



City Council
CITY OF PHILADELPHIA
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**Report of Philadelphia City Council's Joint Committees on
Transportation and Public Utilities and the Environment
Pursuant to Resolution No. 100515:**

Marcellus Shale Gas Drilling's Impact on Philadelphia

December 15, 2010

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On September 28, 2010 the City Council of Philadelphia's Joint Committees on Transportation and Public Utilities and the Environment held hearings on the economic and environmental impacts that shale gas drilling may have on Philadelphia. Nineteen panelists gave testimony.

This report summarizes the verbal and written testimony given at the hearing and presents recommendations for Philadelphia to move forward regarding the impact of Marcellus Shale gas drilling.

City of Philadelphia



Council of the City of Philadelphia
Office of the Chief Clerk
Room 402, City Hall
Philadelphia

(Resolution No. 100515)

RESOLUTION

Authorizing City Council's Joint Committees on Transportation and Public Utilities and the Environment to hold hearings on the economic and environmental impacts that hydraulic drilling of Marcellus Shale will have on Philadelphia and the surrounding region.

WHEREAS, The Delaware River Basin Commission (DRBC) recently stopped all new Marcellus Shale drilling in the Northeastern Pennsylvania region until such time as appropriate environmental regulation is in place; and

WHEREAS, While natural gas is recognized as a cleaner-burning substitute for petroleum which if safely extracted could lessen our dependence on foreign sources of energy while meeting our pressing energy needs and could facilitate the transition from non-renewables towards more renewable sources of energy; and

WHEREAS, Every natural gas well project inherently has the potential to endanger water resources and pollute the environment, as the Marcellus well blowout in Clearfield County on June 3, 2010 illustrated; and

WHEREAS, It is currently unclear whether the Philadelphia Gas Works is already or will be purchasing gas extracted from Marcellus Shale drilling; and

WHEREAS, Natural gas extraction injects toxic water into the well to fracture the rock and poses a risk to our public health and the potability of our drinking water; and

WHEREAS, Extracting natural gas in Marcellus Shale could potentially benefit the Commonwealth economy if managed properly and safely, now, therefore,

BE IT RESOLVED, BY THE COUNCIL OF THE CITY OF PHILADELPHIA, That it hereby authorizes the Joint Committees Transportation and Public Utilities and the Environment to hold hearings on the economic and environmental impacts that hydraulic drilling of Marcellus Shale will have on Philadelphia and the surrounding region.

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RESOLUTION NO. 100515 continued

CERTIFICATION: This is a true and correct copy of the original Resolution, Adopted by the Council of the City of Philadelphia on the seventeenth of June, 2010.

Anna C. Verna
PRESIDENT OF THE COUNCIL

Michael A. Decker
CHIEF CLERK OF THE COUNCIL

Introduced by: Councilmembers Jones, Kenney and Reynolds Brown

Sponsored by: Councilmembers Jones, Kenney, Reynolds Brown, DiCicco, Greenlee, Goode and Green

City of Philadelphia

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INTRODUCTION

ABOUT THE HEARINGS AND THIS REPORT

In accordance with Resolution 100515, the City Council of Philadelphia's Joint Committees on Transportation and Public Utilities and the Environment was authorized to hold hearings on the economic and environmental impacts that Marcellus Shale gas drilling will have on Philadelphia and the surrounding region.

The resulting hearing, which included five panels, was held on September 28, 2010 in City Hall Room 400.

This report is derived from the verbal and written testimony given during the hearing and related resources available after the hearing. Findings were highlighted from the hearing and form the basis for this report's recommendations addressing the impact of potential gas drilling in the Marcellus Shale on Philadelphia.

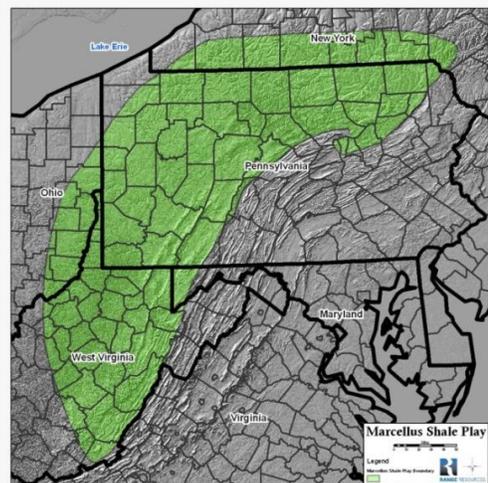
- Councilman Jones: "What we hope to do today is to review the facts, dispel the myths and to create the best public policy which is in the interest of all Philadelphia. I am not necessarily a long-term environmentalist. I have a lot of titles. One of them is Chairman of this Committee, but the one that I care most about is Grandfather, and what we do today will determine the quality of water in Philadelphia for my grandchildren."¹
- Councilman O'Neill: "I would like to thank both Chairmen, you and Councilman Kenney, for bringing this issue to the forefront and not as a taxation issue, which is all I and most people have read about, is whether the tax and how much, not whether to do or what to do about it if you're going to do it. I think this record that will be developed here today will be groundbreaking, to use a play on words, with people looking for more information of a scientific and environmental nature when dealing with this issue rather than just is this the golden goose."²

INTRODUCTION TO THE MARCELLUS SHALE AND GAS DRILLING

The Marcellus Shale is a sedimentary layer underground containing natural gas (methane) tightly packed into pores within the shale. This formation extends from New York through Pennsylvania and West Virginia, and is, on average, located about a mile under the surface.

¹ Transcript p.4

² Transcript pp.6-7



Marcellus Shale lies under headwaters and some tributaries of both the Schuylkill and Delaware Rivers, which combined provide 100% of Philadelphia's drinking water. Thus, although shale gas drilling may occur in only half of the watershed area influencing Philadelphia's water supply³, contaminants from tributaries could flow into both of the main stem rivers supplying all Philadelphia residents with drinking water.

Extracting gas from the Marcellus Shale involves a new technique called "high-volume slick water hydraulic fracturing" in combination with horizontal drilling. The well begins drilling into the earth vertically until it reaches about 8,000 feet below the surface where the Marcellus Shale layer is located. At this point, the drilling is turned horizontally (over the course of a half-mile) and continues another 2,000-8,000 feet across the layer. Within this horizontal leg, hydro-fracking occurs. After a series of explosions to initially fracture the layer, water is pumped down at a high pressure (15,000 psi) for several hours to further fracture the layer allowing the gas to escape into the vertical draft. Because of this process, much concern is directed towards ensuring these fractures do not propagate outside the Marcellus Shale layer.⁴

Over 1,000 incidents of water contamination nationwide have been reported in relation to shale gas drilling. In addition to concerns specific to the hydrofracturing stage, the entire life-cycle process surrounding unconventional gas drilling has come under scientific scrutiny. New York State, in response, has enacted a statewide moratorium on such drilling.

