1703.29.d(1) (1991) ("No [gas drilling] shall be conducted within [three-hundred] feet of the property line, or upon the property of any residential or public building, church, community or institutional building, commercial building, public park or private recreation area without the written consent of the owner.").

[113] RDSGEIS, *supra* note 2, §§ 7.1.5, 7.1.11.1.

[114] 25 PA. CODE § 78.60(b)(7) (2013).

of a surface water or groundwater intake of a public water supply.[115] Setbacks are an important tool for protecting sensitive uses and natural resources from potential impacts of natural gas activities.

C. Disposal or Re-Use of Wastewater

In addition to disclosure requirements and siting regulations, the chemicals used in fracking have caused debate on how to properly deal with fracking wastewater. Flowback contains not only chemicals that were initially added to the water,[116] but also other chemicals that were located underground and mixed with the water when the shale burst open from the fracking process, some of which may be hazardous.[117] Because of these chemicals, flowback cannot be treated by typical municipal water treatment plants, which are not designed to process and treat hazardous wastes.[118] Pennsylvania discovered this the hard way, after sending flowback to its municipal wastewater treatment plants and releasing the inadequately treated water back into the water supply.[119]

Some states are requiring operators to submit a plan for how they will deal with wastewater when applying for a permit.[120] In Ohio, for example, applicants must submit a disposal plan that identifies any disposal well to be used, the name of the person or company disposing of the wastewater, and the ultimate location of disposal.[121] Any change in the disposal plan must be submitted in a timely manner to the Chief of the State's Division of Oil and Gas Resources Management.[122]

Beyond identifying and approving wastewater disposal locations, regulators are also encouraging the recycling and reuse of flowback.[123] The Texas Railroad Commission, which regulates the

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[115] Ill. S.B. 1715, 98th Gen. Assemb., § 1-25(a)(3), (4), (6) (2013).

[116] *See* Negro, *supra* note 27, at 1 (noting that the process of fracking injects millions of chemicals into the earth).

[117] *See* Michael Rubinkam, *Fracking Wastewater Disposal To Be Regulated, EPA Says*, HUFFINGTON POST (Oct. 20, 2011, 12:35 AM), http://www.huffingtonpost.com/2011/10/20/epa-regulation-frack-wastewater_n_1022469.html.

[118] Negro, *supra* note 27, at 6.

[119] Rubinkam, *supra* note 117.

[120] *See* Negro, *supra* note 27, at 3.

[121] OHIO ADMIN. CODE 1501:9-1-02(A)(3) (2013).

[122] *Id.*

[123] Heather M. Corken & Kristen Hulbert, *Flowback Fluid Recycling Regulation in the Marcellus Shale*, HYDRAULIC FRACKING BLOG (Apr. 18, 2013), http://fracking.nortonrosefulbright.com/2013/04/FlowbackFluidRecyclingRegulationInMarcell

oil and gas industry in Texas, recently adopted new regulations to encourage recycling of fracking wastewater on well sites.[124] The former regulations did not sufficiently apply to on-site wastewater recycling.[125] Under the new regulations, drilling operators do not need a permit to recycle water on land that they are leasing, including directly on well sites, or to transfer fluids to another operator's lease to be recycled.[126] Operators can store fluids that are awaiting recycling, or treated fluids, on site in recycling pits that meet certain criteria.[127] The Texas Railroad Commission also allows recycled fluids to be reused without a permit in oil and gas operations for any use authorized by a permit obtained from another state or the federal government.[128]

Oil and gas companies are increasingly turning to recycling and reusing wastewater for fracking, indicating that the technology is more than just economically and technically feasible,[129] but is actually advantageous. In 2013, the largest company in the world engaged in fracking, Halliburton Company, cut the cost of fracking by up to $400,000 per well by using less fresh water in its fracking formula.[130] In the Bakken Shale, it costs approximately $10 million to drill and frack a well, and in the Eagle Ford Shale in Texas, it costs about $7.5 million, leaving significant room for savings.[131] Consequently, drilling services companies are working with operators to reduce the amount of water needed to frack and save

usShale.html.

[124] Press Release, R.R. Comm'n of Tex., TRC Adopts New Hydraulic Fracturing Water Reuse Rules (Mar. 26, 2013), *available at* http://www.rigzone.com/news/oil_gas/a/125356/TRC_Adopts_New_Hydraulic_Fracturing_Water_Reuse_Rules.

