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**“GOIN’ TO CAROLINA IN MY MIND:”
PROSPECTS AND PERILS FOR NATURAL GAS DRILLING IN
NORTH CAROLINA**

Elizabeth Turgeon*

The hydraulic fracturing and horizontal drilling technologies utilized in the extraction of natural gas have proven controversial, particularly in states where the legal infrastructure is unprepared to accommodate the industry. In particular, a newly discovered natural gas reservoir in central North Carolina highlights deficiencies in the state’s laws addressing the serious environmental and public health concerns regarding impacts on the water supply. Looking to other natural gas-producing states as models, North Carolina should adopt statutory measures to protect its water in anticipation of a natural gas industry. Specifically, a severance tax on the production of natural gas in North Carolina should be collected to fund the acquisition of land. This, together with other precautionary measures, would alleviate the negative impacts to water quality and quantity, should natural gas development come to fruition.

I. INTRODUCTION

The recent discovery of natural gas in central North Carolina has drilling companies humming that familiar refrain, “goin’ to Carolina in my mind.”¹ They now await the go-ahead from the General Assembly, which now faces a difficult decision: to frack, or not to frack.

Hydraulic fracturing, or “fracking,” is a technology used in combination with horizontal drilling to extract hard-to-reach types

* J.D. Candidate, University of North Carolina School of Law, 2013.

¹ JAMES TAYLOR, *Carolina In My Mind*, on JAMES TAYLOR (EMI Records 1968).

of natural gas.² It is a contentious topic, as media discourse locally and across the country can attest.³ Fracking is hailed by advocates as the key to accessing a clean, green, domestic energy source.⁴ At the same time, critics consider it to be calamitous to the environment and public health.⁵ Both sides seem adamant to declare fracking an entirely black-and-white issue. This polarization suggests that fracking does not fall neatly within either

² See *Understanding Tight and Shale Gas*, SHELL, http://www.shell.us/home/content/usa/aboutshell/shell_businesses/onshore/shale_tight/ (last visited Oct. 9, 2011). Horizontal drilling, and directional drilling more generally, involve “drilling a curved well, in order to reach a target that is not directly beneath the drill site” as with vertical (straight-down) drilling. *Directional and Horizontal Drilling*, NATURALGAS.ORG, http://www.naturalgas.org/naturalgas/extraction_directional.asp (last visited Oct. 16, 2011). The technology was originally patented by Robert E. Lee in 1891. *Id.* Horizontal drilling is an “invaluable technology” because: it allows drillers access to more hard-to-reach natural gas reservoirs, helps them to extract more natural gas from a formation and from “marginal or mature” fields, and cuts costs by requiring fewer wells to be drilled. *Id.* This is claimed to reduce the economic impact on the land above. *Id.* See *infra* Parts II and III for an explanation of the drilling and fracking processes.

³ See, e.g., Lisa Sorg, *Despite the Dangers of Fracking, North Carolina Lawmakers Want to Legalize It*, INDYWEEK.COM (May 11, 2011), <http://www.indyweek.com/indyweek/despite-the-dangers-of-fracking-north-carolina-lawmakers-want-to-legalize-it/Content?oid=2454484> (summarizing the public debate over allowing horizontal drilling and fracking in North Carolina); see also Tom Zeller Jr., *Hydraulic Fracturing in the Spotlight*, N.Y. TIMES (Dec. 1, 2010, 7:45 AM), <http://green.blogs.nytimes.com/2010/12/01/hydraulic-fracturing-in-the-spotlight/>.

⁴ See generally *Why Natural Gas?*, AMERICA’S NAT. GAS ALLIANCE, <http://www.anga.us/why-natural-gas/jobs/us-benefits> (last visited Oct. 9, 2011).

⁵ See, e.g., Safe Fracking Coal., *Fracking Poses Environmental and Public Health Challenge for Texas*, STATESMAN.COM (June 14, 2011, 12:05 AM), www.statesman.com/opinion/fracking-poses-environmental-and-public-health-challenges-for-1537949.html; see also Rachel Cernansky, *Natural Gas Drilling Harms Eyes, Causes Tumors, Destroys Air: The Ugly Truth Behind the “Natural” Energy Source*, PLANETGREEN.COM (Oct. 15, 2009, 7:40 PM), <http://planetgreen.discovery.com/food-health/gas-drilling-harms-eyes.html> (discussing concerns with health problems that have appeared in connection with fracking). See *infra* Part III for an in-depth description of environmental and health risks posed by natural gas development in general and fracking in particular.

category. Instead, the decision to frack occupies a grey area wrought with scientific uncertainty⁶ and lax regulations.⁷

While natural gas has advantages that cannot be overlooked as unimportant to the state's energy future, fracking would imperil the drinking water supply in central North Carolina, both in terms of quality⁸ and quantity,⁹ requiring the state to proactively address this risk through legislation. N.C. Session Law 2011-276, which establishes some safeguards and mandates a study on the possibility of natural gas extraction in North Carolina, exemplifies the careful thought that must go into this decision, but it is not enough.¹⁰ Neither is its sister bill, N.C. Senate Bill 709, which

⁶ Zeller, *supra* note 3.

⁷ *Inadequate Regulation of Hydraulic Fracturing*, EARTHWORKS, <http://www.earthworksaction.org/halliburton.cfm> (last visited Oct. 9, 2011). *But see* Michael Rubinkam, *Fracking Wastewater Disposal To Be Regulated, EPA Says*, HUFFINGTON POST (Oct. 20, 2011, 11:35 PM), http://www.huffingtonpost.com/2011/10/20/epa-regulation-frack-wastewater_n_1022469.html?ref=fb&src=sp&comm_ref=false (reporting on the U.S. Environmental Protection Agency's recent announcement that it plans to "develop national standards for the disposal of polluted wastewaters" produced by fracking); *see also* U.S. ENVTL. PROT. AGENCY, PLAN TO STUDY THE POTENTIAL IMPACTS OF HYDRAULIC FRACTURING ON DRINKING WATER RESOURCES viii (2011), *available at* http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/upload/hf_study_plan_110211_final_508.pdf ("In response to public concern, the [U.S.] Congress directed the [U.S.] Environmental Protection Agency (EPA) to conduct scientific research to examine the relationship between hydraulic fracturing and drinking water resources."). The first results of the study will be released in 2012. *Id.* at x.

⁸ Press Release, *Fracking in N.C. Could Impact Water Supply for 2.4 Million People*, Geoff Gisler & Kathleen Sullivan, S. Envtl. Law Ctr. (July 22, 2011), *available at* http://www.southernenvironment.org/newsroom/press_releases/fracking_in_n.c._could_impact_water_supply_for_2.4_million_people.

⁹ RICHARD WHISNANT & BILL HOLMAN, 2010 REPORT OF THE WATER ALLOCATION STUDY OF THE ENVIRONMENTAL REVIEW COMMISSION 5 (Dec. 1, 2010), *available at* http://sogweb.sog.unc.edu/Water/images/f/f7/Combined_2010_WAS_reportv2.0.pdf.

¹⁰ *See generally* Act of June 23, 2011, 2011 N.C. Sess. Laws 276 (to be codified as amended at N.C. GEN. STAT. § 113-378). For an analysis of the provisions, positive aspects, and deficiencies of North Carolina Session Law 2011-276, *see infra* Part IV.

threatens to put the cart before the horse by recommending changes in state laws to accommodate the natural gas industry.¹¹

This Recent Development proposes a strategy to internalize the costs of natural gas development in North Carolina and minimize harm to its drinking water supply. Part II examines the current and historical uses of fracking, and the benefits of natural gas. Next, Part III describes the technology in the context of natural gas development and the risks it poses to water. Part IV then introduces the recently discovered shale gas reservoir in central North Carolina and current state laws pertaining to natural gas production. Part V discusses Senate Bill 709 and the issues highlighted by each side of the debate over this controversial proposed legislation. Finally, Part VI of this Recent Development proposes establishing a severance tax on natural gas extraction, a portion of which will be dedicated to the acquisition and preservation of land to prevent contamination and depletion of the water supply in central North Carolina.¹²

II. FRACKING: THE KEY TO UNLOCKING SHALE GAS

Fracking is “a process used to enhance, or ‘stimulate,’ recovery” of natural gas from shale and other less accessible formations of rock following the drilling of the well itself.¹³ Shale is described as an “unconventional” reservoir for natural gas because the gas is lower in concentration and more widely

¹¹ See generally S. 709, 2011 Gen. Assemb., 2011 Sess. (N.C. 2011). See also Jessica Jones, *Fracking Bill Advances*, N.C. PUB. RADIO, <http://wunc.org/programs/news/archive/tjh061411.mp3/view> (June 15, 2011) (quoting N.C. Minority Leader Joe Hackney, who describes this bill as prematurely “[plunging] ahead” with natural gas development in North Carolina). For an analysis of the provisions, positive aspects, and deficiencies of North Carolina Senate Bill 709, see *infra* Part V.

¹² See generally Carol Ernst, *Land Conservation: A Permanent Solution for Drinking Water Pollution*, ON TAP, Spring 2006, at 18–21, 36–40, available at nesc.wvu.edu/smart/pdf/sourcewater/OT_SP06_LAND.pdf (discussing the link between land conservation, improved water quality and quantity, and decreased drinking water costs).

¹³ Elizabeth Dotson, *Drilling a Hole in the Water Supply: Regulation of Injection Wells in Texas*, 10 TEX. TECH. ADMIN. L.J. 267, 269 (2008). But see *infra* note 62 (discussing the need to re-frack wells several times).

dispersed in the formation, and therefore necessitates some form of technology to force it out of a well.¹⁴ Fracking, together with horizontal drilling, increases accessibility and makes it economical to extract gas from shale formations.¹⁵

It was not always used for this purpose. Fracking originated in the 1860's as a method to increase extraction from "hard rock oil wells,"¹⁶ and in the 1900's to separate granite from bedrock in quarries.¹⁷ The technology was patented in 1949 and used commercially thereafter as an "ideal way to bring new life to old wells."¹⁸ However, the combination of fracking with horizontal

¹⁴ See *Facts About Shale Gas*, AM. PETROLEUM INST., http://www.api.org/policy/exploration/hydraulicfracturing/shale_gas.cfm (last visited Oct. 9, 2011). Potentially significant reservoirs of natural gas are described as "plays," and those occurring in shale are called "shale plays." *Id.*; see also Nolan Hart, *What Is A Shale Gas Play?*, THE EAGLE FORD SHALE BLOG (Mar. 3, 2003), <http://eaglefordshaleblog.com/2010/03/03/what-is-a-shale-gas-play/>.

¹⁵ See *Understanding Tight and Shale Gas*, *supra* note 2. The technology has been described as a "game changer." *Review of Emerging Resources: U.S. Shale Gas and Shale Oil Plays*, U.S. ENERGY INFO. ADMIN. (JULY 8, 2010), <http://www.eia.gov/analysis/studies/usshalegas/>. It has resulted in a dramatic increase the United States' supply of natural gas because much more is recoverable than previously thought possible. See MASS. INST. OF TECH., *THE FUTURE OF NATURAL GAS: AN INTERDISCIPLINARY MIT STUDY 2* (2010), available at http://web.mit.edu/mitei/research/studies/documents/natural-gas-2011/NaturalGas_Report.pdf.

