

Testimony of
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To
The Pennsylvania Senate
Policy Committee

Chairman Pippy, Senator Yaw, and members of the Senate Policy Committee, thank you for the opportunity to testify today concerning Marcellus Shale drilling in Pennsylvania.

First a little bit of background on me and Range Resources. Range Resources is the largest natural gas producer in Pennsylvania. Our heritage dates back more than 25 years in Pennsylvania and we currently operate nearly 5,000 wells in Pennsylvania and over 11,000 wells throughout the Appalachian region. Range is an S&P 500 company, headquartered in Ft Worth, Texas with drilling operations in the Southwest, Appalachian and Gulf Coast regions of the United States, with a regional focus on Marcellus Shale development. Our company pioneered the development of the Marcellus Shale in 2004 and has unlocked this tremendous opportunity for Pennsylvania and the nation. We currently employ more than 200 Pennsylvanians and have a regional headquarters in Washington County. I am an officer at Range Resources currently serving as Vice President of the Marcellus Shale Division. Having spent my career in this industry, I have experienced first-hand the huge economic opportunities that natural gas development can bring to a region. During my career I have never witnessed an opportunity as large as the one before us today with the Marcellus Shale.

I know that you all have heard and read about the Marcellus Shale, and the profound impact it can have on Pennsylvania's economy. You also may know that our industry, like much of the U.S. economy, is in a recession. Natural gas prices have declined over 70% from their levels last summer. Just half of the over 2,000 drilling rigs running the U.S. last summer are still operating, the balance setting in yards with crews laid off. Fortunately for Pennsylvania, there will be a small increase in drilling the Marcellus Shale this year, despite a very negative business climate.

In early 2008, reports were widespread in the media that the Marcellus Shale, which covers an area from south-central New York, through Pennsylvania, and well into West Virginia, may contain an immense reserve of natural gas, possibly the largest deposit in the Nation. Daily media stories reported extensive leasing for drilling rights throughout much of the Commonwealth, initial drilling success and fears of environmental impacts from widespread drilling. Natural gas prices were at near record highs. Amidst this media hype, the Department of Environmental Protection imposed additional requirements to the process for obtaining a drilling permit for a Marcellus Shale well. Some of these application requirements proved cumbersome and ineffective, in many cases causing significant permitting delays and confusion among both applicants and the various departments and regions of the DEP.

Over the past nine months, industry and DEP officials have held dozens of meetings to discuss drilling permit application requirements. Representing the industry has been the Marcellus Shale Committee, a committee formed in mid-2008 by about 30 oil and gas producing companies that plan to develop natural gas resources of the Marcellus Shale along with the state's two oil and gas producer associations. Much has been learned through this interaction – by industry about

regulatory concerns – and by the DEP about the drilling process for Marcellus Shale wells – and much progress has been made.

The major regulatory issues surrounding Marcellus Shale drilling relate to erosion and sedimentation, water withdrawal, construction of water impoundments, and disposal of wastewater. Throughout these discussions, there was little disagreement between industry and the DEP concerning the measures necessary to protect the environment. Rather, the discussion centered on developing a clear and predictable application process. We believe that the several changes to the permitting process being implemented by DEP for Marcellus Shale wells will actually improve environmental protection, as there will be an increased focus on industry training and field inspection. On a related issue, industry supported DEP's recent proposal for a significant increase in drilling permit application fees, as we realize the benefit of adequate staffing and effective regulation of our industry.

Let me briefly describe the drilling process and then discuss the major regulatory issues that have been discussed.

The Drilling Process

Significant geologic research is conducted 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. The shallow casing strings that protect fresh water aquifers and workable coal seams are installed using a heavily regulated process controlled by DEP that has been improved and refined over many years of experience. 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 vertical 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 very small fractures in the shale. These fractures typically extend vertically only a few hundred feet from the wellbore in the treated interval, and 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 replaced 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 has adopted an effective permitting process for projects with a disturbed area exceeding five acres.

Water Use

Water usage for Marcellus development is minimal compared to other water uses in Pennsylvania. Both industry and the DEP agree that water use will not be a significant issue as Marcellus Shale drilling increases. 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 may sound 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 expected 2009 drilling level in Pennsylvania's Marcellus Shale, total water use would be about one third of one percent (0.3%) of total water uses in the Commonwealth. Pennsylvania uses 10 billion gallons of water each and every day. The Susquehanna River Basin Commission reports that at twice the peak Barnett level of activity (approx 6,000 horizontal wells per year) that the consumptive water use of that level of activity would be less than one-half of the water used annually on Pennsylvania's golf courses.

Pennsylvania currently does not have water withdrawal regulations, but Act 220 requires registration and reporting of large withdrawals for all uses. The 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 the DEP. The industry 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 much slower 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, the 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.

Chemicals used to frac a Marcellus Shale Well

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. Most companies employ only four or five common chemicals to frac a Marcellus Shale well. These chemicals are the same or very similar to products that are found on the shelves of grocery stores or which we safely use in everyday life, frequently in much larger concentration. 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..
- **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 fracking, 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 out 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 shale. The main constituents are salts made up of primarily sodium chloride and potassium chloride. While the DEP will confirm that salts are the primary constituents of concern in oilfield wastewater, both the DEP and industry are confident that this issue can be safely managed. 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 concentration of 230 parts per million (ppm), a threshold level established by EPA, 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 of Monongahela River samples collected by DEP by Tetra Tech, Inc., an internationally recognized independent environmental engineering firm, shows that oilfield wastewater contributed less than 7% of the total TDS observed in the river. The majority of TDS observed in the river was sourced from acid mine drainage and other industrial sources. TDS levels were exacerbated by a prolonged dry period, lasting over 90 days, during which time the DEP issued drought warnings. 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 only 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 initial 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. 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 the salt issue into perspective, the amount of salt spread just 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 expected to be drilled this year. This does not include the salt used by municipalities, cities, or by the Pennsylvania Turnpike Commission all of which is significant. The majority of road salt ends up in Pennsylvania's streams and rivers and the balance seeps into groundwater.

The DEP and industry have formed a task force to jointly explore numerous alternatives to current wastewater disposal methods, some of which are already being tested in the field, 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 the large assimilative capacity of local streams and rivers, the state's 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. All wastewater in the Barnett is disposed in this manner. Ohio and West Virginia each have more than 100 disposal wells.

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.

The 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 the DEP that this is ultimately an achievable goal, we caution that their projected two-year time frame is not realistic given the huge amounts of capital required and long lead time for construction of required facilities. To the contrary, we believe that for Marcellus Shale development to expand over the next three to five 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 develop this tremendous natural gas resource, protect Pennsylvania’s environment, and support Pennsylvania’s communities where we work. Pennsylvania has the opportunity to be a leader 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 Shale while providing the proper balance of protecting our environment and encouraging new investment in the play. The opportunity to develop a clean and reliable energy source, create and sustain new jobs, and inject billions of dollars into Pennsylvania’s economy must be fostered by elected leaders and regulators. Make no mistake about it: Pennsylvania is in competition with other states. Those states who best encourage this activity will attract the essential capital and resources and will be the true winners. The larger challenge for Pennsylvania’s elected leaders is to drive state and national energy policies that encourage the usage of these newly realized and vast natural gas resources. Nearly every national and international expert agrees that natural gas will be the bridge to our energy future and will play a prominent role in our nation’s energy portfolio for generations.

Thank you very much for your time today.