³ Brunwasser: Written Testimony p. 1

⁴ Boufadel: Transcript p. 43

PANEL DESCRIPTIONS

PANEL 1: SCIENCE

The first panel featured three scientists who presented facts and discussed the potential impacts that shale gas drilling could have upon human health, aquatic life and environmental quality. The panelists exposed gaps in information that must be filled in order to determine the full cost of fracking.

- Dr. David Velinsky – VP for Environmental Research, Academy of Natural Sciences
- Dr. Joseph P. Martin – Professor of Engineering, Drexel University
- Dr. Michel C. Boufadel – Professor of Engineering, Temple University

PANEL 2: INDUSTRY & UTILITIES

The second panel discussed the perspectives of the corporations intending to use unconventional gas drilling technology in the Delaware River Basin and the City departments most relevant to the issue. The Philadelphia Water Department (PWD) serves as a regulatory body focused on watershed protection and ensuring safe drinking water. Philadelphia Gas Works (PGW) is a local gas distribution company that serves 84 percent of the City's residential houses. The Marcellus Shale Coalition (MSC) represents large multinational corporations that profit from Marcellus Shale gas extraction. MSC is comprised of about 43 midstream or gas producer members and associate members, some of which are small businesses.

- Kathryn Z. Klaber – President and Executive Director, Marcellus Shale Coalition
- Bernard Brunwasser – Commissioner, Philadelphia Water Department
 - With Dr. Christopher Crockett – Director of Planning and Research and inventor of the Early Warning System for the Delaware Valley
- Craig White – Chief Operating Officer, Philadelphia Gas Works

PANEL 3: ECONOMIC AND COMMUNITY RESPONDERS

The third panel had a variety of speakers, who each addressed different relevant aspects to consider with drilling Marcellus Shale. A representative from Congressman Joe Sestak's office briefly summarized action being taken on the federal level with regards to shale gas drilling. Two private citizens told their first-hand personal experiences dealing with the effects of drilling. Finally, an economics professor discussed his preliminary analysis of the gas industry's report in favor of drilling.

- Bill Walsh – Congressman Joe Sestak's District Director
- Denise Dennis – Private citizen/historic farmland owner in Marcellus Shale region
- Iris Marie Bloom – Director of Protecting our Waters
- Dr. Frederic Murphy – Professor at Fox School of Business at Temple University

PANEL 4: REGULATORS

The fourth panel presented two members of different government agencies that play an active role in regulating drilling and one representative of two nonprofit corporations that monitor environmental policy in Philadelphia. On the federal level, the Delaware River Basin Commission (DRBC) is an interstate commission managing the water resources of the Delaware River Basin that span Pennsylvania, New York, New Jersey, and Delaware. According to its charter, the DRBC is mandated to protect against “future pollution.” The DRBC regulates applications and permits for the drilling of gas wells. As of now, the DRBC will not review any applications for gas wells, including exploratory and production wells, until new DRBC regulations regarding gas wells are developed and adopted. On the state level, the Pennsylvania Department of Environmental Protection (DEP) enforces Pennsylvania laws relating to oil and gas activities. The Pennsylvania DEP is responsible for conducting on the ground inspections of gas and oil wells, and is charged with protecting water quality throughout the state. In addition, the Energy Coordinating Agency and Keystone Energy Efficiency Alliance were represented as two non-profit corporations that monitor Philadelphia environmental policy.

- Carol Collier – Executive Director of the Delaware River Basin Commission
- Scott Roberts – Deputy Secretary of the Pennsylvania Department of Environmental Protection for Mineral Resource Management
- Matthew Klayman – Representative of Energy Coordinating Agency and Keystone Energy Efficiency Alliance

PANEL 5: FAITH-BASED AND ENVIRONMENTAL ADVOCATES

The fifth panel included leaders from a range of advocacy groups that have a key interest in environmental issues. The leaders voiced the specific concerns of their diverse groups and presented their own arguments against drilling in the Delaware River Watershed.

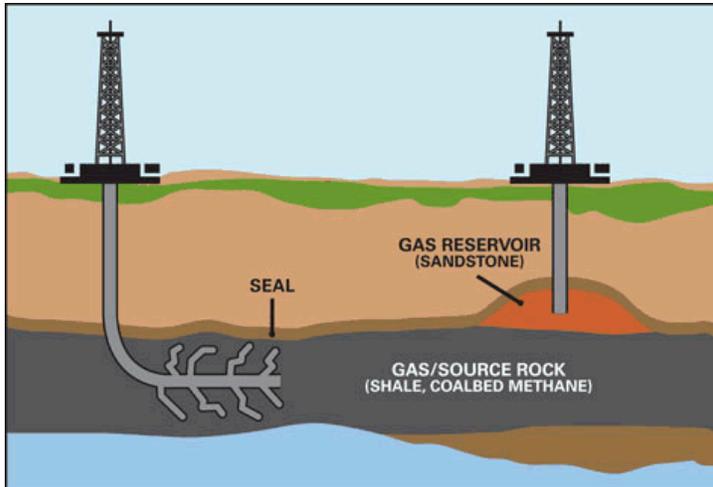
- Rabbi Arthur Waskow – Shalom Center
- Sister Mary Elizabeth Clark – Director of the Sisters of Saint Joseph Earth Center in Chestnut Hill and Special Assistant to President for Sustainability of Chestnut Hill College
- Shireen Parsons – Community organizer with Community Environmental Legal Defense Fund
- Phoebe Coles – Board Member of League of Women Voters of Pennsylvania
- Maya van Rossum – Delaware Riverkeeper Network
- Margery Stein Schab – New York H2O

HEARING FINDINGS

CURRENT TECHNOLOGY

Hydraulic fracturing technology creates many human health and environmental concerns.

“Technical advances in drilling, specifically horizontal drilling, combined with the older technique of hydraulic fracking have now provided a means for economically



accessing this gas. The method is quite simple. Wells are drilled down to the level of the Marcellus, roughly a couple of miles or a mile or so, and the drilling tool is turned horizontally into the shale and then proceeds about a couple miles into the shale. The well is then secured and explosives are introduced into the bottom portion of the horizontal well, and these explosives fracture part of the

Marcellus Shale or other types of shale. At this point, water, a few million gallons, is pumped down with chemical and physical additives to open up much more of the shale to allow the gas to escape into the open spaces. The gas then flows through the fractures and is withdrawn through the vertical shaft.”⁵

- In monitoring wells there is a potential that sensors are not deep enough to detect brine leakage (which is heavier and settles down), leaving resulting contamination undetected until years later.⁶
- Although much of the frack water is used for recycling, there is still no easy way to discard other water, which must be sufficiently treated before producers discharge the water.⁷
 - Dr. Martin asserts that a treatment solution is entirely up to industry, while it is the public’s role to set up standards that industry must satisfy.
- For every well, there are up to five layers of steel casing and cement to prevent brine leakage.⁸
- Refracking used wells could bring hazardous materials closer to the surface.⁹
- The industry currently treats or recycles all of its flow-back water. Many operators

