



Martin O'Malley, Governor
Anthony G. Brown, Lt. Governor
John R. Griffin, Secretary
Joseph P. Gill, Deputy Secretary

December 27, 2010

The Honorable Maggie McIntosh, Chair
House Environmental Matters Committee
251 Taylor House Office Building
Annapolis, MD 21401

The Honorable Joan Carter Conway, Chair
Senate Education, Health & Environmental Affairs Committee
2 West Miller Senate Office Building
Annapolis, MD 21401

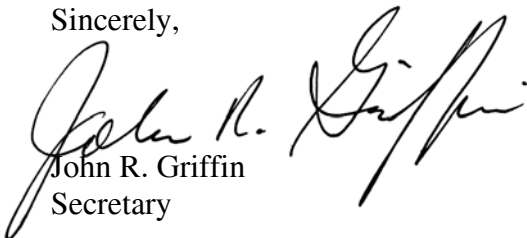
The Honorable Norman H. Conway, Chair
House Appropriations Committee
121 Taylor House Office Building
Annapolis, MD 21401

The Honorable Edward Kasemeyer, Chair
Senate Budget & Taxation Committee
3 West Miller Senate Office Building
Annapolis, MD 21401

Dear Honorable Chairs:

In accordance with the requirements of the 2010 Joint Chairmen's Report (JCR), page 188, the Department of Natural Resources respectfully submits the following report regarding Marcellus Shale natural gas extraction as it relates to Rural Legacy Program easement holders. We look forward to discussing this issue with you further during the upcoming legislative session.

Sincerely,


John R. Griffin
Secretary

cc: Sarah Albert (five copies), DLS
Cathy Kramer (via electronic copy)



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Anthony G. Brown, Lt. Governor
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REPORT ON IMPLICATIONS OF MARCELLUS SHALE GAS DRILLING ON CONSERVED LAND

December 2010

INTRODUCTION

The Joint Chairmen's Report (Section 48) from the 2010 legislative session of the Maryland General Assembly directed "...that the Maryland Department of Agriculture and Department of Natural Resources submit a report to the House Environmental Matters Committee; the Senate Education, Health, and Environmental Affairs Committee; the House Appropriations Committee; and the Senate Budget and Taxation Committee...on policy recommendations for allowing Maryland Agricultural Land Preservation Foundation and Rural Legacy Program easement holders to extract natural gas from the Marcellus Shale formation."

The report below details the issues related to the acquisition of conservation easements through the Rural Legacy Program on properties underlain with Marcellus Shale formation. Maryland established the Rural Legacy Program in 1997, and charged DNR with its implementation. DNR works cooperatively with local governments and land trusts to protect large, contiguous tracts of land and other strategic areas from sprawl development and to enhance natural resource, agricultural, forestry and environmental protection. A principal means of providing that protection is through acquisition of conservation easements from willing landowners within designated Rural Legacy Area (RLAs). The likelihood that owners or lessees of subsurface mineral rights could seek access to the surface of properties underlain with Marcellus Shale to drill for natural gas has impacted DNR's efforts to acquire easements in the Bear Creek Rural Legacy Area in Garrett County.

In the Bear Creek RLA in Garrett County, subsurface mineral rights associated with many properties are owned or leased by parties other than the surface owner. The split mineral rights within the Bear Creek RLA give rise to the specific issue examined in this report: the potential for hydraulic fracturing to occur on lands protected by conservation easements in order to develop shale gas. A geologic formation called the Marcellus Shale lies beneath several states in the northeast including West Virginia, Pennsylvania, and New York, as well as portions of Garrett and Allegany Counties in Western Maryland—including the Bear Creek RLA.

Natural gas locked in deep shale gas reservoirs used to be considered prohibitively expensive to develop. Recent technological advances and increasing prices for natural gas have stimulated interest in developing shale gas. Extracting shale gas relies on the use of a process called hydraulic fracturing, which poses numerous environmental risks. Many of those risks and environmental and human health impacts have already begun to materialize in states where development of the Marcellus Shale is already underway. While the full scope of potential

adverse environmental impacts associated with Marcellus Shale drilling still unknown, it is critical to take into consideration the need to protect the public's investment in the natural resources and conservation values that the Rural Legacy Program was designed to preserve.

In developing its policy recommendations on the issue, the Department has sought to balance two goals:

- to protect the Maryland taxpayer's investment in conservation easements and the natural resources preserved by those investments on land where an environmentally destructive practice could take place; and
- to provide a pathway for willing landowners in the Bear Creek RLA to preserve their land in situations where the possibility of Marcellus Shale gas drilling can be eliminated.

Where subsurface mineral rights associated with a property are leased to a party other than the surface owner, the best way to achieve balance between these two goals is to move forward with easement acquisition only where one of the three following conditions exists:

- 1) the landowner buys out the lease and thereby extinguishes the lease;
- 2) the lease expires, and is thereby extinguished;
- 3) the landowner and the lessee agree to amend the lease to limit allowable activities to gas storage, gas transmission, and protection of gas storage facilities.

In cases where the subsurface mineral rights are owned by (instead of leased to) another party, the landowner would need to engage that party (and, if applicable, the party to which the mineral rights have been leased) to extinguish any ability to drill for natural gas in the Marcellus Shale. The policy does not affect traditional gas storage activities, which will continue to be permitted. Implementation of this policy will provide a way for the Department to purchase easements in the Bear Creek RLA under circumstances that will ensure that conservation values on protected properties are not at risk of adverse impacts from gas drilling activities, particularly by hydraulic fracturing operations.

BACKGROUND

OVERVIEW OF THE RURAL LEGACY PROGRAM

Maryland's Rural Legacy Program was created in 1997 as one of the State's Smart Growth initiatives. The State's nationally-recognized Smart Growth initiatives take an incentive-based approach to discouraging sprawl development. Programs were designed to accomplish this goal by focusing on the complementary objectives of strengthening and directing future growth toward existing communities while preserving the State's rural and natural heritage. To encourage growth in existing communities, a key Smart Growth initiative restricts the availability of state water and sewer funding to developments planned inside identified priority funding areas (PFAs).

