

Testimony of
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To
The Pennsylvania House of Representatives
Environmental and Energy Committee

Chairman George and Representatives, I appreciate the opportunity to testify to your committee concerning the opportunity for developing natural gas resources of the Marcellus Shale in Pennsylvania. I am sure that you have all read or heard about the Marcellus Shale, as it is in the media nearly every day. You have likely heard both positive and negative stories, and, unless you are an expert fact checker, are probably confused about what this opportunity means for Pennsylvania. I hope that I can clarify some of the issues for you.

The Marcellus Shale is an organic-rich shale covering much of western, north-central and northeastern Pennsylvania that contains an enormous quantity of natural gas. While estimates of potentially recoverable reserves vary widely, many believe that the Marcellus Shale could contain the largest reserve of natural gas in the U.S. Development of the Marcellus Shale could not only supply the nation with a clean, secure supply of energy, but could create 100,000 new jobs, or more, in Pennsylvania. In addition to creating jobs related to the drilling, completion, pipeline construction and production of wells, Pennsylvania's industrial capabilities could be utilized to manufacture tubular goods, drilling rigs and many other types of equipment needed for Marcellus Shale development. New industries will begin to migrate to Pennsylvania as a cheap supply of clean fuel and feedstock is developed, and existing industries will reap the benefits of lower cost fuel supplies. Pennsylvania currently imports about 75% of our natural gas consumption. Within a few years, Pennsylvania could become a natural gas exporter. The Commonwealth could lead the nation in the use of compressed natural gas as an automotive fuel, converting fleets of trucks and busses to natural gas, yielding significant savings on fuel and resulting in much cleaner air emissions.

During 2008, a leasing frenzy erupted across Pennsylvania as companies competed for drilling rights. Leasing activity has declined significantly over the past six months, as natural gas prices have fallen to below the \$4.00 per mcf level, about one-third the price level of last summer. The U.S. drilling rig count has dropped by 50%, with over 1,000 idled rigs. Despite an industry downturn, drilling activity in the Marcellus Shale is expected to increase modestly during 2009.

Drilling of the Marcellus Shale is in its very infancy, with only about 300 wells drilled, a mere drop in the bucket compared to the thousands of wells that will be required to fully develop the resource. The challenge for industry is to get the level of drilling activity ramped up in Pennsylvania so that economies of scale can be realized and the Marcellus can compete with other shale plays. Currently, the cost to drill a horizontal shale well in Pennsylvania is as much as one million dollars more than drilling the same exact well in north Texas. The reasons for this higher cost are a combination of regulatory and legislative issues – some permitting obstacles and delays, and some well spacing requirements that did not envision horizontal drilling – and the fact that many services and

supplies required for drilling must be imported from the Southwest or Rocky Mountain regions. We are asking Pennsylvania's legislature and regulatory agencies to foster the development of the Marcellus Shale, not by relaxing any environmental regulations, but by providing a business climate that will promote increased drilling, and by fixing certain regulations. We believe that through the cooperative efforts of government and industry, a proper balance of encouraging the development of the play and protecting the environment can be reached as it has been in many other plays in the US. .

During 2008, when the potential scope of the Marcellus Shale became public knowledge and armies of landmen were unleashed throughout the state, there was much confusion -- among landowners, regulators, and the general public. This was particularly true in north central and northeastern PA, where little or no prior oil and gas activity has occurred. The environmental community raised alarms that Marcellus Shale drilling would ruin Pennsylvania's bountiful water resources. Many media stories have been published, some with accurate information and valid concerns, many with baseless allegations and misinformation.

The truth is that modern drilling techniques are very environmentally safe and leave a surprisingly small footprint. The oil & natural gas industry was born in Pennsylvania 150 years ago, and while the drilling techniques being utilized today are more advanced than those historically used in Pennsylvania, this is not new technology. Tens of thousands of wells have been drilled utilizing this technology in other states in past years with no environmental mishaps. Our industry has a tremendous investment in protecting the environment. Range Resources and other companies have invested about \$4 billion so far developing the Marcellus Shale in Pennsylvania, much of that for lease acquisition. One of our primary goals is to develop this resource in an environmentally friendly manner and to be good corporate citizens of the communities where we work. Many of our employees are outdoors enthusiasts and very concerned with minimizing the environmental footprint of our activities. Reputations and public support are very important, as adverse public policy will make it difficult to achieve our business objectives.

