New York Marine Sciences Consortium

Stony Brook University, Stony Brook, NY 11794-5000; (631)632-8704

An Assessment of Some of the Environmental and Public Health Issues Surrounding Hydraulic Fracturing in New York State

Prepared by
New York Marine Sciences Consortium

December 20, 2011

Larry Swanson, NYMSC Director, lswanson@notes.cc.sunysb.edu
Maureen Krause, Chairman of the NYMSC Board, Maureen.K.Krause@hofstra.edu

The New York Marine Sciences Consortium (NYMSC) is an association of colleges, universities, and degree-granting institutions (28 members, 5 affiliates) with expertise and interest in marine and/or coastal sciences. NYMSC is the voice of New York State's marine science academic community, which strives to influence public policy, communicate science, and increase funding for the marine sciences within New York. Through research and education, NYMSC seeks to find solutions to the challenges that New York's coastal communities face.

In response to the New York State Department of Environmental Conservation's Revised Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas, and Solution Mining Regulatory Program (SGEIS) and the impending decision of the Governor, the Consortium is writing to offer several recommendations regarding the proposed use of hydraulic fracturing for the production of natural gas in New York State. Foremost among these is that the moratorium be extended at least until 2014 when a more comprehensive study of potential impacts on water resources will have been completed by the federal government.

Introduction

Hydraulic fracturing for the production of natural gas is being proposed for the Marcellus Shale in New York State. However, as with many new energy production technologies, there are environmental, health, and safety issues (Howarth and Ingraffea, 2011) that will need to be addressed to ensure that the natural gas can be produced in a manner that meets the environmental goals of New York State. Unique among the many proposed new energy technologies, hydrofracturing involves the use of large quantities of water, an estimated 3.8 million gallons per well (US EPA, 2011), and as a result has potentially great impacts on ground and surface waters, and ultimately coastal and marine environments.

The Marcellus Shale begins near Ohio and West Virginia and extends to Pennsylvania and southern New York. Until recently, the natural gas located in shale formations was not considered to be economically recoverable. The use of advanced production techniques, in particular hydraulic fracturing, has changed this assessment and it is now believed that substantial economic production can be achieved. These techniques were first demonstrated about 10 years ago in the Barnett Shale formations in

Texas. The production of gas from shale formations now accounts for about 15 percent of the natural gas supply in the United States and is expected to rise to 46 percent by 2035 (US Energy Information Administration, 2011).

The production of natural gas from shale formations using hydrofracturing involves the use of water, chemicals, and a propant material (usually sand). Equally important, horizontal drilling techniques must be used in order to make the recovery of the natural gas economical. The combination of these four components (water, chemicals, propants, and horizontal drilling technique) varies depending on the producer and the actual well location. It is the opinion of the NYMSC that further research needs to be done on all four components, their interactions with each other, and their interactions with the environment prior to any decision by New York State to allow hydrofracturing within its borders. If and when the decision is made to allow hydrofracturing, this research is essential to establish a regulatory framework that will ensure the safety of New York State's environment and its citizens' health.

It is important and significant to note that a very few producers have exploited the resources of the Barnett Shale using similar advanced technologies for each well. What is different for the Marcellus Shale and for New York is that a very large number of producers, some of them relatively small companies, will potentially drill hydraulic fracturing wells. Approximately 20,000 leases have been issued in New York State, with the potential for each producer to use a slightly different methodology for hydraulic fracturing fluids, injection of propants, horizontal drilling, and handling of flowback and wastewater disposal. This will complicate policy making, regulatory oversight, and enforcement.

The following is an outline of the primary research questions regarding the environmental impact of hydraulic fracturing of the Marcellus Shale and for New York State. In the absence of clear federal regulations and the exemptions from the Federal Safe Drinking Water Act, Clean Water Act, and the Clean Air Act, we believe that it is imperative for New York State to move cautiously in embracing this industry. Now is definitely a time when the Precautionary Principle should be adopted. That is:

> When an activity is a potential threat to human health or the environment, safeguards should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof (Science and Environmental Health Network, 2011).

