Managing the Risks From Hydraulic Fracturing and Oil and Gas Development Of the Marcellus Shale Region

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Hydraulic fracturing, or “fracking,” to develop oil and gas reserves is a hot topic across the country, and nowhere hotter than the Marcellus Shale region. Stories of water contamination permeate the media and most are based on conclusory allegations.

Legislatures and regulatory agencies have responded, initiating studies such as those being conducted by the U.S. Environmental Protection Agency in Dimock, Pa., and Pavillion, Wyo. In addition, New York state has imposed a moratorium pending what has become a lengthy scientific review with political overtones. Meanwhile, the estimated domestic supplies of oil and gas that can be developed through hydraulic fracturing are staggering.

Hydraulic fracturing has been used for more than 60 years and is a well understood and soundly engineered practice. The process, which opens up the reservoir rock containing oil and gas to improve recovery, is credited with substantially increasing U.S. recoverable oil and gas reserves. So, is hydraulic fracturing a cause for concern? What are the real risks and do they outweigh the benefits?

Knowing the facts and understanding the science is critical to providing valuable advice and proactively taking measures to manage potential litigation issues. This article examines oil and gas development, including hydraulic fracturing, and discusses the best practices that oil and gas producers, private equity investors, law firms, and others can use to help mitigate the risks.

THE CURRENT CLIMATE

The hydraulic fracturing debate is strongly polarized. Consider one week in mid-February. In Harrisburg, Pa., a contingent of roughly 100 concerned citizens pressed the Susquehanna River Basin Commission to stop issuing permits for new water withdrawals until more environmental studies of hydraulic fracturing are completed.

Simultaneously, at a scientific conference on the other side of the continent, the Energy Institute at the University of Texas at Austin released its independent study on shale gas development. Although media coverage is generally negative, the
A detailed evaluation, funded by the university and not supported by energy companies, concluded that there is no evidence of environmental impact from hydraulic fracturing.

A few days later, a New York state judge upheld the town of Dryden’s ban on hydraulic fracturing in what is the first test of local law trumping state law in New York. And recall the flaming faucet in the documentary film “Gasland”? On the same day as the Dryden court ruling, a Texas judge found that the flaming water in a home outside Fort Worth was a hoax and actually a conspiracy to incriminate the producer for the presence of natural gas in the homeowners’ well water.

So, what’s really going on? Is hydraulic fracturing a major risk to human health and the environment or a beneficial technology undergoing undue scrutiny?

THE FACTS ABOUT FRACKING

While the boom in shale development is a phenomenon of the past decade, hydraulic fracturing to improve oil and gas recovery actually has a long history, as expertly presented in “Hydraulic Fracturing: History of an Enduring Technology.” In early 1949, a predecessor to Halliburton performed the first commercial frack of a well in Velma, Okla., for Standard Oil. More than 300 wells were eventually fractured that first year, increasing to more than 3,000 wells per month during the 1950s. Hydraulic fracturing in shale development accelerated in the last decade; it is estimated that more than a million wells have been fracked, and around 60 percent of all wells drilled today are hydraulically fractured.

Why so much fracking? Hydraulic fracturing is credited with increasing U.S. recoverable natural gas reserves by 90 percent and crude oil by at least 30 percent.

Key to the public’s concern are the chemicals used. A typical slick-water fracturing fluid — the type used in the Marcellus and other shales — is about 99.5 percent water and sand. Hydraulic fracturing uses water pumped at high pressure to crack the reservoir rock and thereby allow more oil and gas to flow into the well. Sand is pumped down the well with the water to lodge in these cracks and hold them open after fracturing is complete.

The remaining 0.5 percent of the fluid consists of a small number of chemicals such as a gellant to thicken the water and allow better suspension of the sand, a friction reducer to decrease the required pumping pressure, a biocide to minimize bacterial growth, and a scale inhibitor to prevent deposits from plugging the well pipe. This formulation is based on considerable research and engineering, some of which is absolutely proprietary.

Several states now require disclosure of the chemicals used on a well-by-well basis. FracFocus (www.fracfocus.org) is evolving as the national registry for disclosing this chemical information. Currently, five states — Texas, Colorado, Montana, Louisiana and North Dakota — mandate the use of FracFocus, while four others — Oklahoma, New Mexico, West Virginia and California — are considering it. The Marcellus Shale Coalition also requires its members to use FracFocus, and information for many wells drilled in Pennsylvania, West Virginia and Ohio is available.

