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River Voices

Separating the Frack from the Fiction

Hydraulic Fracturing and Water Resources

by Heather Cooley Pacific Institute www.pacinst.org

Natural gas has been touted by some as a key "bridge fuel" that will transition the United States toward a more low-carbon energy economy. Indeed, recent data shows that carbon dioxide (CO^2) emissions from energy use in the United States have dropped to a 20-year low, driven in part by falling natural gas prices that prompted power plant operators to switch from coal to natural gas.[1] Energy analysts, including the United States Energy Information Administration (U.S. EIA), project that the United States will become increasingly reliant on natural gas. According to U.S. EIA estimates released in January 2012, natural gas production is projected to increase by nearly 30% over the next 25 years, from 22 trillion cubic feet in 2010 to 28 trillion cubic feet in 2035.[2] By 2021, the United States is projected to be a net exporter of natural gas.

What is Natural Gas and Where Can It Be Found?

Like all fossil fuels, natural gas originates from organic matter buried under the Earth's surface. Heat, pressure and bacteria turned this organic matter into oil. In especially deep and hot regions underground, this oil then turned into natural gas.[3] Over time, some of this natural gas moved through small pores in the surrounding rock toward the Earth's surface, where it was either released into the atmosphere or trapped by dense clays and rocks that prevented further migration. It is from these trapped deposits that most natural gas is produced today. Natural gas can occur in oil fields (known as associated gas); in coal seams (known as coalbed methane); in sandstone or shale; or be present in natural gas fields not associated with oil or coal (known as non-associated gas).[4]

Natural gas is commonly classified as either conventional or unconventional (*Figure 1*). Conventional natural gas is generally held as a pocket of gas **beneath** a rock layer with low permeability and flows freely to the surface once the well is drilled. By contrast, unconventional natural gas is more difficult to extract because it is trapped **in** rock with very low permeability. Unconventional natural gas does not flow freely to the surface once the well is drilled. Three common types of unconventional gas include: (1) coalbed methane, which is sourced from within a coal seam or in the surrounding rock; (2) tight natural gas, which is found in low-porosity sandstones and carbonate reservoirs; and (3) shale gas, which is trapped in the pore space of shale rocks.

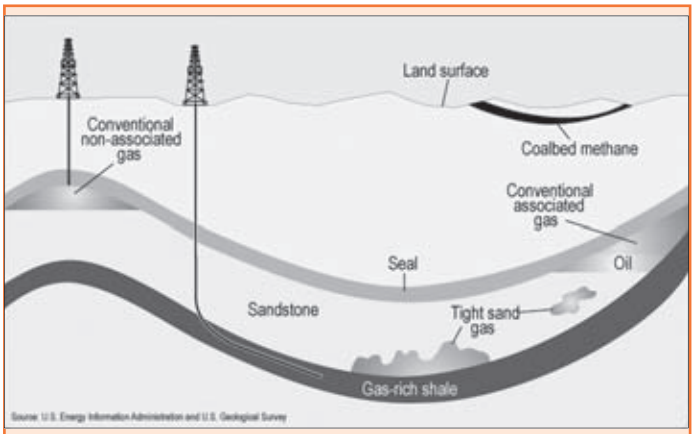

Figure 1. Types of natural gas, including non-associated gas, tight gas, associated gas, shale gas and coalbed methane

Source: U.S. Energy Information Administration (EIA). 2011. "The Geology of Natural Gas Resources." Today in Energy. www.eia.gov/todayinenergy/detail.cfm?id=110.

[1] The reduction in CO2 emissions is also driven by a reduction in gasoline demand and warmer winter temperatures that reduced household heating demands.
[2] U.S. Energy Information Administration (U.S. EIA). 2012. *Annual Energy Outlook 2012 Early Release Overview*. www.eia.gov/forecasts/aeo/er/pdf/0383er(2012).pdf.
[3] U.S. Department of Energy (DOE). 2008. "Fossil Energy: How Fossil Fuels Were Formed." http://fossil.energy.gov/education/energylessons/coal/gen_howformed.html.
[4] U.S. Geological Survey (USGS). 2002. *National Assessment of Oil and Gas Fact Sheet - Natural Gas Production in the United States*. http://pubs.usgs.gov/fs/fs-0113-01/fs-0113-01.pdf.