In fact, the New York Ocean and Great Lakes Ecosystem Conservation Act (ECL Article 14) requires such caution in governance of the Hudson, Niagara, and St. Lawrence Rivers as well as the coastal environments of the Great Lakes and the marine district.

We emphasize that there is a paucity of information regarding the practice of hydraulic fracturing, a lack of scientific consensus on its effects because of that lack of data, and in the absence of sufficient information, recommend that New York State impose a moratorium on hydraulic fracturing of shale oil until these key research questions can be addressed.

Current State of Knowledge and Research Questions

Hydraulic fracturing has the potential to make recoverable vast quantities of America's oil and gas resources, but raises a large number of concerns about human and environmental impacts. In 2010, Congress requested that the US EPA conduct a study to examine the relationship between hydraulic fracturing and drinking water. Its report, which the NYMSC enthusiastically endorses and supports, was issued in November 2011, recognizes the legitimate concerns of citizens and stakeholders, and identified five major research questions listed below:

- What are the potential impacts of large volume water withdrawals from ground and surface waters on drinking water resources?
- What are the possible impacts of surface spills on or near well pads of hydraulic fracturing fluids on drinking water resources?
- What are the possible impacts of the injection and fracturing process on drinking water resources?
- What are the possible impacts of surface spills on or near well pads of flowback and produced water on drinking water resources?

- What are the possible impacts of inadequate treatment of hydraulic fracturing waste waters on drinking water resources?

These questions will be addressed in an initial report to be issued by the US EPA in 2012, and a second, more comprehensive report in 2014. The US EPA study highlights the current lack of understanding about risks and potential impact of hydraulic fracturing, particularly with regard to water, chemicals, and waste.

Water

Water is the main component of the hydrofracturing process. Water is acquired, consumed, and injected along with chemicals and propants, then discharged, treated and disposed, and in some cases, produced. The members of the NYMSC have performed a number of studies of water resources in New York State. The results of this research have raised issues on water usage for hydrofracturing:

- The volume of water pumped in per well is approximately 2.4 million to 7.8 million gallons (SGEIS), with flowback water volumes ranging from 216,000 gallons to 2.7 million gallons per well. It is imperative that NYS view the potential impacts of removal and discharge of water not in terms of single wells, but in terms of the aggregate, cumulative use.
- Such massive withdrawals could affect groundwater and aquifer levels as well as surface water flows to streams, rivers, and lakes. Significant short- and long-term adverse environmental effects are possible to a variety of aquatic ecosystems.
- The Marcellus Shale area is the location for the headwaters for watersheds that supply drinking water to much of downstate New York, New York City, and other states as well.
- Groundwater and surface waters are hydrologically connected. Disruption of flow and/or contamination of either can and will affect both.

Chemicals

- The chemicals injected into hydraulic fracturing wells are not known, as most are proprietary.
- Approximately 15,000 to 60,000 gallons of the total fracturing fluid per well consist of chemical additives. These chemicals are typically stored on site, then mixed with water and propant for injection into the well.

- The exact chemical composition varies from well-to-well and producer-to-producer and is customized for each location, and as many as 750 different chemicals and components have been used to date in U.S. hydraulic fracturing operations (Waxman et al., 2011).
- A number of publicly known chemicals identified in flowback and produced water from hydrofracturing wells are toxic and hazardous (see Appendix E, US Environmental Protection Agency, 2011). As an example of the potential risks, few of these chemicals are discussed.
- Naturally occurring minerals and gases normally sequestered underground may be released during hydraulic fracturing.

The Endocrine Disruption Exchange, or TDEX, is a nonprofit organization that collects scientific research regarding endocrine disruptors. TDEX has identified chemicals within hydraulic fracturing fluid that may have adverse health impacts. For example, 33 percent of the chemicals used are associated with human cancer. Forty three percent are associated with genetic mutation; 41 percent are associated with endocrine disruption; 34 percent are associated with reproductive problems (page 36 SGEIS executive summary). Furthermore, of the chemicals in hydraulic fracturing fluid, 37 percent are volatile (Colborn et al., 2011; Waxman et al., 2011).