⁵ Velinsky: Transcript pp. 12-13

⁶ Boufadel: Transcript pp. 48-52

⁷ Martin: Transcript pp 33-35

⁸ Martin: Transcript pp. 36-38

⁹ Boufadel: Transcript p. 47

have achieved 100 percent recycle, with an average across the industry of more than 60 percent.¹⁰

Roberts: “During the hydraulic fracturing, it’s a high-pressure operation. A hose will burst, the materials will be sprayed out and spilled, or after the water flows back from the well, there’s materials handling problems. And those are unacceptable. They’re illegal under state law, and we should not accept that, period.”¹¹

Roberts: “Right now the statewide average, we’re seeing about 13 percent of the water that is pumped underground comes back up during what’s called the flow-back stage of well.”¹²

¹⁰ Klaber: Transcript p. 107

¹¹ Transcript p. 257

¹² Transcript p. 258

ENVIRONMENTAL IMPACT

While the burning of natural gas is relatively less greenhouse gas-emitting than other traditional fuel sources, the specific method of hydraulic drilling to extract the gas can present many environmental costs.

Boufadel: "The first thing to consider is the injected water contains hazardous compounds. It contains compounds that affect the immune system. This is what's being injected in the ground. Some compounds are carcinogenic, others are mutagenic, and you have endocrine disruptors that affects actually the growth, especially of children."¹³

- Preliminary research (undertaken by Academy of Natural Sciences scientists and a University of Pennsylvania graduate student) suggests that there is a threshold density at which drilling, regardless of how safely or carefully it is practiced, will have a significant impact on the ecosystem:
 - *A sample watershed that experienced high-density drilling exhibited higher electrical conductivity,¹⁴ fewer salamanders,¹⁵ and lower EPT (indicators of healthy ph).*
- There may be lower density of drilling at which ecological impact cannot be detected.¹⁶
- Fracking requires substances that aren't naturally found in the waterways e.g. biocides and scale inhibitors to prevent bacterial growth, lubricants, sand and other coarse materials; the risk and impact of these substances even accidentally reaching the natural environment must be assessed.¹⁷
- Drilling fragments the land and impairs connectivity, reducing available space for organisms and interrupting or blocking important ecological processes.¹⁸

Velinsky: "As environmental scientists, our role is to outline the potential changes to our ecosystem from this process and to point out the relative levels of uncertainty and risk."¹⁹

- Potent endocrine disruptors in contaminated water could also impact organism biology, i.e. feminizing male fish.²⁰

¹³ Transcript pp.43-44

¹⁴ According to Velinsky, testing electrical conductivity is a good way of assessing total TDS and is a good view proxy for human-caused disturbances

¹⁵ Change in Salamander count indicates watershed health due to their high sensitivity to degraded waters and contaminated environments.

¹⁶ Velinsky: Transcript p. 24

¹⁷ Velinsky: Transcript p. 16

¹⁸ Velinsky: Transcript p. 19

¹⁹ Transcript p.10

²⁰ Boufadel: Transcript p. 55

Collier: “Potential water-related impacts we have heard about, which include consumptive use of water for high-volume fracking, treatment and disposal of the drilling wastewater, the flow-back and production waters, potential spills and non-point source runoff, potential contamination of groundwater, and changes to the landscape of the upper basin.”²¹

Velinsky: “So to summarize, there are several sources of environmental impacts from the gas drilling in the Marcellus Shale. First, water withdrawn could have an impact locally on the quantity of water available. Second, there could be impacts on water quality. This could happen from accidental spills, treatment of withdrawn water or other as yet poorly understood processes,”²²

Boufadel: “What would make this situation more dire is that if you have refracking of the well. If someone comes and refrack the well again, that could bring these hazardous chemicals closer to the surface.”²³

Boufadel: “Groundwater containing hazardous chemicals could seep into the Delaware and Schuylkill Rivers for a long duration.”²⁴

- Low flow periods could lessen the expected dilution of contaminated water.²⁵
- Panelists disagreed about whether the injected material would be absorbed into the shale layer.²⁶
 - Martin said that the 8 injected chemicals are mostly organic and would be absorbed into the layer.
 - Boufadel disputed this by noting that no data was found to indicate that they would be absorbed and doubted that most of it would be absorbed because the contact time between the shale and the injected water is unknown.
 - Velinsky added that most organic chemicals to his knowledge have low partitioning to other organics inhibiting absorption and would remain dissolved in the water.

Councilman Jones: “If everything went right, this is the benefit. Real quick, if things go wrong, what would be your nightmare?”

Martin: “My nightmare would be the spill of frack liquid when it’s being carried from a site to some sort of treatment. People do get in accidents, trains do derail, things like that. The nightmare is nightmares. Everything is fairly controlled at the site if we fix these contractual issues. The state has monitors. Maybe they don’t

²¹ Transcript p.230

²² Transcript pp.18-19

²³ Transcript p.47

²⁴ Transcript p. 54

²⁵ Boufadel: Transcript pp. 55-56

²⁶ Transcript pp. 72-74

have enough, but the nightmare that I have is carrying a million gallons of frack water. When they finish an area to recycle it and it's too salty to deal with, it's being carried. Then we are dealing with a low-level variation of how do we move nuclear waste casts in Nevada. That's my nightmare of a spill of salt water on the road."²⁷

²⁷ Transcript pp.85-86

HUMAN IMPACT

Some impacts on the environment necessarily impact humans; however, some of these impacts are more particularly salient for human health.

Bloom: "This is the most important public health issue in our region in our time. And, of course, it is an environmental issue, but I think it's very important for us to understand this is a public health issue."²⁸

Drinking Water and Public Health

Councilman Jones: "What percentage of our drinking water potentially or does come under Marcellus Shale?"

Brunwasser: "I guess it would be between 40 to 50 percent."²⁹

- At present, while PGW does not purchase gas from the Marcellus Shale directly, Marcellus Shale gas may possibly still get delivered to Philadelphia if it is stored in underground fields that the City also has under contract.³⁰
- Injected water for fracturing contains hazardous compounds that affect the immune system, cause cancer, cause genetic mutations and disrupt the body's endocrine to stunt growth if it reaches the surface or aquifers.³¹
 - There are naturally occurring fractures and cracks in any geology—it may be possible for these fractures to conduct fluids up to the surface.³²
- 13% of water that is pumped underground for fracking will come back up from the well as flow-back.³³ This flowback contains many toxic chemicals including benzene brine and heavy metals and the flowback releases these toxic chemicals to the surface.
- The flowback is also radioactive. Marcellus Shale has high levels of radium-226, a leading cause of lung cancer and bone cancer. Samples have shown levels of radium-226 as high as 16,000 picocuries per liter, this is 3,200 times the safe level of radium-226 in drinking water.³⁴

