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Fracing the Environment?: An Examination of the Effects and Regulation of Hydraulic Fracturing.

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COMMENT

FRACING THE ENVIRONMENT?: AN EXAMINATION OF THE EFFECTS AND REGULATION OF HYDRAULIC FRACTURING.

By Brian J. Smith[1]

I. INTRODUCTION

"[F]racing is now essential to economic production of oil and gas and commonly used throughout Texas, the United States, and the world,"[2] and as worldwide demand for fossil fuel rises, it will become an increasingly necessary practice. Recent technological advances in hydraulic fracturing ("hydro-fracing," "fracking," or just "fracing") allow developers access to oil and natural gas buried deep within shale formations that had been inaccessible. The evolution in technology brought a rapid increase in urban gas drilling, a change that could

1. Brian J. Smith, J.D. Texas Wesleyan School of Law, B.A. Texas Christian University. Special thanks to Preston Ward for helpful suggestions and criticism.

2. Coastal Oil & Gas Corp. v. Garza Energy Trust, 268 S.W.3d 1, 7 (Tex. 2008).

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have significant environmental consequences. Today, 80% of all wells drilled in the United States used fracing.[3]

But as is often the case, legal developments surrounding the process have not kept pace with technological developments. Section II of this Article explores the basics of the hydraulic fracturing process, including disposal of wastewater. The Article then examines the sources of the fracing water. Disposal of the wastewater is the focus of Section IV. Section V examines some of the environmental risks associated with the fracing process. Section VI analyzes the current regulations governing fracing, and Section VII suggests how the law could be improved to more adequately protect the environmental interests of residents and businesses while balancing the interests of developers.

II. THE PROCESS OF HYDRAULIC FRACTURING

Fracing is a process by which immense volumes of water and other fluids are pumped into a well with intense pressure forcing those fluids into subsurface rock formations.[4] The pressure creates cracks in the rock along natural fault lines in oval patterns, in opposite directions from the well.[5] The "frac fluid" contains small amounts of sand used to hold the fractures or "fracs" open against the enormous pressure that would otherwise force them shut as soon as the fluid drains.[6] When the frac fluid is drained, it leaves open cracks for gas and oil to flow to the wellbore.[7] Fracing increases the flow of gas or oil from the formation, ergo increasing production from that well.[8] Although originally developed as early as 1949, fracing has only recently become an essential component of oil and gas production.[9] Developers commonly use fracing throughout the State of Texas and also throughout the United States, and its use is increasing around the globe.[10]

A. *Frac Fluid Composition*

Frac fluid is typically composed of 98% fresh water and sand, with chemical additives comprising roughly 2% of the compound.[11] Recently, the New York State Department of Environmental Conserva-

3. Robert Evans, *Halliburton's Hydraulic-Fracturing Will Set World on Fire*, TECHEYE.NET (Nov. 9, 2010), http://www.techeye.net/science/halliburtons-hydraulic-fracturing-will-set-world-on-fire.

4. *Garza*, 268 S.W.3d at 6.

5. *Id.*

6. *Id.* at 6–7.

7. *Id.* at 7.

8. *Id.*

9. *Id.*

10. *Id.*

11. N.Y. DEP'T OF ENVTL. CONSERVATION, NATURAL GAS DEVELOPMENT AND HIGH VOLUME HYDRAULIC FRACTURING 42 (2009), http://www.dec.ny.gov/docs/materials_minerals_pdf/ogdsgeischap5.pdf.

tion collected compositional information on many of the additives that were proposed for use to frac shale formations in New York.[12] Six service companies and twelve chemical suppliers provided additive product compositional information to the department.[13] In all of the formulas there were a total of 260 different chemicals.[14]

Although the exact composition of frac fluid used in a particular well is unknown because most operators consider their formula to be a trade secret, operators have recently begun increasing disclosure in response to industry-wide pressure.[15] Interestingly, this pressure has not just come from environmental activists but increasingly from shareholders as well.[16] At this time, regulations governing disclosure are all over the map. On the one hand, Governor Perry signed an act in June of 2011 that will require operators in Texas to disclose the contents of the frac fluids they use.[17] On the other hand, two chemical manufactures in Wyoming have sought trade secret status with the state to avoid disclosing the chemical composition of their fracing fluid.[18] And the New York Department of Environmental Conservation recently concluded that hydraulic fracturing to drill for natural gas can be done safely and should be permitted in most of the state.[19]

In 2004, the Environmental Protection Agency ("EPA") conducted a study of the alleged dangers associated with fracing.[20] According to the report, some of the more dangerous chemicals found in frac fluid include benzene, toluene, ethylbenzene, and xyenes.[21] The report stated that the use of diesel fuel in fracturing fluids may introduce

12. *Id.*

13. *Id.* at 34.

14. *Id.*

15. Ben Casselman, *'Fracking' Disclosure to Rise*, THE WALL STREET JOURNAL, June 20, 2011.

16. Ben Casselman & Daniel Gilbert, *Investors Press Energy Firms on 'Fracking' Disclosure*, THE WALL STREET JOURNAL, May 24, 2011, http://online.wsj.com/article/SB10001424052702303654804576341732861572382.html.

17. Act of May 29, 2011, 82nd Leg., R.S., H.B. 3328, (to be codified at TEX. NAT. RES. CODE ANN. § 91.851), http://www.capitol.state.tx.us/tlodocs/82R/billtext/pdf/HB03328F.pdf.

18. Marie C. Baca, *Two Companies Seek Trade Secret Status for Fracking Fluids in Wyoming*, PROPUBLICA (Nov. 2, 2010), http://www.propublica.org/article/two-companies-seek-trade-secret-status-for-fracking-fluids-in-wyoming.