¹⁶ David Hines, *How Long Has Hydrofracking Been Practiced?*, THE INST. FOR ENERGY & ENVTL. RES. FOR NE. PENN. (Mar. 15, 2011), <http://energy.wilkes.edu/pages/203.asp>. Hard rock is exactly what it sounds like: incredibly "tough" rock which complicates access to oil or natural gas both in terms of drilling and cost, since "[t]he harder the rock, the longer it takes to drill. And the longer it takes to drill, the more it costs." Thomas Hardisty, *Big Oil is Tuning into Hard Rock to Get to Petroleum Resources*, 37 HOUSTON BUSINESS JOURNAL no. 44 (2007), available at <http://www.bizjournals.com/houston/stories/2007/03/19/focus13.html>.

¹⁷ *A Short History of Hydraulic Fracturing*, NAT. GAS AMERICAS, <http://naturalgasforamerica.com/a-short-history-of-hydraulic-fracturing.htm> (last visited Oct. 17, 2011). Incidentally, this method was used at the Mt. Airy Quarry in North Carolina. *Id.*

¹⁸ Carl T. Montgomery & Michael B. Smith, *Hydraulic Fracturing: History of an Enduring Technology*, J. PETROLEUM TECH., Dec. 2010, at 26, 27, available at <http://www.spe.org/jpt/print/archives/2010/12/10Hydraulic.pdf>. The patent recipient was Halliburton Oil Well Cementing Company. *Id.*

drilling, as well as its application to shale formations, is an advancement of the 1980's.¹⁹ Drilling companies in Texas deployed the method in the early 1990's to increase productivity of their natural gas wells.²⁰ The utility of this technology stimulated its spread across the country.²¹

Together, fracking and horizontal drilling have contributed to the reputation of natural gas as an "irresistible force" in other states.²² Natural gas is commonly promoted as a relatively clean fuel, particularly in comparison to coal or oil, because it produces fewer air pollutants when it is burned.²³ Moreover, it is seen as a

¹⁹ See R. Marcus Cady, *Drilling Into the Issues: A Critical Analysis of Urban Drilling's Legal, Environmental, and Regulatory Implications*, 16 TEX. WESLEYAN L. REV. 127, 132–33 (2009). Shale is described as a "fine-grained sedimentary rock that forms from the compaction of silt and clay-sized particles." *What Is Shale?*, NAT. GAS AMERICAS, <http://naturalgasforamerica.com/what-is-shale.htm> (last visited Oct. 17, 2011). Shale formations complicate the extraction for natural gas, as much of the gas remains "trapped within tiny pore spaces or absorbed onto clay mineral particles that make-up [sic] the shale." *Id.* This is where horizontal drilling and fracking come into play. *Id.*

²⁰ *Hydraulic Fracturing of Oil & Gas Wells Drilled in Shale*, GEOLOGY.COM, <http://geology.com/articles/hydraulic-fracturing/> (last visited Oct. 9, 2011). This technology increases the amount of natural gas able to be produced from shale by increasing its permeability. NAT. GAS AMERICAS, *supra* note 19. Permeability is described as "the capability of a rock to transmit fluids." JEFFREY C. REID, N.C. GEOLOGICAL SURVEY, INFORMATION CIRCULAR 36: NATURAL GAS AND OIL IN NORTH CAROLINA 2 (2009), *available at* http://www.geology.enr.state.nc.us/pubs/PDF/NCGS_IC_36_Oil_and_Gas.pdf. Fracking fractures the shale, freeing some of the trapped gas within the rock and allowing it to travel to the well. NAT. GAS AMERICAS, *supra* note 19. See generally J. DANIEL ARTHUR ET AL., ALL CONSULTING, EVALUATING THE ENVIRONMENTAL IMPLICATIONS OF HYDRAULIC FRACTURING IN SHALE GAS RESERVOIRS (2008), <http://www.all-llc.com/publicdownloads/ArthurHydrFracPaperFINAL.pdf> (describing how hydraulic fracturing increases productivity from a well).

²¹ *Hydraulic Fracturing of Oil & Gas Wells Drilled in Shale*, *supra* note 20.

²² Roderic Fleming, *Hydraulic Fracturing, Louisiana Water Law, and Act 1955: An Irresistible Economic Force Meets an Immovable Legal Object*, 24 TUL. ENVTL. L.J. 363, 364 (2011).

²³ *Why Natural Gas?*, *supra* note 4. Methane comprises seventy to ninety percent of natural gas, *Background*, NATURALGAS.ORG, <http://www.naturalgas.org/overview/background.asp> (last visited Oct. 17, 2011). It is important to note that methane "can leak at any stage of the entire process leading up to

“bridge to a low-carbon future,”²⁴ both in terms of emitting less carbon dioxide²⁵ and easing the transition to renewable resources.²⁶ Because of its ability to provide reliable power, natural gas is also touted as an “essential partner” to intermittent renewable energy resources.²⁷

In addition to these purported environmental benefits, natural gas is a plentiful, domestic energy source.²⁸ Natural gas proponents are quick to note that natural gas reserves in the U.S. have grown by thirty-five percent in the past two years to more

consumption,” and poses a serious threat to air quality. Leon D. Brathwaite, *Shale-Deposited Natural Gas: A Review of Potential* 26 (Cal. Energy Comm’n, Draft Staff Paper, CEC-200-2009-005-SD, 2009), available at <http://www.energy.ca.gov/2009publications/CEC-200-2009-005/CEC-200-2009-005-SD.PDF>. Methane is a much more potent greenhouse gas than carbon dioxide, especially during the first few decades after it is emitted. Robert W. Howarth et al., *Methane and the Greenhouse-Gas Footprint of Natural Gas from Shale Formations: A Letter*, 106 CLIMATE CHANGE 679, 685 (2011), available at <http://www.springerlink.com/content/e384226wr4160653/>. In the first twenty years, natural gas has a greenhouse gas footprint twenty percent to two times greater than coal. *Id.* at 679. Thus, although methane emissions are only one of total greenhouse gas emissions in the United States, they nonetheless comprise “about 9 percent of the greenhouse gas emissions based on global warming potential.” Brathwaite, *supra*, at 26.

²⁴ MASS. INST. OF TECH., *supra* note 15, at 1 (2010).

²⁵ *Natural Gas and the Environment*, NATURALGAS.ORG, <http://www.naturalgas.org/environment/naturalgas.asp> (last visited Oct. 9, 2011). However, if natural gas “also displaces some nuclear power,” carbon dioxide emissions may actually increase. INT’L ENERGY AGENCY, SPECIAL REPORT: ARE WE ENTERING A GOLDEN AGE OF GAS? WORLD ENERGY OUTLOOK 2011 8 (2011), available at http://www.iea.org/weo/docs/weo2011/WEO2011_GoldenAgeofGasReport.pdf. In addition, the “carbon footprint of a horizontal well far exceeds that of a typical vertical well” in terms of necessitating “more carbon-based fuels drilling mud, and water,” running equipment and pumps. Brathwaite, *supra* note 23. It is estimated that each well requires 4300 to 6500 truck trips. Aurana Lewis & Bill Holman, *State Regulation of Hydraulic Fracturing*, Duke Univ. Nicholas Inst. for Envtl. Pol’y Solutions, N.C. ST. COOPERATIVE EXTENSION (Apr. 12, 2011), <http://www.ces.ncsu.edu/lee/Natural%20Gas/ShaleGasRegulationbyStates4-10-11.pdf>.

²⁶ See Zeller, *supra* note 3.

²⁷ *Why Natural Gas?*, *supra* note 4 (stating that natural gas supplies “reliable power when the sun sets or the wind dies down”).

²⁸ *Id.*

than 2000 trillion cubic feet.²⁹ Such growth is partially the result of fracking being combined with horizontal drilling, which has enabled access to “an abundance” of natural gas in shale reservoirs.³⁰ Moreover, current estimates of natural gas available in the U.S. exceed that of oil in Saudi Arabia.³¹ Thus, natural gas offers the opportunity for the U.S. to wean itself from foreign oil.³²

Finally, advocates assert that natural gas development can help create jobs. The natural gas industry currently sustains 135,000 jobs in North Carolina, accounting for 2.9% of its economy.³³ In other areas of the country where natural gas and shale gas has been found, the industry created many new jobs³⁴ and reenergized other industries,³⁵ thereby boosting the local economy.³⁶ Today’s economic climate and unemployment rate strengthen the argument for natural gas.³⁷

²⁹ *Id.* “Natural gas is typically priced and sold in units of a thousand cubic feet (Mcf, using the Roman numeral for one thousand). Units of a trillion cubic feet (tcf) are often used to measure large quantities, as in resources or reserves in the ground” GROUND WATER PROT. COUNCIL & ALL CONSULTING, MODERN SHALE GAS DEVELOPMENT IN THE UNITED STATES: A PRIMER 3 (2009), available at http://www.netl.doe.gov/technologies/oil-gas/publications/epereports/shale_gas_primer_2009.pdf. “A tcf is one billion Mcf” *Id.*

³⁰ MATTHEW E. MANTELL, DEEP SHALE GAS: ABUNDANT, AFFORDABLE, AND SURPRISINGLY WATER EFFICIENT 2 (2009), available at http://www.energyindepth.org/wpcontent/uploads/2009/03/MMantell_GWPC_Water_Energy_Paper_Final.pdf.

³¹ *Why Natural Gas?*, *supra* note 4.

³² Cady, *supra* note 19, at 131.

³³ Carlton Carroll, *New Study: U.S. Oil and Natural Gas Industry Supports 135,000 jobs in North Carolina*, AM. PETROLEUM INST. (May 4, 2011), <http://www.api.org/Newsroom/industry-jobs-nc.cfm>.

³⁴ *Boom of Natural Gas Activity Could Mean Ohio Jobs*, TRIB. CHRON. (Sept. 11, 2011) <http://www.tribune-chronicle.com/page/content.detail/id/146392/Boom-of-natural-gas-activity-could-mean-Ohio-jobs-.html?isap=1&nav=5031>.

³⁵ Jeff Brady, *Gas Drilling Boom Brings New Life to Steel Industry*, NAT’L PUB. RADIO (Oct. 13, 2011), npr.org/2011/10/13/141139535/gas-drilling-boom-brings-a-new-life-to-steel-industry.

³⁶ See Rebecca Clarren, *Wyoming’s Natural Gas Boom Sees Growing Pains*, CNN MONEY (June 4, 2007, 4:27 PM), http://money.cnn.com/magazines/fortune/fortune_archive/2007/06/11/100082885/index.htm.

³⁷ *See Why Natural Gas?*, *supra* note 4.

III. SHALE GAS DEVELOPMENT AND RISKS TO OUR WATER

In spite of these advantages, “[t]he economic benefits [of natural gas] . . . should not be viewed in a vacuum.”³⁸ Natural gas production processes pose numerous risks to the environment, which are then passed on to the people and species that depend on it for clean water.³⁹ Such “hidden, nonmarket costs” may surpass the value of the resource.⁴⁰ Over the lifespan of a shale gas well, various risks to the water supply arise, contributing to those costs.

A. *Setting the Stage: Construction and Drilling*

Although fracking receives the most attention in terms of its environmental impacts on water, it is important to note that site construction and well drilling processes exacerbate these risks. An average horizontal well disturbs three to five acres,⁴¹ and these wells may be spaced less than a tenth of a square mile apart.⁴²

³⁸ Adam J. Bailey, *The Fayetteville Shale Play and the Need to Rethink Environmental Regulation of Oil and Gas Development in Arkansas*, 63 ARK. L. REV. 815, 817 (2010).