Hydraulic fracturing uses roughly 4 million to 6 million gallons of water per well, a number that has increased as longer horizontal lengths are drilled and multi-stage fracks are completed. This is not an insignificant volume of water, but, according to one energy company, comparatively is the same amount as needed to grow eight...
acres of corn, irrigate a golf course for a month, or operate a large (1,000-megawatt) coal-fired power plant for 12 hours. Many oil and gas producers are moving to water recycling, using the same water in multiple fracks and thereby reducing the amount being sourced and ultimately requiring disposal.

CASES IN THE SPOTLIGHT: DIMOCK

With all of that activity over a 60-year history, it seems reasonable to assume that if there was a major environmental problem associated with hydraulic fracturing, it should have reared its head by now in the form of ample scientific evidence. While there have been a handful of sites with alleged groundwater impacts from fracking, two have captured the spotlight: Dimock and Pavillion. Both are being investigated by the EPA.

In Dimock, a small town in northeastern Pennsylvania, some residents observed impacts to their water in 2009 when shale gas drilling started in the area. The impacts included cloudiness, discoloration and odor. An immediate linkage to hydraulic fracturing was asserted since the impacts were noted shortly after drilling began.

Sampling identified the presence of dissolved methane, leading the Pennsylvania Department of Environmental Protection to shut down drilling operations and require the producer to provide an alternate source of drinking water and eventually install treatment systems in the affected homes. In the consent order with the producer, DEP cited the presence of dissolved methane and/or combustible gas showing up within six months of completing the wells, and therefore the producer was assumed to be responsible for the impacts.

The producer has continued to sample the water and, in 2011, the EPA reviewed the data and initially determined that there was no immediate health threat. In January, after further data review, the EPA changed its decision, citing elevated levels of arsenic,
barium, manganese, phenols, sodium and turbidity. Furthermore, the EPA decided to provide water to four homes as an emergency removal action under the authority of Section 104(a) of the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. § 9601, and to conduct its own water testing at more than 60 homes. In mid-March and early April, the EPA released the testing data for 31 of those homes, stating that the test results do not support a health concern. Sampling is ongoing, and the story will continue.

While the circumstantial cause-and-effect explanation sounds intuitive — drilling and fracturing started, observable impacts were noted, dissolved methane and other compounds were detected — there are some problematic holes in that logic when considering the science.

As noted in the Energy Institute study, there is a tendency to assume that “observations of sudden onset of water well contamination are caused by some form of leakage of fluids from the gas well. For methane contamination, the gas must become dissolved (to the methane saturation point) in groundwater surrounding the gas well, followed by the flow of this water through the aquifer to surrounding water wells.”

The study then identifies several flaws in the cause-and-effect logic:

• **Timing** — Most well owners state they observed impacts as soon as drilling and fracturing began or shortly thereafter. From a groundwater flow and transport standpoint, however, it is hydrogeologically impossible for allegedly impacted water to flow from the oil or gas well to the water well in this timeframe.

• **Nature of detected “contamination”** — Metals, including iron, manganese and arsenic are the “contaminants” most commonly detected in water well samples. Yet none of these are typical of the fluids used in fracturing or the return flows from the well post frack.

• **State of nature** — As more information becomes available on the natural condition of groundwater overlaying areas where natural gas is present, including the Marcellus Shale, the data suggest that dissolved methane is a natural occurrence. While some impacts are indeed present at Dimock, they do not appear to be from hydraulic fracturing. Their source and cause is unclear but may be naturally occurring. Fortunately, the detected concentrations do not exceed health standards. A more definitive answer would be possible if baseline water-quality data prior to drilling were available.

**PAVILLION**

Pavillion is located in west-central Wyoming above the Pavillion gas field. Similar to Dimock, the EPA collected groundwater samples under CERCLA authority after residents complained of taste and odor issues following hydraulic fracturing of nearby gas wells. As documented in the draft investigation report, the EPA took four samples between March 2009 and April 2011, sampling domestic, municipal and livestock wells as well as installing and sampling two deep monitoring wells (784 and 918 feet). Based on the sample results, the EPA concluded in its report that “constituents associated with hydraulic fracturing have been released in the Wind River drinking water aquifer at depths above the current production zone.”