[125] 16 TEX. ADMIN. CODE § 3.8(d)(3)(A) (2012), *amended by* 16 TEX. ADMIN. CODE § 3.8(d)(7)(B) (2013).

[126] 16 TEX. ADMIN. CODE § 3.8(d)(7)(B) (2013).

[127] *See id.* §§ 3.8(d)(3)(F), (d)(4)(G).

[128] *See id.* § 3.8(d)(7)(B)(ii).

[129] Nichola Groom, *Analysis: Fracking Water's Dirty Little Secret—Recycling*, REUTERS (July 15, 2013), http://www.reuters.com/article/2013/07/15/us-fracking-water-analysis-idUSBRE96E0ML20130715 ("The oil and gas industry is finding that less is more in the push to recycle water used in hydraulic fracturing. . . . [O]il and gas companies are increasingly treating and reusing flowback water from wells, which unlike freshwater is very high in salt, with good results.").

[130] David Wethe, *Halliburton Cut Fracking Water Costs by $400,000 a Bakken Well*, BLOOMBERG (Mar. 5, 2013), http://www.bloomberg.com/news/2013-03-06/halliburton-cut-fracking-water-costs-by-400-000-a-bakken-well.html.

[131] *Id.*; Groom, *supra* note 129.

on costs.[132] For example, in July 2013, Halliburton began working with Nuverra Environmental Solutions Inc., which will assist with transportation, storage, and fluid management, to increase reuse and recycling of flowback in the Bakken Shale.[133] Halliburton's reported goal is for the oil and gas industry to cut its use of fresh water in fracking by 25% by the end of 2014.[134]

Reusing and recycling water also saves on costs by eliminating hundreds of truckloads that currently bring water to well sites and haul away wastewater from the well sites for disposal.[135] This would also reduce traffic, impacts on roads, and costs of maintaining roads. In Pennsylvania, where there are few disposal wells because of the geography, and treatment facilities are not capable of treating the flowback, meaning flowback must be shipped elsewhere (to Ohio) for underground injection, it is estimated that 40% to 90% of the flowback is recycled.[136] The geography in Pennsylvania does not lend itself to providing underground disposal wells as compared to other states, and obtaining a permit to build a new one has been difficult due to the public's concerns for groundwater contamination.[137] There are a handful of deep injection wells used in Pennsylvania for oil and gas waste, and much of the fracking wastewater gets trucked—at a significant cost—from Pennsylvania to Ohio, which has a large number of disposal wells.[138] Accordingly, more flowback in Pennsylvania is recycled and reused for fracking. Recycling wastewater is more common or is increasing where there are regulations against treating the flowback; regulations and/or geography preclude or severely limit underground injection of flowback; or water is scarce, like in Texas.[139]

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[132] *See Nuverra Gets Developmental Deal With Halliburton*, BLOOMBERG BUSINESSWEEK (July 15, 2013), http://www.businessweek.com/ap/2013-07-15/nuverra-gets-development-deal-with-halliburton.

[133] *Id.*

[134] Wethe, *supra* note 130.

[135] Groom, *supra* note 129.

[136] *Id.*; WATER STRESS 2013, *supra* note 54, at 11.

[137] Groom, *supra* note 129.

[138] *Id.*; *Deep Injection Wells: How Drilling Waste Is Disposed Underground*, STATE IMPACT (last visited Apr. 4, 2014), http://stateimpact.npr.org/pennsylvania/tag/deep-injection-well/.

[139] Groom, *supra* note 129. ("Drought conditions in Texas have helped prompt the industry to recycle more in all geographies. Though fracking makes up less than 1 percent of overall water use in the state, it makes up more than 50 percent of water use in certain counties, according to a 2011 report by the University of Texas.").

Recycling alone may not be sufficient to protect water supplies, however, because much of the fracking fluid stays underground.[140] To reduce the use of pristine freshwater for fracking, regulators could require that operators use waters of diminished quality, rather than the watershed or state's first-rate waters, which certain uses require.[141] For example, the Delaware River Basin Commission's (DRBC) proposed regulations, discussed further below, encourage the use of sources other than fresh water by allowing for a streamlined approval process, called Approval by Delegated Authority (ADA), whereby the Executive Director of the Commission can approve the project in certain situations.[142] Specifically, ADAs would apply to projects using treated wastewater that meets certain criteria, mine drainage water, recovered flowback and production water if within the same state, and importation of non-contact cooling water from outside the basin.[143] Further, if the source of the water is located within the same state as the well, the operator can reuse flowback and production water in compliance with conditions of the approval from the host state without further approval from the Commission.[144]