19. Delvin Barrett & Ryan Dezember, *Hydraulic Fracturing Backed by New York Agency*, THE WALL STREET JOURNAL, July 1, 2011, http://online.wsj.com/article/SB10001424052702303763404576418193848488766.html.

20. U.S. ENVTL. PROT. AGENCY, EPA 816-F-04-017, EVALUATION OF IMPACTS TO UNDERGROUND SOURCES OF DRINKING WATER BY HYDRAULIC FRACTURING OF COALBED METHANE RESERVOIRS; NATIONAL STUDY FINAL REPORT (2004) [hereinafter NATIONAL STUDY FINAL REPORT], http://www.epa.gov/ogwdw/uic/pdfs/cbmstudy_attach_uic_final_fact_sheet.pdf.

21. U.S. ENVTL. PROT. AGENCY, EPA 816-R-04-003, EVALUATION OF IMPACTS TO UNDERGROUND SOURCES OF DRINKING WATER BY HYDRAULIC FRACTURING OF COALBED METHANE RESERVOIRS: HYDRAULIC FRACTURING FLUIDS 4-11 (2004) [hereinafter HYDRAULIC FRACTURING FLUIDS], http://www.epa.gov/ogwdw/uic/pdfs/cbmstudy_attach_uic_ch04_hyd_frac_fluids.pdf.

these chemicals into underground sources of drinking water.[22] If this is true, introduction of these additives into drinking water in significant amounts could indeed raise serious health concerns.

Negative side effects of benzene exposure include a decrease in red blood cells, which can lead to anemia and excessive bleeding, ultimately affecting the immune system and increasing the chance for infection.[23] And prolonged benzene exposure is shown to increase risk of some cancers.[24] Toluene, likewise, has been linked to serious short-term and long-term health effects. Short-term effects include fatigue, nausea, weakness, and confusion.[25] Long-term effects of Toluene exposure include tremors; speech impairment; loss of hearing, vision, memory, and coordination; and liver and kidney damage.[26] Exposure to ethylbenzene can result in drowsiness, fatigue, headache, and eye and respiratory irritation in the short term and damage to the liver, kidneys, central nervous system, and eyes in the long term.[27] Xylene ingestion causes gastrointestinal distress and may cause toxic hepatitis.[28] In spite of the grave effects of these chemicals, the 2004 EPA report states that even though the process can introduce these chemicals into the water table, fracing is not a significant threat to drinking water.[29] Yet, the 2004 report has been widely criticized, forcing the EPA to begin a new study of the risks associated with fracing. The new study began in 2011 and will be completed in late 2012.[30]

B. *Water Usage*

Fracing horizontally-drilled wells requires an enormous amount of water. For example, it has been estimated that each well drilled in the Barnett Shale consumes approximately three million gallons of fresh water through production and completion, roughly 60% of which is groundwater; estimates for groundwater usage with fracing across the United States have been as high as 90%.[31] But as shale drilling in-

22. *Facts About Benzene*, CTRS. FOR DISEASE CONTROL AND PREVENTION, http://www.bt.cdc.gov/agent/benzene/basics/facts.asp (last visited July 8, 2011).

23. *See* HYDRAULIC FRACTURING FLUIDS, *supra* note 21.

24. *See Facts About Benzene*, *supra* note 22.

25. U.S. ENVTL. PROT. AGENCY, *Technical Factsheet on Toluene*, http://www.epa.gov/ogwdw000/pdfs/factsheets/voc/tech/toluene.pdf (last visited July 5, 2011).

26. *Id.*

27. DEP'T OF HEALTH & HUMAN SERVS., AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY, *Public Health Statement: Ethylbenzene* (2010), http://www.atsdr.cdc.gov/ToxProfiles/tp110-c1-b.pdf.

28. *Occupational Safety and Health Guideline for Xylene*, U.S. DEP'T OF LABOR, OCCUPATIONAL SAFETY & HEALTH ADMIN., http://www.osha.gov/SLTC/healthguidelines/xylene/recognition.html (last visited July 5, 2011).

29. NATIONAL STUDY FINAL REPORT, *supra* note 20.

30. *Hydraulic Fracturing*, U.S. ENVTL. PROT. AGENCY, http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/index.cfm (last updated Thursday, June 23, 2011).

31. JAMES BENÉ ET AL., TEX. WATER DEV. BD., NORTHERN TRINITY / WOODBINE GROUNDWATER AVAILABILITY MODEL: ASSESSMENT OF GROUNDWATER USE IN THE

creases, it is projected that surface water will soon become the primary source of fresh water used for fracing because surface water is the main water source in shale areas.[32]

Oil and gas operation in the Barnett Shale amounted to a mere 0.5% of all water use within the region in 2005, but given the rise in drilling activity, it will likely exceed 1.7% of total use when final numbers for 2010 are compiled.[33] Yet, projecting water use for more than a short time into the future can be difficult.[34] Water use in drilling operations can be subject to volatility in the natural gas market, changes in operations technology, regulatory restrictions, and in the Barnett Shale in particular, the actual geologic extent of the formation.[35] Thus, it is possible that actual water use could be much higher than these early estimates.

III. SOURCES OF WATER USED FOR FRACING

In order to fracture deep subsurface rock formations to extract oil and gas, operators must use a significant amount of water. But that water may reach the well from a variety of sources. It is common that the oil and gas lease will address water use directly, but this is not always the case. When the land cannot supply adequate water necessary for fracing, operators will purchase the water they need. This Section briefly explains operators' rights to use surface water and procurement of water for fracing operations where surface water is not adequate.