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River Network

Connecting People, Saving Rivers

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River Network is a national, nonprofit organization whose mission is to empower and unite people and communities to protect and restore rivers and other waters that sustain the health of our country.

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FROM THE PRESIDENT

Photo Credit: River Network collection

Our nation is now producing around 30 trillion cubic feet of natural gas a year with no clear understanding of how it will impact our water resources. But the high domestic production means low prices and a chance to review what we have learned.

The water needed to extract natural gas varies from 50,000 gallons per well in some coal-bed fields and up to 10 million gallons per well in some shale-gas formations. We know that as much as 75% of that water may stay underground—stressing available water supplies in drought situations—and that the a toxic cocktail of "produced" water sometimes shows up in the wrong places.

Researchers, including the U.S. EPA, need to finish critical research on the water impacts of fracking before we really understand the water footprint of natural gas. Some issues, like fugitive methane emissions associated with development of shale gas, complicate the picture even more. According to a recent Cornell study, increasing these emissions may actually make climate change even worse over the 20 year horizon.[1]

River Network wants to help your organization respond to natural gas development appropriately, knowledgably and effectively. We want to help you be heard as you work to address the impacts of oil and natural gas. Let's make time now to learn from each other and follow the science on the impacts that increased natural gas production can have on our watersheds. Let's not make the same mistakes with this technology that we have in the past with other energy production processes.

Todd Ambs, President
River Network

1 Robert Howrath, et. al, Cornell University, published in Journal of Climate Change, 2011

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Historically, natural gas production from unconventional resources has been limited. In 1990, unconventional resources in the United States accounted for 2.6 trillion cubic feet of natural gas per year, or about 15% of total production (*Figure 2*). By 2035, U.S. EIA analysts project that annual production from unconventional sources in the United States will increase to 21 trillion cubic feet per year and represent 77% of total natural gas production. Shale gas accounts for the vast majority of growth in natural gas production, although some growth is also projected for tight gas. By contrast, natural gas production from conventional resources is projected to decline during this period.[5]

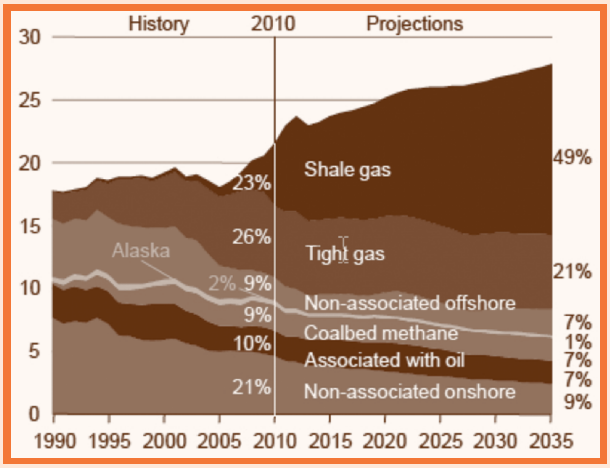

Figure 2. U.S. natural gas production (trillion cubic feet) by source, 1990-2035

Source: U.S. Energy Information Administration (EIA). 2012. Annual Energy Outlook 2012 Early Release Overview. www.eia.gov/forecasts/aeo/er/pdf/0383er(2012).pdf.

Unconventional natural gas resources are located across the United States. Currently, about 19 states are producing natural gas from shale and coalbed methane fields, although others are expected to be developed in the future.[6] Overall, shale gas has the widest distribution and is found in states throughout the western, midwestern and northeastern United States (*Figure 3*). Coalbed methane and tight gas are less widely distributed but are generally found in the same regions as shale gas.