²⁸ Transcript p. 182

²⁹ Brunwasser: Transcript pp. 122-123

³⁰ White: Transcript p. 114

³¹ Boufadel: Transcript pp. 43-44

³² Boufadel (Using an example of Lake Ontario for the City of New York): Transcript pp. 44-45

³³ Roberts: Transcript p. 258

³⁴ Bloom: Transcript p. 185-186

Water Availability and Usage

- Water withdrawn could impact the quantity of water available locally.³⁵
- Hydraulic fracturing impacts the free services that natural ecosystems provide to human society such as water filtration for nutrient removal and fisheries.³⁶

Location and Duration of Hazards

- “Frack” water released: if it’s at the end of a waterway i.e. Penn’s landing it would probably have little effect on local water system, but if released in a 1st or 2nd order stream then the impact could be profound.³⁷
- This hazardous groundwater can continue to seep into the Delaware and Schuylkill over a long duration.³⁸
 - This is already a recognized concern since the EPA requires deep-well injectors (who inject hazardous materials 10,000 ft below the surface) to must explain or predict where chemicals will move within 10,000 years since injection.³⁹

Additional Findings:

Case Study of Accident at Dimock

- On New Year’s Day 2009, a gas well exploded because the cement well casement cracked. Well is designed by Halliburton and affects 32 residents of Dimock. Residents have to have their water delivered to them for all their needs – for bathing, cooking, drinking and household chores because their water is contaminated.(Dennis: Transcript p. 171)
- In September of 2009, 13 more families in Susquehanna County filed suit against gas drillers for water contamination by poisonous fracking fluid, sickening a young child in one of those families. It will cost \$10 million to pipe in replacement water for the families in Dimock because the nine square mile aquifer is permanently contaminated. (Bloom: Transcript p. 189)

New York City Action on Drilling

- The New York City Council and Mayor have commissioned a study on the effects of drilling on the New York City watershed. They hired a firm, Hazen and Sawyer, to conduct an engineering study that took 11 months and cost about a million dollars. (Bloom: Transcript pp.186-187)
- The conclusion of the study was that there should be no fracking and no horizontal drilling in the Marcellus Shale within seven miles of New York City’s watershed.

³⁵ Velinsky: Transcript p. 18

³⁶ Velinsky: Transcript p. 15, 20

³⁷ Velinsky: Transcript pp. 17-18

³⁸ Boufadel: Transcript pp. 53-54

³⁹ Boufadel: Transcript pp. 47-48, 56

ECONOMIC IMPACT OF DRILLING

While assessing the possible economic impacts of drilling, the beneficial aspect of job creation and revenue generation of drilling need to be weighed against the adverse effect of destroying local recreational industries.

Walsh: “There is extraordinary economic potential associated with the development of Marcellus Shale resources. However, as the oil spill in the Gulf reminded us, there is also great risk when industry is allowed to police itself when our quality of life, present or future, is at stake.” (Transcript p. 162)

Possible Beneficial Economic Impact

- Capitalizing on drilling for Marcellus shale gas could keep money in Pennsylvania (e.g. Lock Haven) rather than foreign sources and could help economically-troubled parts of the state.⁴⁰
- However, panelists did not give the same answer for the amount of gas Marcellus Shale could supply.⁴¹
 - Boufadel believed Marcellus Shale could provide 2 years of supply for the U.S.
 - Velinsky suggested 20 years of supply.
- According to Klaber, now that natural gas prices nationally are low and stable, a result of significant supply from shale gas development across the nation, the use of clean-burning natural gas becomes even more viable for a city like Philadelphia.⁴²
- The gas industry (nationally or state) contribution of more than \$1 billion in revenue to state and local governments this year alone.⁴³
- On behalf of the industry, Penn State University researchers projected more than eight billion in annual economic value and nearly 90,000 jobs created by Marcellus development to date.⁴⁴

Councilman Greenlee: “I know you said you have not at this point dealt with Marcellus. Do you see a timeframe where you have to make a decision if you will or do you feel comfortable that there’s no reason to rush into that?” (Transcript p.118)

- White: “Well, I think the economics of supply and demand are going to drive that. The price of Marcellus Shale gas to deliver to Philadelphia is not economical. There’s no direct connection at this point in time. So to build new pipeline capacity is very expensive. The capacity that we have to the Gulf Coast is very cheap.” (Transcript p. 118-119)

⁴⁰ Martin: Transcript pp. 30-31

⁴¹ Transcript p. 60

⁴² Klaber: Transcript p. 97

⁴³ Klaber: Transcript p. 99

⁴⁴ Klaber: Transcript pp. 99-100

Dennis: “Just as corporations received tax breaks based on the rationale that they would create jobs for Americans, only to then take those jobs overseas where labor is cheap in order to make their shareholders’ profits higher, the gas companies will take natural gas from Pennsylvania, pay a few people chump change and reap stratospheric profit, leaving us to clean up the mess they left behind.” (Transcript p. 178)

Murphy: “I would say that one would have to take the economic impact statement with a jaundiced eye. One would have to put on one’s green eyeshade and recognize that this is a sell document. And the industry is so highly profitable, otherwise it wouldn’t be paying so much in upfront royalties, that there is still the opportunity to regulate and still have the gas produced or the jobs here.” (Transcript p.213)

Klayman: “It is essential for all Pennsylvanians to benefit from the Marcellus Shale by using revenue from the extraction to help reduce their energy consumption this year and every year. Investing at least ten percent of the tax in the increase of energy efficiency of residential, commercial, municipal and industrial customers across the state will pay lasting economic, social and environmental dividends statewide. It will also help prepare us for the even higher energy prices when even higher energy prices which will inevitably follow when the shale gas resource is depleted.” (Transcript p.268)

- According to Klaber, there are firms growing in Philadelphia to serve the gas industry, e.g. environmental consulting firms, law firms, water management companies and pipeline firms.⁴⁵

Possible Adverse Economic Impact

- The recreational offerings of the Delaware River create a significant source of revenue for local communities. If the Delaware River suffers environmental damage as a result of drilling, this revenue could be lost.
- The River is a popular venue for canoeing and white water paddling. There are 20 canoe liveries that operate along the Delaware River. Some employ as many as 200 people and have attendance of 60,000 or more in a given year. One livery alone can create gross revenue or more \$3 million a year for our region. In one year, the River attracted over 367,000 white water paddlers who spent over \$20 million, contributing almost \$10 million to local economies and supporting 447 jobs.⁴⁶
- The River also is a popular venue for trout fishing. In one year, the River produced over 17 and a half million dollars in local business revenue as well as 348 jobs. Revenue produced three and a half million dollars in wages and over \$719,000 in local taxes, translating into almost \$30 million in local economic activities.⁴⁷
- The attractive nature of the River encourages River festivals to take place in local

⁴⁵ Klaber: Transcript p. 101

⁴⁶ Rossum: Transcript p. 304

⁴⁷ Rossum: Transcript p. 304-305 (Note – Rossum cites economic data on trout fishing that she cautions is 20 years old)

communities near the River. In a short period of time, these festivals generate businesses for local communities. These festivals include ones such as Lambertville's Shad Fest that drew 30,000 to 35,000 people to the local community for one weekend.