A. *Water on the Tract*

The mineral estate is the dominant estate. Thus, the mineral estate has an implied right to use water for the development of the minerals on that tract without liability to the surface owner.[36] For example, in *Sun Oil Co. v. Whitaker*, a surface owner sought to enjoin the mineral estate owner from using surface water for developing the minerals underlying the tract.[37] The surface owner alleged that the excessive use of surface water destroyed his crops.[38] But, the Texas Supreme Court found for the developer and held that the mineral estate can use water on the tract to aid in recovery of minerals on that tract. The dominant

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NORTHERN TRINITY AQUIFER DUE TO URBAN GROWTH AND BARNETT SHALE DEVELOPMENT 14 (2007), http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0604830613_BarnetShale.pdf; R. Marcus Cady, Comment, *Drilling Into the Issues: A Critical Analysis of Urban Drilling's Legal, Environmental, and Regulatory Implications*, 16 TEX. WESLEYAN L. REV. 127, 139 (2009).

32. JAMES BENÉ ET AL., *supra* note 31, at 14.

33. JAMES BENÉ ET AL., *supra* note 31, at 21–22; Cady, *supra* note 31, at 139.

34. JAMES BENÉ ET AL., *supra* note 31, at 21–22; Cady, *supra* note 31, at 139.

35. JAMES BENÉ ET AL., *supra* note 31, at 14–15; Cady, *supra* note 31, at 139.

36. Sun Oil Co. v. Whitaker, 483 S.W.2d 808, 810–11 (Tex. 1972).

37. *Id.* at 809.

38. *Id.*

estate theory is only limited by the accommodation doctrine and the requirement that the water taken from the land must be for the benefit of that tract. The catch, of course, is when tracts are pooled, the water from a single tract can be used to benefit all tracts within the pooled unit.

B. *Operators Purchasing Water*

Much of the water used in drilling operations comes from rivers, creeks, lakes, and discharge water from industrial or city wastewater treatment plants. Water can also be purchased from the city when drilling inside city limits and delivered through existing conduits, such as fire hydrants.[39] And with such high demand for water at drill sites, some cities have seized the opportunity to supply water to the operators. Inside the Marcellus Shale, the city of DuBois has sold oil and gas operators water at one cent per gallon, up to 400,000 gallons per day.[40] In that same shale, the Mt. Jewett Borough Water Authority is now selling water for four cents per gallon with a limit of 20,000 gallons per day.[41]

IV. How the Wastewater is Disposed

This Section examines the process of disposing wastewater from fracing and transportation of the wastewater from the tract, including the use of lined disposal pits on the drilling site. This Section concludes by briefly examining saltwater disposal wells and how wastewater is disposed for those wells in particular.

A. *Wastewater Disposal*

Oil and gas production yields enormous amounts of wastewater. The "frac water"—the billions of gallons of water mixed with sand and various chemicals used in the drilling process—that swells to the surface after fracing is known as flow-back water.[42] This flow-back water is waste, and it is contaminated with a variety of industrial chemicals, possibly including Benzene, a highly toxic substance.[43] Flow-back water has a typical concentration of 20,000 to 30,000 parts per million ("PPM") of chlorides and 40,000 to 50,000 PPM of total

39. Chesapeake Energy, *Natural Gas Production: Water Management*, AskChesapeake.com, http://www.askchesapeake.com/Barnett-Shale/Production/Pages/WaterManagement.aspx (last visited July 5, 2011).

40. *Marcellus Shale/Natural Gas: Monthly Roundup*, pottercountypa.net (Feb. 2010), http://www.pottercountypa.net/natural_gas/DevelopmentsFeb2010.pdf.

41. *Id.*

42. *See* Tom Kane, *New Hazard of Gas Drilling: Flow-back Water*, The River Reporter (Narrowsburg, N.Y.), Jan. 8, 2009, http://www.riverreporter.com/issues/09-01-08/news-backflow.html.

43. *See id*; Cady, *supra* note 31, at 140.

dissolved solids ("TDS").[44] Between 20% and 40% of water used for fracing returns to the surface as flow-back water within two to three weeks of the frac.[45] That means approximately 900,000 to 2.1 million gallons of water will flow back from fracing for each gas well drilled.

Another type of wastewater produced from fracing is subterranean saltwater which is expelled from the reservoir along with the remainder of the frac water when oil and gas are extracted.[46] This brine that flows from the well is creatively referred to as produced water. Produced water has a typical chloride concentration of over 70,000 PPM—many times saltier than ocean water—and a TDS concentration in excess of 150,000 PPM.[47] Because of their high salinity and chemical content, both flow-back water and produced water are corrosive to machinery and equipment and are toxic to humans. Either can poison groundwater and ruin soil to a degree that even the heartiest vegetation would have difficulty taking root for years to come. A significant leak or spill would create a barren wasteland on the surface surrounding the well site.

So where does all this water go? Operators in the Barnett Shale eventually dump wastewater into injection wells or saltwater disposal wells. But before the water can be moved, it often sits in tarp-lined pits at the drill site. The disposal wells are not necessarily adjacent to the drill site. Operators often haul the water along busy roads, across crowded intersections, and through residential neighborhoods. Because a single well may require over 100 hauls of fresh water and waste during the fracing process, the opportunity for an accident is significant. And there is risk operators may spill wastewater while dumping into these pits. It is also not unheard of for linings to leak, allowing chemical-ridden water to seep into the soil, perhaps for days before the problem is noticed and corrected.

B. *Saltwater Disposal Wells*

The Texas Railroad Commission ("RRC") issues all permits and has exclusive jurisdiction over the regulation of saltwater disposal wells ("SWD").[48] SWD wells are wells through which operators inject contaminated wastewater deep into rock formations to dispose of it.

44. Tom Hayes, Inst. Eng'r, Gas Tech. Inst., Development of Technologies for the Reuse of Flowback and Produced Waters Associated with Shale Gas Production, International Coalbed & Shale Symposium (May 20, 2010), http://www.rpsea.org/attachments/contentmanagers/3328/2010_Interntional_CSGS_Forum-Reuse_of_Flowback_and_Produced_Waters-Tom_Hayes-5-19-10.pdf; Cady, *supra* note 31, at 140.