IV. KEY REGULATORY CHALLENGES

A. Finding the Right Regulatory Scale

It is a challenge to determine how much of a role each level of government should play in regulating natural gas activities—federal, state, and local. Debate ensues over whether the EPA should play a stronger role or whether states should continue to take the lead on regulating the industry. Many state officials attest that states have a history of regulating this industry, some states have been doing it for decades, and that shifting the primary regulatory responsibility away from the states would be inefficient.[145] Supporters of the states taking the lead also argue

[140] *Id.*
[141] *See id.*
[142] Del. River Basin Comm'n, *supra* note 59, § 7.4(b).
[143] *Id.* §§ 7.4(a)(3)–(5).
[144] *Id.* § 7.4(a)(5).
[145] *See, e.g.*, Protecting States' Rights to Promote American Energy Security Act, H.R. 2728, 113th Cong. § 2 (2013) (proposing to prohibit the Department of the Interior from regulating fracking, and instead defer to state regulations).

that states differ with regard to their priorities, economies, and geographies, with the end result being that the same regulations would not work equally well in all states, and states are in the best position to weigh the costs and benefits.[146] Opponents to this approach argue that different state regulatory regimes create a patchwork of differing rules for the industry to comply with, states are not equipped to appropriately regulate this industry, and the production of energy is of national interest so should be regulated at the federal level.[147]

Adding to the mix, there are some examples of regional attempts to manage and regulate impacts to water resources from fracking.[148] For example, the DRBC was established by the Delaware River Basin Compact in 1961 by Congress and four states—Delaware, New York, Pennsylvania, and New Jersey—to manage the water resources in the Basin, and is governed by a commission consisting of appointees of the governors of those states and a representative of the U.S. Army Corps of Engineers.[149] Over one-third of the Basin sits on top of the Marcellus Shale,[150] which spans forty eight thousand square miles and contains large amounts of gas reserves primarily underneath Pennsylvania and New York, among other states in the region.[151] The DRBC is proposing standards for its approval of all projects involving exploratory or production wells in the Basin.[152] The DRBC administers and plans for the use of the Basin's water resources and must approve any project that may have a substantial effect on the Basin's waters.[153] Under the Compact's authority, the Executive Director of the DRBC

[146] *See, e.g.*, David Spence, *No: States Can Best Balance the Competing Interests*, WALL ST. J., Apr. 15, 2013, at R5.

[147] *See, e.g.*, Jody Freeman, *Yes: A National Issue Can't Be Addressed State by State*, WALL ST. J., Apr. 15, 2013, at R5.

[148] *See, e.g.*, *About DRBC*, DEL. RIVER BASIN COMM'N, http://www.state.nj.us/drbc/about/ (last modified July 3, 2013).

[149] *Id.*

[150] *Natural Gas Drilling Index Page*, DEL. RIVER BASIN COMM'N, http://www.state.nj.us/drbc/programs/natural/ (last modified July 18, 2013) ("Much of the new drilling interest taking place in northeastern Pennsylvania and southern New York is targeted at reaching the natural gas found in the Marcellus Shale formation, which underlies about 36 percent of the Delaware River Basin.").

[151] NAT'L PARK SERV., U.S. DEP'T OF THE INTERIOR, DEVELOPMENT OF THE NATURAL GAS RESOURCES IN THE MARCELLUS SHALE 1–2 (Nov. 2009), http://www.marcellus.psu.edu/resources/PDFs/marcellusshalereport09.pdf.pdf.

[152] Robert M. Schick et al., *Litigation Environment for Drilling and Hydraulic Fracturing*, 43 ENVTL. L. REP. 10221, 10222 (Mar. 2013).

[153] Del. River Basin Compact, Pub. L. No. 87-328, §§ 3.1, 3.8, 75 Stat. 688, 692, 694 (1961).

determined that all projects involving exploratory or production wells must obtain approval from the DRBC, essentially putting into effect a moratorium on natural gas development in the Basin in 2010 until the appropriate standards are adopted.[154]

The DRBC published proposed rules for natural gas activities in the Basin in December 2010, received about sixty nine thousand public comments in response to the proposed rules, and after eighteen hours of public hearings, issued a revised draft of the rules on November 8, 2011.[155] The DRBC had scheduled a vote on the proposed rules in November 2011, but canceled it in response to Delaware Governor Markell's announcement that he would vote against them.[156] Since that time, the DRBC has been undergoing further review of the proposed regulations, including reviewing scientific studies on the impacts of natural gas drilling on water resources, performing water quality and quantity monitoring to determine baseline conditions, and reviewing new regulations and performance standards adopted by states, federal agencies, and certain organizations.[157]