³⁹ See MICHAEL WOOD & SHARON WARD, PA. BUDGET & POLICY CTR., RESPONSIBLE GROWTH: PROTECTING THE PUBLIC INTEREST WITH A NATURAL GAS SEVERANCE TAX 15–16 (2009), available at <http://pennbpc.org/sites/pennbpc.org/files/Responsible%20Growth%20-%20PA%20Severance%20Tax.pdf> (“New gas production activity will have an unavoidable negative impact on the environment. The construction of the well, pipelines, and access roads will temporarily degrade surface water quality (in streams) due to increased surface erosion.”).

⁴⁰ Brathwaite, *supra* note 23, at 25 (internal quotation omitted).

⁴¹ Lewis & Holman, *supra* note 25. These figures do not include access roads to the site. See JOHN A. VEIL, ARGONNE NAT’L LAB., FINAL REPORT: WATER MANAGEMENT TECHNOLOGIES USED BY MARCELLUS SHALE GAS PRODUCERS 5 (2010), available at <http://www.evs.anl.gov/pub/doc/Water%20Mgmt%20in%20Marcellus-final-jul10.pdf>.

⁴² GROUND WATER PROT. COUNCIL & ALL CONSULTING, *supra* note 29, at 17. These figures apply to the Haynesville, Marcellus, and Antrim shale plays, and are the equivalent of forty acres between wells. *Id.* The exact number depends on state regulations. LISA SUMI, EARTHWORKS, OIL & GAS ACCOUNTABILITY PROJECT, SHALE GAS: FOCUS ON THE MARCELLUS SHALE 18 (2008), available at <http://www.earthworksaction.org/pubs/OGAPMarcellusShaleReport-6-12-08.pdf>. In addition, “downspacing” is common once a shale play is developed. *Id.* at 18. Regardless of their proximity to one another, a concern that arises from the construction of well sites is forest fragmentation.

New pavement and compacted soil⁴³ cause rainwater to flow across terrain more quickly and in greater quantities, reducing its ability to filter into the land and recharge groundwater, while increasing its propensity to erode the banks of waterways and to carry pollutants into surface water bodies.⁴⁴ Thus, if there is too much impervious surface area and not enough natural land cover in a watershed, a “measurable decline in water quality” results.⁴⁵ Moreover, when water entering a treatment facility is of poorer quality, the costs associated with treating the water, and thus the price of drinking water for consumers, increase.⁴⁶ Sediment

Laura C. Reeder, *Creating a Legal Framework for Regulation of Natural Gas Extraction from the Marcellus Shale Formation*, 34 WM. & MARY ENVTL. L. & POL’Y REV. 999, 1010 (2010). This results in a loss of habitat for wildlife, as well as decreased water quality. WOOD & WARD, *supra* note 39, at 3.

⁴³ JADE FREEMAN ET AL., STATISTICAL ANALYSIS OF DRINKING WATER TREATMENT PLANT COSTS, SOURCE WATER QUALITY, AND LAND CHARACTERISTICS 5 (2008), *available at* http://wren.palwv.org/library/documents/landnwater_9_2008_whitepaper.pdf. Soil may become so impacted that its bulk density nears that of concrete. WOOD & WARD, *supra* note 39, at 18. New pavement includes not only the well site itself but also access roads to the site. *See* Lewis & Holman, *supra* note 25.

⁴⁴ KELLEY HART, THE TRUST FOR PUBLIC LAND, THE UPPER NEUSE CLEAN WATER INITIATIVE CONSERVATION PLAN 4 (2006), *available at* <http://cloud.tpl.org/pubs/landwater-nc-upper-neuse-full-report.pdf>. These pollutants may include fuels and hydraulic fluids which have leaked from construction equipment. Hannah Wiseman, *Regulatory Adaptation in Fractured Appalachia*, 21 VILL. ENVTL. L.J. 229, 256 (2010). Soil erosion not only temporarily affects the surface water quality of streams, but can “permanently change surface water runoff patterns altering the amount of water flowing in streams and changing the stream ecosystem.” WOOD & WARD, *supra* note 39, at 15. Accumulated sediment can “smother aquatic species” as well as “bury fish habitat.” HART, *supra* at 5.

⁴⁵ HART, *supra* note 44, at 4 (“When development occurs on a large scale, the remaining natural features that protect water quality in the watershed—wetlands, forests, and small streams—become stressed.”). “[H]ealthy forests absorb and control stormwater, reducing negative impacts on streams and waterways.” *Id.* “Wetlands help mitigate floods, filter pollutants, recharge groundwater, and maintain a healthy (and hydrologically stable) watershed.” *Id.* at 5. “[Small] streams . . . play an important role in maintaining the health of larger tributaries.” *Id.*

⁴⁶ *See* FREEMAN ET AL., *supra* note 43, at 6.

accumulation can also limit the storage capacity of reservoirs, affecting the quantity of water supplies.⁴⁷

The drilling process poses additional risks to water.⁴⁸ First, a vertical well is drilled to a point immediately above the “target . . . gas reservoir” within the shale formation.⁴⁹ Then, the wellbore is directed along a curved path until it horizontally converges with the reservoir.⁵⁰ The most serious concern with this process is the nearly one million gallons of water⁵¹ required to remove the drill cuttings, which may also contaminate the water.⁵² This new demand for water vies with current uses⁵³ and can strain supplies.⁵⁴

B. *Breaking Rock: Hydraulic Fracturing*

Fracking, however, arguably poses the greatest risks to the water supply. At this point, a perforating gun inside the well is

⁴⁷ HART, *supra* note 44, at 4.

⁴⁸ See Lewis & Holman, *supra* note 25.

⁴⁹ Lynn Helms, *Horizontal Drilling*, 35 DMR NEWSLETTER, Jan. 2008, 1, available at <https://www.dmr.nd.gov/ndgs/newsletter/NL0308/pdfs/Horizontal.pdf>.

⁵⁰ *Id.*

⁵¹ VEIL, *supra* note 41, at 10.

⁵² DANIEL J. SOEDER & WILLIAM M. KAPPEL, U.S. GEOLOGICAL SURVEY, WATER RESOURCES AND NATURAL GAS PRODUCTION FROM THE MARCELLUS SHALE 1 (2009), available at <http://pubs.usgs.gov/fs/2009/3032/pdf/FS2009-3032.pdf>, reprinted in Daniel J. Soeder & William M. Kappel, *Water Resources and Natural Gas Production from the Marcellus Shale*, GEOLOGY.COM <http://geology.com/usgs/marcellus-shale/> (last visited Oct. 9, 2011). The water is used to “create a circulating mud that cools the bit and carries the rock cuttings out of the borehole.” *Id.* Drill cuttings may contain radioactive material, or “NORM.” Wiseman, *supra* note 44, at 256. NORM can contaminate water supplies “if not treated or disposed of properly.” INT’L ENERGY AGENCY, *supra* note 25, at 61.

⁵³ WOOD & WARD, *supra* note 39, at 19.

⁵⁴ INT’L ENERGY AGENCY, *supra* note 25, at 15. Water for drilling could be drawn from “surface water bodies, groundwater, municipal potable water supplies, or reused water from some other water source [such as] flowback water from a previously fractured well.” VEIL, *supra* note 41, at 10. It must also be remembered that “[a]s the scale of operations and production expands, the number of wells increases significantly,” which only further taxes the water supply. INT’L ENERGY AGENCY, *supra* note 25, at 63.

aligned with the most probable locations to yield natural gas.⁵⁵ The perforating gun uses an electrical charge to puncture the well and surrounding shale.⁵⁶ Next, a blend of water, sand, and chemicals is injected into the well at high pressure, which props open the holes made by the perforating gun, and makes a path for the trapped gas to flow into the well.⁵⁷ The well is fractured one section at a time, and a “plug” is placed between each section.⁵⁸ The plugs are removed upon completion of the process to allow the gas to be produced from the well.⁵⁹

That fracking requires a “substantial amount of water”⁶⁰ is an understatement. A “typical” treatment by fracking can require 7.8 million gallons of water.⁶¹ Additionally, a well might be re-fracked several times.⁶² Multiply this by the number of wells, and the figure rises to an astonishing amount of water.⁶³ The water supply

⁵⁵ SHELL, HYDRAULIC FRACTURING: YOUR QUESTIONS ANSWERED 2, available at http://www-static.shell.com/static/usa/downloads/onshore/abc002_hyd_frac_insert0623.pdf.

⁵⁶ *Hydraulic Fracturing: Extracting Natural Gas from a Shale Formation*, PITTSBURGH POST-GAZETTE, www.post-gazette.com/downloads/20110227_Drilling_process.pdf (last visited Oct. 17, 2011).

⁵⁷ Cady, *supra* note 19, at 133 (footnote omitted). These chemicals function as “friction reducer[s], biocides, [and] scale inhibitor[s].” *Id.* See sources cited *supra* notes 69, 71, and 78 for an accounting of some of the various chemicals included in fracking fluid.

⁵⁸ SHELL, *supra* note 55.

⁵⁹ *Id.*

⁶⁰ Dotson, *supra* note 13, at 274.

⁶¹ Wiseman, *supra* note 44, at 236 n.31. This is roughly the amount of water needed “to supply about 150 homes for a year.” Jeff Ray, *Gas Drilling Company Recycling “Fracking” Water*, CBSDFW.COM (Oct. 13, 2011, 3:51 PM), <http://dfw.cbslocal.com/2011/10/13/gas-drilling-company-recycling-fracking-water/>.

⁶² See Dotson, *supra* note 13, at 275 (explaining that a well might be re-stimulated not once but several times in the years that follow the initial fracking); see also SUMI, *supra* note 42, at 11 (footnote omitted) (“It has been established that only 10% of GIP [(gas in place)] is recovered with the initial completion. Refracturing the shale can increase the recovery rate by an additional 8% to 10%.”).

⁶³ See GROUND WATER PROT. COUNCIL & ALL CONSULTING, *supra* note 29. Wells may be placed less than a mile apart in some states. SUMI, *supra* note 42, at 18–20. The shale play in central North Carolina extends across approximately 25,000 acres. JEFFREY C. REID & KENNETH B. TAYLOR, N.C.

in North Carolina is already strained due to drought,⁶⁴ “largely unregulated major water withdrawals,”⁶⁵ and a growing population.⁶⁶ In response to these threats posed to water resources, a 2010 report to the Environmental Review Commission recommended a “moratorium on water withdrawals for shale gas development.”⁶⁷

C. *What Goes Down Must Come Up: Flowback and Formation Water*

Depletion of the water supply is not the only risk posed by fracking. Although fracking fluid contains up to ninety-nine percent water,⁶⁸ the remainder comprises thousands of gallons of

GEOLOGICAL SURVEY, SHALE GAS POTENTIAL IN TRIASSIC STRATA OF THE DEEP RIVER BASIN, LEE AND CHATHAM COUNTIES, NORTH CAROLINA WITH PIPELINE AND INFRASTRUCTURE DATA 1 (2009), *available at* http://www.geology.enr.state.nc.us/pubs/PDF/NCGS_OFR_2009-01_20090709.pdf. One square mile is equivalent to 640 acres. NAT’L INST. OF STANDARDS AND TECH., U.S. OFFICE OF WEIGHTS AND MEASURES, NIST HANDBOOK 44-2012: SPECIFICATIONS, TOLERANCES, AND OTHER TECHNICAL REQUIREMENTS FOR WEIGHING AND MEASURING DEVICES, app. at C-5 (2012), *available at* <http://www.nist.gov/pml/wmd/pubs/upload/AppC-12-hb44-final.pdf>.