Many oil and gas producers are moving to water recycling, using the same water in multiple fracks.
The EPA acknowledged that arriving at this conclusion was complex and necessitated multiple lines of reasoning. Several of these were the detection of petroleum hydrocarbons, man-made compounds such as isopropanol and glycols, as well as breakdown products from these compounds. However, the confounding issue with the detection of these compounds in groundwater is that they were also detected in blank samples (*e.g.*, trip blanks, equipment blanks and field blanks) employed for quality-assurance/quality-control purposes. Blank samples are used to evaluate whether contaminants have been artificially introduced in the field or laboratory as a result of inadequate equipment decontamination, ambient conditions, shipping and handling procedures, or other sources resulting in biased analytical results.

And for those samples where a duplicate sample was also collected, the relative percent difference between the detected concentration in the sample and its duplicate was high for several compounds. These occurrences suggest some issues related to data quality resulting from the sample matrix, field-sampling techniques, or laboratory analytical procedures, and raise questions about their validity. The EPA report also goes on to state that baseline data prior to hydraulic fracturing would have been valuable in assessing any impact to groundwater.

The draft report is undergoing peer review, the wells will be retested, and like Dimock, the story at Pavillion will continue.

**BEST PRACTICES PROVIDE RISK MANAGEMENT**

As evident from the debate surrounding Dimock and Pavillion, baseline groundwater data are immensely valuable and the collection of such data is becoming a best practice. Do other practices provide similar or greater value? Indeed the industry is developing and employing many best practices for these reasons.

The Marcellus Shale Coalition has developed best practices to guide member producers across the spectrum of their exploration and production activities. And the Canadian Association of Petroleum Producers has developed a suite of practices tailored specifically to hydraulic fracturing. Some of the key areas covered by such practices include:

- Well design and construction
- Site operations
- Hydraulic fracturing chemical use and disclosure
- Water management

Proper well design and construction may be the most important practice. Rigorous engineering, construction, and testing will ensure well integrity and minimize the chances for an unintentional release from leakage, blowout or hydraulic fracturing. This includes requirements and procedures for well casing, cementing, dealing with lost circulation of drilling fluids, and pressure testing along with defined roles and responsibilities and appropriate training.

Requirements and procedures for site operations is another best practice to help ensure that activities being conducted at the well site are coordinated, protective, and effectively de-risked. In Dimock, there were surface spills of hydraulic fracturing fluids. And in Pavillion, there were releases from historical surface pits. A well-run...
drilling and production site with a high standard of care will help minimize the risk of an accidental or unintentional release.

Hydraulic fracturing chemical use and disclosure is another best practice. As implemented, the potential chemicals being considered in the frack design are evaluated, and if alternatives or substitutes exist, then those with the lowest risk profile that also meet the performance specifications for the frack are selected. Those chemicals ultimately used in the frack are then disclosed on FracFocus or other registries.

As noted earlier, hydraulic fracturing requires water, necessitating a sound management scheme to cover sourcing and delivery, onsite use and handling, and eventually disposal. Sourcing and delivery can have an adverse effect on the surrounding community in the form of heavy truck traffic and the associated burden on road infrastructure. Minimizing this traffic through the use of pipelines and centralized storage impoundments can help reduce the impacts.

And reuse can reduce the overall volume of fresh water needed to fracture additional wells. Mobile treatment systems are emerging to treat the flowback from one fracking operation so that it can be used in the next one.

Reuse also reduces the volume of flowback requiring disposal, which in the case of the Marcellus Shale often involves transport to underground injection wells in Ohio. One of these injection wells near Youngstown, Ohio, is thought to have triggered a dozen small earthquakes, and that injection well is currently shut down pending further study. The injection well is located near a fault zone, and similar seismic phenomena associated with injection wells near fault zones have been reported in the Barnett Shale in Texas. 19

CONCLUSION

Hydraulic fracturing is a long-standing technology for improving oil and gas recovery. To date there is no clear evidence that fracturing has caused significant environmental impacts. However, best practices exist to help ensure that this is the case — not only from fracturing but from all aspects of oil and gas development activities.

NOTES


6 Id. at 27.

7 Id. at 28.

Id.


Groat & Grimshaw, supra note 2, at 67-68.

Id.


Id. at 33.


Cliff Frohlich & Eric Potter, Univ. of Texas at Austin; Chris Hayward & Brian Stump, Southern Methodist Univ., Dallas-Fort Worth Earthquakes Coincident with Activity Associated with Natural Gas Production, The Leading Edge 270-275 (March 2010), available at http://tle.geoscienceworld.org/content/29/3/270.full.pdf+html.

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