



Statement to Democratic Policy Committee
Marcellus Shale Natural Gas Development
Testimony of Tracy Carluccio, Deputy Director
Delaware Riverkeeper Network
July 27, 2011

Thank you Mr. Chairman, Representative Santarsiero, and members of the Committee for holding this Hearing here today and for the invitation to present testimony to the Committee. I am the Deputy Director of the Delaware Riverkeeper Network (DRN), a nonprofit membership organization dedicated to the defending and restoring the Delaware River and its tributaries and habitats throughout its entire 13,000 square mile watershed in Pennsylvania, New York, New Jersey and Delaware. We were established in 1988 and have about 8,000 members, many of whom live in Pennsylvania.

Natural gas development is a defining issue for us here in the Delaware River Watershed. By that I mean the advent of gas drilling in the Basin will define the future of the River, its natural assets and the water supply of over 15 million people, delivering 1,803 mgd to public water supplies. That's about 5% of the Nation's population from a relatively small watershed, only .4% of the land mass of the continental U.S.¹ In fact, the Delaware River is one of the largest water supply basins in the mid-Atlantic, providing more drinking water than any adjacent basin.

For instance, the Susquehanna River Basin (27,500 square miles) is more than twice as large as the Delaware River Basin (12,769 square miles) yet the Susquehanna provides 6.2 million people with water, less than half of what the Delaware provides each day. That's why river historian Richard Albert recounted that the river has been dubbed "A Little Giant" because of the command performance it must meet every day.²

About 5.5 million people in Pennsylvania get their water from the Delaware River, adding up to 679 million gallons of water per day, second to New York State, which is the largest water user at 800 mgd because of the New York City reservoirs in the headwaters of the Delaware, providing drinking water to 7 million New York City residents.

¹ <http://www.state.nj.us/drbc/thedrb.htm>

² Richard C. Albert, "Damming the Delaware: The Rise and Fall of the Tocks Island Dam", 1987.

The value of this water supply has recently been calculated by a University of Delaware study at \$3,767,000. Looking at the many aspects of economic value that the River provides, this study concludes “The Delaware Basin contributes close to \$22 billion in annual market/non-market value to the regional economy...”³ Much of that value derives from forests, water supply and high water quality; I have attached a copy of a graph from that report that details these values (page 4). There are 2,271,000 jobs in Pennsylvania’s portion of the Delaware River Basin and 43% of Pennsylvania’s population lives in the Watershed, even though only 14% of the State is contained here. The Delaware River supports the largest freshwater port in the world.⁴ Again, the Delaware Watershed may be relatively small but it is a great provider and is intensely used.

This is part of what is at stake here in the Delaware River Basin, should gas drilling commence. Also at stake is the National Wild and Scenic River, designated by Congress for its outstanding attributes and resources, a National Estuary, and the exceptional water quality of the nontidal Delaware. The water quality of the Delaware River is so high that the entire 197-mile nontidal river is protected by a special regulatory program enacted by the Delaware River Basin Commission (DRBC) over the past 2 decades to prevent water quality degradation. In fact, the Delaware River is the longest stretch of anti-degradation waters in the Nation – and it is the longest undammed river east of the Mississippi. These distinctions make the Delaware an irreplaceable resource, an extraordinary natural asset, a unique and powerful provider.

In 2009, the DRBC determined that as a result of water withdrawals, wastewater disposal, and other activities, natural gas extraction projects could affect the water quality of the River’s Special Protection Waters by altering their physical, biological, chemical or hydrological characteristics. In 2010, the DRBC enacted a moratorium on gas drilling while natural gas-specific regulations are developed for the Basin; that moratorium is still in effect.