⁶⁴ See WHISNANT & HOLMAN, *supra* note 9, at 5 (explaining that North Carolina has experienced droughts in recent years, which strains the state’s current water supply). North Carolina encountered its “worst drought in recorded history” in 2007–2008. SAVE WATER NC, <http://www.savewaternc.org/> (last visited Oct. 17, 2011). Due to “continued growth coupled with changing weather patterns . . . [the state is] vulnerable to more serious droughts in the future.” *Id.* At the time of writing, central North Carolina is facing “abnormally dry” to “moderate drought” conditions. *Drought Monitor Archive*, N.C. DROUGHT MGMT. ADVISORY COUNCIL, <http://www.ncdrought.org/archive/index.php> (select “October 25, 2011” from “Select An Archive” dropdown menu) (last visited Nov. 9, 2011).

⁶⁵ WHISNANT & HOLMAN, *supra* note 9, at 5.

⁶⁶ *Id.* The population in the Cape Fear River Basin, in which Chatham, Lee, and Moore Counties are situated, is expected to grow by another two million people in the next two decades. N.C. OFFICE OF ENVTL. EDUC. AND PUB. AFFAIRS, CAPE FEAR RIVER BASIN 3, *available at* <http://www.ee.enr.state.nc.us/public/eoaddress/riverbasins/capefear.150dpi.pdf>.

⁶⁷ WHISNANT & HOLMAN, *supra* note 9, at 24.

⁶⁸ U.S. ENVTL. PROT. AGENCY, HYDRAULIC FRACTURING RESEARCH STUDY 2 (2010), *available at* <http://www.epa.gov/safewater/uic/pdfs/hfresearchstudyfs.pdf>.

potentially harmful chemicals.⁶⁹ The natural gas industry's reluctance to disclose the exact types and amounts of these chemicals⁷⁰ hinders environmental enforcement and water treatment.⁷¹ A study on the potential health effects from exposure to the 362 identifiable chemicals used in natural gas production⁷² found that ninety percent of such chemicals "had at least one potential health effect,"⁷³ and forty-seven percent "have the potential to affect the endocrine system."⁷⁴

The risks to water quality persist long after the fracking fluid is injected into the well. Some of the chemical-laden fluid returns to the surface during the following few weeks.⁷⁵ The majority stays within the formation,⁷⁶ where it can potentially contaminate

⁶⁹ Wiseman, *supra* note 44, at 238.

⁷⁰ Cady, *supra* note 19, at 140 (Industry "consider[s] [the composition of the fracking fluid] a 'trade secret' "). Moreover, the composition of the fluid often "varies from one geologic basin or formation to another." *Chemical Use in Hydraulic Fracturing*, FRAC FOCUS, <http://fracfocus.org/water-protection/drilling-usage> (last visited Oct. 17, 2011).

⁷¹ WOOD & WARD, *supra* note 39, at 18.

⁷² THE ENDOCRINE DISRUPTER EXCHANGE, SUMMARY STATEMENT 2-3 (2011), available at http://www.endocrinedisruption.com/files/Multistate_summary1-27-11Final.pdf (summarizing findings from Theo Colborn et al., *Natural Gas Operations from a Public Health Perspective*, 17 HUMAN AND ECOLOGICAL RISK ASSESSMENT, 1039 (2011)). The 362 chemicals considered in this study were the only ones able to be identified with CAS numbers, out of the 649 chemicals contained in 980 different products used in natural gas production. *Id.* at 3.

⁷³ *Id.* at 2.

⁷⁴ *Id.* at 4. The effects include those on "human and wildlife development and reproduction." *Id.* This is cause for concern, even if these chemicals make up only one percent of the fracking fluid, because "[t]he endocrine system operates at very low concentrations of hormones, often in parts-per-billion or less, making it susceptible to very low levels of exposure." *Id.* at 5. In addition, these "[e]ffects might not be seen for months or years and would be difficult to trace back to exposure to gas industry chemicals." *Id.* This exemplifies that "[e]xternalities can occur long after the economic activity ends." WOOD & WARD, *supra* note 39, at 13.

⁷⁵ VEIL, *supra* note 41, at 13. Approximately 13.5% of the fracking fluid returns to the surface as "flowback" water. *Id.*

⁷⁶ Brathwaite, *supra* note 23, at 27.

groundwater if the well casing is inadequate.⁷⁷ The well also generates “produced” water from within the formation, which may flow from the well for years after drilling.⁷⁸ Collectively, this wastewater is a toxic soup⁷⁹ that must be managed and disposed of with care to avoid contamination of surface water.⁸⁰

D. Now What?: Managing the Wastewater

Before disposal, the wastewater is often stored on-site in open-air pits⁸¹ or tanks.⁸² Both pose risks of leaks,⁸³ which can “[contaminate] the soil beneath and possibly [enter] the water supply,”⁸⁴ tainting drinking water and destroying aquatic habitat.⁸⁵

⁷⁷ Lewis & Holman, *supra* note 25. The presence of methane in drinking water wells “has been a common complaint among people living in gas drilling areas across the country.” Abrahm Lustgarten, *Scientific Study Links Flammable Drinking Water To Fracking*, PROPUBLICA (May 9, 2011, 3 PM), <http://www.propublica.org/article/scientific-study-links-flammable-drinking-water-to-fracking/single>. A recent study detected a link between the presence of methane in drinking water and natural gas drilling activities nearby. Stephen G. Osborne et al., *Methane Contamination of Drinking Water Accompanying Gas-Well Drilling and Hydraulic Fracturing*, 108 PNAS 8172, 8172 (2011), available at <http://www.pnas.org/content/108/20/8172.full.pdf+html>. The researchers identified “leaky well casings . . . [as] the most likely cause of the contamination.” Lustgarten, *supra*.

⁷⁸ VEIL, *supra* note 41, at 40. Produced water “makes up the majority” of the wastewater. Dotson, *supra* note 13, at 287.

⁷⁹ See Dotson, *supra* note 13, at 277 (listing contaminants present in wastewater from a gas well.) This Recent Development refers to flowback and produced water collectively as “wastewater.”

⁸⁰ *Id.* at 287.

⁸¹ AMY MALL ET AL., NATIONAL RESOURCES DEFENSE COUNCIL, DRILLING DOWN: PROTECTING WESTERN COMMUNITIES FROM THE HEALTH AND ENVIRONMENTAL EFFECTS OF OIL AND GAS PRODUCTION 21 (2007), available at <http://www.nrdc.org/land/use/down/down.pdf>. Open-air pits (also called ponds) sometimes spray wastewater into the air using an aeration system in order to “accelerate evaporation.” *Id.* at 23.

⁸² *Id.* at 25.

⁸³ See Lewis & Holman, *supra* note 25. These risks include lining failures, pit overflows, incompatibility of the liner with the fluid, incompatibility between chemicals, volatile chemical releases, and secondary containment failure. *Id.*

⁸⁴ WOOD & WARD, *supra* note 39, at 17.

⁸⁵ ARGONNE NAT’L LAB. ET AL., A WHITE PAPER DESCRIBING PRODUCED WATER FROM PRODUCTION OF CRUDE OIL, NATURAL GAS, AND COAL BED

The longer the wastewater remains in the pit, the higher the chance of contamination.⁸⁶

Allowable methods of disposal vary from state to state.⁸⁷ One option is to treat the wastewater on-site or in traditional wastewater plants, and then to discharge the treated water into surface or drinking water.⁸⁸ However, most municipal facilities lack—and cannot afford—the infrastructure to treat the huge quantities of wastewater generated from natural gas development.⁸⁹ Moreover, the impurities in the wastewater may damage elements of the treatment process⁹⁰ and thereby increase treatment costs.⁹¹ In addition, treatment will fail to fully remove the high levels of salinity and naturally occurring radioactive material in the wastewater.⁹² Treatment merely dilutes contamination, which, when emptied into local rivers, spreads the problem throughout the watershed.⁹³

A second option for disposal is underground injection of the wastewater into “the original source [or] into wells or other

METHANE 13–14 (2004), *available at* <http://www.evs.anl.gov/pub/doc/ProducedWatersWP0401.pdf>.

⁸⁶ Wiseman, *supra* note 44, at 264.

⁸⁷ *Id.* Although currently states are the primary regulators with regard to fracking, the U.S. Environmental Protection Agency recently announced that it plans to “develop national standards for the disposal of polluted wastewaters” produced by fracking. *See* Rubinkam, *supra* note 7.

⁸⁸ GROUND WATER PROT. COUNCIL & ALL CONSULTING, *supra* note 29, at 68. This method is mainly utilized in Pennsylvania for wastewater produced from the Marcellus Shale. *Id.* at 69.

⁸⁹ WOOD & WARD, *supra* note 39, at 18.

⁹⁰ *Id.*

⁹¹ FREEMAN ET AL., *supra* note 43, at 6–7. Increased treatment costs are passed on to the consumer. *See supra* Part III, Subsection A.

⁹² Lewis & Holman, *supra* note 25.

⁹³ Reeder, *supra* note 42, at 1013. The entire watershed becomes implicated as “the effects of that dumping will accumulate and spread.” *Id.* An additional problem is posed by a lack of regulatory oversight, to ensure that untreated wastewater is not illegally dumped. *See* Abrahm Lustgarten, *State Oil and Gas Regulators are Spread Too Thin to Do Their Jobs*, PROPUBLICA (Dec. 30, 2009, 1:38 p.m.), <http://www.propublica.org/article/state-oil-and-gas-regulators-are-spread-too-thin-to-do-their-jobs-1230>.

geological formations.”⁹⁴ Although the U.S. Environmental Protection Agency points out that injection wells avoid contamination of surface water,⁹⁵ they present an opportunity for contamination of groundwater.⁹⁶ This method of disposal has been linked to drinking water contamination in the past.⁹⁷

Third, wastewater may be recycled, as is done in several shale plays across the United States.⁹⁸ If performed on-site, recycling has the benefit of curbing truck travel⁹⁹ and reducing the potential for accidental spills.¹⁰⁰ Yet the process is “energy-intensive” and concentrates the radioactivity of the wastewater.¹⁰¹ This method does result in less waste, however, as treated wastewater can be

⁹⁴ Dotson, *supra* note 13, at 277. The type of well used for underground injection is most commonly classified as a Class II well under the Safe Water Drinking Act, and allows for the injection of “brines and other fluids associated with oil and gas production.” GROUND WATER PROT. COUNCIL & ALL CONSULTING, *supra* note 29, at 32. It is used in the Barnett, Fayetteville, Haynesville, Marcellus, Woodford, Antrim, and New Albany Shales. *Id.* at 69.

⁹⁵ *Class II Wells—Oil and Gas Related Injection Wells (Class II)*, U.S. ENVTL. PROTECTION AGENCY, <http://water.epa.gov/type/groundwater/uic/class2/> (last updated Dec. 13, 2010).

⁹⁶ See Theo Colborn et al., *Natural Gas Operations from a Public Health Perspective*, 17 HUMAN AND ECOLOGICAL RISK ASSESSMENT 1039, 1054 (2011).