Rural Legacy is the chief incentive program aimed at affirmatively protecting rural and natural areas outside the PFAs. The concerns to which the General Assembly was responding when it created the Rural Legacy Program are enumerated in legislative findings:

Sprawl development and other modifications to the landscape in Maryland continue at an alarming rate, consuming land rich in natural resource, agricultural, and forestry value, adversely affecting water quality, wetlands and habitat, threatening resource-based economies and cultural assets, and rending the fabric of rural life.¹

Given these concerns, the General Assembly created the Rural Legacy Program to “enhance natural resource, agricultural, forestry and environmental protection . . . while maintaining the viability of resource-based land usage and proper management of tillable and wooded areas through accepted agricultural and silvicultural practices for farm production and timber harvests.”² To accomplish these objectives, the Rural Legacy Program provides state funds to local governments and land trusts to purchase property interests—including easements—from willing sellers in designated RLAs.³

Local governments and land trusts (“sponsors”) apply to the Rural Legacy Board for designation of RLAs. To ensure that diverse interests and geographical areas would be represented in RLA designation decisions, the General Assembly created a Rural Legacy Advisory Committee (RLAC).⁴ The RLAC is composed of representatives from various public and private sectors from across the state with an interest in Maryland’s land preservation efforts, including a representative of the mineral resources industry.⁵ The RLAC reviews applications from sponsors and makes recommendations for RLA designations to the Rural Legacy Board.

The Rural Legacy Board evaluates applications in light of the RLAC’s recommendations and based on the dimensions set forth by the General Assembly in its creation of the Rural Legacy Program. Sponsors must provide information on the significance of the agricultural, forestry, and natural resources proposed for protection.⁶ Examples given by the General Assembly of values that demonstrate the “importance of the land to be protected” include “farmland, forests, wetlands, wildlife habitat and plant species, vegetative buffers, or bay or waterfront access.”⁷ Examples of “resource-based industries or services” that may be eligible for protection through Rural Legacy land conservation are “agriculture, forestry, recreation, and tourism.”⁸

Once a RLA has been designated, landowners who are interested in protecting their land through the Rural Legacy Program work with sponsors to develop a proposed conservation easement. The easement is a legal document that details the conservation values of the property and the restrictions that preserve those values, along with the rights reserved by the landowner. DNR

¹ MD. CODE ANN., NAT. RES., §5-9A-01(a)(1) (2010).

² MD. CODE ANN., NAT. RES., §5-9A-01(b)(1) (2010).

³ MD. CODE ANN., NAT. RES., §5-9A-01(b)(2) (2010).

⁴ MD. CODE ANN., NAT. RES., §5-9A-08 (2010).

⁵ MD. CODE ANN., NAT. RES., §5-9A-08(b)(10) (2010).

⁶ MD. CODE ANN., NAT. RES., §5-9A-05(c)(1) (2010).

⁷ MD. CODE ANN., NAT. RES., §5-9A-05(c)(1)(ii) (2010).

⁸ MD. CODE ANN., NAT. RES., §5-9A-05(c)(4) (2010).

has prepared a model easement, which contains provisions common to all Rural Legacy Program easements. During an easement negotiation with a particular landowner, the model easement is modified according to the specific features on the property to be protected.

Before presenting proposed easements to the Board of Public Works, DNR works with sponsors to ensure that easements comply with Rural Legacy Program requirements. If all requirements have been satisfied and the Board of Public Works approves a Rural Legacy easement, State funds are disbursed to compensate the landowner for the restrictions that the easement places on the property. The conservation easement is filed with the local county land records, and the conditions and rights detailed in the agreement become part of the property's deed. Rural Legacy easements are perpetual, meaning that the easement binds both the current landowner and those who subsequently own and/or lease the land, permanently protecting the property and instituting a stewardship ethic that passes through the generations.

MINERAL RIGHTS AND THE RURAL LEGACY PROGRAM

With regard to mineral rights, the General Assembly provided that landowners who participate in the Rural Legacy Program may “reserve mineral rights for extraction in accordance with applicable law and the terms of the easement or fee acquisition.”⁹ The Rural Legacy Model Easement, in turn, prohibits “all manner of industrial uses and activities,”¹⁰ and provides that:

Excavation, dredging, or removal of loam, peat, gravel, soil, rock, sand, surface or sub-surface water or other material substance in a manner as to affect the surface or otherwise alter the topography of the property is prohibited, whether by grantors or third parties, except for: (1) the purpose of combating erosion or flooding; (2) agriculture or other permitted uses on the property; (3) wetlands or stream bank restoration; or (4) the construction and/or maintenance of permitted structures and associated utilities, means of access, man-made ponds and wildlife habitat. Grantors shall not sell, transfer, lease, or otherwise separate any mineral rights, currently owned or later acquired, from the surface of the property. All manner of surface mining is prohibited. Sub-surface mining or drilling is permitted only in accordance with Treasury Regulation 1.170A-14(g)(4) and subject to grantees' approval...grantees shall consider whether the impact will be limited, localized, and irremediably destructive of conservation attributes.¹¹

The referenced federal Treasury regulation, which represents a national standard for land trusts, governs when a landowner may deduct the value of a donated conservation interest (such as a conservation easement) for income tax purposes. The model easement references (and the Rural Legacy Program follows) the U.S. Treasury regulation for two reasons. First, some of the purchased easements in the Rural Legacy Program are the result of negotiated discounts and may

⁹ MD. CODE ANN., NAT. RES., §5-9A-05(n) (emphasis added) (2010).

¹⁰ Md. Dep't Natural Res., *Rural Legacy Program Model Conservation Easement*, Art. III. § A., <http://www.dnr.state.md.us/land/rurallegacy/download.asp> (last visited Jul. 6, 2010).