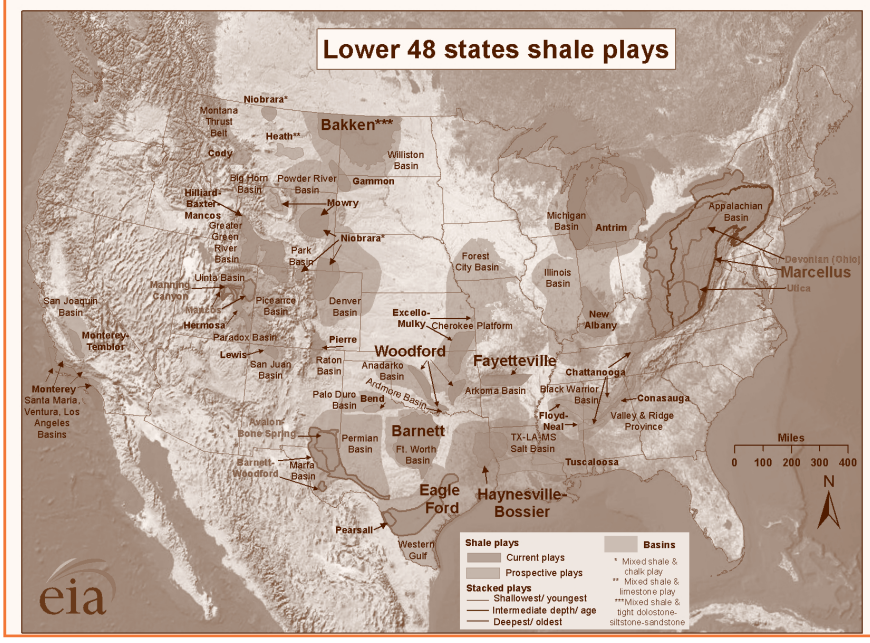

Figure 3. U.S. shale gas plays

Source: U.S. Energy Information Administration (EIA). 2011. "Maps: Exploration, Resources, Reserves, and Production." Natural Gas.

[5] U.S. Energy Information Administration (EIA). *Annual Energy Outlook 2012 Early Release Overview*. www.eia.gov/forecasts/aeo/er/pdf/0383er(2012).pdf.
[6] U.S. Energy Information Administration (EIA). "Unconventional Dry Natural Gas Production." *Natural Gas Data*. www.eia.gov/naturalgas/data.cfm#production.

The rapid development of unconventional natural gas resources has been largely facilitated by the use of directional drilling and hydraulic fracturing. Directional drilling allows for the development of wells that extend vertically for a distance below the Earth's surface and then extend horizontally through the target formation. The horizontal section of the well greatly increases exposure to formations containing natural gas compared to conventional vertical wells. Hydraulic fracturing, described in detail below, further improves the productivity of these wells. Together, these technologies have allowed for exploitation of a resource that had previously been uneconomical.

What is Hydraulic Fracturing?

Hydraulic fracturing, or fracking, refers to the process by which a fluid—a mix of water, sand and chemical additives—is injected into wells under high pressure to create cracks and fissures in rock formations that improve the production of these wells. Hydraulic fracturing was first developed in the early 20th century but was not commercially applied until the mid-to-late 1940s. Although initially developed to improve the production of oil and gas wells, hydraulic fracturing has been used in other applications, including developing drinking water wells,[7] disposing of waste, and enhancing electricity production from geothermal energy sources.[8] Hydraulic fracturing is standard practice for extracting natural gas from unconventional sources, including coalbeds, shale and tight sands, and is increasingly being applied to conventional sources to improve their productivity. While the process is the same, the various applications of hydraulic fracturing differ in their water requirements, the amount and types of chemicals employed, and the quantity and quality of wastewater generated. According to a Congressional testimony from a representative of the Interstate Oil and Gas Compact Commission, a multi-state government agency, hydraulic fracturing is used on 90% of all oil and gas wells drilled in the United States,[9] although insufficient data are available to confirm this estimate.