- There are also a number of boating activities taking place along the Delaware and the Schuylkill. The Schuylkill has hosted over 20 regattas in one year, bringing in as many as 5000 visitors from all over the country.⁴⁸

⁴⁸ Rossum: Transcript p. 306

RESEARCH & DEVELOPMENT NEEDS

There are numerous uncertainties and lack of objective information, and a substantial cumulative impact assessment is needed prior to large-scale drilling.⁴⁹ Accordingly, there is a need for objective, reliable scientific information to eliminate the reliance on anecdotal findings.⁵⁰

Velinsky: “I will discuss some preliminary research that has been conducted on these impacts and briefly indicate that further research we feel is necessary to resolve a variety of uncertainties that remain.” (Transcript p.10)

Councilwoman Brown: “What value may there be in a study where there’s a collective set of stakeholders?”(Transcript p. 80)

- Dr. Boufadel: “I think that’s’ definitely the best way to go about it, to have studies we have many stakeholders. There are sometimes advantages for having entities such as universities and the Academy involved in these studies, because the goal is there’s no liability. The EPA study we will likely hear nothing till it is done three years from now, whereas studies conducted by any of us, you know, as far as we get data, we would just share them, because that’s what we do.” (Transcript p. 81)

Inquiries from the Hearing

- Councilman Jones asked Dr. Crockett to determine whether PWD conducts tests for chemicals included in a list he gave to Dr. Crockett.⁵¹
- Councilman Jones asked Dr. Crockett to find whether the particles and chemical compounds reportedly found in already-treated flow-back water are harmful if ingested.⁵²

Councilman Jones: “I want you to look at this list of chemicals that are used in the process of fracking and tell me, do we currently test for any of these chemicals?” (Transcript p. 132)

- Crockett: “You’re giving me a long list, but I’ll you that the Water department, if you check your consumer confidence reports that we have online for the City of Philadelphia, we basically put up on that website in our consumer confidence report, which we also mail out to all customers, a list of all the chemicals that we test for and the concentrations found in drinking water, as well as we discuss what’s in our rivers and streams. We can take this list back and compare that and we can get back to you, but a number of these compounds, though some of them are very specific, they do roll u pinto general other compounds that we would pick up in our monitoring. Not necessarily real-time.”

⁴⁹ Velinsky and Boufadel
⁵⁰ Boufadel: Transcript p. 42
⁵¹ Transcript pp. 132-134
⁵² Transcript p. 134

(Transcript pp: 132-133)

Councilman Jones: “So on of the recommendations you will make to this panel after reviewing this list is to see if, A. currently do we test for these things.” (Transcript p. 133)

Pending Research

Velinsky: “We believe that gas in the Marcellus Shale may have positive effects on the Pennsylvania economy and there may be possible ways to extract it safely. At this time, however, there remains significant uncertainties, and we urge a cumulative impact assessment on the scale described above before large-scale drilling is undertaken.” (Transcript p.25)

Boufadel: “When we started checking this issue, we found out that there’s really a lacuna, a major lack of information, of objective studies conducted on the topic. There were anecdotal findings here and there. Lots of things were in the media, but really nothing that is published in scientific journals.” (Transcript p.42)

Dennis: “Someone needs to be an adult in this situation. Someone needs to stand up and say, stop, wait and listen.” (Transcript p.180)

- Continuing research on the impacts of varying densities of drilling.⁵³
- While the EPA study wouldn’t be completed until three years from the time of the hearing, other ongoing and earmarked studies can report on effects sooner.⁵⁴
 - At Congress’ request, the EPA will study the ‘potential impact of hydraulic fracturing on human health and the environment. The study will be conducted through a transparent, peer-reviewed process, with significant stakeholder input’.⁵⁵
 - The EPA is currently designing a plan for the research that will begin in 2011, with some outcomes and research products available in 2012.
- PWD is installing monitoring equipment at its Baxter Water Treatment Plant on the Delaware to track sodium chloride levels in the river, which may help indicate the impact of drilling wastewater.⁵⁶
- In October, the PWD will participate in a Water Research Foundation workshop with regional and national water suppliers, regulators and the scientific community to identify potential risk assessment projects associated with natural gas drilling.⁵⁷
 - The workshop is intended to improve the understanding of the potential risks of hydraulic fracturing and associated natural gas development

⁵³ Martin: Transcript pp. 68-69

⁵⁴ Boufadel: Transcript p. 81

⁵⁵ “Hydraulic Fracturing: Drilling for Answers.” EPA Science Matters newsletter.

(http://www.epa.gov/research/sciencematters/june2010/scinews_fracking.htm). June 2010.

⁵⁶ Brunwasser: Written Testimony p. 3

⁵⁷ Brunwasser: Transcript pp. 94-95

activities to drinking water supplies, and strategies for reducing or eliminating any such identified risks.

Suggestions for Further Research

- Investigation of possible air pollution from drilling.⁵⁸
- Study the impacts of long-term exposure of a watershed to Marcellus Shale drilling activities, the cumulative impact of drilling activities and, in particular, impact of exposure to water with higher on the ecosystem services of a small watershed.
- Investigation of the speed of groundwater movement.⁵⁹
- Find less toxic substitutes for existing hazardous materials that are injected after drilling.⁶⁰
- Investigation into the cause of preexisting methane in private Pennsylvania wells.
 - A Center for Rural Pennsylvania study suggests that approximately 40 percent of the 1.2 million private water wells in Pennsylvania are contaminated.⁶¹

⁵⁸ Boufadel: Transcript p. 42; Velinsky: Written Testimony p. 3

⁵⁹ Boufadel: Transcript p. 47

⁶⁰ Boufadel: Transcript pp. 65-66

⁶¹ Klaber: Transcript pp. 109-110

REGULATORY ISSUES

- EPA-enforced deep-well injection studies and fees cost about \$300,000 and a year to process, while a Pennsylvania well license costs \$2,500 (and requires a water management plan).⁶²
 - Boufadel opined that the cost of acquiring a well license should be higher and stressed the importance of an understanding of geology prior to awarding a drill license, which Pennsylvania well permits do not take into account.
- While each well drilled in the state is filed in the DEP's public record, along with a list of the materials that are injected, the particular concentrations of each substance is not disclosed by every driller.⁶³
 - Furthermore, these substances are given under a generic trade name, but the specific chemicals are withheld.⁶⁴

Councilman Jones: "Even though they (companies) don't tell the public, do they tell someone, some regulatory agency, that this is what I'm putting in the ground so that you know?" (Transcript p.68)