¹¹ DNR, *Rural Legacy Program Model Conservation Easement*, Art. III. § N., <http://www.dnr.state.md.us/land/rurallegacy/download.asp> (last visited Jul. 6, 2010).

therefore qualify as bargain sales or gifts. Secondly, even where Rural Legacy easements are purchased at full market value, DNR—as a matter of policy—follows the regulation because it represents a practical approach to allowing certain extraction practices where such practices do not subvert the conservation values of the property to be protected.

The U.S. Treasury regulation provides that the requirements for a conservation deduction are not met “if at any time there may be extractions or removal of minerals by any surface mining method.”¹² Similarly, with respect to subsurface extraction, no deduction will be allowed if “any method of mining that is inconsistent with the particular conservation purposes of a contribution is permitted at any time.”¹³ However, a deduction may be allowed “in the case of certain methods of mining that may have limited, localized impact on the real property but that are not irretrievably destructive of significant conservation interests.”¹⁴

MINERAL RIGHTS POLICIES OF THE MARYLAND ENVIRONMENTAL TRUST

The Maryland Environmental Trust (MET) works with landowners interested in donating conservation easements on their properties. Accordingly, the U.S. Treasury regulation discussed above, applies directly to all MET easements. Therefore, MET does not currently accept donated easements on lands with mining potential unless the mineral rights are subordinated to the conservation easement. With regard to natural gas storage (as opposed to drilling for and extracting natural gas), MET decided in 2007 to follow the positions of the Rural Legacy Program.

MINERAL RIGHTS AND NATURAL GAS STORAGE IN GARRETT COUNTY

Portions of northwestern Garrett County lie over a geologic formation called the Accident Dome, within which lies the Oriskany Sandstone. Now a depleted reservoir, the Accident Dome previously produced natural gas. Gas drilling and production took place in the Accident area from the 1930s through the early 1960s.¹⁵ During that period, landowners situated within the Accident Dome sold and/or leased their mineral rights with the result that properties in the area are now “split estates”—surface and subsurface (mineral) rights are held by different parties.

Although its gas stores have been depleted for decades, the porous sandstone that remains within the Accident Dome has served as an excellent gas storage field for the Texas Eastern Transmission Corporation (now Spectra Energy) since 1962. Spectra Energy is the dominant leaseholder of mineral rights in the Accident Dome. The company uses the Accident field as a storage reservoir along Spectra Energy’s 8,700 mile Texas Eastern Transmission pipeline, which connects Texas and the Gulf Coast with the northeastern United States.¹⁶ Gas is injected into the

¹² Treas. Reg. § 1.170A-14(g)(4)(i) (as amended in 2009).

¹³ Treas. Reg. § 1.170A-14(g)(4)(i) (as amended in 2009).

¹⁴ Treas. Reg. § 1.170A-14(g)(4)(i) (as amended in 2009).

¹⁵ Garrett County Historical Society, *Garrett County History: Early Settlers*, <http://www.deepcreeklake.com/gchs/history/G010911C.htm> (last visited Jul. 7, 2010).

¹⁶ Spectra Energy, *Texas Eastern Transmission*, http://www.spectraenergy.com/what_we_do/businesses/us/assets/texas_eastern/ (last visited Jul. 7, 2010).

Accident field during the summer months where it is stored until winter, when it is withdrawn for transmission north and east to Baltimore, Pennsylvania, and beyond.

BEAR CREEK RURAL LEGACY AREA

In fiscal year 2002, upon the recommendation of the Rural Legacy Board, the Board of Public Works approved Garrett County's application for designation of 31,437 acres in the northern part of the County as the Bear Creek RLA. The Bear Creek RLA encompasses and was established to protect numerous features within Garrett County, including agricultural land and forests in the Bear Creek watershed, Deep Creek Lake, the Cove Scenic Overlook, and the Bear Creek Fish Hatchery.¹⁷

Decades of experience with natural gas storage in the Accident field have demonstrated that natural gas storage is often compatible with the types of conservation values that the Rural Legacy Program was established to protect. Accordingly, the Rural Legacy Board approved the Bear Creek RLA to protect farms with severed or leased mineral rights with the understanding that gas storage activities would continue to take place on lands encumbered with Rural Legacy easements, provided that such storage activities do not unduly compromise the natural and working resources the RLA was established to protect. DNR does not purchase easements on properties where so much gas storage infrastructure is present that the conservation values of a property are undermined. This policy is consistent with the Rural Legacy Program's model easement, and with the U.S. Treasury regulation regarding mineral rights and qualified conservation easements.

The designation of the Bear Creek RLA and the policy of purchasing easements on qualifying properties within the Accident natural gas storage field benefited both landowners and the public. Willing owners of qualifying properties could receive compensation for protecting their land's conservation values, despite the fact that their mineral rights had been severed or leased. DNR, working with Garrett County, could purchase easements on critical landscapes despite severed mineral rights, secure in the knowledge that those rights would only be used for an activity (gas storage) that is generally compatible with the conservation values that the Rural Legacy Program is intended to protect. The advent of drilling for natural gas in the Marcellus Shale, however, has disrupted this balance.

NATURAL GAS EXTRACTION FROM THE MARCELLUS SHALE

Historically, most natural gas has been produced from conventional petroleum deposits in porous sandstone and carbonate (like the Oriskany sandstone within the Accident Dome). In such deposits, naturally-occurring hydrodynamic pressure moves the petroleum toward the surface until it becomes trapped by an impermeable cap-rock, where natural gas accumulates over the petroleum.

¹⁷ DNR, *Maryland's Approved Rural Legacy Areas*, <http://www.dnr.state.md.us/land/rurallegacy/allrurallegacyareas.asp> (last visited Jul. 6, 2010).