There is a general disagreement about how to define hydraulic fracturing. The discourse surrounding hydraulic fracturing has been marked by confusion and obfuscation due to a lack of clarity about the terms used to characterize the process. Some, including industry representatives, define hydraulic fracturing narrowly, referring only to the process by which fluids are injected into a wellbore. They argue that some of the challenges that have been identified, such as wastewater disposal and spills, are common to all oil and gas operations and therefore are not specifically associated with hydraulic fracturing.

Others, however, define the issue more broadly to include impacts associated with well construction and completion, the hydraulic fracturing process itself, and well production and closure.[10] For these groups, hydraulic fracturing and unconventional natural gas production are synonymous with one another because hydraulic fracturing has allowed for the development of these unconventional natural gas resources. Without hydraulic fracturing, shale gas production would be severely constrained, or even nonexistent.

[7] New Hampshire Department of Environmental Services (NHDES). 2010. "Well Development by Hydrofracturing." http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/documents/dwgb-1-3.pdf.
[8] Note that chemicals are not used in some of these applications, e.g. for drinking water wells.
[9] Carrillo, V. 2005. *Testimony Submitted by Victor Carrillo, Chairman, Texas Railroad Commission Representing the Interstate Oil and Gas Compact Commission*. http://archives.energycommerce.house.gov/reparchives/108/Hearings/02102005hearing1428/Carrillo.pdf.
[10] U.S. EPA. 2011a. *Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources*. Washington DC: Office of Research and Development. www.epa.gov/hfstudy/HF_Study_Plan_110211_FINAL_508.pdf.; ProPublica.2012. "What is Hydraulic Fracturing?" *Fracking - Gas Drilling's Environmental Threat*. http://www.propublica.org/special/hydraulic-fracturing-national.

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Why Are Some of the Key Issues Associated with Fracking?

To better identify and understand the key issues, the Pacific Institute interviewed 16 representatives of state and federal agencies, academia, industry, environmental groups, and community-based organizations in the United States. Their responses are summarized in *Figure 4*. Although a relatively small sample size, the interviews were extensive, and the detailed responses from these diverse stakeholders are indicative of the broad range of concerns associated with hydraulic fracturing.

While concerns about impacts on the environment were the most commonly cited, social and economic concerns were also identified, including worker health and safety and aesthetic/community impacts associated with the rapid industrialization of largely rural environments. The top three issues identified by the interviewees included spills and leaks, wastewater management and water withdrawals. Impacts on air quality were also identified as key concerns by nearly two-thirds of those interviewed. Other issues included water quality, ecosystems/habitat destruction, truck traffic on local roads, and conflicts regarding surface and mineral rights among landowners.