Delaware Riverkeeper Network engaged 8 experts to analyze the proposed natural gas regulations that were issued by the DRBC in December of last year. These were published despite a storm of protest and requests from thousands to conduct a comprehensive environmental analysis, including cumulative impact studies, of the potential effects of gas development on the Delaware River Watershed. 69,800 submissions (a record number) were received by the DRBC from the public on the proposal; they are reviewing and plan to respond to those comments in the coming months. The DRBC is composed of the Governors of the four states that drain to the river and a federal representative (Army Corps of Engineers). The NY Attorney General’s office has filed a lawsuit against DRBC for not following federal environmental law by prematurely issuing the draft rules.⁵ The decisions about gas drilling in

³ Gerald J. Kauffman, “Socioeconomic Value of the Delaware River Basin in Delaware, New Jersey, New York, and Pennsylvania, *The Delaware River Basin, an economic engine for over 400 years*”, University of Delaware, Water Resources Agency, Final Draft May 25, 2011.

⁴ Ibid.

⁵ [http://www.ag.ny.gov/media_center/2011/may/DRBC%20Complaint%20\(Final\).pdf](http://www.ag.ny.gov/media_center/2011/may/DRBC%20Complaint%20(Final).pdf)

the Basin will be decided by the DRBC and, doubtless, the courts. But what Pennsylvania does or not do also directly affects what will happen here. This is exercised through Governor Corbett's vote on the DRBC and Pennsylvania's influence there, which is pushing to jump start drilling in the Basin. And the Marcellus Shale Advisory Commission report is key in terms of the importance of the State's role.

DRN's experts that reviewed the draft gas regulations for DRN concluded that they do not provide the protection needed to meet the standards of Special Protection Waters. In our comment to the DRBC on the draft rules, we explained that one of the major flaws in the regulations is a heavy reliance on Pennsylvania and New York regulations which are not adequate. They are not only not sufficient to meet the Delaware River's non-degradation goals but they are not able to protect Pennsylvania or New York. Attached is a brief summary of the lengthy comment DRN submitted to DRBC. We have also provided a DVD with all of the expert reports and DRN's full comment for the Committee here today. Also attached is an Expert Sheet that addresses aquifer protection issues.

The Marcellus Shale Advisory Commission has issued a report that ignores most of the crucial aspects of risk associated with gas extraction. Policy makers need to do more.

Some suggestions of areas that need critical attention but are overlooked or not adequately addressed by the Commission report:

- Casing and construction safety standards should require Best Available Technology. See the attached Expert Sheet regarding aquifer protection that explains why the cementing and steel casing standards are not sufficient to isolate contaminants introduced and produced by well development from ground water and aquifers.
- Air quality degradation must be stopped by the removal of exemptions, use of best available technology, and the valid assessment of cumulative impacts on air and climate change from the standpoint of emissions (especially VOC's, NOx, and other pollutants such as small particulates and carcinogenic chemicals) and methane, one of the most powerful greenhouse gases.
- Monitoring and baseline water well and stream quality assessment must be required of water supplies within the full zone of influence of a gas well project; testing and ongoing monitoring during and after gas well construction and production must be required at the expense of the well operator.
- Gas pipelines, compressors and other infrastructure needs to be brought under one planning and assessment program to get handle on environmental impacts from the myriad of pipelines currently under way.
- A cumulative impact analysis of the adverse effects of gas development on communities and the environment needs to be conducted—including water volume, stream and river flows, water quality, air and surface impacts.
- A moratorium should be enacted in Pennsylvania while a comprehensive analysis is done and then that information used to develop improved regulations and practices.