45. *Gas Drilling Wastewater: Flowback and Brine Treatment in Pennsylvania*, MARCELLUS-SHALE.US, http://www.marcellus-shale.us/drilling_wastewater.htm (last visited July 7, 2011); Cady, *supra* note 31, at 140.

46. *See Gas Drilling Wastewater*, *supra* note 45; Cady, *supra* note 31, at 140.

47. Cady, *supra* note 31, at 140.

48. TEX. WATER CODE ANN. §§ 27.031, 27.002(6) (West 2008 & Supp. 2010).

The potential problem with this is that the toxic water could seep into water used for drinking or irrigation.

What a concerned landowner can do if an operator plans to drill a saltwater disposal well on his homestead may be limited. Unless the oil or gas lease restricts the mineral estate's rights, the mineral estate has the right to use the surface as reasonably necessary for the production of oil and gas. Unfortunately for the landowner, disposal wells are considered reasonably necessary for the production of oil and gas, but only for dumping waste *from that particular leasehold.*[49] Municipalities can further protect property owners near drill sites by ordinances limiting the number of new disposal wells or by requiring more stringent regulation of disposal. The City of Fort Worth, for example, now prohibits commercial disposal wells and has, for many years, imposed a moratorium on new SWD well permits within city limits.[50] Fort Worth also has ordinances requiring a closed-loop drilling system, whereby the need for storing wastewater in the lined pits before transport to a disposal well is obviated.[51]

The RRC permitting process offers some moderate protections to property owners. For example, every applicant for a saltwater disposal well permit must give notice and allow every "affected person" the opportunity to protest the application at a hearing before the RRC.[52] The Texas Administration Code defines an "affected person" to include any person who has or will suffer actual injury or economic damage—other than as a member of the general public—from the drilling of a new disposal well.[53] Under this definition, the owner of the surface tract upon which the well will be located, operators of wells within one-half mile, and the county clerk or other appropriate official all have a right to notice of a permit application and have an opportunity to protest.[54] Applicants for commercial disposal well permits must also give notice to the record owner of every adjoining surface tract.[55]

In order to obtain a permit for a disposal well, an applicant must show that: "(1) the injection well is in the public interest; (2) the use will not endanger or injure any oil, gas, or other mineral formation; (3) proper safeguards will protect surface and groundwater; and (4)

49. TDC Eng'g, Inc. v. Dunlap, 686 S.W.2d 346, 349 (Tex. App.—Eastland 1985, writ ref'd n.r.e.).

50. FORT WORTH, TEX., CODE OF ORDINANCES ch. 15, art. II § 15-42(A)(29) (2010), http://library.municode.com/index.aspx?clientId=10096&stateId=43&stateName=Texas.

51. *Id.* § 15-42(A)(3).

52. 16 TEX. ADMIN. CODE §§ 3.9(5)(E)(ii), 3.46(c)(1) (2011) (Tex. R.R. Comm'n, Disposal Wells, Fluid Injection into Productive Reservoirs).

53. *Id.* § 3.9(5)(A).

54. *Id.* §§ 3.9(5)(A), 3.46(c)(1).

55. *Id.* §§ 3.9(5)(B), 3.46(c)(2).

the applicant has satisfied the showing of financial responsibility."[56] The RRC has historically construed the public interest requirement liberally, such that increased oil and gas production alone can be enough of a public interest to justify issuing a new permit.[57] In *Texas Citizens for a Safe Future and Clean Water v. Railroad Commission of Texas*, the Austin Court of Appeals affirmed the district court's judgment that the Railroad Commission had not deprived disposal well permit opponents of due process rights in granting the permit for a disposal well.[58] The opponents argued that the expanded traffic on narrow, winding roads would create a safety hazard for pedestrians and children who often use the road; therefore, the SWD well was against the public interest.[59] But, the Commission found that the development of additional disposal wells in the Barnett Shale would in fact serve the public interest by allowing more opportunity for oil and gas production.[60] Ultimately, the Texas Supreme Court upheld the Commission's decision, finding its interpretation of "public interest" was entitled to deference on appeal at the trial court.[61]

In *Berkley v. Railroad Commission of Texas*, owners of land near a proposed wastewater well opposed the Commission's issuance of a SWD permit.[62] The landowners claimed that the granting of the permit allowed a trespass and constituted a taking of their land without compensation due to a failure to follow proper procedures and a lack of sufficient evidence.[63] They also claimed that the Commission did not have sufficient evidence to support a finding that the well was in the public's interest because evidence showed additional trucks traveling to and from the proposed well could cause public safety hazards and could damage surrounding properties.[64] The court, however, held that the mere presence of such evidence was insufficient to reverse the Commission's decision of allowing the well.[65] The court addressed the Berkleys' claims of trespass and taking, holding that just because an issued permit could cause some negative results does not mean the mere granting of a permit creates an actionable claim.[66]

The RRC has also imposed strict regulatory requirements for the drilling and operation of saltwater disposal wells. Operators must

56. TEX. WATER CODE ANN. § 27.051(b) (West Supp. 2010).
57. Grimes v. State, No. 03-04-00154-CV, 2005 WL 2043842, at *4 (Tex. App.—Austin, Aug. 26, 2005, no pet.) (mem. op.).
58. R.R. Comm'n of Tex. v. Tex. Citizens for a Safe Future & Clean Water, 336 S.W.3d 619, 633 (Tex. 2011).
59. *Id.* at 622.
60. *Id.*
61. *Id.* at 632.
62. Berkley v. R.R. Comm'n of Tex., 282 S.W.3d 240 (Tex. App.—Amarillo 2009, no pet.).
63. *Id.* at 242.
64. *Id.* at 244.
65. *Id.*
66. *Id.* at 242–43.