⁹⁷ U.S. GEN. ACCOUNTING OFFICE, GAO/RCED-89-97, DRINKING WATER: SAFEGUARDS NOT PREVENTING CONTAMINATION FROM INJECTED OIL AND GAS WASTES 19–21 (1989) [hereinafter U.S. G.A.O.], available at <http://archive.gao.gov/d26t7/139245.pdf>. Wastewater from injection wells can make its way into drinking water “directly, through cracks and leaks in the well casing, or indirectly, through nearby wells, such as those once used for oil and gas production, that have ceased operating.” *Id.* at 2. Nevertheless, “[t]he approximately 144,000 Class II wells in operation in the United States inject over two billion gallons of brine every day.” *Class II Wells—Oil and Gas Related Injection Wells (Class II)*, *supra* note 95. The wastewater is referred to as “brine” because it contains such high concentrations of chloride and dissolved solids, making them extraordinarily saline. U.S. G.A.O., *supra*, at 2.

⁹⁸ GROUND WATER PROT. COUNCIL & ALL CONSULTING, *supra* note 29, at 69 (reporting that recycling is used in the Barnett, Fayetteville, Marcellus, and Woodford Shales). See *id.* at ES-2 for a map of shale plays in the United States.

⁹⁹ Lewis & Holman, *supra* note 25.

¹⁰⁰ Cady, *supra* note 19, at 141.

¹⁰¹ Lewis & Holman, *supra* note 25. See *supra* notes 52 and 79 (regarding naturally occurring radioactive material (NORM) in wastewater).

reused later on.¹⁰² One recycling facility in the Barnett Shale allows eighty percent of the fluid to be reused.¹⁰³ Because recycling reduces the need for new water as well as for a place to dispose of wastewater, it is expected to become an increasingly popular option in the future.¹⁰⁴

A final means of disposal for wastewater is land application or farming, which is utilized in the Woodford Shale¹⁰⁵ and is the primary method of disposal in the Fayetteville Shale.¹⁰⁶ This process involves “the controlled and repeated application of wastes to the soil surface.”¹⁰⁷ Compounding the environmental concerns, the untreated wastewater poses further risks of surface and drinking water contamination.¹⁰⁸

IV. COMING TO A SHALE PLAY NEAR YOU: NATURAL GAS POTENTIAL IN NORTH CAROLINA

North Carolina may face these risks in the near future. A shale formation recently discovered in the central part of the state is estimated to contain enough natural gas to supply the state for forty years.¹⁰⁹ Because relatively little is known about the shale play,

¹⁰² VEIL, *supra* note 41.

¹⁰³ MALL ET AL., *supra* note 81, at 22.

¹⁰⁴ ARTHUR ET AL., *supra* note 20, at 19–20.

¹⁰⁵ GROUND WATER PROT. COUNCIL & ALL CONSULTING, *supra* note 29, at 69.

¹⁰⁶ ARTHUR ET AL., *supra* note 20, at 19.

¹⁰⁷ MALL ET AL., *supra* note 81, at 22.

¹⁰⁸ See, e.g., Mireya Nevarro, *Fracking Water Killed Trees, Study Finds*, N.Y. TIMES (July 12, 2011, 8:23 AM), <http://green.blogs.nytimes.com/2011/07/12/fracking-water-killed-trees-study-finds/> (discussing the negative impacts of land application on vegetation).

¹⁰⁹ John Murawski, *North Carolina Sits on Trove of Natural Gas*, NEWS & OBSERVER (Apr. 4, 2010, 7:06 AM), <http://www.newsobserver.com/2010/04/04/420496/nc-sitting-on-a-trove-of-natural.html>. The shale play in central North Carolina is known as the Deep River Basin; see *infra* Part IV.A. Shale with natural gas potential was also discovered in western North Carolina in what is known as the Dan River Basin. JEFFREY C. REID & ROBERT C. MILICI, U.S. GEOLOGICAL SURV. AND N.C. GEOLOGICAL SURV., OPEN-FILE REPORT 2008-1108: HYDROCARBON SOURCE ROCKS IN THE DEEP RIVER AND DAN RIVER TRIASSIC BASINS, NORTH CAROLINA 2–5 (2008), available at <http://pubs.usgs.gov/of/2008/1108/ofr2008-1108.pdf>. This Recent Development, however,

and because there is also relatively little legal infrastructure to support a natural gas industry in the state, the N.C. General Assembly has enacted legislation to address the uncertainties which follow.

A. *The “New” North Carolina Shale Play*

The Deep River Basin in the central part of the state is 150 miles long,¹¹⁰ extending across North Carolina at a slight southwest-to-northeast diagonal, from Anson County at the “bottom” of the state to Granville County at the “top.”¹¹¹ Three geological formations exist within the Deep River Basin, but the one of particular interest is known as the Cumnock Formation.¹¹² This formation is promising for natural gas extraction because it is comprised of darker shales—800 feet thick in portions of its approximately 25,000-acre span¹¹³—which have “long been recognized . . . as potential petroleum source beds.”¹¹⁴ Samples have also yielded favorable numbers in two key indicators of the presence of shale gas in organic geochemistry, total organic carbon (“TOC”) and genetic source potential,¹¹⁵ which signals the potential

discusses only the Deep River Basin and the unique issues it presents to drinking water in the central part of the state.

¹¹⁰ REID & TAYLOR, *supra* note 63.

¹¹¹ REID & MILICI, *supra* note 109, at 2. The most attention has been focused on Chatham, Lee, and Moore Counties. See, e.g., *Overview/Introduction*, N.C. DEP’T. OF ENV’T. AND NATURAL RES., http://portal.ncdenr.org/c/journal/view_article_content?groupId=14&articleId=4240336&version=1.0&ajax=true (last visited Oct. 26, 2011). For a map of the North Carolina counties where the Deep River Basin is located, see REID & MILICI, *supra* note 109, at 3. The basin was “named for the Deep River coal field” that existed there earlier. *Id.* The Deep River Basin consists of the Durham, Sanford, and Wadesboro sub-basins, which contain approximately 7000 feet of Triassic strata, or layers of sediment from the Triassic period of the Mesozoic era. REID & TAYLOR, *supra* note 63. These basins formed 225 million years ago and filled with sediment from the “erosion of the nearby mountains,” which over time formed the shale formation. REID, *supra* note 20, at 3.

¹¹² See REID & TAYLOR, *supra* note 63, at 1.

¹¹³ *Id.*

¹¹⁴ REID, *supra* note 20, at 1.

¹¹⁵ REID & MILICI, *supra* note 109, at 9–10, 17–18. To form petroleum: sedimentary deposits containing organic debris [must] be buried at sufficient depths so that they are ‘cooked’ by the Earth’s natural heat

for profitable amounts of natural gas.¹¹⁶ In fact, preliminary drilling in the Cumnock Formation has produced natural oil and gas in six of twenty-eight test wells.¹¹⁷ These are all encouraging signs for those seeking natural gas in the Deep River Basin.

Data from the basin's Triassic layers have evidenced geological "traps" that form seals, enabling reservoirs of natural gas to accumulate in pockets of rock.¹¹⁸ Although this promising stretch of shale sits less than 3000 feet beneath Lee and Chatham Counties,¹¹⁹ there are additional factors to be considered when assessing accessibility. Historically, Triassic sedimentary rocks found in North Carolina basins have proven infeasible for purposes of extracting natural gas, given their low porosity and permeability.¹²⁰ The Cumnock Formation is no exception, despite the existence of some "fracture zones . . . [which] may serve as migration pathways for gas" to enhance porosity.¹²¹ Therefore, a joint report by the U.S. Geological Survey and the N.C. Geological Survey suggests that horizontal drilling, along with hydraulic

over time. With progressively deeper burial, the organic remains are converted to a substance called kerogen. The kerogen, in turn, is converted to natural gas and oil as depths of burial and corresponding temperatures and pressures increase.

REID, *supra* note 20, at 1. Darker shale tends to correspond to an "abundance of organic matter" because it has been preserved in an environment with low oxygen levels. *Id.* Rock samples with a greater amount of total organic carbon (TOC) "are more likely to be sources for natural gas because of their relatively high thermal maturation and abundance of type III kerogen." *Id.* In other words, they contain more kerogen and have had more time to "cook," good news for those seeking natural gas.

¹¹⁶ REID & MILICI, *supra* note 109, at 8, 17.

¹¹⁷ REID & TAYLOR, *supra* note 63, at 1.

¹¹⁸ REID & MILICI, *supra* note 109, at 19. See *supra* note 111 for an explanation of Triassic layers.

¹¹⁹ REID & TAYLOR, *supra* note 63, at 1.

¹²⁰ REID & MILICI, *supra* note 109, at 19. Porosity and permeability are factors that affect the ability of natural gas to move within the rock formation. REID, *supra* note 20, at 1. Porosity describes the open spaces within the rock formation. *Id.* at 2. Permeability refers to "the capability of a rock to transmit fluids" between interconnected pores. *Id.* The less porous and permeable the rock formation, the more difficult it is to extract natural gas. *Id.*

¹²¹ REID & MILICI, *supra* note 109, at 19.

fracturing, “may be useful” to access this hard-to-reach natural gas source.¹²²

B. The Drill Bit Stops Here: Current North Carolina Law

Although coal exploration and production have occurred in North Carolina since the Revolutionary War era,¹²³ the same cannot be said for petroleum. From 1925 to 1998, 128 fruitless petroleum exploration wells were drilled in the state.¹²⁴ It was not until 2008 that geologists published a report recognizing a “thick section of organic shale as a potential gas resource” in North Carolina.¹²⁵ The state’s relatively ‘bare-bones’ legal infrastructure governing the extraction of oil and natural gas reflects this history.

The Oil and Gas Conservation Act of 1945 (“O.G.C.A.”) and the regulations promulgated thereunder prohibit horizontal drilling in North Carolina.¹²⁶ The underground injection of toxic wastes is also proscribed,¹²⁷ as well as the underground injection of fluids produced in extracting oil or gas or used to enhance the recovery of those resources.¹²⁸ Together, these limitations amount to a ban on fracking, a process that incorporates both horizontal drilling and underground injection procedures.¹²⁹ Thus, the current law in North Carolina is unfavorable to shale gas development—at least in rhetoric.

¹²² *Id.* at 22.

¹²³ N.C. Geological Survey, *North Carolina’s Shale Gas Potential: Who Knew?*, N.C. DEP’T. OF ENV’T. & NATURAL RES., http://portal.ncdenr.org/c/document_library/get_file?uuid=35b88e58-af77-47ee-af99-8df32b24b8d3&groupId=14 (last visited Oct. 26, 2011).

¹²⁴ REID, *supra* note 20, at 1.

¹²⁵ N.C. Geological Survey, *supra* note 123, at 5; *see generally* REID & MILICI, *supra* note 109.

¹²⁶ N.C. GEN. STAT. §§ 113-392(c), 393(d) (2009); 15A N.C. ADMIN. CODE 5D.0007(e) (2010).

¹²⁷ 15A N.C. ADMIN. CODE 02C.0213(b) (2010).

¹²⁸ *Id.* 02C.0209(b)(1)(A), (B).