- Martin: "Yes. It's on the well record that's filed at the DEP that they have to list the materials they put in. They don't necessarily have to put in the concentrations. But that's in the public record for every well that's drilled...What is not fully disclosed...are the concentrations, but the contents are there" (Transcript pp.68-69)

Councilwoman Brown: "So are we hearing that there are no standard protocols, if you will, that the public is uniformly made aware of?" (Transcript p.69)

- Martin: "No." (Transcript p.69)

Councilwoman Brown: "There are no protocols, one. And, two, the public is not uniformly made aware of whatever the substance they're getting at the end of the drill?" (Transcript p.69)

- Velinsky: "That's correct. And one of the things is that the drillers may say we're putting a chemical in and they give you the trade name, but they don't tell you the specific chemical." (Transcript p.70)

- While engineering capability is here, stakeholders need an understanding of contractual issues (how work is contracted and subcontracted) in order to determine responsibility and liability in case of emergency on and off-site (e.g. an accident during the transportation of water for treatment).⁶⁵

⁶² Boufadel: Transcript pp. 56-57

⁶³ Boufadel: Transcript p. 65

⁶⁴ Velinsky and Martin: Transcript p. 70

⁶⁵ Martin: Transcript pp. 83-86

Councilman Jones: “How often in the lifetime of a well or over a period of a year should a well be inspected?” (Transcript p.246)

- Roberts: “We try to go out and inspect those wells that are in production, really that’s not where the problems occur. The problems would occur during those drilling operations. So we try to target having our inspectors going out at points of the process that are most likely to have problems.” (Transcript p.248)

Councilman Jones: “So in that phase, how many times is a good number of inspections?” (Transcript p.248)

- Roberts: “It depends again on the nature of the operation and the operator, but four, five, six times.” (Transcript p.248)

Councilman Jones: “ How often and is there a process by which you monitor a well being shut down?” (Transcript p.249)

- Roberts: “Yes. There are specific legal requirements in the State of Pennsylvania for what’s called well plugging, and when that well reaches the end of its commercial life, the owner or operator of that has an affirmative obligation to plug that well. It has to be done in a particular manner to make sure that the gas from a depth isn’t leaking up the well bore and it’s safe.” (Transcript pp. 249-250)

Councilman Jones: “So is it equally as a vulnerable time as the initial drilling?” (Transcript p.250)

- Roberts: “Oh, absolutely. And obviously with the Marcellus wells being as young as they are, we don’t have any that have reached that point in their life expectancy.” (Transcript p.250)

Roberts: “We absolutely agree with the public and everybody else that the industry needs to be transparent with what they are using in these wells. And it is more difficult than perhaps was explained earlier in trying to get the industry to do that, but as was mentioned, we are changing our regulations and modifying them.” (Transcript p.256)

- PWD communicated water supply concerns, e.g. disposal of wastewater and degradation of water quality due to land clearing, to the EPA and Pennsylvania DEP.⁶⁶
- PWD is considering Marcellus Shale emergency planning while developing an expansion of the Del. Valley Early Warning System, which serves as the “essential communication tool and spill response mechanism for the Delaware River basin.”⁶⁷
 - PWD encourages the DRBC to require drill pad operators and all parties with

⁶⁶ Brunwasser: Written Testimony p. 2

⁶⁷ Brunwasser: Written Testimony p. 2

- permits relating to natural gas extraction and disposal to join and participate in the Del. Valley EWS⁶⁸ and to help bolster the system to support more real-time monitoring.^{69,70}
- The EWS covers 7,000 square miles of the 13,000 square mile Delaware watershed, which includes Philadelphia, while 40 or 45 percent of the watershed is not covered.⁷¹
 - There are gaps in coverage that PWD stresses should be filled in order to ensure that Philadelphia is quickly made aware of events upstream.⁷²

Councilman Jones: “In your Early Warning Systems, could you describe for us how they, A, connect to other counties and how far does that go to the actual site of drilling of Marcellus Shale?” (Transcript p.124)

- Brunwasser: “I may turn this over to one of my experts, but I can tell you that about 280 miles of river are monitored by the Marcellus Shale, and over 7000 miles of stream are monitored as well. Our watershed I think is approximately 13000 square miles all together, the Delaware watershed, and about – and more than half of that is covered by our EWS system.” (Transcript p.124)

Councilman Jones: “So what percentage is not covered by the Early Warning System leading up to that Marcellus Shale?” (Transcript p.125)

- Brunwasser: “Well, I’ll be hazarding a guess, but I stand to be corrected by my staff. I suppose it’s about 40 percent is not covered, 45 percent is not covered. And again, this was – this is under the Philadelphia Water Department’s authority. We would love to see – and one of the points that I think I made in my testimony, what we would love to see is for any potential driller, extractor of this natural gas to be forced to join us, forced to join this EWS, which would continue it all the way up through the Marcellus Shale area and make that part of the – and they should also contribute to bolstering this system so we could have real-time monitoring in more places, more often and so forth.” (Transcript p.125)

Councilman Jones: “Do you have enough people to monitor this?” (Transcript p.238)

- Collier: “Let me start off with saying that right now I do not have a full complement of employees, because we are dependent on state and federal funding, and since 1996, we’ve received one year of federal funding. So we do not have the dollars that we’re supposed to have.” (Transcript p.238)

⁶⁸ Brunwasser: Written Testimony p. 3

⁶⁹ Brunwasser: Transcript p. 125

⁷⁰ Klaber too supports this: Transcript p. 126 “In fact, one of our members, East Resources, last year did embark on a project contributing, I think it was, close to a million dollars to put in the Susquehanna River an in-place monitoring network. And so that is certainly within our recent history and something look forward to pursuing with you.”

⁷¹ Brunwasser: Transcript pp. 124-125

⁷² Crockett: Transcript p. 127

- MSC operators will include information on their hydraulic fracturing chemicals to DEP under the new Chapter 78 rules in *each* well completion report.⁷³
 - Earlier this year Governor Rendell announced that the DEP will be hiring even more staff to help implement these rules, which MSC supports.
- Under a least cost procurement requirement, PGW currently purchases all its gas from the Gulf Coast region, from where it accesses the cheapest gas supply through a low cost interstate pipeline network. However, if Marcellus Shale gas could be delivered at a cheaper cost and in an environmentally friendly manner, PGW would consider purchasing Marcellus Shale gas.⁷⁴
 - PGW would not guess when Marcellus Shale gas price would be a viable option but noted that prices move quickly.⁷⁵
- Councilman Jones insisted that the industry be even more transparent when posting information about their injected chemicals, which Klaber of the MSC supports.⁷⁶

⁷³ Klaber: Transcript p. 104

⁷⁴ White: Transcript pp. 112-114, White: Transcript pp. 118-119 “The price of Marcellus Shale gas to deliver to Philadelphia is not economical. There’s no direct connection at this point in time. So to build new pipeline capacity is very expensive. The capacity that we have to the Gulf Coast is very cheap. So we have a tremendous advantage. Even with slightly more expensive Gulf Coast supply, we can actually have it delivered to Philadelphia at a more economical price than we could if we were to connect to some of the new proposed projects for pipelines.”