now enclose all zones above the disposal zone in steel casing and cement to prevent contamination of groundwater.[67] The disposal wells must also be drilled deep enough to reach the Ellenberger, porous limestone formations saturated with saltwater well below sources of fresh water. To police these regulations, the RRC has authority to go onto private property to inspect injection wells for compliance.[68]

The Fort Worth Star-Telegram recently reported two instances of serious disposal well leaks in the Barnett Shale. In October 2008, a well in Aledo, Texas was shut down due to both underground leaks and aboveground spills of wastewater.[69] A month later, in nearby Brock, leaks in a wastewater transmission pipe running beneath two plant farms caused the destruction of vegetation and probably resulted in long-term contamination of groundwater.[70] One theory regarding the cause of the leak is that the thousands of gallons of brine continuously pumped through the transmission pipe eventually corroded the metal tubing resulting in seepage and rupture of the pipe.[71] Regardless of the cause, this incident is indicative of the many problems inherent in transporting highly corrosive and toxic chemicals from drill sites. That is, hauling toxins in trucks through urban or residential areas increases the risk of spills or accidents, but pumping the fluids through underground transmission schemes may not be any safer. In fact, this method raises an additional concern about the difficulty of identifying and locating leaks in pipes buried beneath the surface.[72] Finally, perhaps the most worrisome safety concern is the flammability of waste byproducts from the drill site. Natural gas condensate, or "wet gas," a common byproduct in oil and gas operations, is highly flammable and has been known to ignite or explode even when handled and disposed of carefully.

C. *Recycling of Wastewater*

Some operators have looked into the possibility of recycling wastewater. Because of its extreme corrosiveness (possibly affecting not only the productivity of the well but also corroding the machinery and piping, resulting in further leaks), wastewater cannot be immediately reused for drilling purposes but would have to be first recycled and stripped of its salinity and chemical content.

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67. 16 TEX. ADMIN. CODE § 3.9(8) (2011) (Tex. R.R. Comm'n, Disposal Wells).

68. TEX. WATER CODE ANN. § 27.071 (West Supp. 2010).

69. Mike Lee, *Saltwater Disposal Well Shut Down for Spills, Leaks*, Fort Worth Star-Telegram, Oct. 31, 2008, http://startelegram.typepad.com/barnett_shale/files/saltwater_disposal_well_shut_down_for_spills_leaks.htm.

70. Chelsea L. McGowan, *Brock Residents Demand Testing on Well Water*, Weatherford Democrat, Nov. 6, 2008, http://weatherforddemocrat.com/local/x1155989062/Brock-residents-demand-testing-on-well-water?keyword=topstory.

71. *Id.*

72. *Id.*

Unfortunately, many recycling operations have been halted or severely cut back due to industry concerns of economic viability, inefficiency, and recycling capacity.[73] To an operator, it is far less expensive just to dump wastewater into a disposal well than to invest time and money toward establishing a recycling program.

V. ENVIRONMENTAL RISKS OF FRACING

The withdrawal of groundwater poses additional problems for a surface owner, such as insufficient downstream water, negatively impacting the quantity and quality of animal habitats, and increased droughts.[74] One of the main concerns regarding groundwater removal is aquifer depletion, which could affect public and private water supply wells.[75] Depletion occurs when more water is being removed from an aquifer at a rate greater than the recharge rate.[76] Aquifer depletion will reduce groundwater discharge to streams and lakes.[77] Flowing rivers and streams are merely a surface manifestation of what is flowing through the shallow soils and rocks; once the water is transported away from where it was taken, the water will not cycle back to the well source like it naturally would.[78]

Storm water runoff is a valuable source of water for lakes, streams, and aquifers.[79] But storm water has great potential to carry contaminates from drilling operations to lakes, streams, and into groundwater.[80] Drilling and fracing operations can alter the natural flow of storm water, allowing potential contaminants to be introduced to ordinary storm-water runoff.[81] Spills on the surface can occur as a result of tank ruptures, equipment or surface impoundment failures, overfills, vandalism, accidents, ground fires, or improper operations.[82] Spilled, leaked, or released fluids could flow to a surface body of water, infiltrate the ground, or be collected in storm water runoff reaching other bodies of water.[83]

Contamination of surface water and groundwater with fracing additives can occur as a result of failure to have proper storm water con-

73. Jack Z. Smith, *Wastewater from Natural Gas Drilling is Made Clean*, Fort Worth Star-Telegram, Oct. 23, 2010, http://www.star-telegram.com/2010/10/23/2570000/wastewater-from-natural-gas-drilling.html.

74. N.Y. STATE DEP'T OF ENVTL. CONSERVATION, DIV. OF MIN. RES., DRAFT SUPPLEMENTAL GENERIC ENVIRONMENTAL IMPACT STATEMENT ON THE OIL, GAS AND SOLUTION MINING REGULATORY PROGRAM, 6-4 (Sept. 2009), *available at* http://www.dec.ny.gov/docs/materials_minerals_pdf/ogdsgeischap6.pdf.

75. *Id.* at 6-6.

76. *Id.*

77. *Id.* at 6-7.

78. *Id.*

79. *Id.* at 6-15.

80. *Id.*

81. *Id.*

82. *Id.* at 6-16.

83. *Id.*

trols, ineffective site management, ineffective surface and subsurface fluid containment practices, poor well construction and grouting, or accidental spills and releases.[84] The *Garza* case demonstrates one of the main causes of groundwater contamination in fracing operations: no one can really be sure where drilling is going to go. And the same is true for the frac fluid once it is introduced into the ground—flow and destination cannot be controlled.