Benzene, at an average concentration of 480 mg/L, was measured in samples of flowback water (some 20-40 percent of the hydraulic fracturing fluids returned to the ground surface) from Pennsylvania and West Virginia. The US EPA's maximum acceptable contaminant level for benzene in drinking water is 0.005 mg/L. According to Cornell University's Water Resources Institute, flowback water can pollute aquifers or groundwater and if water has such high amounts of benzene, human health can be affected (New York Water Resources Institute, 2011).

In 2008 and 2009, the NYSDEC conducted tests on brine (fluid associated with produced gas) in the Marcellus Shale to determine the amount of radium 226 (Heavenrich, 2009). Of the 12 wells analyzed, it was found that the level of radium within the brine was thousands of times higher than what is normally allowed in drinking water, and 250 times the amount allowable in the general environment (Heavenrich,

2009). Radium 226 contamination can possibly lead to an increased chance of developing anemia or cancer.

Methane contamination in drinking water is another concern. While some scientific reports and several media reports of methane contamination in wells have been released, the frequency and severity of incidents are unknown. More study is clearly needed, as the potential consequences are serious.

Waste Storage and Disposal

When natural gas or oil is extracted from a well, the hydraulic fracturing processes produce "flowback" and produced water from the well. This water is stored on-site in tanks and in impoundment pits. Waste water may be transported off-site for treatment. While the SGEIS states that operators "plan to maximize reuse of flowback water for subsequent high-volume hydraulic fracturing operations," there are no regulations requiring this.

Waste disposal for hydraulic fracturing fluids can pollute water sources. Total dissolved solids (TDS) can reach levels of 200,000 mg/L in hydraulic fracturing waste water, complicating waste disposal and treatment. The Pennsylvania Department of Environmental Protection presumed TDS increases in the Monongahela River were due to disposal of untreated hydraulic fracturing waste water within the river. The department issued advisories to use bottled water for 325,000 customers (Kargbo et al., 2010). Such pollution in New York could affect millions of residents.

Evaporation Pits

The wastewater chemicals stored in evaporation pits during the hydraulic fracturing process can be toxic as well. According to TDEX's published study, "Natural Gas Operations from a Public Health Perspective" (Colborn et al., 2011), 73 percent of the chemicals placed in evaporation pits are on the Emergency Planning and Community Right to Know Act's list of toxic chemicals. Ninety percent of the chemicals placed in the evaporation pits are on the 2005 EPA Superfund List (Colborn et al., 2011).

Extreme Weather Events

Recent extreme flooding in upstate New York occurred in many of the counties that sit on top of the Marcellus Shale. NYS draft requirements for hydrofracturing presumably will ban the placement of well pads and waste storage in flood plains, but

those maps have not been redrawn to reflect new climate predictions of increased frequency and severity of weather extremes. There is potential for release of waste from impounding pits which could contaminate surface and ground water.

Recommendations

It is clear that hydraulic fracturing could have devastating, long-lasting consequences in New York State and affect public health. All New Yorkers should be concerned that the practice of hydrofracking has been given exemptions to protections provided by the Federal Safe Drinking Water Act and the Clean Water Act. That in itself must raise doubts about the process. There is a lack of sound scientific information regarding it. In order to ensure public safety and protect the environment, companies that plan to drill must fully disclose information regarding their operations. This information must be a prominent part of a contract offered to a property owner.

Because of the complex issues surrounding hydraulic fracturing, the NYMSC requests that the State create a non-partisan technical committee, independent of state agencies, for the purpose of advising the highest levels of New York State government. Its function would be to keep abreast of the pertinent science, and to use the best science to formulate sound policy.