- No forced pooling. People should not be forced to lease their mineral rights if they do not want to. Pooling should not be used to address spacing; spacing requirements are needed and should be based on environmental and community impacts, not on maximizing gas extraction.
- No further leasing of state parks, forests, or other publicly owned lands.
- Municipalities must be allowed to exercise their full responsibilities under local regulatory laws; the Commission's recommendation that zoning should not "unreasonable impede" gas drilling misses the point of local zoning, which is to protect and plan for resources and residents within municipal jurisdiction. Such a qualitative and judgmental standard is totally inappropriate.
- Setbacks must be measured outward from the horizontally fractured zone of a gas well, as described in the attached Expert Sheet, and must be at least 5000 feet from structures and water sources. A Duke University study released this year and Paul Rubin's expert report produced for DRN explain the phenomena of gas migration that is plaguing communities where drilling is occurring in Pennsylvania.⁶ All pollution from gas well development activities must be the responsibility of the well operator in perpetuity, not limited to 1000 to 2500 feet and a one year time frame.
- Land changes must be brought under control; huge areas of natural land are being transformed to an urban condition due to well construction. Pennsylvania streams are being ruined because stormwater permits are not required unless 5 acres or more is disturbed (only a minimal erosion and sediment control plan). Also, Pennsylvania's high quality streams are not protected by the newly enacted 100 foot buffer requirements in Chapter 102 because gas drilling is exempted.
- Drilling wastewater should not be discharged without removal of all hazardous components and should not be discharged to waterways. On site drilling waste burial also must be prohibited; the burying of these contaminated wastes provides an easily available pathway directly to groundwater and the surface for pollution – the cuttings and sediments can contain hydrocarbons, heavy metals, and in some cases radioactive materials that reside in the deep geology where the Marcellus is located.
- Penalties, sureties and bonding are not high enough to cover the cost of remediation or to be a deterrent.
- Oversight and enforcement is inadequate at every level, at permit review (sometimes as little as 2-30 minutes of staff time for a drilling permit, discovered by DRN in a gas well permit appeal), inspection, and enforcement. PADEP issued 2755 drilling permits in 2010 and that number is outpaced this year. Drilling activity is increasing, not slowing down and staffing cannot be cut (as the State Budget did again this year) or remain stagnant.
- Public health analyses and tracking is needed to assess the impacts on people.

Thank you for the time to speak with you today. The Delaware River has been fought over since George Washington crossed it in the Revolutionary War. Its waters the subject of

⁶ <http://www.nicholas.duke.edu/cgc/HydraulicFracturingWhitepaper2011.pdf>;
<http://www.delawariverkeeper.org/resources/Reports/Rubin%20report%20finalfinalTOC4.9%202011%20.pdf>.

legendary lawsuits between states that were settled by the Supreme Court and gave birth to a new watershed-based approach to water resource management. Billions of dollars have been spent on cleaning up the Delaware River and countless people have fought to bring this river back from polluted oblivion in the last century. Once too depleted to even support the migration of the American Shad, this river is now one of the few that allows such special species to thrive. Too much has been invested in this river to allow it to be brought down by an industrial activity that enjoys unjustifiable exemptions from portions of every major federal environmental law⁷ and by inadequate regulation at the state and regional level because gas drilling is seen as a given, as sacrosanct. I am here to tell you that we won't let this happen, that it shouldn't be happening anywhere in Pennsylvania and that we cannot sacrifice our water for gas.

Thank you and I am happy to take questions.

⁷ Due to years of lobbying by the industry, the oil and gas industry is exempt from protections in the Clean Air Act, the Clean Water Act, the Superfund law, the Resource Conservation and Recovery Act, and the Safe Drinking Water Act. In addition, they are not covered by public right-to-know provisions under the Emergency Planning and Community Right-to-Know Act.

Attachment 1

Summary of Delaware Riverkeeper Network's concerns regarding DRBC's Draft Natural Gas Development Regulations:

The proposed rules do not prevent degradation of the Special Protection Waters of the Delaware River Watershed nor do they provide water quality protection for the drinking water of 15 million people. They do not protect from the adverse impacts of individual wells in the short or long term, nor do they address the cumulative impacts of water withdrawal, land transformation, and well construction from multiple wells as gas builds out. There is no method proposed to prevent the degradation and pollution that natural gas drilling will cause to the River's water resources including its habitats, streams, and communities, making this harm inevitable.