¹²⁹ *Water Wiki: Moratorium on Fracking in NC*, UNIV. OF N.C. SCHOOL OF GOV’T, http://sogweb.sog.unc.edu/Water/index.php/Moratorium_on_fracking_in_NC (last visited Jan. 25, 2011); *see also* *Shale Gas: Current Regulation*, N.C. DEP’T. OF ENV’T & NATURAL RES., <http://portal.ncdenr.org/web/guest/current-regulation> (last visited Oct. 17, 2011).

Still, state law does allow vertical well drilling.¹³⁰ Accordingly, the O.G.C.A. and its corresponding regulations establish a permissible system for exploratory oil and gas drilling.¹³¹ The statute sets forth permit requirements and authorizes the N.C. Department of Environment and Natural Resources (“D.E.N.R.”) to issue permits, inspect wells, and take other actions to enforce the law and to legislate as needed.¹³² Significantly, the stated purposes for rulemaking authority by D.E.N.R. place environmental protection both at the beginning and end of the list.¹³³

Legislation recently passed by the N.C. General Assembly appears to continue prioritizing environmental integrity by couching the statute in terms of landowner protections, research, and public hearings.¹³⁴ However, in establishing these measures, the statute makes an unequivocal advance in the direction of bringing the state’s newly recognized natural gas prospects to fruition. Session Law (“S.L.”) 2011-276 makes several changes to the O.G.C.A. that open the door to an incoming natural gas industry.¹³⁵ First, it substantially increases the bond for exploratory oil and gas drilling,¹³⁶ as well as registration and abandonment fees.¹³⁷ The law adds new provisions to ensure that surface owners are notified of and compensated for damages from oil and gas prospecting on their property.¹³⁸ Finally, the law establishes maximum lease terms such that after a period of ten years, conveyed mineral rights will revert back to the surface owner.¹³⁹

¹³⁰ N.C. GEN. STAT. §§ 113-392(c), 113-393(d) (2009).

¹³¹ *Id.* § 113-378.

¹³² *Id.* § 113-391(a), (b), (c).

¹³³ *Id.* § 113-391(c)(1), (16).

¹³⁴ *See generally* Act of June 23, 2011, § 1, 2011 N.C. Sess. Laws 276 (to be codified as amended at N.C. GEN. STAT. § 113-378).

¹³⁵ *House Bill 242/S.L. 2011-276*, N.C. GEN. ASSEMB., <http://www.ncga.state.nc.us/gascripts/billlookup/billlookup.pl?Session=2011&BillID=H242H242> (last visited Oct. 17, 2011). (showing that the N.C. General Assembly ratified S.L. 2011-276 on June 17, 2011 and Governor Beverly Perdue signed it into law).

¹³⁶ § 1, 2011 N.C. Sess. Laws at 276.

¹³⁷ *Id.* § 2.

¹³⁸ *Id.* § 3(b).

¹³⁹ *Id.*

While this statute provides greater protections to landowners and the environment, it also creates a legal infrastructure that encourages a natural gas industry.

Furthermore, S.L. 2011-276 directs D.E.N.R., the N.C. Department of Commerce, and the N.C. Consumer Protection Division of the Department of Justice to conduct a comprehensive study of the “oil and gas resources present in the Triassic Basins and in any other areas of the State,” and instructs D.E.N.R. to hold at least two public hearings before February 2012 “to promote awareness of the issue.”¹⁴⁰ Additionally, the legislation instructs the agencies to assess the means of exploration and extraction, as well as potential impacts, regulatory issues, and legal issues that are involved.¹⁴¹ Though comprehensive, the aim of this study, among other things, is to evaluate fracking as a particular means of extraction, as evidenced by the overall mission statement for the investigation.¹⁴² Fracking is also mentioned several times in the list of information the study requires to be gathered.¹⁴³ One of these instances is in the context of its potential environmental

¹⁴⁰ *Id.* § 4(1).

¹⁴¹ *Id.* §§ 4–8.

¹⁴² *Id.* § 4. In pertinent part, the agencies “shall study the issue of oil and gas exploration in the State and the use of directional and horizontal drilling and hydraulic fracturing for that purpose.” *Id.*

¹⁴³ *Id.* §§ 4(2), (3), (4), (9). First, the legislation directs D.E.N.R. to study “[m]ethods of exploration and extraction of oil and gas, including directional and horizontal drilling and hydraulic fracturing.” *Id.* § 4(2). Next, it requires D.E.N.R. to “specifically examine the expected water usage from hydraulic fracturing, water resources in the area in which drilling may occur, as well as existing water users in the area that may be impacted by increased consumption of water for use in hydraulic fracturing.” *Id.* § 4(3). S.L. 2011-276 also calls for D.E.N.R. to study “[p]otential environmental impacts, including constituents or contaminants that may be present in the fluid used in the hydraulic fracturing process.” *Id.* § 4(4). Finally, the legislation concludes with a catch-all provision that directs D.E.N.R. to report on “[a]ny other pertinent issues that the Department deems relevant to oil and gas exploration in the State and the use of hydraulic fracturing for that purpose.” *Id.* § 4(9).

impacts.¹⁴⁴ The long laundry list in the text of the law indicates that the drafters are considering the hazards of fracking.¹⁴⁵

While the study is a cautionary measure that claims to be objective, the way in which it is being carried out nonetheless signals North Carolina's receptiveness to horizontal drilling and fracking. The study is intended to assess how the natural gas industry might fit into the state's current regulatory scheme, and it seems the state is in a great hurry to accomplish this task as the study is to be presented to the Environmental Review Commission in May 2012.¹⁴⁶ At the time of writing, the first of the two hearings to receive public comments on the scope of the D.E.N.R. study has taken place.¹⁴⁷ At that hearing, held on October 10, 2011, speakers aired their concerns about the relatively short period of time and small budget that the study has been allotted.¹⁴⁸ This is a valid criticism, considering both the breadth and depth of the study, as contemplated in S.L. 2011-276. A cursory study that does not provide the time and resources to adequately address all facets—including the risks—of shale gas production will not allow the legislature to make a truly informed decision about the wisdom of allowing the natural gas industry to enter North Carolina.

¹⁴⁴ *Id.* § 4(4).

¹⁴⁵ *See generally id.* § 4(4) (listing several possible environmental impacts, "including constituents or contaminants that may be present in the fluid used in the hydraulic fracturing process; the potential for the contamination of nearby wells and groundwater, as well as the options for disposal and reuse of the wastewater produced; stormwater management; the potential for emission of toxic air pollutants; impacts on wildlife; management and reclamation of drilling sites, including orphaned sites; management of naturally occurring radioactive materials (NORM) generated by the drilling and production of natural gas; and the potential for seismic activity in the area in which drilling may occur").

¹⁴⁶ *Id.* § 4.

¹⁴⁷ *Shale Gas: Public Input/Contact Us*, N.C. DEP'T. OF ENV'T AND NATURAL RES., <http://portal.ncdenr.org/web/guest/public-input> (last visited Oct. 17, 2011).

¹⁴⁸ Martha Quillin, *Residents Ask for Slowdown on N.C. Gas Study*, NEWS & OBSERVER, Oct. 11, 2011, <http://www.newsobserver.com/2011/10/11/1556542/residents-plea-no-fracking-rush.html>.

V. CHANGES ON THE HORIZON: NORTH CAROLINA SENATE BILL 709

The same legislative session also introduced a sister bill, N.C. Senate Bill (“S.B.”) 709.¹⁴⁹ Titled the “Energy Jobs Act,” this pending legislation touts new jobs, revenue for the state, and a domestic energy source as its underlying premises for the sweeping regulatory changes it seeks to enact.¹⁵⁰ The bill first establishes a fund for “[a]ny revenues and royalties paid to the State as a result of offshore or onshore leasing, exploration, development, and production of all energy resources”¹⁵¹ It also directs the Governor to enter into an interstate compact with South Carolina and Virginia in an effort “to develop a unified regional strategy” regarding offshore energy resources.¹⁵²

Notably, the bill directs D.E.N.R. to report on the “commercial potential” of North Carolina’s onshore shale gas as well as the requisite “regulatory framework” to develop it.¹⁵³ This study is to be conducted in conjunction with the study directed by S.L. 2011-276,¹⁵⁴ the studies feature similar provisions,¹⁵⁵ including their shared deadline.¹⁵⁶ S.B. 709 calls for D.E.N.R. to assess current state laws and suggest changes in the law with regard to horizontal drilling and hydraulic fracturing.¹⁵⁷ The study is also intended to “[p]rovide an inventory of all water supplies and evaluate the availability of water supply and potential impacts on other water users in any area of shale gas interest”¹⁵⁸ Finally, D.E.N.R. is charged with proposing regulations to assess “the technical and

¹⁴⁹ *Senate Bill 709 Information/History*, N.C. GEN. ASSEMB., <http://www.ncga.state.nc.us/gascripts/BillLookup/BillLookup.pl?Session=2011&BillID=s+709&submitButton=Go> (last visited Oct. 9, 2011).

¹⁵⁰ *See generally* S.B. 709, 2011 Gen. Assemb., 2011 Sess. (N.C. 2011).

¹⁵¹ *Id.*

¹⁵² *Id.*

¹⁵³ *Id.*

¹⁵⁴ *Id.*

¹⁵⁵ Act of June 23, 2011, § 4, 2011 N.C. Sess. Laws 276 (to be codified as amended at N.C. Gen. Stat. § 113-378).

¹⁵⁶ S.B. 709, 2011 Gen. Assemb., 2011 Sess. (N.C. 2011).

¹⁵⁷ *Id.*

¹⁵⁸ *Id.*

public health and public safety merits of shale gas exploration and energy production” and to manage the permit process.¹⁵⁹

Again, although framed in the terms of a study, S.B. 709 makes major inroads for the natural gas industry in North Carolina. The proposed study appears to be more brazen than its sister bill,¹⁶⁰ particularly in its call to recommend changes in the law to accommodate drilling for natural gas—something that has not gone unnoticed by North Carolina citizens.¹⁶¹ Although the bill passed both houses of the General Assembly in June 2011, Governor Perdue subsequently vetoed it.¹⁶² The bill was then placed on the calendar for an override vote during the short legislative session in July and again in September 2011,¹⁶³ but the House of Representatives did not address it.¹⁶⁴ However, S.B. 709 is not dead; it is likely to show up again in the next short legislative session,¹⁶⁵ and the bill’s sponsor, State Senator Bob Rucho, has

¹⁵⁹ *Id.*

¹⁶⁰ Laura Leslie, *House Gives First Gives First Nod to Drilling, Fracking in NC*, WRAL.COM (June 13, 2011), <http://www.wral.com/news/state/nccapitol/blogpost/9724324/>.

¹⁶¹ *NC Legislature Eager To Allow Fracking*, NC STUDENT ENERGY NETWORK (May 23, 2011), <http://ncstudentenergynetwork.wordpress.com/2011/05/23/nc-legislature-eager-to-allow-fracking/>. See also, e.g., *Conservation Insider Bulletin*, N.C. LEAGUE OF CONSERVATION VOTERS (June 27, 2011), <http://nclcv.org/news/cib/20110627/>.

¹⁶² STATE OF N.C., OFFICE OF THE GOVERNOR, GOVERNOR’S OBJECTIONS AND VETO MESSAGE (June 30, 2011), available at <http://www.ncga.state.nc.us/sessions/2011/S709Veto/govobjections.pdf>.