The DRBC's proposed rules address water withdrawal and water use, siting of natural gas wells and natural gas development plans, and wastewater treatment and discharge.[158] They also state that the DRBC will rely on the oil and gas regulatory program of the state in which the well is located for the regulation of the construction and operation activities of the well and well pad.[159] They also provide that if a state regulation, including a setback, is more stringent than a DRBC regulation, the more stringent rule applies.[160] In addition, no more than three-hundred gas wells will

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[154] Schick et al., *supra* note 152, at 10222. At the DRBC's meeting on July 10, 2013, chair Michele Siekerka provided an update of the Commission's efforts since the meeting that was canceled in November 2011. DEL. RIVER BASIN COMM'N, *supra* note 150.

[155] DEL. RIVER BASIN COMM'N, DELAWARE RIVER BASIN COMMISSION *REVISED* DRAFT NATURAL GAS DEVELOPMENT REGULATIONS "AT-A-GLANCE" FACT SHEET, (Nov. 8, 2011), http://www.state.nj.us/drbc/library/documents/naturalgas-REVISEDdraftregs-factsheet110811corrected.pdf.

[156] *Commission Cancels Planned Vote On Landmark Hydraulic Fracturing Rules*, INSIDEEPA.COM (Nov. 22, 2011), http://insideepa.com/inex.php?option=com_content&view=article&id=2383034.

[157] Statement of Michele Siekerka, Commission Chair, Del. River Basin Comm'n (July 10, 2013), *available at* http://www.state.nj.us/drbc/library/documents/statement-of-chair071013.pdf.

[158] *See* Del. River Basin Comm'n, *supra* note 59, §§ 7.3(b)(1)–(2), 7.3(b)(4)–(5), 7.5(d).

[159] *Id.* § 7.1(i).

[160] *Id.* § 7.5(d)(1)(iii), (d)(2)(i).

be permitted until the program is reviewed and approved for resumption at a public meeting.[161] This provides for a trial period in which the regulations can be tried and then assessed.

Under the proposed regulations, the DRBC must approve all water sources in the basin used for natural gas activities.[162] New withdrawals or permitted sources that require increased allocations must receive a docket or protected area permit from the DRBC before undergoing natural gas development.[163] An operator may only withdraw water from sources identified on an "Approved List of Water Sources."[164] The regulations also require surface and groundwater sampling before and after well pad construction.[165] The DRBC will perform surface water sampling before and after well pad construction and each well stimulation, and annually after fracking occurs.[166] However, the operator may apply for approval to conduct the surface sampling.[167] In addition, the operator must submit groundwater sampling reports of sampling done before and after well pad construction for all natural gas wells.[168] Furthermore, wastewater and fracking fluid must be stored in water-tight tanks,[169] and flowback must be used or removed from the well site within ninety days.[170]

While the proposed regulations address an impressive array of water supply and quality concerns through a variety of mechanisms, the DRBC's proposed regulations appear to be at a standstill.[171] While the DRBC has been undergoing review and studies since November 2011, no outward steps have been taken toward scheduling a vote on the proposed regulations.[172] As time

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[161] *Id.* § 7.3(m).
[162] *Id.* § 7.3(b)(1)(i).
[163] *Id.* § 7.4(a).
[164] *Id.* § 7.3(b)(3).
[165] *Id.* § 7.4(e)(4)(x)(A), (e)(4)(x)(B).
[166] *Id.*
[167] *Id.* § 7.4(e)(4)(x)(A)(4).
[168] *Id.* § 7.4(e)(4)(x)(A), (e)(4)(x)(B).
[169] *Id.* § 7.4(e)(3)(xv)(B)(1).
[170] *Id.* § 7.4(e)(3)(xv)(A)(1).
[171] *See* New York v. U.S. Army Corps. of Eng'rs, 896 F. Supp. 2d 180, 186 (E.D.N.Y. 2012). The DRBC's proposed regulations were challenged in federal court by New York State and a group of nongovernmental organizations, which alleged that the defendants were required, but failed, to provide an environmental impact statement under the National Environmental Policy Act in preparing these proposed rules. *Id.* at 183, 192–93. The U.S. District Court for the Eastern District of New York dismissed the case without prejudice for ripeness, as the proposed rules had not yet been adopted. *Id.* at 195, 198.
[172] *Id.* at 186.