Some specific concerns about the draft rules are:

- DRBC wrongly acquiesces to State regulations in many crucial areas. These include:
 - stormwater management (PA and federal government largely exempt gas well development);
 - stream protection (PA exempts gas drilling from Exceptional Value and High Quality stream buffer standards—the best of the best streams in PA);
 - drilling, cementing and well construction, making aquifer contamination unavoidable (for instance, many regulatory aspects of the PA Oil and Gas Act are largely substandard);
 - air quality (PA exempts individual gas wells from state air pollution standards);
 - setbacks from homes, public buildings, roads, and public and private water supply wells are all deferred to state standards (PA and NY have grossly inadequate setback standards);
 - DRBC and the States measure setbacks from the well pad, not the horizontal well bore and hydraulic fracture zone (where pollution can occur);
 - Centralized wastewater impoundments are allowed and left under state regulations despite DRBC's finding that open waste pits on well sites are too dangerous and require closed tank systems to capture all flowback.
 - On site drilling waste burial should be prohibited (this is allowed in PA and NY)
- No limits on how many wells can be drilled and how closely they can be spaced from each other; this means the drillers are in control of how intensely the Watershed is developed (they are serving their bottom line), not the DRBC (who is charged with protecting water resources).
- Much gas well development will occur without the planning DRBC proposes for more than 5 well pads or companies who have leaseholdings of 3200 acres or more. At 10-12 wells per pad, 50 to 60 gas wells can be drilled without any plan oversight and variances, exemptions and limited expansions could make matters worse. Even where natural gas development plans are required, it is not clear how the planning will limit adverse environmental impacts nor is it clear how cumulative analyses can be made from these plans to avoid large scale degradation.
- No restriction on the dangerous chemicals that will be used in drilling and hydraulic fracturing ("fracking"); approximately 260 chemicals - and another 40 compounds with secret ingredients that the industry will not disclose— are being used in fracking fluids in Pennsylvania and other states where shale gas is being mined (NYSDEC Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas, and Solution Mining Regulatory Program, 2009). Many of these chemicals are hazardous to humans and other species, many are toxic such as naphthalene,

glutaraldehyde, and acrylamide and some are classified as carcinogenic by the federal government such as benzene, formaldehyde, and methanol.

- Public disclosure of all of the ingredients in the chemical formulas used in fracking is not required (just because the federal 2005 Energy Policy Act exempts fracking from the Safe Drinking Water Act doesn't mean the DRBC should). Public participation of many permitting aspects is missing.
- Proposed wastewater standards do not require the removal of all of the hazardous constituents in gas drilling wastewater. Cuttings from the drilling process and solids that are left from wastewater filtering are not classified as hazardous waste even though they contain hazardous materials, which will allow them to go to common landfills (just because the federal government has a special exemption for gas processing solids doesn't mean the DRBC should).
- DRBC proposes to protect flood hazard areas BUT allows variances so that only floodways, the stream area that carries the bulk of floodwater, are clearly off limits.
- DRBC proposes an Approval by Rule that will allow fast track approval of gas drilling and some water withdrawals, with no opportunity for public comment and input. In PA, the rush to drill has led to pollution and accidents throughout the Marcellus shale fairway (PADEP records show 2010 violations of oil and gas environmental permits=2,486, wells drilled, 2010=2,755; violations in 2011 have ballooned to about 11 per day).

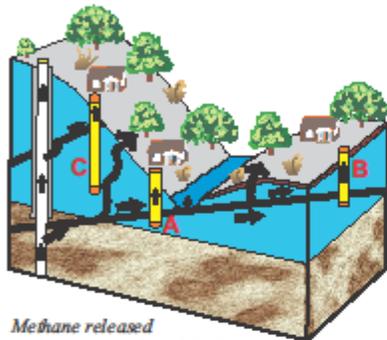


What the experts have to say about ...