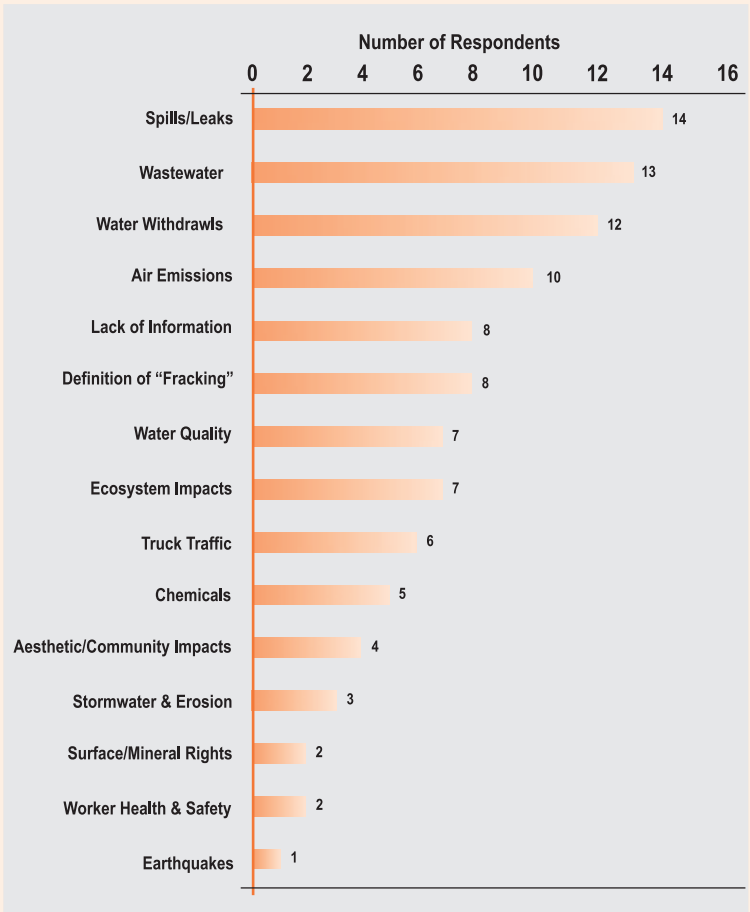

Figure 4. Key concerns identified by interviewees

Note: Results based on interviews with 16 representatives from state and federal agencies, academia, industry, environmental groups, and community-based organizations.

Despite the diversity of viewpoints among those interviewed, there was surprising agreement about the range of concerns and issues associated with hydraulic fracturing. Interviewees identified a broad set of social, economic, and environmental concerns, foremost among which are impacts of hydraulic fracturing on the availability and quality of water resources. In particular, key water-related concerns identified by the interviewees included:

1) water withdrawals;
2) groundwater contamination associated with well drilling and production;
3) wastewater management; truck traffic and its impacts on water quality;
4) surface spills and leaks; and
5) stormwater management.

Additional information on the water-related concerns can be found in the full report, which can be downloaded at www.pacinst.org/reports/fracking/index.htm.

Summary

Hydraulic fracturing has generated a tremendous amount of controversy in recent years. There are daily media reports on this topic from outlets across the United States and in a host of other countries, including Canada, South Africa, Australia, France and England. It is hailed by some as a game-changer that promises increased energy independence, job creation and lower energy prices. Others are calling for a temporary moratorium or a complete ban on hydraulic fracturing due to a range of environmental, social and public health concerns.

Much of the public attention on hydraulic fracturing has centered on the use of chemicals in the fracturing fluids and the risk of groundwater contamination. The mitigation strategies identified to address this concern have centered on disclosure and, to some extent, the use of less toxic chemicals. While chemical disclosure can be useful for tracking contamination, risks associated with fracking chemicals are not the only issues that must be addressed. The massive water requirements for fracking and the potential conflicts with other water needs, including for agriculture and for ecosystems, pose major challenges. Methane contamination of drinking water wells is also a concern according to some field studies, as are the serious challenges associated with storing, transporting, treating and disposing of wastewater. Indeed, interviewees more frequently identified the overall water requirements of hydraulic fracturing and the quantity and quality of wastewater generated as key issues.

Although data and information about hydraulic fracturing is growing, a lack of credible and comprehensive data and information is a major impediment to identify and clearly assess the key water-related risks associated with hydraulic fracturing and to develop sound policies to minimize those risks. Due to the nature of the business, industry has an incentive to keep the specifics of their operations secret in order to gain a competitive advantage, avoid litigation, etc. Additionally, there are limited number of peer-reviewed, scientific studies on the process and its environmental impacts. While much has been written about the interaction of hydraulic fracturing and water resources, the majority of this writing is either industry or advocacy reports that have not been peer-reviewed. As a result, the discourse around the issue is largely driven by opinion. This hinders a comprehensive analysis of the potential environmental and public health risks and identification of strategies to minimize these risks.

Finally, there exists a lack of clarity about the terms used to characterize the process. For example, the American Petroleum Institute, as well as other industry groups, using one definition of fracking, argues that there is no link between their activities and groundwater contamination. Yet, documented cases in Dimock, Pennsylvania and an ongoing investigation in Pavillion, Wyoming provide evidence of groundwater contamination. In these cases, however, contamination was associated with the integrity of the well casing and wastewater disposal, which are integral parts of the hydraulic fracturing process, but not the injection of the fluids underground per se.

Additional work is needed to clarify terms and definitions associated with hydraulic fracturing to support more fruitful and informed dialog and to develop appropriate energy, water and environmental policy.