¹⁶³ *Senate Bill 709 Information/History*, N.C. GEN. ASSEMBLY, <http://www.ncga.state.nc.us/gascripts/BillLookUp/BillLookUp.pl?Session=2011&BillID=s+709&submitButton=Go> (last visited Oct. 9, 2011); see also Denise G. Weeks, *House Calendar, 97th Legislative Day*, N.C. GEN. ASSEMB. (Sept. 12, 2011), available at <http://www.ncga.state.nc.us/Calendars/PastCalendars/House/2011/09-12-2011%20House%20cal.pdf>.

¹⁶⁴ *Conservation Insider Bulletin*, N.C. LEAGUE OF CONSERVATION VOTERS (Sept. 19, 2011), <http://www.nclcv.org/cib/cib-9-19-2011>.

¹⁶⁵ Julie Robinson, *NC General Assembly Update—2nd Special Session Concludes*, N.C. SUSTAINABLE ENERGY FOUND. (Sept. 15, 2011), <http://energync.org/blog/ncsea-news/2011/09/15/nc-general-assembly-update-2nd-special-session-concludes>; see also *Conservation Insider Bulletin*, *supra* note 164.

expressed his confidence that “it’s within one or two votes” of passing.¹⁶⁶

Is this in the best interest of North Carolinians? S.B. 709 threatens to formulate changes in the law to provide inroads for a new industry, the implications of which the state does not yet fully comprehend. Citizens are right to counsel caution in order to sufficiently consider the potential impacts to water and resulting consequences to human health. However, taking heed should not become an excuse for North Carolina to stick its fingers in its ears. It would be unwise for the state to ignore the possibility of natural gas development within its borders when drilling companies have already begun signing leases with its citizens.¹⁶⁷ North Carolina must prepare on a regulatory level. By failing to develop an adequate legal framework where an obvious gap exists, North Carolina would also be failing in its duty to protect its citizens from a serious risk. Natural gas is beneath North Carolina soil, the technology exists to extract it, and the industry is ready to do just that. The worst possible scenario would involve lifting the ban on fracking before implementing the necessary regulatory protections to safeguard the environment and the public health. This environmental nightmare played out in Pennsylvania, the so-called “poster-child for things that can go wrong when producing oil or gas,” in the form of poisoned drinking water wells and rivers.¹⁶⁸

Perhaps the real problem with S.B. 709 and S.L. 2011-276 is that the studies are misleading; neither articulates whether each study is a truly precautionary measure intended to guide policymaking decisions. Instead, this legislation gives symbolic

¹⁶⁶ Dan Way, *GOP Works to Override Governor’s Veto of Energy Jobs Bill*, CAROLINA JOURNAL (Oct. 10, 2011), http://www.carolinajournal.com/exclusives/display_exclusive.html?id=8341.

¹⁶⁷ Michael Futch, *The Shale Gas Boom: Energy Exploration in North Carolina*, THE FAYETTEVILLE OBSERVER, May 22, 2011, <http://fayobserver.com/articles/2011/05/22/1084179?sac=Home>.

¹⁶⁸ See Amy Mall, *Pennsylvania Continues to Lead the Pack with News of Inadequate Oil and Gas Regulation*, SWITCHBOARD —NAT. RESOURCES DEF. COUNCIL STAFF BLOG (April 12, 2011), http://switchboard.nrdc.org/blogs/amaill/pennsylvania_continues_to_lead.html (describing several serious incidents that have been associated with natural gas extraction activities, as well as industry pushback against stricter regulations).

lip service to environmental and public health concerns under the guise of careful circumspection. Viewed through this perspective, new laws and regulations should be enacted to effectively bolster the state's professed prioritization of environmental integrity and to ensure water security.

VI. TURN IT GREEN: A SEVERANCE TAX TO PROTECT NORTH CAROLINA'S DRINKING WATER

The studies ordered by S.L. 2011-276 and S.B. 709, Governor Perdue's veto of S.B. 709, and the environmental and public health hazards described above illustrate several points. First, a great deal of uncertainty exists as to the extent of the many potential risks to water associated with natural gas development. Secondly, North Carolina remains unprepared in terms of its regulations for an incoming natural gas industry. Finally, despite these risks and the regulatory void, there is a great deal of momentum to "get cracking on fracking."¹⁶⁹ In addition to the essential measures of tightening regulatory safeguards and requiring best management practices throughout the process, a conservation offset must be implemented. Specifically, a funding provision to benefit land acquisition and preservation is imperative. This should be funded by a severance tax on natural gas extraction in North Carolina.

A. *Of Taxes and Trees*

Currently, thirty-nine states impose severance taxes on various resources, from timber and fossil fuels to clams and oysters.¹⁷⁰ As of 2009, twenty-seven states taxed natural gas production¹⁷¹ by applying a fixed rate-based tax on the market price of natural gas.¹⁷² Most states allot the largest portion of revenue to a general

¹⁶⁹ Leslie, *supra* note 160 (quoting Rep. John Blust, R-Guilford).

¹⁷⁰ Julie Zelio & Lisa Houlihan, *State Energy Revenues Update*, NAT'L CONF. OF STATE LEGISLATURES (June 2008), <http://www.ncsl.org/default.aspx?tabid=12674>.

¹⁷¹ WOOD & WARD, *supra* note 39, at 23.

¹⁷² *Id.* at 26. There are three ways to levy a severance tax. A "volume-base" tax, often called a "well-head tax" when applied to natural gas or oil, assigns a certain fee per given quantity of gas. *Id.* at 25-26. A "fixed rate-based" tax, on the other hand, constitutes "a percentage of the price of the resource." *Id.* The

state government fund.¹⁷³ A portion can also go to local governments or to a fund dedicated to a specific purpose.¹⁷⁴ If commercial production of shale gas is in North Carolina's future, a severance tax must be levied on the extraction of natural gas to offset the potential environmental costs of those activities. The acquisition and preservation of natural land cover is a simple way to mitigate natural gas development's risks to the state's water supply, and to bolster other precautionary measures.¹⁷⁵

Natural land cover provides key ecosystem services, or "eco-services," to the state, its people, and its native species.¹⁷⁶ In

third type of severance tax is a hybrid that "include[s] both components." *Id.* Most states probably choose a fixed rate-based tax because this type of tax tracks the likely increase in price as natural gas, being a non-renewable resource, becomes more scarce. *Id.*

¹⁷³ PA. BUDGET AND POLICY CTR., SHARED COSTS, SHARED RESOURCES: STATE DISTRIBUTION OF SEVERANCE TAX REVENUES 1 (2009), *available at* <http://pennbpc.org/sites/pennbpc.org/files/How%20States%20Distribute%20Severance%20Tax%20Revenues.pdf>.

¹⁷⁴ *Id.* For example, some states "earmark in statute severance tax revenue for environmental cleanup or conservation," and set up a separate fund for that purpose. *Id.* Other states dedicate revenues to a permanent fund, "where severance tax dollars can be saved to invest for the future." *Id.* Dedicating a portion of North Carolina's severance tax to fund land acquisition and conservation, as this Recent Development suggests, could borrow from both of these ideas to fund immediate and future land acquisition and management.

¹⁷⁵ See KIM HOPPER, THE TRUST FOR PUBLIC LAND, SOURCE PROTECTION HANDBOOK: USING LAND CONSERVATION TO PROTECT DRINKING WATER LAND 10 (2005). This book describes land conservation as a "critical component of [water] source protection." *Id.* It is part of a "multi-barrier approach to providing clean drinking water" which also includes "treatment and filtration, and distribution system integrity. . . ." *Id.* Finally, this approach is described as "an extremely effective tool that can protect public health [and] prevent increased treatment costs." *Id.*

¹⁷⁶ See generally Robert Costanza et al., *The Value of the World's Ecosystem Services and Natural Capital*, 387 NATURE, 253 (1997), *available at* http://www.uvm.edu/giee/publications/Nature_Paper.pdf; see also Press Release, U.S. Endowment for Forestry and Communities, "Healthy Watersheds through Healthy Forests Initiative" Partners Announced 1 (Feb. 3, 2011), *available at* http://www.usendowment.org/images/HWHF_Press_Release_draft_1_12_10.pdf ("[T]he ecosystem value of forests [must] be recognized as a vital part of the nation's critical natural resources infrastructure."). See *Ecosystem Services*, U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE,

particular, forests are instrumental to maintaining water quality by filtering out nutrients and sediments from storm water that would otherwise pollute bodies of surface water.¹⁷⁷ Protecting forests and other important categories of land¹⁷⁸ will maximize these eco-services currently strained by various pressures such as population growth.¹⁷⁹ These eco-services, particularly those benefiting water quality and quantity, will be impaired by natural gas development in North Carolina. Creating a severance tax that will provide funding to acquire and protect land, and thereby maintain eco-services, is a smart investment in good water quality in central North Carolina.¹⁸⁰ Thus, the severance tax itself, and the portion to

<http://www.fs.fed.us/ecosystems-services/> (last updated Nov. 8, 2011) (“Forests provide a full suite of goods and services that are vital to human health and livelihood, natural assets we call ecosystem services.”).

¹⁷⁷ *Fact Sheet*, UPPER NEUSE CLEAN WATER INITIATIVE, http://www.ctnc.org/site/DocServer/UNCWI_Fact_Sheet_2011-01.pdf?docID=2681 (last visited Oct. 17, 2011).

¹⁷⁸ See LAND FOR TOMORROW, SAVING THE GOODLIEST LAND 19 (2005), available at <http://www.landfortomorrow.org/wp-content/uploads/2011/06/LFT.Resources.NAdocs.GoodliestLand-main.pdf>. The study indicates that the following types of land are important for water quality: rivers, wetlands, floodplains, and coastal waters; working forests; local parks and trails; state parks and trails; game lands and other natural areas; urban forests; and land visible from scenic highways. *Id.* at 10. The study also lists the following types of land as beneficial in providing flood protection: rivers, wetlands, floodplains, and coastal waters; working farms; working forests; state parks and trails; game lands and other natural areas; and urban forests. *Id.*; see also *Rivers and Lakes—Water Funds: Investing in Nature and Clean Water*, THE NATURE CONSERVANCY, <http://www.nature.org/ourinitiatives/habitats/riverslakes/water-funds-investing-in-nature-and-clean-water-1.xml> (June 22, 2011) (explaining the relationship between land degradation, loss of eco-system services, water quality degradation, and increased treatment costs).

¹⁷⁹ LAND FOR TOMORROW, *supra* note 178, at 4; see also *Healthy Watersheds through Healthy Forests Initiative: Background*, UNIV. N.C. ENVTL. FIN. CTR., <http://www.efc.unc.edu/projects/healthywatersheds.htm#efcrole> (last visited Oct. 17, 2011).