NATURAL GAS DRILLING & AQUIFER PROTECTION



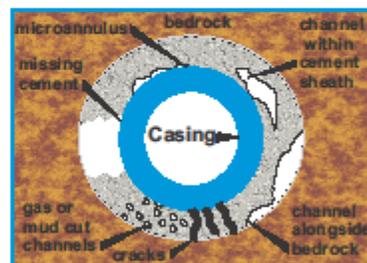
- ◆ Groundwater quality throughout the Delaware River Basin is at high risk of being degraded by methane, uranium, radium, radon, chromium, lead, arsenic, barium, benzene, bromide, sodium chloride, H₂S, 2-butoxyethanol (2-BE), 4 Nitroquinoline-1-oxide (4-NQO) and other pollutants.
- ◆ The sealant materials (cement and steel) being used to line boreholes to isolate and protect aquifer waters have a short design life. In places, these materials are already failing.



Methane released under pressure from failed cement sheaths and casings follows fractures to homeowner wells, water bodies, and the land surface.

Life of Aquifers ♦ Through geologic time, layers of sediments were deposited and compacted into bedrock. The land was subsequently uplifted and then eroded for over 1,000,000 years by the Delaware River and its many tributaries. In response, fresh groundwater flow now moves slowly from upland areas towards valleys. These freshwater aquifers are physically isolated and far above deep, saline, waters and gas-rich bedrock formations. Wells tap the pure freshwater aquifers we drink from. Gas wells pose a real threat to well water quality because they provide unnatural pathways for contaminants to rise under pressure from deep within the earth and to mix with potable water. If saline and freshwater zones remain disconnected, our aquifers will continue to provide pristine water to our children and their grandchildren for another 1,000,000 plus years. If the two become connected, the results would be devastating for future generations - robbing them of needed groundwater.

Life of a Well ♦ The gas industry considers the life of a well in terms of its productive life, which typically ranges between 4 and 20 years. This is the time period when isolation of gas-rich formations from the overlying freshwater aquifers matters most to them. Loss of zonal isolation equates directly to loss of profits because the gas is not captured. When a gas well is no longer profitable, it is plugged and abandoned. Plugging involves removal of an inner steel casing placed during well construction and then cementing of the open borehole to seal off gas bearing and saline geologic horizons from the overlying freshwater aquifer. To provide long-term protection, the cement sheath, casing, and inner cement plug must remain fully intact for the life of the aquifer (999,980+ years).



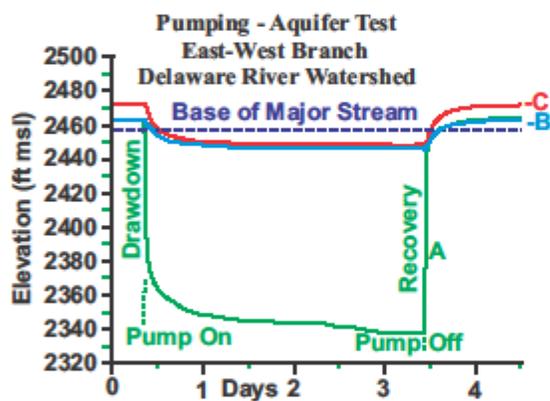
Types of cement channels in annular spaces that may permit upward methane migration. Modified from Newhall (2006).



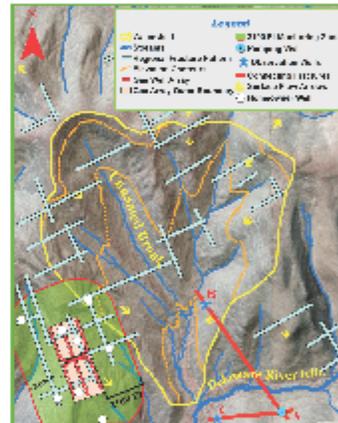
Corroded and pitted casing (Shutterstock). Steel and cement subjected to harsh, corrosive, downhole conditions can degrade in a matter of years, thereby resulting in an explosive, contaminant, and health risk to nearby landowners.