passes, it is increasingly likely that the underlying data will need to be updated in order to ensure that the rules are appropriate and reasonable.[173] With states taking significantly different approaches to how and to what degree they regulate fracking, it may not be politically plausible for the Commissioners to agree on the proposed regulations.[174]

Although a regional approach may more likely allow for consideration of water resources on a watershed basis, which may be more effective, or even necessary, from a water resources management perspective, it is fraught with the political challenges inherent to needing agreement among multiple states and even more competing interests than what state or local regulators typically face.[175] Perhaps for this reason, the Great Lakes Compact, which regulates large water withdrawals in the Great Lakes region, exempts gas wells from its regulations.[176] Even if regional commissions or the EPA take on greater roles in regulating the industry, states will likely continue to play a prominent role in regulating fracking.[177] A noticeable upside is that states learn from each other's lessons and experiments with how to most effectively regulate a highly complex and quickly changing industry.

States are reassessing their regulations of natural gas drilling,[178] or creating them for the first time, with a keen eye toward adequately protecting and managing water resources.[179] Illinois passed regulations of fracking in May 2013 that have been touted as the best example of regulations of the oil and gas industry in the

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[173] *See id.* at 184 (noting that the DRBC creates and updates long-term regulations regarding the Basin).

[174] Philip Bump, *The Increasingly Local Politics of Fracking*, ATLANTIC WIRE (May 8, 2013), http://www.theatlanticwire.com/national/2013/05/local-politics-fracking/65016/.

[175] *See* Symposium, *Lessons From the Watershed Negotiations*, 12 FORDHAM ENVTL. L.J. 419, 446 (2001).

[176] Nicholas Schroeck & Stephanie Karisny, *Hydraulic Fracturing and Water Management in the Great Lakes*, 63 CASE W. RES. L. REV. 1167, 1178–80 (2013).

[177] Press Release, U.S. House of Representatives Committee on Natural Resources, Witnesses Highlight States' Successes in Regulating Fracking: Tell Federal Government to Stay Out of the Process (July 25, 2013), *available at* http://naturalresources.house.gov/uploadedfiles/7_25_13_emr_fracking_leg_hearing.pdf.

[178] *See* DiCosmo, *supra* note 86 ("Pennsylvania, Texas, Colorado and other natural gas producing states have all taken steps to improve their regulations in response to [environmental] concerns.").

[179] *See* 225 ILL. COMP. STAT. 732/1–1 (2013); *Understanding the Illinois Hydraulic Fracturing Regulatory Act (HB 2615)*, ENVTL. LAW & POLICY CTR., http://elpc.org/illinoisfrackingbill (last updated Jan. 3, 2014) [hereinafter *Illinois Hydraulic Fracturing*].

country and a commendable product of bipartisan efforts.[180] These regulations include several key provisions that address water resources, both with regard to quantity and quality.[181] Regarding water supply and use issues, the regulations require an applicant for a drilling permit to provide thorough information on where[182] and how[183] the well will be drilled, how much water is anticipated to be used, where the water will come from,[184] what chemicals will be used,[185] and how wastewater will be dealt with.[186] The applicant must provide notice of its application to all landowners within fifteen-hundred feet of the well,[187] and any person who may be adversely affected by the permit application may file objections to the application or request a public hearing.[188]

With regard to water quality concerns, the operator must also show proof of five-million dollars or more in insurance coverage for any environmental contamination.[189] In addition, an independent third party must sample all water sources within fifteen-hundred feet of the well site for contaminants to have a base line.[190] The operator must conduct sampling six months, eighteen months, and thirty months after the fracking has been completed.[191] Any contaminants found after the fracking process that were not found beforehand will be presumed to have resulted from fracking.[192] The law requires the operator to dispose of any toxic flowback within sixty days after fracking,[193] and fracking fluid and wastewater must be stored in above-ground storage tanks.[194] Further, anyone who suspects contamination from fracking can bring a claim and request

[180] *See Illinois Hydraulic Fracturing*, *supra* note 179 ("Collectively, the Act's provisions amount to the strongest protections against fracking-related water pollution in the country.").

[181] *Id.*

[182] 225 ILL. COMP. STAT. 732/1-35(b)(2) (2013).

[183] *Id.* 732/1-35(b)(4)–(6).

[184] *Id.* 732/1-35(b)(10).

[185] *Id.* 732/1-35(b)(8).

[186] *Id.* 732/1-35(b)(11).

[187] *Id.* 732/1-40(c)(1).