In contrast, the Marcellus Shale formation is an “unconventional” gas resource.¹⁸ The Marcellus is located at depths of 4,000 – 8,500 feet beneath most of West Virginia, parts of Pennsylvania, New York, Ohio, and Virginia, and portions of western Maryland. In Maryland, the Marcellus Shale is located above, and in relative proximity to, the Oriskany sandstone underneath portions of Allegany and Garrett Counties. The entire Bear Creek RLA is underlain with Marcellus Shale.

“Unconventional” gas shales like the Marcellus are fine-grained rocks containing petroleum deposits that are not significantly affected by hydrodynamic pressure. They differ from rocks like the Oriskany Sandstone in that the pores in the shales are so small that petroleum and gas deposits cannot flow through them without the occurrence of natural or artificial fractures. Accordingly, extracting natural gas from tight shale formations like the Marcellus was long considered to be cost prohibitive.

In recent years, that economic calculus has changed. Several factors have combined to make production profitable. Directional drilling technology now allows for wells to be bored vertically into the desired formation and then extend out horizontally. The process of hydraulic fracturing (explained below) is used to crack the shale, which allows the gas deposits therein to flow up the well. The availability of these technologies combined with recent high prices for natural gas have led to increased interest in exploring and producing gas from the Marcellus Shale.

Natural gas is expected to play an increasingly important role in the nation’s energy future. Shale gas, in turn, is expected to become a significant source of natural gas: by 2020, it is predicted to account for 20 percent of the nation’s total natural gas supply.¹⁹ Drilling operations in the Marcellus Shale are underway in Pennsylvania, West Virginia and New York. Pennsylvania has seen the most significant shale gas drilling activity, with 1,173 permits issued for Marcellus Shale wells in the first five months of 2010.²⁰ However, in Pennsylvania, legislators have proposed a one-year ban on hydraulic fracturing in the Marcellus Shale, during which a proposed commission would study and analyze the practice’s environmental, social and economic impacts.²¹ Penn State University has announced the creation of the Marcellus Center for Outreach and Research, an education and research initiative that will focus on the environmental, social and economic impacts of Marcellus Shale gas drilling.²² In West Virginia, 299 Marcellus wells were drilled in 2008, and the pace of drilling is expected to increase substantially, with about 900 wells predicted to be drilled per year by 2020.²³ In New York, 20

¹⁸ For a comprehensive report on unconventional gas shales, see Anthony Andrews, *et al.*, *Unconventional Gas Shales: Development, Technology and Policy Issues*, Cong. Research Serv. Report No. R40894 (Oct. 2009).

¹⁹ U.S. Evtl. Prot. Agency, *Hydraulic Fracturing Study*, 1, <http://www.epa.gov/safewater/uic/pdfs/hfresearchstudyfs.pdf> (last visited Jul. 13, 2010).

²⁰ The Center for Rural Pennsylvania, *A Look at Oil and Gas Drilling Permits Issued in Pennsylvania*, Rural Perspectives, Vol. 19., No. 3 (Jul./Aug. 2010), 5, available at <http://www.rural.palegislature.us/newsletter.html#4> (last visited Aug. 18, 2010).

²¹ Pa. S.B. 1447 (as introduced and referred to committee, Jul. 22, 2010), available at <http://www.legis.state.pa.us/cfdocs/legis/home/session.cfm> (search by bill no.) (last visited Jul. 23, 2010).

²² Penn State Launces New Education, Research Center on Marcellus Shale (Aug. 18, 2010), <http://live.psu.edu/story/47867> (last visited Aug. 20, 2010).

²³ National Energy Technology Laboratory, *Projecting the Economic Impact of Marcellus Shale Gas Development in West Virginia: A Preliminary Analysis Using Publicly Available Data*, v-vi (March 31, 2010), available at <http://www.ioawv.com/pdfs/WVMarcellusEconomics3.pdf> (last visited Aug. 18, 2010).

vertical wells have been drilled into the Marcellus Shale since 2005, and the state received applications to drill horizontal Marcellus wells.²⁴ However, the use of horizontal drilling and high-volume hydraulic fracturing is effectively on hold while the New York's Department of Environmental Conservation conducts an environmental impacts analysis.²⁵ The Maryland Department of the Environment (MDE) received the first four applications to drill into the Marcellus shale in Maryland in October 2009.²⁶

ENVIRONMENTAL RISKS OF HYDRAULIC FRACTURING

THE PROCESS

The process of extracting shale gas is the subject of considerable controversy due to the potential adverse environmental impacts from the gas production process. Hydraulic fracturing (often referred to as “hydrofracturing,” “fracking,” or “hydrofracking”) involves pumping fluids and sand down wells under pressures high enough to crack the target rock formation. The fluids also carry the sand (called the propping agent or proppant) into the cracks and fissures created by the pressure. The sand holds the fissures open so that the gas can flow out of the shale and up the well.

Although hydraulic fracturing was first employed in Texas oil fields in the 1940s to increase the output of conventional wells toward the end of their productive life, the scale of its recent use to develop gas shale has caused considerable concern. Between two and five million gallons of hydraulic fracturing fluids (“frack fluids”) are used in each shale gas well.²⁷ The frack fluids consist water and chemical additives used to improve effectiveness of the fracturing job in a variety of ways, such as achieving the proper viscosity and reducing friction.

Many of the environmental risks associated with hydraulic fracturing stem from these two characteristics of hydraulic fracturing: the use (and need for safe disposal) of significant volumes of water; and the addition of numerous chemical components to the water. The chief concerns are summarized below.

²⁴ New York State Department of Environmental Conservation, Oil and Gas Searchable Database, Wells Data Search, <http://www.dec.ny.gov/cfm/xtapps/GasOil/search/wells/index.cfm> (Results from build search: “Producing Formation” “equals” “Marcellus” as of Aug. 18, 2010).