Heather Cooley is Co-Director of the Water Program at the Pacif c Institute. Based in Oakland, California, the Pacif c Institute celebrates 25 years of advancing environmental protection, economic development and social equity with science-based solutions that lead to social and political change.

All Hands on Deck:

The National Front in the Fight Against Fracking

by Nadia Steinzor

Earthworks Oil & Gas Accountability Project

www.earthworksaction.org

While everyone uses and depends on different forms of energy, far fewer of us think about what producing it can mean for the people and environments directly affected. But in an age of rapid climate change and threats to air and water quality, that could be slowly changing. Even as the fossil fuel train we've long been traveling on continues to rush down the tracks, communities and decisionmakers are working to stop it—and many are waving a flag that reads "No Fracking."

Slang for hydraulic fracturing, the technology that fractures shale rock in order to release the trapped gas, "fracking" has for many people become synonymous with the overall process of oil and gas development. The sudden widespread use of the word reflects the equally rapid rise of natural gas extraction and production in the United States (and globally). According to the U.S. Energy Information Administration, in mid-2012, there were nearly 490,000 producing natural gas wells in the United States, 60,000 more than in 2005.[1] A growing proportion of this gas, as well as U.S. oil, comes from shale formations like the Marcellus, Barnett, Haynesville, Bakken and Eagle Ford.

Developed in its initial form in the 1940s, fracking has now arrived in or could reach everyone's "backyard." This includes places with denser development and higher populations (such as the East and Midwest) than has been the case with previous U.S. energy development. When it comes to impacts on communities and natural environments—not least of all the nation's waterways and watersheds—practically everyone now lives downstream.

How We got Here

For a long time, getting gas and oil from shale was viewed as economically and technologically unfeasible. This began to change several years ago, when new approaches to hydraulic fracturing were combined with horizontal drilling and it became possible to drill deep underground and through tight formations.

A main motivation behind this shift was the decline of easy-to-reach oil and gas resources worldwide and the growing push in the United States to produce more energy from domestic sources (ostensibly for national security reasons). The economic recession has also played a strong role, making it easier for companies to secure leases with owners of mineral rights and land, for elected officials to support activities that could create jobs, and for state governments to accelerate drilling in the pursuit of revenue. In the rush to drill, the gas industry has put still-emerging practices and technologies to use before their safety has been established or their risks fully understood, in effect placing the heaviest "burden of proof" of harm on impacted individuals and communities.

Such trends have been bolstered by the decades-long influence of the oil and gas industry on national energy policies. The most glaring example of this is the suite of special exemptions from key provisions of seven bedrock federal environmental laws. Some of these loopholes date back to the 1980s and others were created as recently as 2005, but all of them make it much easier and less financially burdensome for industry to pursue and accelerate activities. For example, by never having to disclose the chemicals injected underground for hydraulic fracturing (Safe Drinking Water Act); seek permits for stormwater runoff

[1] "Number of producing gas wells." U.S. Energy Information Administration data tables. Available at http://205.254.135.7/dnav/ng/ng_prod_wells_s1_a.htm.

(Clean Water Act); collectively count up levels of emissions from facilities in order to meet federal air standards (Clean Air Act); or subject waste to classification as hazardous so that it can't be disposed of in rivers, streams and landfills (Resource Conservation and Recovery Act).[2]

Where We're Headed

In a nation that relies on fossil fuels for more than 80 percent of its energy, the stage is set for keeping the oil and gas spigot turned on. Yet as concerns over the environmental and health impacts of industrial energy development increase, the presumption of "business as usual" is starting to shift, and a different scenario could well emerge.

Reports of health problems experienced by people and animals are increasing, research is emerging on pollution caused by drilling and production facilities, and violations by the industry (including chemical spills, equipment failure and improper handling of waste) are on the rise.[3] In response, communities and organizations are mobilizing to learn more about fracking and to demand an end to oil and gas drilling that harms public health, water and air quality, and the climate.