Life of Cement & Life of Steel ♦ Long-term protection of freshwater aquifers from deep, contaminant-laden, bedrock formations breached by gas wells relies completely on the durability of the materials used to physically isolate them. Water quality protection must be viewed relative to the life of aquifers. Therefore, sealant materials must also have a design life equal to the useful life of aquifers. Extensive research conducted by the gas industry and others reveals that cement failure will occur in less than 100 years due to numerous factors that include shrinkage, debonding, and the development of channels that allow gas and fluid migration. Debonding occurs at the casing/bedrock and cement/casing interfaces. A micro-annulus of 0.001 inches is sufficient to allow gas flow. Similarly, research shows that steel casing also has a design life of less than 80 years - in some cases far less due to exposure to saline water and acid gases (i.e., < 4 years). **Thereafter, material failure and groundwater degradation are assured.**

Setback Distances From Water Bodies & Homeowner Wells ♦ Analysis of hydrologic data reveals that gas well array (i.e., multiple horizontal boreholes stemming from a single well pad) setback distances of less than 2,100 feet from water bodies (e.g., reservoirs, lakes, rivers, streams, wetlands) and homeowner wells may pose a significant water quality risk. DRBC draft gas drilling regulations propose a setback distance of 500 feet between vertical boreholes and water bodies. This distance appears to lack the empirical data needed to document that it will protect water resources. One key hydrogeologic factor involved is whether cement sheath failure coincident with hydrofracking events and well decommissioning will result in rapid transmission of 1) pressurized methane, Light Non-Aqueous Phase Liquids (LNAPLs), and other pollutants to homeowner wells and water bodies, and 2) free and dissolved gas flow through leaking well annuli and fractures during gas production. Pumping tests and analyses of known contaminant incidents provide a means of assessing this. Pumping tests that stress groundwater within fractured bedrock aquifers provide a rigorous means of assessing fracture interconnectivity. The hydrograph of a pumping test (below) conducted in the Delaware River Basin documented the effects of turning a pumping well on and off in less than five minutes in observation wells up to 2,100 feet away. Because this documents long-distance hydraulic connections, it is likely that contaminants driven by high pressures during hydraulic fracturing events and after well decommissioning will adversely impact wells. There is also evidence that methane is released from fractures and wellbores at far greater distances. In addition, some fractures naturally release methane. Because hydraulic fracturing within gas well arrays may interconnect these fractures, it would, from a water quality protection standpoint, be prudent to expand the setback distance beyond the well array. **Pumping test data provides solid documentation for mandating minimum setback distance to at least 2,100 feet as measured from the outer boundary of well arrays to all water resources and homeowner wells.**



Hydrograph showing rapid hydraulic response between a pumping well and two observation wells



Schematic showing minimum setback distance from a gas well array and well A, B, C orientation. Homeowner wells should not be within the array.

Fracture Sets Are Connected Over Thousands Of Feet ♦ The above hydrograph documents the hydraulic response of observation wells B and C from pumping well A. The schematic set-up of the orientation of these wells relative to themselves and a major stream is depicted on the figure above. Well B is 2,100 feet NW of Well A and Well C is 1,000 feet to the west. Observation Well B is situated on the opposite side of a valley, beyond a major Delaware River tributary that hydrologists might have considered to be a significant groundwater divide (see also front page figure). This test demonstrates that pressurized methane-rich waters can impact water supplies across major groundwater divides in different watersheds - anywhere along open, permeable, portions of fractures.

Rapid Contamination of Homeowner Wells ♦ Methane excursions from gas wells constructed along the same fracture set as homeowner wells will contaminate drinking water supplies. This will occur when zonal isolation sealant materials fail, in a time frame ranging from days to 100 years.

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