Flow-back water components are another significant environmental concern. Flow-back water can include undissolved solids, metals, gelling agents, and frac fluid.[85] Flow-back water can be released from hoses or pipes used to transfer the water to tanks, tank leakage, and leakage from on-site surface impoundment.[86] When a well is fraced, gas sometimes migrates from its current location into potable water due to the uncontrollable nature of the fracing process.[87] Flow-back water and frac fluid are classified as non-hazardous industrial waste, which generally does not require manifesting, and usually prevents tracking and verification of disposal destination on an individual load basis.[88]

VI. Current Regulations Governing Fracing

This Section reviews federal, state, and municipal regulations that govern hydro-fracing in Texas, specifically detailing how the city of Fort Worth has addressed the concerns of both landowners and operators.

A. *Regulations of Groundwater Pollution*

Water pollution is potentially a serious risk of fracing. Some of the many pollutants common to drill sites are crude oil, flow-back water, the highly toxic frac fluids, and treatment chemicals, among many others. And again, a considerable amount of salty produced water can come to the surface through drilling operations, which by itself is a significant threat of groundwater contamination.

There is extensive federal regulation of water pollution: the Clean Water Act,[89] the Oil Pollution Act ("OPA"),[90] the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"),[91] and the Resources Conservation and Recovery Act

84. *Id.*
85. *Id.* at 6-17.
86. *Id.*
87. *Id.* at 6-36.
88. *Id.* at 6-38.
89. Clean Water Act, 33 U.S.C.A. §§ 1251–1287 (West 2000 & Supp. 2011).
90. Oil Pollution Act, 33 U.S.C.A. §§ 2701–2762 (West 2000 & Supp. 2011).
91. Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601–9675 (2006).

("RCRA")[92] all seek to preserve the integrity of fresh water. The Safe Water Drinking Act ("SWDA"), however, is the only federal law significant to groundwater pollution in urban and suburban areas.[93] The SWDA charges the Texas Commission of Environmental Quality ("TCEQ") with regulation of water pollution across the State of Texas.[94] But the propriety of this charge is questionable since prevention and remediation of pollution caused by oil and gas activities are well within the jurisdiction of the RRC.[95]

The standards and procedures for reporting pollution, the requirements for clean-up, and the penalties for causing groundwater pollution from oil and gas activities are found in title 16 of the Texas Administrative Code governing "Economic Regulation" and are enforced by the RRC. Texas law broadly defines groundwater pollution as:

> Pollution of surface or subsurface water—The alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any . . . water in the state that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property, or to public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purposes.[96]

Operators who discover any discharge of oil and gas waste must immediately notify the appropriate local authorities (usually an RRC field office) and take steps to contain the waste and "to protect human health and the environment."[97] The party responsible for the discharge must begin cleaning up as much of the waste as possible, as soon as possible after discovering the spill. The operator must restore the site of the accident to a state that "no longer presents a hazard to human health or the environment."[98]

In 2005, the Energy Policy Act amended the SWDA, creating what is known as the "Halliburton loophole," one of the major amendments that excludes the use of fracing fluid from the SWDA.[99] That section provides the chemical composition of frac fluid does not need

92. Resources Conservation and Recovery Act, 42 U.S.C. §§ 6901–7000 (2006).

93. 42 U.S.C. § 300(f) (2006).

94. TEX. WATER CODE ANN. § 26.121 (West 2008).

95. TEX. NAT. RES. CODE ANN. § 91.101 (West 2011); TEX. WATER CODE ANN. § 26.131(b); TEX. HEALTH & SAFETY CODE ANN. § 361.003(11)(B)(i)–(iii) (West 2010).

96. 16 TEX. ADMIN. CODE § 3.8(a)(28) (2011) (Tex. R.R. Comm'n, Water Protection); 30 TEX. ADMIN. CODE § 327.2(14) (Tex. Comm'n on Envtl. Quality, Definitions).

97. 16 TEX. ADMIN. CODE § 3.98(x)(1)(A), (2)(A) (Tex. R.R. Comm'n, Standards for Management of Hazardous Oil and Gas Waste).

98. *Id.* § 3.98(x)(3)(A)–(B).

99. Energy Policy Act of 2005, Pub. L. No. 109-58, § 322(1)(B)(ii), 119 Stat. 594, 694.

to be disclosed to the EPA.[100] Before the amendment, the SWDA allowed the EPA to take action against anyone who used underground injection activities that would endanger drinking water by introducing contaminates into the water.[101]

The efficacy of these provisions is still uncertain in practice. For example, in the event of a spill, the nearest RRC field office may be hundreds of miles from the site of the accident. The RRC did not even have an office in Tarrant County until late 2008, in spite of the proliferation of oil and gas activity in the Barnett Shale since at least 2005.[102] Until the Fort Worth field office was established, all activity in the north Texas area fell to the jurisdiction of a district office in Kilgore, Texas.[103] How effective could oversight have been in situations where the nearest regulatory authority is a several-hour drive from the drill site?

B. *Fort Worth's Regulation of Fracing*

Rather than wait for the RRC, Fort Worth responded to the rise in drilling activity through several 2006 amendments to its 2001 ordinance.[104] As citizen complaints of violations by operators increased, the City appointed an eighteen-member task force to consider possible amendments that would better balance the interests of operators and residents.[105] The drilling ordinance currently in effect was adopted in December 2008. Under the new rules, Fort Worth regulates noise levels, drilling of fresh water wells, compressor stations, landscaping and screening, drilling within a floodplain, saltwater disposal, measures for controlling water quality, road repairs, and sets the allowable distance from existing structures that wells may be drilled. The ordinance also provides for the appointment of a gas inspector to enforce these provisions.