Increasingly, decisionmakers have been forced to listen—as illustrated by the U.S. Department of Energy's issuance in 2011 of stronger-than-expected recommendations for protecting the environment and health from gas drilling and a recent proposal from the U.S. Environmental Protection Agency (EPA) to greatly strengthen oil and gas air emissions regulations.

Yet the surge in awareness and activism is going head-to-head with existing trends. A loud and steady drumbeat for expanding shale gas production can be heard at the highest levels of policy. In the 2012 State of the Union Address—reflecting pressures in Congress and the position of many of its members—President Obama said several times that natural gas must be part of the nation's energy mix going forward. Perhaps not surprisingly, members of the current U.S. House of Representatives and Senate have to date received more than $20 million in campaign contributions from the oil and gas industry.[4]

In today's political climate, some Congressional leaders seek to prevent tighter regulation of industry practices and to reduce the authority of the EPA. The New Alternative Transportation to Give Americans Solutions (NATGAS) Act, which would provide federal financial incentives for natural gas vehicles, has been introduced. Similar incentive and tax credit programs to encourage the production and use of natural gas already exist or are being planned in states nationwide.[5] And the proportion of electricity generation coming from natural gas is growing as coal-fired power plants are converted.

The tension between widespread concerns over fracking and the policy status quo is also playing out in states, which have long held the authority to regulate oil and gas activities within their borders. But to a large degree, state regulations remain too lax and outdated to address modern-day industrial gas development, which uses far more water, land and chemicals and produces much more pollution and

[2] "Loopholes for Polluters: The oil and gas industry's exemptions to major environmental laws." Earthworks, 2011.
[3] "List of the Harmed" compiled by the Pennsylvania Alliance for Clean Water and Air, http://pennsylvaniaallianceforcleanwaterandair.wordpress.com/the-list/; Humes, Edward, "Fractured Lives: Detritus of Pennsylvania's Shale Gas Boom." *Sierra Magazine*, July/August 2012; Colborn, T., Kwiatkowski, C., Schultz, K., and Bachran, M, "Natural gas operations from a public health perspective," 2011, *Human & Ecological Risk Assessment* 17(5):1039-1056; and reports by Earthworks OGAP on the failure of oil and gas oversight and enforcement in six states (Colorado, New Mexico, New York, Ohio, Pennsylvania, and Texas) at www.earthworksaction.org.
[4] Oil Change International. "Dirty Energy Money" database and interactive website, www.dirtyenergymoney.org.
[5] U.S. Department of Energy, Alternative Fuels Data Center. "Natural Gas Laws and Incentives." www.afdc.energy.gov/fuels/laws/3253.

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waste than in the past. Compounding this situation is a lack of capacity and resources at state regulatory agencies to enforce regulations on the books or to monitor an increasing number of facilities. Regulators at all levels are also under political pressure to facilitate industry expansion through permitting and limited oversight.

In short, the rapid pace of industry and infrastructure expansion is increasingly divergent from the much slower pace of gaining scientific understanding of its impacts and achieving policy and regulatory measures to prevent them from happening. Despite daunting hurdles, the growing wish by citizens for different energy choices and the rapid rise of an anti-fracking movement could, step by step, help bridge this gap.

Ways to Get There

Two polls this past spring illustrate how much "fracking awareness" has grown and how much work remains. First, a Bloomberg News National Poll indicated that three times as many Americans want more regulation of fracturing than less.[6] Then the University of Texas at Austin Energy Poll revealed that nearly two-thirds of Americans had not heard of or were unfamiliar with the terms "hydraulic fracturing" and "fracking."[7]

On the federal level, organizations and activists are stepping up efforts to defend the authority and work of the EPA and to close the oil and gas loopholes in U.S. laws, including advancing the Fracturing Responsibility and Awareness of Chemicals (FRAC) Act focusing on the Safe Drinking Water Act, and the Bringing Reductions to Energy's Airborne Toxic Health Effects (BREATHE) Act focusing on the Clean Air Act.