About 30 companies presently interested in developing the Marcellus Shale in Pennsylvania have joined with the two state oil and gas associations, IOGA and POGAM, to form the Marcellus Shale Committee (MSC). The MSC has committed well over \$1 million to a statewide educational campaign. An educational website (www.pamarcellus.com) has already been established and will be continually expanded. The MSC has had a display booth at numerous events around the Commonwealth, including the Pennsylvania Farm Show where it literally attracted thousands of interested citizens. The MSC is working in cooperation with the Penn State Cooperative Extension group to educate landowners and local public officials about the Marcellus Shale. A speaker's bureau has been created to provide presentations upon request to various civic groups.

Industry and DEP have been working closely for the past several months to evaluate potential environmental impacts from drilling and discussing ways that the permitting process can be streamlined without sacrificing environmental protection. The Governor's office has been very helpful in facilitating this discussion. We are optimistic that DEP is developing a well-reasoned, predictable and streamlined regulatory process that will promote effective development of Marcellus Shale resources while ensuring environmental protection.

Let me briefly describe the drilling process and then discuss some of the environmental concerns that have been raised.

The Drilling Process

Significant geologic investigation is required prior to drilling, including frequent use of three-dimensional seismic surveys. Once a well location is selected, a drilling pad is graded and rocked to create a useable area of about two acres. A portable drilling rig is then moved onto location and set up. Drilling proceeds vertically, with a steel casing string set and cemented through fresh water aquifers, another string set and cemented through any minable coal seams (if present), and then another casing string set to protect the shallow oil and gas intervals. Vertical drilling continues to a depth just above the Marcellus Shale and, using directional drilling techniques, a curve is drilled with a radius of about 500 feet, followed by a horizontal lateral wellbore 2,500 to 4,000 feet in length. This horizontal wellbore is at a depth of 6,000 to 8,000 feet. A final casing string is run to the end of the lateral wellbore and cemented. The drilling rig moves off location, and a smaller service rig is set up. Holes or perforations are shot in the casing where the shale is to be fraced.

Next, the well is hydraulically fractured, commonly referred to as “fracing”. Water, sand and a small portion of safe chemicals are pumped at a high rate and pressure down the inner casing and into the shale, creating a network of fractures in the shale. These fractures typically extend only a few hundred feet from the wellbore in the treated interval, and thus are approximately 1 mile or more below the fresh-water bearing zones. Following the frac treatment, water is flowed back from the well, leaving sand to prop open the fractures, providing pathways for gas to flow. Fracing connects a large surface area of rock with the wellbore, allowing gas to flow from the extremely low permeability rock to the wellbore.

Erosion and Sedimentation Control

Horizontal drilling techniques that will be used for developing much of the Marcellus Shale allow drilling of multiple wells from a single drilling pad, draining 500 acres or more with temporary surface disturbance of 2% or less, including the drilling pad, access road and pipeline. For comparison, this is far less than a typical select cut timbering operation, which causes about 8% surface disturbance. If drilling activity in the Marcellus ever reaches the level of the Barnett Shale in north Texas, currently the largest producing gas field in the country, temporary surface disturbance using pad drilling methods may be about 50,000 acres per year, all utilizing best management practices for erosion and sedimentation control. This is about 2.5% of the land area that is tilled for agricultural purposes each year in Pennsylvania (approx. 2,000,000 acres). Once drilling and pipeline installation are completed, disturbed areas are graded, topsoil is replace and land is re-vegetated. Permanent land use during production is very small, requiring an access road and a small pad for production equipment. DEP is working toward a streamlined approach to E&S permitting for projects with a disturbed area exceeding five acres. We support this initiative.

Water Use

A horizontal shale well requires 3-5 million gallons of water to drill and complete, less than 1% of that volume for drilling and the balance for fracing. Pennsylvania has abundant water supplies, second in the U.S. only to Alaska in miles of streams. While 3-5 million gallons per well seems like a large volume, it represents a one-time use of less than 2

inches of water spread out over an area of about 80 acres. Since full development of the resource will take many years, this is an insignificant fraction of Pennsylvania's water supply. In fact, at the 3,000 well per year drilling level achieved by the Barnett Shale, which is about 10 times the current Pennsylvania drilling level, total water use would be about one third of one percent (0.3%) of total water uses in the Commonwealth. The SRBC reports that at twice the peak Barnett level of activity (approx 6,000 horizontal wells per year) that the consumptive water use of the that level of activity would be less than one-half of the water used annually on Pennsylvania's golf courses.