1. Gas Well Permits

Under the old ordinance, wells were divided into three categories: (1) high impact; (2) urban; or (3) rural. The 2008 ordinance, however, classifies wells based upon their distance from existing structures. Under the new ordinance, "a well permit shall not be issued for any

100. *Fracking Hazards Obscured by "Halliburton Loophole"*, NEWSINFERNO (Sept. 2, 2010), http://www.newsinferno.com/health-concerns/fracking-hazards-obscured-by-halliburton-loophole/.

101. *Id.*

102. *Texas Railroad Commission to Open Fort Worth Office*, Basin Oil & Gas, Sept. 2008, http://www.fwbog.com/index.php?page=article&article=37.

103. *Id.*

104. *See* FORT WORTH, TEX., CODE OF ORDINANCES ch. 15, art. II (2010), http://library.municode.com/index.aspx?clientId=10096&stateId=43&stateName=Texas.

105. Will Brackett, *New Task Force Set to Study Barnett Gas Well Ordinance*, Fort Worth Bus. Press, Feb. 15, 2008, http://www.fwbusinesspress.com/archives (search "Task force" Search Term1, "Brackett" Search Author).

well to be drilled within six hundred (600) feet of a Residence, Religious Institution, Hospital Building, School, or Public Park."[106] The City may, however, permit such a well if it is either approved by the City Council after notice and public hearing, or if all "Protected Use" property owners give express written consent.[107] If approved, a well may be drilled as close as 300 feet from a public building or 200 feet from a habitable structure.[108]

Although there is no specific approval process to obtain a permit for gas wells beyond the 600-foot radius, an applicant must still give several forms of notice.[109] Before filing a permit application, the operator must first publish notice of intent to file in a local newspaper for at least ten consecutive days.[110] The operator must also conspicuously post signs around the proposed drill site at least ten days before submitting the application.[111] Upon filing the application, the City will mail, at the applicant's expense, notice to surface owners within 1,000 feet of the proposed well.[112]

The ordinance also requires every application include: (1) a plat of all structures and improvements within 600 feet and a list of the owners of record; (2) a description of the water source to be used; (3) RRC permit information; (4) a road maintenance plan; (5) an EPA storm water pollution prevention plan; (6) a noise management plan; (7) a surface reclamation plan; (8) a TCEQ determination of groundwater depth; and (9) a showing of financial responsibility.[113] Most significantly, Fort Worth's new ordinance requires operators to use a closed loop mud system, which internally contains the waste generated during drilling. This obviates the need for the tarp-lined "mud pits" common in other areas.[114] The ordinance also requires trucks to use designated truck routes or commercial delivery routes rather than residential roads.[115] Drilling on urban gas sites may be conducted at any time. Hydraulic fracturing, work over operations, and deliveries, however, all must be conducted during daylight hours and may not be performed on Sundays.[116]

These new restrictions were in place for almost a full year before the City of Fort Worth finally rejected an application.[117] In October

106. FORT WORTH, TEX., CODE OF ORDINANCES ch. 15, art. II, § 15-36(A).
107. *Id.* § 15-36(A)(1)–(2).
108. *Id.* § 15-42(C)(1)(d)–(e).
109. *Id.* § 15-36(E)(1)–(3).
110. *Id.* § 15-36(E)(2).
111. *Id.* § 15-36(E)(3).
112. *Id.* § 15-36(E)(1).
113. *Id.* § 15-35(C).
114. *Id.* § 15-42(A)(3).
115. *Id.* § 15-42(A)(37).
116. *Id.* § 15-42(A)(16), (41).
117. John-Laurent Tronche, *City Council Rejects Chesapeake's Request for Eighth Avenue Drill Site*, Fort Worth Bus. Press, Oct. 7, 2008, http://www.fwbusinesspress.com/archives (Search "Ryan Place" Search Term1, "Tronche" Search Author).

of 2008, the City Council unanimously rejected an application by Chesapeake Energy to drill a well within 300 feet of existing homes.[118] Chesapeake attempted to alleviate safety and pollution concerns by promising interested neighborhood groups it would take certain precautions to reduce noise, divert trucks from residential streets, run gas pipelines along rail lines, and build walls to hide graffiti-decorated railcars from view.[119]

2. Disposal of Wastewater

The Fort Worth ordinance disallows commercial saltwater disposal within the city, and permits for private wells are only available if stringent specifications are met.[120]

The City does grant some, perhaps dangerous, concessions to oil and gas operators. Chesapeake Energy, for example, operates a saltwater disposal well near downtown Forth Worth under an agreement allowing the company to pipe wastewater from thirty-one gas wells to a single disposal well within the city limits.[121] In return for this grant to Chesapeake, the City reserved the right to experiment with innovative recycling techniques for future utility revenue generation by attempting to recycle a portion of the wastewater.[122]

The Fort Worth ordinances are a step in the right direction but are far short of a final solution. It is inescapable that oil and gas production will generate some wastewater. And the problems of wastewater disposal are compounded with urban drilling because of the increased traffic and population density. Imposing strict regulations on very limited urban disposal programs can mitigate some of the risks of disposal but do not make it completely safe. The best solution is some form of wastewater recycling. Sadly, developers do not see the cost of recycling wastewater to be worth the environmental benefits in doing so. It may take a significant technological development for developers to begin recycling on their own initiative. Without advances in recycling technology, operators will continue to view trucking or piping waste to rural disposal wells and disposal programs within the city limits as their only options. Until then, the heavy hand of the state will likely remain the only possible incentive for oil and gas operators to further explore recycling techniques.