[188] *Id.* 732/1-40(c)(3)(G).

[189] *Id.* 732/1-35(a)(3).

[190] *Id.* 732/1-80(b).

[191] *Id.* 732/1-80(c).

[192] *Id.* 732/1-85(b)–(c).

[193] *Id.* 732/1-75(c)(5).

[194] *Id.* 732/1-75(c)(1) ("[H]ydraulic fracturing additives, hydraulic fracturing fluid, hydraulic fracturing flowback, and produced water shall be stored in above-ground tanks during all phases of drilling, high volume horizontal hydraulic fracturing, and production operations until removed for proper disposal.").

an investigation by the Department of Natural Resources.[195] The regulations also require disclosure of chemicals used in fracking both before and after the drilling occurs.[196] After operations are completed, the operator must submit a completion report, which must include the source from which the water used in fracking was drawn, a description of how the flowback was disposed or reused, and a chemical disclosure report identifying each chemical used in the fracking fluid.[197] Although the regulations do not specify testing or analytical methods, they lay out a relatively comprehensive scheme for addressing water quantity and quality concerns, from the beginning phase of natural gas activities to the end.

B. Keeping Up with Technology

A key challenge in regulating this industry is that the technology is quickly evolving. How do state and local governments implement a working regulatory framework that is sufficiently responsive and relevant to the latest technology being used by the industry and that requires the best technologies available for ensuring that the operations are done in a manner that is safe, and that feasibly and effectively protects water resources?

Regulators need to be aware of what technologies are available for extraction and what impacts they have, and what technologies are available for processing and recycling wastewater. While the drilling, processing, and exploration technology has developed rapidly, regulators are struggling to keep up and timely amend regulations to ensure that they are most relevant for the industry today. Moreover, the technologies continue to evolve; thus, regulators must continue to educate themselves and update their regulations to be most appropriate and effective. On the one hand, because the oil and gas industry is largely regulated at the state level, each state where drilling is occurring or could occur has the burden of staying on top of the latest technologies and implementing the most appropriate regulations. This is more challenging for each state to carry this burden than for the federal government to undertake this responsibility and be the sole regulator. On the other hand, states truly are taking a variety of

[195] *Id.* 732/1-83(a)–(b).
[196] *Id.* 732/1-35(b)(8), 1-75(f)(9).
[197] *Id.* 732/1-75(f).

paths toward regulating this rapidly evolving industry, and new regulations are being proposed, discussed, or adopted around the country often through discussions with the industry, the most knowledgeable actor. There is certainly an argument that at least some states are moving more quickly than the federal government, which notoriously has difficulty agreeing on even uncontroversial regulations.

Given the technologies that are being developed and studied, it seems that regulators could do more to encourage or require recycling of wastewater, such as using tracers to test for contaminants, as recommended by a recent study by University of California Berkeley Law Center.[198] Regulations can determine the quality and source of water used, the level of treatment of wastewater, and how often recycling and reusing of water occurs. Regulations can encourage reusing and recycling wastewater by making it more difficult and expensive to obtain authorization to dispose of wastewater through underground injection. They can also facilitate recycling of wastewater by not requiring permits, like in Texas, or streamlining the permitting process. In addition, regulators can provide incentives for reusing and recycling water, or require that a percentage of water used in fracking be recycled water or brackish water. Ultimately, to be most effective, regulators must continuously work to be well informed, transparency must be demanded, and peer-reviewed studies of impacts and feasibility of available technologies are needed.

V. CONCLUSION

With the natural gas industry only expanding throughout the United States,[199] and as water users and ecosystems feel increasing competition for water resources, innovative approaches to managing water resources are not just good ideas; they are critical. Although water supplies and competing uses vary from jurisdiction to jurisdiction, and watershed to watershed, officials should not only

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[198] MICHAEL KIPARSKY & JAYNI FOLEY HEIN, REGULATION OF HYDRAULIC FRACTURING IN CALIFORNIA: A WASTEWATER AND WATER QUALITY PERSPECTIVE 6 (Apr. 2013), http://www.law.berkeley.edu/files/ccelp/Wheeler_HydraulicFracturing_April2013.pdf.

[199] U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2013 WITH PROJECTIONS TO 2040, at 79 (Apr. 2013), http://www.eia.gov/forecasts/aeo/pdf/0383(2013).pdf (illustrating the drastic percentage increase in total natural gas production and shale gas production, as predicted from 2011 through 2040).

learn from the best science available, but also from other regulators' challenges, successes, and creativity.