Pennsylvania currently has no water withdrawal regulations, but Act 220 requires registration and reporting of large withdrawals for all industrial uses. DEP believes that they have authority to regulate water withdrawal under the Clean Streams Law. While the industry disagrees with this interpretation, it has agreed to continue utilizing best management practices for water withdrawal that are acceptable to DEP, and continues to work with the DEP to further develop and refine those methods to ensure protection of our water resources. In the Susquehanna River Basin, which covers about one-half of the Marcellus Shale play and Delaware River Basin, which covers only a small portion of the northeastern tip of the play, interstate compact commissions have regulations and require permits for water withdrawal and consumption. The SRBC has been very proactive in working with industry to permit necessary withdrawals. The DRBC has been slow to react. DEP has agreed to defer to permitting programs of the SRBC and DRBC in their respective river basins. In the Ohio River Basin of western Pennsylvania, DEP has agreed to review impacts of water withdrawal using SRBC methodology. By working together, the DEP and industry have made significant improvements in methodology, analysis and paperwork for water withdrawals.

Industry and regulators agree that water withdrawal from streams nearby to well locations is preferable, as water can be pumped through temporary surface pipelines to storage impoundments near the well sites without the need for trucking, eliminating about 1,000 truckloads for each horizontal well and reducing truck traffic on local roads. A common sense approach that allows for withdrawals during high flow periods in the winter and spring and avoids excessive withdrawals during dry periods will protect in-stream uses. Both industry and the DEP do not believe that water use will be a significant issue as Marcellus Shale drilling increases.

Chemicals used in Frac Water

Many allegations have been made about the dangers of chemicals used in fracking. The fact is that very few chemicals are used in the "slickwater" fracs designed for shale wells, and they are in incredibly dilute concentrations. The several chemicals that are utilized in fracking shale wells are the same or very similar to products that are found on the shelves of grocery stores or to which we are frequently exposed in everyday life. Despite allegations to the contrary, specific chemicals used in typical shale fracturing fluids were provided to DEP nearly a year ago and have been posted on their website for public review.

Chemicals typically used in a slickwater shale frac include the following:

- **friction reducer** – makes water slippery, reduces pumping horsepower; commonly used in wastewater treatment industry, constituent of soft contact lenses; constituent in some children's toys; used as a soil conditioner in farming.
- **biocide** – a disinfectant used to kill bacteria; commonly used for hand sanitation and disinfecting surgical instruments and hospital surfaces; used as embalming fluid.

- **scale inhibitor** – controls scaling in wellbore that could inhibit gas flow, commonly used in maintenance of public and private water systems; also in cellophane and baby diapers.
- **oxygen scavenger** – prevents chemical reactions that require oxygen, commonly used in water softeners and to clean iron stains; also used in the food processing and packaging industry and in many pharmaceutical products.
- **acid** – cleans cement; commonly used in swimming pools and many household applications

Frac fluids are safely handled and mixed on the surface, then delivered down the wellbore through multiple casing strings that isolate the groundwater supplies from the wellbore. Industry has agreed to an extensive testing program of frac fluids and flowback fluids from Marcellus Shale wells throughout the state. We asked PADEP, WVDEP and EPA to provide a list of chemicals of concern that they would like to see tested; the list includes over 250 manmade and naturally occurring substances. Early results of testing from two wells in southwestern Pennsylvania indicate that there are no detectable manmade chemicals of concern in the flowback fluid.

Wastewater disposal

Following fracing, water that flows back is collected at the well site in either lined impoundments or tanks. A portion of that flowback can be re-used. The remaining fluid is then trucked to a permitted wastewater disposal facility. Based on our extensive experience in southwestern Pennsylvania, one-third to one-half of the water used to frac a horizontal Marcellus Shale well flows back to the surface, pushed by the natural gas pressure in the shale. The remaining water is permanently trapped in the shale.

Flowback water contains a number of dissolved constituents that are naturally occurring in the rock. The main constituents are salts made up of primarily sodium chloride and potassium chloride. DEP will confirm that salts are the primary constituents of concern in oilfield wastewater.

Traditional disposal of oilfield wastewater in Pennsylvania has been to eliminate harmful heavy metal constituents from the water, then discharge clean salt water into rivers or large streams where it is diluted to safe levels. This is also the method used by nearly every industry, not just the oil & gas industry, for discharge of wastewater from their industrial processes. This is a safe practice as long as discharge volumes are carefully controlled and monitored. The constituent of concern in surface discharge of brines is the chloride ion (from salt) which at a certain threshold concentration (230 ppm is the threshold established by EPA); it begins to have an impact on fresh water aquatic life.