²⁵ New York State Department of Environmental Conservation, Gas Well Drilling in the Marcellus Shale, <http://www.dec.ny.gov/energy/46288.html> (last visited Aug. 18, 2010) (noting that while the environmental impact analysis is ongoing, “any entity that applies for a drilling permit for horizontal drilling in the Marcellus Shale and opts to proceed with its permit application will be required to undertake an individual, site-specific environmental review.)

²⁶ Brigid Kennedy, *MDE Takes First Look at Marcellus Shale*, e-MDE Vol. IV., No. 2 (Dec. 2009), <http://www.mde.state.md.us/ResearchCenter/Publications/General/eMDE/vol4no2/naturalgas.asp> (last visited Jul. 8, 2010).

²⁷ U.S. E.P.A., *Hydraulic Fracturing Study*, 2, <http://www.epa.gov/safewater/uic/pdfs/hfresearchstudyfs.pdf> (last visited Jul. 13, 2010).

UNKNOWN CHEMICAL COMPONENTS

Just what chemicals are used (and in what combination) in any given well is one of the points of most controversy in the public policy debate surrounding hydraulic fracturing. From the perspective of companies that provide hydraulic fracturing services, the composition of hydraulic fracturing fluids is the proprietary result of years of research and development, and widespread dissemination of the information could result in a loss of competitive advantage.²⁸ Companies also point out that “material safety data sheets” (MSDS) posted at well sites to comply with federal worker safety requirements provide disclosure.

Concerned observers question whether the information contained in MSDS documents is sufficient to provide notice to the public or to state and local regulators of the potential for particular compounds to contaminate surrounding land and waters. They point out that MSDS sheets do not require the disclosure of chemical additives that are subject to a claim of confidential business information. Additionally, MSDS documents may provide generic terms for chemicals, which may not indicate whether nontoxic or toxic chemicals in a given category are being used.

The New York State Department of Environmental Conservation has conducted a comprehensive analysis of MSDS documents submitted to the agency for nearly 200 products used or proposed for use in hydraulic fracturing operations in the state’s Marcellus Shale.²⁹ The petroleum distillates extracted from the documents include such compounds as kerosene, stoddard solvent, and petroleum naphtha. Although the mixtures vary in their composition, they have similar adverse health effects. Depending on the route and amount of exposure, petroleum distillates are associated with adverse effects on the gastrointestinal system and central nervous system, as well as skin irritation, blistering, and peeling.³⁰

Moreover, aromatic hydrocarbon compounds such as benzene (a known human carcinogen), ethylbenzene (a possible human carcinogen), toluene, and xylene can also occur in petroleum distillates. Data provided by three national hydraulic fracturing services companies in response to a request from Congress reveal that they used these chemicals as well as diesel fuel in frack fluids.³¹ The lack of information about the full spectrum of chemicals associated with hydraulic fracturing make it difficult to fully assess the environmental risks posed by the process.

²⁸ Abrahm Lustgarten, *Buried Secrets: Is Natural Gas Drilling Endangering U.S. Water Supplies?*, ProPublica (Nov. 13, 2008), <http://www.propublica.org/article/buried-secrets-is-natural-gas-drilling-endangering-us-water-supplies-1113> (last visited Aug. 10, 2010) (quoting Diana Gabriel, company spokesperson for Halliburton, a provider of hydraulic fracturing services).

²⁹ For the full analysis, including information on health effects, see New York State Department of Environmental Conservation, *DRAFT Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program: Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs* (Sept. 30, 2009), 5-44 – 5-65, available at <ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf> (last visited Aug. 10, 2010).

³⁰ *Id.* at 5-61 – 5-62.

³¹ Memorandum from Chairman Henry Waxman, Energy and Commerce Committee, U.S. House of Representatives to Members of the Subcommittee on Energy and the Environment (Feb. 18, 2010), 2, http://energycommerce.house.gov/Press_111/20100218/hydraulic_fracturing_memo.pdf (last visited Jul. 13, 2010).

RISKS TO DRINKING WATER SUPPLIES

Hydraulic fracturing poses numerous risks to water quality. Underground sources of drinking water could be contaminated by the chemicals in frack fluid as they are injected deep into the shale gas formations. As the wells are drilled, compounds that occur naturally in the shale formation—such as metals and radionuclides—could be released and introduced into underground aquifers.

Linking hydraulic fracturing to contamination of water wells is difficult due to the unknowns of the precise nature and concentrations of chemicals used at any given drilling site and the lack of sufficient pre- and post-drilling monitoring. However, available information provides reason for concern. More than 1,000 cases of contamination suspected to be caused by hydraulic fracturing have been documented by courts and state and local governments in Colorado, New Mexico, Alabama, Ohio, and Pennsylvania.³² In 2009, both the U.S. Environmental Protection Agency (EPA) and the federal Bureau of Land Management found evidence of water well contamination in Wyoming, both potentially linked to hydraulic fracturing operations.³³ Also in 2009, EPA hired a consulting firm to analyze reports of drinking water contamination allegedly linked to hydraulic fracturing. The firm concluded that 12 of the instances of contamination examined may be linked to hydraulic fracturing but that “to date, EPA has insufficient information on which to make a definitive decision.”³⁴

RISKS TO SURFACE WATERS

The quality of surface waters could also be impaired due to hydraulic fracturing operations. According to the New York State Department of Environmental Conservation, reasonably anticipated impacts to surface water resources include stormwater runoff; surface spills, leaks and pit or surface impoundment failures; and waste disposal.³⁵ A *Denver Post* investigation of spill reports in Colorado revealed that over the past several years, oil and gas companies have reported spills of natural gas, water that is produced from the formation along with the natural gas (“produced water”), and frack fluids totaling 106,000 barrels (nearly 4.5 million gallons).³⁶ Many of those spills reached groundwater and/or surface water.³⁷

³² Abrahm Lustgarten, *Buried Secrets: Is Natural Gas Drilling Endangering U.S. Water Supplies?*, ProPublica (Nov. 13, 2008), <http://www.propublica.org/article/buried-secrets-is-natural-gas-drilling-endangering-us-water-supplies-1113> (last visited Aug. 10, 2010).