⁷⁵ White: Transcript p. 119

⁷⁶ Transcript pp. 142-145

POST-HEARING ACTIVITY

LETTER TO DRBC

On October 14th Councilman Curtis Jones, Jr. and Councilwoman Blondell Reynolds Brown wrote to the DRBC requesting that the Commission “not issue draft regulations governing any projects related to gas drilling in the Basin at this time, or at any time prior to the completion of the EPA study and your own cumulative impact study.



CURTIS JONES, JR.
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(215) 686-3416 or 3417
Fax No. (215) 686-1934

COUNCILMAN - 4TH DISTRICT

October 14, 2010

Executive Director Carol R. Collier
Delaware River Basin Commission
25 State Police Drive
P.O. Box 7360
West Trenton, NJ 08628-0360
609-883-9500 - Phone
609-883-9522 - Fax

RE: Halt on Hydro-Drilling Regulations until Completion of Scientific Studies

Dear Commissioners,

We are writing to thank you for your work on behalf of our watershed and specifically for Executive Director Carol Collier's testimony at Philadelphia's Joint Hearing of the Environment and Public Utilities Committees on September 27, 2010. The in-depth expertise and other testimony our committee heard at the hearing re-enforced our concerns and left us with more questions than answers regarding the impact of gas drilling in the Delaware River Basin on Philadelphia's environment and economic future.

Science should guide Environmental policy, placing the horse of science before the cart of policy. Clearly more time is needed to enable study and evaluation of the new technology. Not doing so is analogous to driving a vehicle that has not passed auto-safety regulations.

A letter from the federal Environmental Protection Agency which was entered into the record at our hearing indicated that they are in the process of embarking on a two-year study of the risks to water and to air of Marcellus Shale drilling. This will be the first major scientific study of this gas extraction technology and should be the driver of any new regulations that govern unconventional drilling. Furthermore, it makes eminent sense to withhold permitting of gas wells, and in fact to not issue new rules, permits for water withdrawals, waste discharge, or test wells, until a cumulative impact study has been done. As you know, the Commission applied for federal funding for a cumulative impact study on the effects of natural gas development on the water resources of the Basin.

On June 23 the House Appropriations Committee Subcommittee on Interior, Environment, and related agencies approved \$1 million for the U.S. Geological Survey (USGS) and the Commission to conduct that study. The foresight the Commission has shown in seeking these funds is great and will make the Commission's goals possible. Thus, we are writing to request specifically that you not issue draft

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regulations governing any projects related to gas drilling in the Basin at this time, or at any time prior to the completion of the EPA study and your own cumulative impact study.

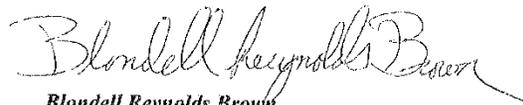
Following our Council hearing, recent events indicates the Commonwealth DEP is facing enormous challenges to regulate even existing laws regarding gas extraction, as evidence of the frack fluid spill in Cumberland County last week. Neither the state nor federal government require companies to disclose exactly what fluids, in their proportions, are being utilized. As you might remember, this was the major concern of Dr. Joseph Martin, of Drexel University, who testified in support of drilling at our hearing.

The stakes are high; we do not want potentially harmful drilling to occur because of inadequate or incomplete regulation. We hope you will agree that waiting until a cumulative impact study is complete is necessary and appropriate before issuing regulations, so we understand the environmental standards required to protect our water, air, climate, biodiversity, economy, and human health.

Very truly yours,



Curtis Jones, Jr.
Councilman-4th District



Blondell Reynolds Brown
Councilwoman- at large

ACCIDENTS AND CATASTROPHIC INCIDENTS

1. On December 7 the EPA announced that Range Resources, which also drills in Pennsylvania, has polluted an aquifer in Texas with benzene, a carcinogen. The EPA ordered Range to replace drinking water for the affected families immediately on an emergency basis.⁷⁷
2. On October 8 DEP reported that Seneca Resources, shale gas drilling company, destroyed an "exceptional value" wetlands in Tioga County, PA.⁷⁸
3. On October 20th in Chartiers Township a truck spilled most of a 5,000 gallon tank of "flowback." Flowback contains all the original hydrofracking chemicals AND radioactive materials including uranium and radium 226, as well as arsenic, cadmium, etc.⁷⁹
4. In early October a truck spilled fracking fluid; the spill spanned over 30 miles in Columbia County, PA.⁸⁰
5. In mid-November a 13,000 gallon fracking fluid spill in Lycoming County, PA contaminated a spring and a tributary to Sugar Run stream.⁸¹

⁷⁷ Randy Lee Loftis, "EPA: 2 Parker County homes at risk of explosion after gas from 'fracked' well contaminates aquifer," *The Dallas Morning News*, Dec. 9, 2010 (<http://www.dallasnews.com/sharedcontent/dws/news/healthscience/stories/120810dnmetgasleak.fdeda6d.html>)

⁷⁸ Vivian Silvestri, "Company Illegally Impacted Exceptional Value Wetland Restoration Work Underway," *Bucks County Courier Times*, Oct. 7, 2010 (http://www.phillyburbs.com/news/local/courier_times/courier_times_news_details/article/2463/2010/october/07/company-illegally-impacted-exceptional-value-wetland-restoration-work-underway.html)

⁷⁹ Kathie O. Warco, "Fracking Truck Runs Off Road; Contents Spill," *Observer Reporter*, Oct. 21, 2010 (http://www.uppermon.org/news/Other/OR-Frac_Truck_Spill-21Oct10.html)

⁸⁰ Philip A. Holmes, "Fracking fluid leak may reach 30 miles," *Williamsport Sun-Gazette*, Oct. 9, 2010 (<http://www.sungazette.com/page/content.detail/id/554795/Fracking-fluid-leak-may-reach-30-miles.html?nav=5011>)

⁸¹ COMMONWEALTH OF PENNSYLVANIA, Dept. of Environmental Protection, *DEP Investigating Lycoming County Fracking Fluid Spill at XTO Energy Marcellus Well*, <http://www.portal.state.pa.us/portal/server.pt/community/newsroom/14287?id=15315&typeid=1> (Nov. 22, 2010).