Numerous allegations have been made by environmental groups that discharge of treated wastewater into surface waters of the Commonwealth will pollute our streams and rivers, despite the historical record of safe operation of these facilities. You probably read stories last fall about the high total dissolved solids (TDS) levels recorded in the Monongahela River. Some DEP officials implied that a significant part of the problem was caused by disposal of oilfield wastewater. An extensive analysis by Tetra Tech, Inc., an internationally recognized independent environmental engineering firm, of Monongahela River samples collected by DEP shows that oilfield wastewater contributed 7% or less of the total TDS observed in the river. The majority of TDS observed in the river came from acid mine drainage and other industrial sources. TDS levels were exacerbated by a prolonged dry period, lasting over 90 days. The highest level of chloride recorded in the Monongahela River during the fall of 2008 was 56 ppm, far below the 230 ppm threshold

for impact to aquatic life. Natural gas drilling wastewater is believed to have contributed less than one-half of that total chloride level. A copy of the complete Tetra Tech report is available upon request from the Independent Oil and Gas Association of Pennsylvania. Contrary to statements made by some DEP personnel, we believe that Pennsylvania's rivers have significant assimilative capacity for safe disposal of oilfield wastewater, sufficient for significant expansion of current drilling level for many years. Further, we believe that treatment and disposal of oilfield wastewater at municipal sewage treatment plants can be safe and effective if carefully monitored and with appropriate pre-treating.

To put this issue into perspective, the amount of salt spread on Pennsylvania's state highways by PennDOT for ice control is about 750,000 tons annually. This is about the same amount of salt that would be generated from the flowback water from 3,000 horizontal Marcellus Shale wells, or about 10 times the number of wells currently being drilled. This does not include the salt used by municipalities, which is significant. The majority of road salt ends up in Pennsylvania's streams and rivers, the balance seeping into groundwater.

DEP and industry have formed a task force to jointly explore numerous alternatives to current wastewater disposal methods, including the following:

1. Reuse of flowback water for fracing additional wells. This would not only reduce volumes of wastewater but would reduce the amount of fresh water required for fracing.
2. Injection of wastewater into deep rock layers. This method is widely and safely used in many other producing regions of the U.S. and the world. Historically, this method has not been used extensively in Pennsylvania because of its geology and the limited volume of wastewater generated. Industry will be actively exploring deep disposal options over the next several years. We are confident that deep disposal will be part of the wastewater disposal portfolio, but it is too early to say how large a part it will play.
3. Distillation and Crystallization. These technologies have been used for decades for desalinization of seawater, and more recently for other water treatment solutions. This technology is very capital intensive and energy intensive, but could play a significant role in treating of flowback and produced water from the Marcellus Shale. Preliminary engineering studies indicate that a plant capable of treating 1 million gallons per day of wastewater would cost nearly \$100 million and require over two years to procure equipment and construct. This process could create distilled water and salt, which could either be land filled or, with additional processing, may be suitable to produce useable salt products.

DEP has set a long-term goal to reduce new discharges of treated oilfield wastewater to 500 ppm of TDS, before entering the surface waters of the Commonwealth. While we agree with DEP that this is ultimately an achievable goal, we caution that the two-year time frame coupled with the huge amounts of capital required may make it difficult to reach this goal in only 2 years.. To the contrary, we believe that in order for Marcellus Shale development to expand over the next 3-5 years, additional permits for discharge of treated wastewater into surface waters of the Commonwealth will be required, and that this activity can be conducted with no adverse environmental impact.

To summarize, Range Resources and the other companies developing the Marcellus Shale in Pennsylvania are committed to getting it right – to efficiently developing this tremendous natural gas resource, protecting Pennsylvania’s environment, and supporting Pennsylvania’s communities where we work. Pennsylvania has the opportunity to be a leading state in the production and use of natural gas and to establish a true and realistic plan to achieve energy independence. The Commonwealth of Pennsylvania should focus on a long-term approach that is one of encouraging the responsible development of the Marcellus while providing the proper balance of protecting our environment and encouraging new investment in the play. The ability to create a clean and green energy source, create and sustain new jobs, and pump billions of dollars into the Pennsylvania economy cannot be missed. Make no mistake about it; Pennsylvania is in competition with other states for the investment needed to develop this play, and the money and resources will flow to the state with the best plans to encourage that development.

Thank you very much for your time today.