³³ *Id.*

³⁴ Memorandum from Chairman Henry Waxman, Energy and Commerce Committee, U.S. House of Representatives to Members of the Subcommittee on Energy and the Environment (Feb. 18, 2010), 6, http://energycommerce.house.gov/Press_111/20100218/hydraulic_fracturing_memo.pdf (last visited Jul. 13, 2010).

³⁵ New York State Department of Environmental Conservation, *DRAFT Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program: Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs* (Sept. 30, 2009) (the “SGEIS”), 6-3, available at <ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf> (last visited Aug. 10, 2010).

³⁶ Burt Hubbard, *Millions of Gallons Spilled in Colo. Over 2½ Year Period*, *Denver Post*, Jun. 28, 2010, http://www.denverpost.com/ci_15391192 (last visited Aug. 10, 2010).

³⁷ *Id.*

Additionally, while frack fluid and produced water (together, “flowback water”) may sometimes be recycled/reused at another drilling site, a variety of factors may prevent reuse of some portion of the flowback water.³⁸ Ensuring the safe disposal of flowback water presents a challenge. Although as much as 99.5 percent of the three million gallons of frack fluids used at a typical shale gas well may be water and sand, the remaining 0.5 percent represents 15,000 gallons of chemicals. In addition to the chemicals added to the frack fluid, the fluid that comes out after treatment will also contain naturally-occurring compounds from the shale formation and the water within it. Together, the recovered frack fluid and produced water will likely contain heavy metals, radionuclides, hydrocarbons, and high levels of total dissolved solids (TDS – salt and other minerals), all of which are difficult to treat. If the chemical load exceeds the capabilities of the wastewater treatment plants that the frack fluid is eventually directed to, the plants will discharge effluent containing those chemicals into surface waters.

Regulators in states in which drilling is already underway have encountered such situations. Portions of the Marcellus Shale, including underlying Western Maryland, are radioactive.³⁹ In New York, the Department of Environmental Conservation analyzed wastewater samples collected in late 2008 and 2009 from thirteen vertical wells drilled into the Marcellus Shale and found levels of radium-226 as high as 267 times the limit safe for discharge into the environment.⁴⁰ In Pennsylvania, the Department of Environmental Protection investigated the cause of corroding machinery at industrial plants along the Monongahela River.⁴¹ Samples taken from the river revealed levels of TDS twice what the agency considers safe. A major factor in the river’s contamination was the drilling wastewater that nine municipal treatment plants had discharged into the Monongahela. High levels of TDS also contributed to a significant fish kill

³⁸ New York State Department of Environmental Conservation, *DRAFT Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program: Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs* (Sept. 30, 2009) 5-119, available at <ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf> (last visited Aug. 10, 2010) (noting factors that may prevent reuse of flowback water: “no other wells being fractured within reasonable time frames or a reasonable distance, prohibitively high contaminant concentrations which render the water untreatable to usable quality, or unavailability or infeasibility of treatment options for other reasons”).

³⁹ See U.S. Geological Survey, *Assessment of Appalachian Basin Oil and Gas Resources, Devonian Shale-Middle and Upper Paleozoic Total Petroleum System, Figure 13: Devonian shale assessment units, showing net thickness of radioactive shale and areas of closely spaced drilling* (2006),

<http://pubs.usgs.gov/of/2006/1237/pdf%20figs/fig13.pdf> (last visited Jul. 14, 2010).

⁴⁰ New York State Department of Environmental Conservation, *DRAFT Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program: Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs* (Sept. 30, 2009) (the “SGEIS”), 5-129, Appendix 13, available at <ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf> (last visited Aug. 10, 2010) (Sample of production brine from Webster T1 Well in Schuyler County contained 16,030 +/- 2,995 pCi/L of radium-226); Comments of the State of New York Department of Health, Bureau of Environmental Radiation Protection on the SGEIS, available at http://s3.amazonaws.com/propublica/assets/natural_gas/nysdoh_marcellus_concerns_090721.pdf (last visited Aug. 18, 2010) (noting that the effluent water discharge limit for radium-226 is 6E-08 microCi/ml (60 pCi/L) and citing NYCRR Part 16, Appendices). See also Abraham Lustgarten, *Is New York’s Marcellus Shale Too Hot to Handle?*, ProPublica (Nov. 9, 2009), <http://www.propublica.org/article/is-the-marcellus-shale-too-hot-to-handle-1109> (last visited Jul. 15, 2010).

⁴¹ Joaquin Sapien, *With Natural Gas Drilling Boom, Pennsylvania Faces Onslaught of Wastewater*, ProPublica (Oct. 4, 2009), <http://www.propublica.org/article/wastewater-from-gas-drilling-boom-may-threaten-monongahela-river> (last visited Jul. 15, 2010).

in Dunkard Creek, a tributary to the Monongahela River that flows along the border of Pennsylvania and West Virginia.⁴²

IMPACTS ON WATER QUANTITY

Another water-related risk of hydraulic fracturing stems from the massive volumes of water used in shale gas wells. In its draft environmental impacts analysis concerning the use of horizontal drilling and high volume hydraulic fracturing to develop shale gas, the New York State Department of Environmental Conservation explains:

Water for hydraulic fracturing may be obtained by withdrawing it from surface water bodies away from the well site or through wells drilled into groundwater aquifers. Without proper controls on the rate, timing and location of withdrawals, stream flow modifications could result in negative impacts to a stream's best uses, including but not limited to the aquatic ecosystem, downstream riverine and riparian resources, wetlands, and aquifer supplies.⁴³

HAZARDOUS WASTE RISKS

Fluids spilled, leaked or released as the result of events such as tank ruptures, equipment or surface impoundment failures, accidents or improper operations could infiltrate the ground, reaching subsurface soils.⁴⁴ There is limited information available concerning the environmental contaminants that could be contained in such spilled fluids.