RECOMMENDATIONS

GENERAL RECOMMENDATIONS

1. There must be no drilling, or projects related to gas drilling (including exploratory wells and water withdrawals), permitted in the Delaware River watershed until both the EPA hydraulic fracturing risks study and the cumulative impact studies specific to the Delaware River Basin are completed, assessed, and publicly debated.⁸²
 - a. Those cumulative impact studies must include those performed by the Delaware River Basin Commission (DRBC) and U.S. Geological Survey (USGS); the Academy of Natural Sciences; and Temple University.
2. Based on the combined results of both the national EPA study and the Delaware River Basin-specific cumulative impacts studies, the City of Philadelphia will determine whether it is advisable to call for the entire Delaware River Basin to be kept off limits to unconventional gas drilling techniques, due to the potential for catastrophic risk; potential costs; and the inherent and cumulative risks to water, air, climate, farms, food, economy, fish and wildlife, scenic value and tourism base, and human health.
3. In keeping with Philadelphia City Council's adoption of the Earth Charter, and in keeping with the precautionary principle as established by modern science and as articulated by Dr. Boufadel in the September 28th hearing, Council hereby establishes its moral responsibility to actively prevent future pollution and ecological destruction rather than waiting until it occurs and then attempting to undo the damage.
4. A non-biased economic analysis should be conducted to examine exactly what jobs will be created in Pennsylvania as a result of unconventional drilling and the amount of job creation applicable to Philadelphia residents.⁸³
 - a. These potential job gains must be weighed against potential job loss and economic destruction created by
 - i. "boom and bust" cycles;
 - ii. loss of eco-tourism dependent on healthy, intact ecosystems and/or scenic beauty;
 - iii. potential worst-case catastrophic scenarios (blowout; aquifer contamination; and/or salt line approaching Philadelphia water intakes) and
 - iv. jobs potentially created by investment in energy efficiency and conservation, wind, solar, geothermal, and other aspects of a long-term sustainable renewable energy economy.
5. When a severance tax (tax on gas extraction) is instituted in Pennsylvania, we should direct at least 30% of the revenue of the tax to fund environmental

⁸² Support given by Velinsky (Academy of Natural Sciences): Transcript p. 25 and Boufadel: Transcript p. 78

⁸³ Murphy states that economic impact statement given by industry is biased and not well-supported to assert their claims on job creation: Transcript p. 213

mitigation and enforcement work – specifically to mitigate past, present and future damage done by coal, oil and gas development in Pennsylvania, and to support energy-efficiency initiatives, including efficiency initiatives for all natural gas, propane, and fuel oil customers statewide.⁸⁴

6. Based on the risks identified in the hearing, and on incidents and accidents escalating since that time, City Council reinforces its earlier resolutions, specifically
 - a. “Cart before Horse” principle established by the March 25th resolution and the October 15th letter from Councilman Jones and Councilwoman Blondell Reynolds Brown: no rules related to gas drilling projects in the Delaware River Basin should be released, finalized or enacted until the EPA studies and cumulative impact studies are complete, assessed, and widely debated; if rules are released without benefit of such studies, they should be withdrawn.
 - b. A statewide moratorium, as called for in bills introduced in the state legislature by Senator Ferlo and Representative Tony Payton, or similar moratoria bills which may be introduced in the future, should be enacted to protect Pennsylvania’s other two watersheds as well: the Susquehanna River Basin and the Ohio River Basin
7. Hydrofracking technology, and all aspects of unconventional gas drilling, should be subject to all relevant Federal environmental laws, including the Safe Drinking Water Act, Clean Water Act, Clean Air Act, waste treatment laws and Superfund Law.
8. All chemicals used in hydrofracking, including their commonly understood scientific names (not trade names), proportions, and concentrations, should be required to be disclosed by the industry.
9. To enforce this disclosure, the FRAC Act (Fracturing Responsibility and Chemicals Act) should become federal law

AGENCY SPECIFIC RECOMMENDATIONS

1. The EPA hydraulic fracturing risks study should address risks to drinking water, as it is doing; and also assess risks to water quality and aquatic life; air quality; biodiversity, and climate.⁸⁵
2. The DRBC / USGS cumulative impact study of gas drilling impacts in the Delaware River Basin should emphasize human health risks. It should include not only drinking water threats but also the impact of air pollution, global warming impacts from “cradle to grave” gas extraction, loss of biodiversity, and loss of scenic value. It should assess the need for adequate emergency planning related to fires, blowouts, explosions, and major contamination incidents, as well as the actual cost of worst-case scenarios, both acute and long-term (i.e., future contamination over the course of hundreds of years due to billions of gallons of toxic fluids left underground in the Delaware River Basin)The DRBC should not

⁸⁴ Support given by Klayman: Transcript p. 265

⁸⁵ Support given by Boufadel: Transcript p. 42 and Velinsky: Written Testimony p. 3

issue regulations until the cumulative impact studies are released and the DRBC can base its regulations on such findings.⁸⁶

3. The DRBC / USGS studies should also specifically address the question of combined impacts of billions of gallons of consumptive water use from unconventional gas drilling, also referred to as “de-watering,” with increased global warming impacts from unregulated greenhouse gas emissions from gas drilling; combined with ongoing sea level rise, drought, and increased salinity due to brine and road salt use for de-icing purposes, to determine how to avert: a) water from our streams and rivers becoming un-potable due to high salt content; b) the salt line in the Delaware approaching Philadelphia water intakes; and c) the eventual inundation of Philadelphia due to sea level rise; and, prior to that, ongoing inundation of ecologically valuable wetlands (currently happening)
4. When the DRBC regulations are released they should be subject to a comprehensive public comment process, which should extend for a year after the EPA study and cumulative impact studies are complete to inform the public debate; including hearings in Philadelphia.
5. The DRBC should require drilling companies to join and participate in the Delaware Valley Early Warning System. In addition, the DRBC should contribute support to the system with an increase in real time monitoring of wells.⁸⁷
 - a. The monitoring system should be enhanced to include deeper detection technology.
6. The DEP should increase the number and frequency of its inspections on gas wells and be allocated additional staff to meet this requirement.⁸⁸
7. The DEP should increase the well bond fee and require bonds for each well drilled.
8. The Philadelphia Gas Works should continue its practice of not purchasing Marcellus Shale gas.
9. The Philadelphia Gas Commission should adopt policies that allow the Philadelphia Gas Works to calculate the environmental costs of Marcellus Shale gas and other supplies in accordance within their least cost procurement requirement.⁸⁹
10. The Philadelphia Water Department should adjust its water quality testing protocols to prepare to detect any fracking chemicals or radioactive substances contained in processed water present in the Philadelphia water supply.

⁸⁶ Support given by Rossum: Transcript p. 308-310

⁸⁷ Support given by Brunwasser: Written Testimony p. 3, Brunwasser: Transcript p. 125, and Klaber: Transcript p. 126 “In fact, one of our members, East Resources, last year did embark on a project contributing, I think it was, close to a million dollars to put in the Susquehanna River an in-place monitoring network. And so that is certainly within our recent history and something look forward to pursuing with you.”

⁸⁸ Support given by Roberts: Transcript p. 255

⁸⁹ White from the PGW would consider Marcellus Shale gas if it could be accessed cheaply and in an environmentally friendly manner. Therefore, the environmental impact should be quantified in a standardized manner to maintain the integrity of the least cost procurement: Transcript p. 119