More and better science concerning the impacts of hydraulic fracturing is required before New York State allows this industry to move forward. If ever there is a need to observe the Precautionary Principle, it is with hydraulic fracturing. The NYMSC recommends that a moratorium on hydraulic fracturing be extended until at least 2014, following the completion by the US EPA of its comprehensive and necessary study on the potential impacts of hydraulic fracturing on drinking water resources. Its report, as well as the advice of the non-partisan technical committee, warrant full consideration prior to any decision regarding hydraulic fracturing in New York State. Through scientific research, consequences will be better understood, and associated pollution and health problems can be avoided. Many of the complex land and property rights issues could be clarified and the public will have an opportunity to more completely understand the ramifications of hydraulic fracturing development.

References

Colborn, Theo, Kwiatkowski, Carol, Kwiatkowski, Kim, and Bachran, Mary. "Natural Gas Operations from a Public Health Perspective." Retrieved Nov. 11, 2011 from http://www.endocrinedisruption.com/files/Oct2011HERA10-48forweb3-3-11.pdf.

Heavenrich, Sue S. 2009. Radioactivity Present in Marcellus Waste. Retrieved Nov. 11, 2011 from http://www.tiogagaslease.org/images/BVW_11_26_09_2.pdf.

Howarth, Robert W. and Ingraffea, A. 2011. "Should Fracking Stop?" Comment, *Nature*, Vol. 477, 271-274.

Kargbo, David M., Wilhelm G. Ron, and Campbell, J. David. "Natural Gas Plays in the Marcellus Shale: Challenges and Potential Opportunities." Retrieved Nov. 11, 2011 from pubs.acs.org/doi/pdf/10.1021/es903811p.

"New York State Water Resources Institute - Gas Wells - Waste." *New York State Water Resources Institute - Home*. Web. Retrieved Nov. 11, 2011 from http://wri.eas.cornell.edu/gas_wells_waste.html.

"New York State Water Resources Institute - Gas Wells - Water Use." *New York State Water Resources Institute - Home*. Retrieved Nov. 11, 2011 from http://wri.eas.cornell.edu/gas_wells_water_use.html.

New York State Department of Environmental Conservation. (2011, September). Supplemental generic environmental impact statement on the oil, gas and solution mining regulatory program (revised draft). Well permit issuance for horizontal drilling and high-volume hydraulic fracturing to develop the Marcellus Shale and other low-permeability gas reservoirs. Albany, NY: New York State Department of Environmental Conservation, Division of Mineral Resources, Bureau of Oil and Gas Regulation. Retrieved November 20, 2011, from ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf.

"Science and Environmental Health Network - Hydrofracking and the Heinz Award - October 2011." *Science and Environmental Health Network - Home Page*. 5, Oct. 2011. Retrieved Nov. 11, 2011 from http://www.sehn.org/Volume_16-6.html.

"Science and Environmental Health Network - Precautionary Principle." *Science and Environmental Health Network - Home Page*. Retrieved Nov. 11, 2011 from http://www.sehn.org/wing.html.

US Energy Information Administration. 2011. Annual Energy Outlook 2011, Office of Integrated and International Energy Analysis, US Department of Energy, Report Number: DOE/EIA-0383(2011). Retrieved Nov. 26, 2011 from http://www.eia.gov/forecasts/aeo/

US Environmental Protection Agency. 2011. Radium | Radiation Protection. Retrieved Nov. 11, 2011 from http://www.epa.gov/radiation/radionuclides/radium.html

US Environmental Protection Agency. 2011. Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources. Office of Research and Development, US Environmental Protection Agency, Washington, D.C. Report Number EPA/600/R-11/122/November 2011/www.epa.gov/hydraulicfracturing. Retrieved Nov. 26, 2011 from http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/upload/FINAL-STUDY-PLAN-HF_Web_2.pdf

Waxman, H.A., Markey, E.J., and DeGette, D. (2011, April). Chemicals used in hydraulic fracturing. Retrieved Nov. 21, 2011, from http://democrats.energycommerce.house.gov/sites/default/files/documents/Hydraulic%20Fracturing%20Report%204.18.11.pdf.