The EPA and the Agency for Toxic Substances and Disease Registry maintain a list of the 275 contaminants that are most commonly found at the nation's worst, abandoned toxic waste sites (Superfund sites). As shown in Table 1, below, multiple chemicals used in frack fluids as well as naturally-occurring radioactive materials detected in Marcellus production brine appear on the list, demonstrating the potential for frack fluids and/or flowback water to cause long term land contamination.

⁴² Rebecca Renner, *Salt-loving algae wipe out fish in Appalachian stream*, 43 Environ. Sci. Technol. 9046-47 (Dec. 15, 2009), <http://pubs.acs.org/doi/pdf/10.1021/es903354w> (last visited Jul. 26, 2010).

⁴³ New York State Department of Environmental Conservation, *DRAFT Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program: Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs* (Sept. 30, 2009), 6-4, available at <ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf> (last visited Aug. 10, 2010). For additional discussion of the potential impacts of water withdrawals, see *id.*, 6-4 – 6-8.

⁴⁴ New York State Department of Environmental Conservation, *DRAFT Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program: Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs* (Sept. 30, 2009), 6-16, available at <ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf> (last visited Aug. 10, 2010).

Table 1: Potential Land Contaminants in Frack Fluids and Marcellus Production Brine⁴⁵

Rank on 2007 Superfund Contaminant List	Substance Name	Chemical Abstracts Service (CAS) Registry No.
<i>Chemical Additives in Hydraulic Fracturing Fluids</i>		
184	Acetone	67-64-1
157	Ammonia	1336-21-6
6	Benzene	71-43-2
252	Dimethyl Formamide	68-12-2
99	Ethyl Benzene	100-41-4
244	Formaldehyde	50-00-0
78	Napthalene	91-20-3
71	Toluene	108-88-3
58	Xylene	1330-20-7
<i>Naturally-Occurring Radioactive Materials Detected in Marcellus Production Brine</i>		
213	Cesium-137	010045-97-3
95	Radium-226	013982-63-3
106	Radium-228	015262-20-1
113	Thorium-228	014274-82-9
107	Thorium-230	014269-63-7
111	Uranium-234	013966-29-5
107	Uranium-235	015117-96-1

SURFACE DISTURBANCE

Finally, each shale gas well has a footprint of approximately four acres, and the Maryland Geological Survey notes that “the degree of disturbance is roughly equivalent to building a house.”⁴⁶ Roads to access well sites must also be built, and accidents involving trucks transporting fluids and other materials increase the risk of site-specific contamination. It should also be noted that, in addition to the drilling and extraction operation, the gas must be transported. The transmission of the gas requires the construction of gathering lines, transmission lines and compressor stations, all of which can adversely impact forests, streams and other resources. The long-term adverse environmental impacts on a property from the drilling operation may remain well into the foreseeable future. On any property, such surface disturbance can lead to an increase in sediment runoff during storm events, leading to

⁴⁵ Chemicals used in hydraulic fracturing: 1) New York State Department of Environmental Conservation, *DRAFT Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program: Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs* (Sept. 30, 2009), 5-45 – 5-51, available at <ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf> (last visited Aug. 10, 2010) (“NYSDEC SGEIS”); and 2) Chesapeake Energy, *Hydraulic Fracturing Facts*, <http://www.hydraulicfracturing.com/Fracturing-Ingredients/Pages/information.aspx> (last visited Jul. 12, 2010). Naturally-Occurring Radioactive Materials: NYSDEC SGEIS, Appendix 13. Listing and ranking of chemicals on Superfund List: Agency for Toxic Substances and Disease Registry, *2007 CERCLA Priority List of Hazardous Substances*, <http://www.atsdr.cdc.gov/cercla/07list.html> (last visited Jul. 14, 2010).

⁴⁶ Maryland Geological Survey, *Information Concerning the Marcellus Shale and the Search for Natural Gas in Western Maryland* (updated Dec. 14, 2009), <http://www.mgs.md.gov/geo/marcellus.html>.

compromised water quality. On properties protected by conservation easement, surface disturbances are restricted by the terms of the easement to preserve and protect the land's natural and agricultural features. Rural Legacy Program easements strictly limit the construction of dwelling units on protected properties and limit the total square footage they may occupy.⁴⁷ Some easements may also place a limit on the total area of impervious surface allowed on a protected property.⁴⁸ These standard restrictions on typical land use activities are necessary to ensure that the conservation values of the property are maintained.

OVERVIEW OF THE REGULATORY STRUCTURE

For a variety of reasons, the use of hydraulic fracturing to extract shale gas is not subject to many of the environmental controls that apply to other industrial activities that pose similar risks. At the federal level, the process and some of its impacts are exempt from several key environmental laws, including the Safe Drinking Water Act. Regulation of hydraulic fracturing is thus left primarily to the states. Together, the relative novelty of the process as applied to shale gas and the evolving nature of the knowledge about its risks pose challenges to state regulations developed for more conventional oil and gas drilling.

In Maryland, the first hydraulic fracturing operations into the Marcellus Shale (if approved) will be subject to statutory and regulatory provisions that address oil and gas drilling generally.⁴⁹ While these regulations may be sufficient for standard drilling operations, certain additional provisions may be added to address requirements that are specifically related to hydraulic fracturing. Additionally, the lack of baseline geologic and hydrologic data for this area makes evaluation of impacts and risk analysis difficult, if not impossible. The discussions of this issue and the subsequent modifications to regulations, law, policies and process that are undertaken in other jurisdictions will inform Maryland as it moves to address this activity in general, and as it pertains to conserved land.