¹⁸⁰ See *Fact Sheet*, *supra* note 177 (“Land conservation is a cost-effective way to preserve the quality of drinking water sources in the basin.”). Many municipalities have employed land conservation. See, e.g., Elsa Brenner, *Croton to Buy Land to Protect Water Supply*, N.Y. TIMES, Oct. 3, 2004, <http://www.nytimes.com>. Organizations have also been formed to protect local watersheds by protecting the land. See, e.g., *Protecting Water by Protecting*

be dedicated to land acquisition and preservation, will be a function of many factors, which extend from economics to ecology. To start out, state lawmakers can look to other states' severance taxes on natural gas as models.¹⁸¹ For example, Arkansas assesses a tax on the market value of natural gas sold each month.¹⁸² The percentage of the tax, in turn, depends on the classification under which a given natural gas source falls.¹⁸³ The tax ranges from 1.25% to five percent¹⁸⁴ and is assessed on the producer who actually removes the natural gas from the ground.¹⁸⁵ Producers are allowed to deduct marketing costs when calculating the value owed in taxes.¹⁸⁶ But the severance tax comes with teeth: a misdemeanor charge and \$100–\$500 fine result from noncompliance.¹⁸⁷

Land: The Upper Neuse Clean Water Initiative, CONSERVATION TRUST FOR N.C., http://www.ctnc.org/site/PageServer?pagename=prot_upperneuse (last visited Oct. 17, 2011). National programs have also been initiated to fund this cause. See, e.g., Press Release, *supra* note 176 (discussing the “Healthy Watersheds Through Healthy Forests Initiative” of the U.S. Endowment of Forestry and Communities); THE TRUST FOR PUBLIC LAND, THE ECONOMIC BENEFITS OF LAND CONSERVATION 24–27 (Constance T.F. de Brun ed. 2007), available at http://www.njkeepitgreen.org/documents/econbens_landconserve.pdf (describing national efforts by The Trust for Public Land to protect water through a multi-barrier approach including forest conservation).

¹⁸¹ Using other state severance tax models in coming up with a severance tax in North Carolina will help provide the “[s]implicity, clarity and rate issues [that] are essential elements of good tax regulation.” THE LEAGUE OF WOMEN CONSERVATION VOTERS OF PA., MARCELLUS SHALE NATURAL GAS EXTRACTION STUDY, STUDY GUIDE IV: TAXING NATURAL GAS EXTRACTION FROM MARCELLUS SHALE, 4 (2009), <http://palwv.org/issues/marcellusshale/Marcellus%20Shale%20Study%20Guide%20Parts%201-5.pdf>.

¹⁸² 32 Ark. Reg. 5, NG-10 (Nov. 2008).

¹⁸³ *Id.* at NG-10. The four categories of natural gas wells are “Conventional Gas,” “New Discovery Gas,” “High-Cost Gas,” and “Marginal Gas.” *Id.* The Director of the Oil and Gas Commission determines the category in which to place a given well. *Id.* at NG-8.

¹⁸⁴ *Id.* at NG-6.

¹⁸⁵ *Id.* at NG-6(B).

¹⁸⁶ *Id.* at NG-4.

¹⁸⁷ *Id.* at NG-10(E).

B. *Pennsylvania: A Case Study*

Other states provide valuable insight into arguments for and against a severance tax on natural gas production. Pennsylvania is the most recent arena in which this battle has been waged.¹⁸⁸ After former Governor Edward Rendell proposed a severance tax on natural gas production in February 2009,¹⁸⁹ a fierce debate ignited between the “environmental coalition” and “the oil and gas industry” as to the relative merits of such a measure.¹⁹⁰ More than a year later, Governor Rendell signed the 2010-2011 budget into law, which included a “statement of the intention of the Democratic House Majority Leadership and the Republican Senate Majority Leadership” to enact a severance tax.¹⁹¹ Although the legislation was to be passed by October 1 of that year,¹⁹² it became entangled in the Pennsylvania General Assembly,¹⁹³ and as of the time of this writing the bill has yet to be passed.¹⁹⁴

¹⁸⁸ See generally WOOD & WARD, *supra* note 39.

¹⁸⁹ *Id.* at 3.

¹⁹⁰ Tom Barnes, *Environmental Groups, Drillers Debate ‘Severance Tax’ on Natural Gas*, POST-GAZETTE.COM (March 17, 2009), <http://www.post-gazette.com/pg/09076/956148-85.stm>. Environmental groups argue that a tax would “boost the state’s environmental stewardship funds, which pays for cleaning up streams and protecting state forests,” and could assist state agencies and local governments in paying for “added costs . . . and damage to the environment caused by drilling equipment.” *Id.* On the other hand, industry argues that the tax “will have a considerable negative impact on the state’s ability to compete with other states” for a natural gas industry. *Id.*

¹⁹¹ *Pennsylvania Legislature Expresses Intention to Enact a Natural Gas Severance Tax*, BRACEWELL & GIULIANI (July 15, 2010), http://www.bracewellgiuliani.com/index.cfm/fa/news.advisory/item/3714b13a-4a68-4d20-afb9-caf690cbab2d/Pennsylvania_Legislature_Expresses_Intention_to_Enact_a_Natural_Gas_Severance_Tax.cfm. The fiscal code was passed on July 6, 2010. *Id.*

¹⁹² *Id.*

¹⁹³ See *The Marcellus Shale Formation: Pennsylvania’s Natural Gas Severance Tax Controversy*, JONES DAY (Oct. 2010), http://www.jonesday.com/marcellus_shale_formation/ (commenting that the Pennsylvania legislature “has been embroiled in a fierce debate” over whether to pass the severance tax). As of October 2010, the legislature had already “missed the October 1 deadline and seems to be at an impasse.” *Id.* The General Assembly “has been divided along traditional lines” on this issue, “with environmentalists and Democrats largely

Governor Rendell contended that a severance tax would help shrink the budget deficit¹⁹⁵ as well as “compensate local residents for the disruption and environmental degradation” brought about by natural gas development.¹⁹⁶ This sentiment was echoed by the nonpartisan Pennsylvania Budget and Policy Center, which stated that a severance tax would provide a means of “internalizing” the “externalities” created by but “not fully paid for by the producers.”¹⁹⁷ Supporters of the tax note that other states impose severance taxes on the extraction of their resources, and that Pennsylvania is the lone “major fossil fuel producing state” that does not assess a severance tax.¹⁹⁸ These supporters point to other states that impose a severance tax on natural gas, noting that the tax has “not deterred resource exploration or production, or the growth of related employment.”¹⁹⁹ Finally, advocates argue that any added costs passed on to the consumers will be “more than offset” by the reduction in the cost of transporting natural gas.²⁰⁰

supporting a higher severance tax, while industry and Republicans seek lesser or no taxation.” *Id.*

¹⁹⁴ See Ry Rivard, *Report Warns of States’ Gas Fees*, CHARLESTON DAILY MAIL (Oct. 18, 2011), <http://www.dailymail.com/News/statenews/201110170215> (stating that “Pennsylvania has no tax on [natural] gas”).

¹⁹⁵ Barnes, *supra* note 190.

¹⁹⁶ JONES DAY, *supra* note 193.

¹⁹⁷ WOOD & WARD, *supra* note 39, at 3. “Externalities” are described as external costs of an economic activity, which are “not paid for by the firms and individuals enjoying the economic benefit of those activities.” *Id.* at 12. Such “externalities can occur long after the economic activity ends,” as when the coal mining industry in Pennsylvania ebbed and left the state with a costly problem of surface water contaminated by “acid mine drainage.” *Id.* at 13. Proponents of a severance tax argue that something similar could happen with natural gas development to the state’s drinking water. *Id.* at 18. Without a tax, this report argues, such costs “will not be taken fully into account by producers or consumers in making investment or consumption decisions. Instead, these costs will be borne substantially by state and local taxpayers.” *Id.* at 3.

¹⁹⁸ *Id.* at 3.

¹⁹⁹ *Id.* at 4.

²⁰⁰ *Id.* at 32. Because “transportation costs are a large portion of the final cost to consumers,” Pennsylvanians would ultimately pay less for natural gas produced at home. *Id.*

Opponents of the tax argue in turn that a severance tax will drive up expenses for natural gas drilling companies.²⁰¹ In turn, this would “destroy the industry in its formative years,”²⁰² driving it out of Pennsylvania and into states “where [the] taxing climate is more favorable.”²⁰³ If the industry remained in Pennsylvania, opponents of the tax highlight the concern that “consumers, not producers would bear the burden,” yet producers would still feel the pain when consumers turn to cheaper energy sources.²⁰⁴ Finally, those against a severance tax argue that ultimately, the benefits to the state from the revenue would be negligible.²⁰⁵ Incumbent Governor Tom Corbett agrees with this viewpoint and openly opposes a severance tax on natural gas.²⁰⁶ Pennsylvania’s ongoing battle over a severance tax, although inconclusive, offers helpful considerations for North Carolina legislators to ponder in constructing their own severance tax on natural gas extraction.

VII. CONCLUSION

All eyes are on North Carolina as its legislature contemplates the next step. Clearly, there are both useful and harmful aspects to natural gas and the technologies utilized to extract it from shale formations. Natural gas in the Deep River Basin promises a new

²⁰¹ ROSE M. BAKER & DAVID L. PASSMORE, PA. STATE INST. FOR RESEARCH IN TRAINING & DEV., BENCHMARKS FOR ASSESSING THE POTENTIAL IMPACT OF A NATURAL GAS SEVERANCE TAX ON THE PENNSYLVANIA ECONOMY 3 (2010), available at <http://ssrn.com/abstract=1667022>.

²⁰² ALEX KAPLAN & JAMES BROWNING, COMMON CAUSE EDUC. FUND, DEEP DRILLING, DEEP POCKETS: THE CAMPAIGN CONTRIBUTIONS & LOBBYING EXPENDITURES OF THE NATURAL GAS INDUSTRY IN PENNSYLVANIA 16 (2010), available at <http://www.commoncause.org/atf/cf/%7Bfb3c17e2-cdd1-4df6-92be-bd4429893665%7D/MARCELLUSSHALESTUDY.PDF>.

²⁰³ THE LEAGUE OF WOMEN CONSERVATION VOTERS OF PA., *supra* note 181, at 5.

²⁰⁴ BAKER & PASSMORE, *supra* note 201, at 18.

²⁰⁵ *Id.* at 3.

²⁰⁶ Borys Krawczeniuk, *Corbett: Natural Gas Tax Could Hurt Pa.*, POST-GAZETTE.COM (Mar. 17, 2011, 12:00 AM), <http://thetimes-tribune.com/news/corbett-natural-gas-tax-could-hurt-pa-1.1120608#axzz1eOc60Q6Q>. Governor Corbett believes that “the tax would not end state budget woes but could alienate ‘a cornerstone of the future.’” *Id.* Additionally, he is concerned that a tax would cause the natural gas drilling industry to move to other states. *Id.*

source of domestic energy and job growth for the state. However, this opportunity must be weighed against the potential harm to drinking water quality and quantity, and ultimately against the health of the North Carolinians for whom a clean, adequate supply is essential. The General Assembly may ultimately determine that these negative aspects outweigh the benefits and refuse to overturn the laws that currently prevent fracking. For now, however, the state should prepare itself—on a regulatory level—for the possibility of natural gas development. The General Assembly must enact legislation now to obtain the funding needed for land acquisitions to ensure drinking water security for the future. A budding natural gas industry can provide these funds through a severance tax on natural gas production. This Recent Development's proposal is one of give-and-take: only by giving back to "the goodliest soyle under the cope of heaven"²⁰⁷ can we continue to extract the water—and energy—we need.

²⁰⁷ Monique Prince, *Documenting the American South—Summary: The First Voyage to Roanoke*, UNIV. OF N.C. AT CHAPEL HILL, <http://docsouth.unc.edu/nc/barlowe/summary.html> (last visited Oct. 9, 2011) (quoting Ralph Lane, the first governor of Virginia); see also LAND FOR TOMORROW, *supra* note 178, at 1.