C. *Other State and Municipal Regulation of Fracing*

On November 16, 2010, the city of Pittsburgh, Pennsylvania adopted an ordinance, by unanimous vote, banning natural gas drilling

118. *Id.*
119. *Id.*
120. FORT WORTH, TEX., CODE OF ORDINANCES ch. 15, art. II, § 15-42(A)(29).
121. *Id.*
122. *Id.*

in the city.[123] The mayor must sign the ordinance before it becomes effective. If he refuses to sign it, the council can overrule his veto by vote.[124] Drilling companies have indicated that they may challenge the ban in court.[125] The New York State Senate passed a fracing moratorium, withholding issuance of all permits in the Marcellus Shale area through May 15, 2011.[126] This ban of fracing gave the New York Department of Conservation an opportunity to fully investigate the negative effects associated with fracing.[127] In spite of the moratorium, the Department concluded that fracing can be done safely and recommended that New York continue to permit the practice in order to develop shale gas, and the moratorium was not extended.[128]

Texas has recently taken a large regulatory step by becoming the first state to require public disclosure of the chemicals used in hydraulic fracturing.[129] The new law requires operators to publicize not only what chemicals they use but also the amounts used.[130] Operators must begin disclosure by July 2012.[131] Nevertheless, it will probably be some time before it is certain what effect disclosure will have. But, disclosure will undoubtedly begin to alleviate some environmental concerns and is an important step toward balancing both economic and environmental interests.

VII. SOLUTIONS FOR SUSTAINABILITY

Current regulations and rules that govern fracing are inconsistent and largely inadequate to assuage concerns of public health and safety. Solving this problem will most likely require government mandates requiring operators to reveal the chemical composition of the fracing fluid and possibly regulations on the contents and composition of the fluids. But, disclosure and regulation is only a start—albeit an important one. Regulation regarding spills and clean up of wastewater could still be tightened. Some water contamination may be an unfortunate inevitability of the fracing process at this time, but where contamination occurs, the contamination has to be cleaned up quickly and appropriate notification be made to the public when accidents do

123. Mari Margil & Ben Price, *Pittsburgh Bans Fracking (and Corporate Personhood)*, ALTERNET.ORG (Nov. 16, 2010), http://www.alternet.org/water/148881/pittsburgh_bans_fracking_(and_corporate_personhood)_?page=entire.

124. *Id.*

125. *Id.*

126. Abrahm Lustgarten & Nicholas Kusnetz, *New York Senate Passes Temporary Ban on Hydraulic Fracturing*, PROPUBLICA.ORG (Aug. 4, 2010), http://www.propublica.org/article/new-york-senate-passes-temporary-ban-on-hydraulic-fracturing.

127. *Id.*

128. Barrett & Dezember, *supra* note 19.

129. *See* Act of May 29, 2011, 82nd Leg., R.S., H.B. 3328, (to be codified at TEX. NAT. RES. CODE ANN. § 91.851), http://www.capitol.state.tx.us/tlodocs/82R/billtext/pdf/HB03328F.pdf.

130. *Id.*

131. *Id.*

occur. Effective and efficient clean up requires cooperation between government agencies and operators, which necessitates the need for meaningful but sensible regulation. Although it is too early to tell what effect Texas's new disclosure law will have, more states should consider adopting similar provisions.

But what may be more important over the long term is controlling the amount of surface and ground water used for fracing. The massive fresh water consumption associated with hydraulic fracing is rapidly depleting available fresh water resources both on the surface and below. To address the consumption problem, recycling should be required for all water that flows back to the surface after the fracing process. State governments should be prepared to use both the carrot and the stick to promote recycling efforts. That is, local governments should begin subsidizing programs to develop more efficient and cost-effective water-recycling technology, but as technology improves, governments may eventually need to implement penalties for developers that do not recycle or that still consume too much water. Without developments in recycling practices and technology, recycling will not be a long-term, economically feasible option for producers and could possibly lead to increases in the price of natural gas. But without also implementing incentives for operators who take steps to recycle, these advances are not likely to arrive any time soon.

States and municipalities should also consider targeted regulation concerning disposal wells. Currently, Texas law appears to presume that the need for additional disposal wells outweighs concerns of nearby residents on the grounds that economic development is in the broader public interest. Although it is undisputed that economic development is in the public interest, more could be done to regulate the location of these wells, such as requiring a disposal well be no closer than 2000 feet from a residence like Fort Worth does. Because disposal wells, in particular, are prone to leaking, states and municipalities with high urban drilling activity should consider adopting a regulatory scheme similar to the Fort Worth ordinance discussed above.

These regulatory steps must be taken proactively in order to be effective. The City of Fort Worth was forced to respond to many of these problems after drilling and fracing in local neighborhoods had begun to affect residents' daily lives. But such reactionary regulation often results in solutions that are less than ideal for both residents and developers due to perceived urgency to act. For regulatory changes to be effective and balanced, municipalities should focus on implementing regulation before, or shortly after, the first wells in an area are drilled. Due to the growing need for energy sources, any type of blanket prohibition against standard fracing practices would not be feasible because the hydraulic fracturing is the only method for accessing oil and gas reserves buried within shale formations. Public safety, however, should not be pushed aside either. For these reasons, regu-

lations that reward operators who implement advanced technologies that more effectively re-use water and dispose of waste will have better long-term effect than restrictive, prohibitory directives.

VIII. CONCLUSION

Only in recent years has hydraulic fracturing come into widespread use. But if current trends continue, this practice will only increase over the next several years. Unfortunately, this will likely be a heavily litigated issue before real, significant legal developments in the regulation can take effect. To be truly effective, prospective regulation must adequately protect the interests of landowners and residents near drill sites without stifling economic development, so far proven to be a difficult task. But every state or municipality that takes affirmative steps to ensure safety creates another legal experiment in effectively regulating the industry. For good or for bad, production of oil and gas is a necessary part of modern life and integral to the world's infrastructure, and production from dense residential areas is a necessary component of that industry. Thus, rules and regulations must be adopted to ensure that fracing in urban areas can continue to be carried out safely and that residents who live near drill sites will not be afraid of harm caused by byproducts of oil and gas production.