POLICY REGARDING RURAL LEGACY EASEMENTS IN GARRETT COUNTY

As additional applications to drill in the Marcellus Shale in Western Maryland are submitted, MDE will work to respond to the General Assembly's charge to address the risks that hydraulic fracturing poses to public health, safety and the environment. The question currently facing DNR is more narrow, but for purposes of the future of the Rural Legacy Program in Garrett County, equally important. In developing its policy on the issue, DNR seeks to achieve two goals. The Department is eager to pursue Rural Legacy Program easement opportunities in the Bear Creek RLA and to preserve the natural and agricultural values that led to the area's designation. However, it must ensure that the expenditure of taxpayer dollars to purchase

⁴⁷ DNR, *Rural Legacy Program Model Conservation Easement*, Art. III. § E., <http://www.dnr.state.md.us/land/rurallegacy/download.asp> (last visited Jul. 6, 2010).

⁴⁸ DNR, *Rural Legacy Program Model Conservation Easement*, Art. III. § E., (see optional language following subsection (6)), <http://www.dnr.state.md.us/land/rurallegacy/download.asp> (last visited Jul. 6, 2010).

⁴⁹ MD. CODE ANN., ENVIR., §§14-101 *et seq.* (2010); COMAR §§ 26.19.01, 26.19.02.

conservation easements in the area results in the quality of land protection in perpetuity intended by the Rural Legacy Program.

As detailed in this report, hydraulic fracturing is an industrial activity that poses numerous risks to natural resources including some of the very features that the Bear Creek RLA was designated to protect. Unlike natural gas storage, with its decades-long track record of compatibility with land preservation, the use of hydraulic fracturing to develop shale gas is a relatively new practice. Knowledge about its risks continues to evolve. Thorough studies and analyses, such as the study that Congress has asked the U.S. EPA to conduct regarding the impacts of hydraulic fracturing on groundwater and New York's environmental impacts analysis, are only now being undertaken. It is unclear at this point in time how the existing regulatory structure will address impacts to natural resources, surface waters, fisheries, aquatic life, and human health.

Accordingly, at this time the lack of information about the full environmental risks and potential impacts of hydraulic fracturing make it impossible to determine whether the activity can be made compatible with the purposes for which properties are protected by Rural Legacy easements. As explained earlier in this report, Rural Legacy easements prohibit industrial activities and strictly limit permissible subsurface mining activities in accordance with the applicable federal Treasury regulation. That regulation proscribes methods of mining that are inconsistent with the conservation purposes of the easement. Therefore, the Department's policy is to move forward to acquire Rural Legacy easements only where it can be sure that hydraulic fracturing will not take place on the property to be conserved.

The fact that many properties in the Bear Creek RLA are located over the Marcellus Shale formation and have severed mineral rights means that the mineral rights owners or lessees could seek to conduct hydraulic fracturing operations on those properties. In Maryland, under certain conditions, mineral rights owners may retain an implied easement to access the surface of a property in order to extract the minerals below.⁵⁰ The fact that the surface owner places a conservation easement on a property does not affect the mineral rights (and the associated right of surface access, where it exists) unless the mineral rights owner releases the rights or subordinates them to the conservation easement.

Uncertainties remain regarding the efficacy of purchasing conservation easements where there is potential for drilling for natural gas, particularly by hydraulic fracturing. It will be necessary to answer the question of impacts from the larger perspective before it can be addressed from the perspective of conservation easements. Therefore, on properties where mineral rights have been leased to a third party (thereby potentially enabling that third party to undertake explorative and extractive drilling for natural gas on the surface), the Department will move forward to preserve qualified properties only if one of the following conditions exists:

- 1) the landowner buys out the lease and thereby extinguishes the lease;
- 2) the lease expires, and is thereby extinguished; or
- 3) the landowner and the lessee agree to amend the lease to limit allowable activities to gas storage and transmission and protection of gas storage facilities.

⁵⁰ Calvert Joint Venture #140 v. Ross R. Snider, et ux., 816 A.2d 854, 874 (Md. 2003).

In cases where the landowner does not own his or her property's sub-surface rights (i.e., the mineral rights have been severed), the landowner would need to engage Spectra Energy and the third party subsurface owners – possibly with the help of Garrett County – to extinguish any ability to drill for natural gas in Marcellus Shale in order to move forward.

This policy allows the Department to purchase easements in the Bear Creek RLA under circumstances that will ensure that conservation values on protected properties are not damaged by gas extraction and production operations, particularly operations that involve hydraulic fracturing. DNR's policy also allows natural gas storage and transmission – activities that have proven to be compatible with the conservation values that the Rural Legacy Program seeks to protect – to continue to take place on protected properties.

As noted earlier in this report, Spectra Energy uses the Accident field for natural gas storage and transmission, and the company is the dominant mineral rights lessee in the area. Since the spring of 2009, the Department (working together with Garrett County) has attempted to contact Spectra Energy and to work with the company to develop lease amendments that would comply with the Department's policy.

If landowners in the Accident field cannot participate in the Rural Legacy Program and are therefore unable to be compensated for preserving their land, they may choose instead to sell their properties (or portions thereof) for subdivision and residential development. From Spectra Energy's standpoint, this would mean that the company's gas storage and transmission infrastructure would be located across numerous small residential parcels, each with a different owner. Such a situation would undoubtedly be more complicated for the company than working with fewer owners of larger parcels. DNR and Garrett County have communicated this incentive for working to facilitate continued landowner participation in the Rural Legacy Program to Spectra Energy. To date, the Department has not received a formal response from the company.

DNR is currently coordinating with MDE, the lead regulatory agency, to address a wide range of concerns regarding potential adverse environmental impacts from drilling in the Marcellus Shale on a variety of resources including forest fragmentation, aquatic species, rare, threatened, and endangered species and significant ecological areas, as well as impairments to water quality, from drilling in the Marcellus Shale. At this point in time, sufficient information is not available and broader environmental questions are still sufficiently unresolved to determine whether drilling for and the production of natural gas in the Marcellus Shale can be made compatible with the natural resources and conservation values that conservation easements are designed to preserve.