Efforts are focusing on the work of interstate River Basin Commissions, which have the authority to restrict gas development that harms drinking water and aquatic life. In response to Marcellus Shale drilling, campaigns have been launched to influence the decisions and policies of the Delaware River Basin and Susquehanna River Basin Commissions; demands include comprehensive, long-term planning rather than a permit-by-permit approach to drilling; tight regulations that put water and ecosystem quality first; and putting environmentally sensitive areas off-limits.

Coalitions of environmental and citizen organizations are also coming together to advance state legislation that offers greater protections and to defeat bills that give industry a green light to drill anywhere, anytime, and in any way they want. Many improvements in existing regulations are needed, in particular with regard to setbacks for facilities, technologies to control emissions, and waste treatment and disposal methods, as well as much greater oversight of industry operations.

The local level has also become a key (and increasingly heated) battleground, based in large part on the authority of municipalities to determine and restrict the location of development, including industrial activities. Concerned citizens have been turning out at town council meetings and working with local officials to adopt and strengthen comprehensive plans and zoning laws in order to address aspects of gas development such as leasing facility siting, truck traffic and waste and chemical storage, and to protect waterways and drinking water supplies, homes, schools, and agricultural and tourism areas. Another tactic has been the adoption of ban ordinances that are

[6] Poll article at http://www.bloomberg.com/news/2012-03-15/tigher-fracking-regulations-favored-by-65-of-u-s-in-poll.html.
[7] Poll at http://www.utenergypoll.com/

based on the concepts of community rights and local self-government. As a result, hundreds of towns and counties nationwide have modified their land use laws and adopted drilling moratoria or bans to prevent gas development from occurring within their boundaries. (See box below for more information.)

From towns to state capitals to Washington, DC, the debate over natural gas development is taking place in a context in which the science does not exist to extract oil and gas safely; regulations are not in place or being enforced to protect communities and the environment; and the current methods of oil and gas production risk worsening water and air pollution and climate change. For all these reasons, Earthworks and many other organizations and communities nationwide form a movement that is growing every day and making itself known in more places. Together, we can all work to stop the rush to drill, protect the places we love, reduce our dependence on dirty energy, and ultimately pave the way for a truly clean energy future.

MUNICIPAL CONTROL & ACTIONS

In the fight to prevent harm from natural gas development, many people are sticking close to home and working through local laws and governments. In response, the gas industry has sought—through pressure on local officials, lobbying for and against particular legislation, and legal actions—to reduce municipal control and preempt local laws, claiming that only the state has the power to oversee gas and oil development.

Nonetheless, just this year, two court decisions reinforced the power of local governments to determine the "where" of gas development, even if the state retains the "how" through its authority to adopt and impose regulations.

In February, the New York state Supreme Court upheld the right of two towns (Dryden and Middlefield) to prohibit gas development as part of their land use and zoning decisions. In Pennsylvania, Act 13, passed by the state legislature this past spring, would have eliminated local zoning powers in relation to gas development and allowed for the waiver of protective setbacks through gas permits. But a swift legal challenge brought by seven municipalities and Delaware Riverkeeper Network proved successful, with the state Commonwealth Court declaring in July that local governments indeed have the right to adopt provisions to protect their land and residents from harm.[8]

With the restriction of municipal zoning rights being eyed by the gas industry and its legislative supporters in other states, these cases could potentially be precedent-setting. At the time of writing, Pennsylvania Governor Corbett's administration has filed an appeal to the court decision on Act 13 and the "home rule" abilities of New York towns are shaping up to play a major role in how the state moves forward with gas development. Stay tuned!

[8] See explanation blog posting of the court decision by the Natural Resources Defense Council at http://switchboard.nrdc.org/blogs/draichel/victory_in_pa - court_declares.html.

Human Health:

The True Cost of Fracking

by Steve Dickens
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There are close to a half million gas wells currently operating in the U.S. that employ hydraulic fracturing (fracking) as a means to extract the gas from shale rock formations. Numerous pollutants are released into the air, water and soil as a result of fracking procedures. Releases occur from volatilization from lagoons containing flow-back ("produced") water from wells, spills from trucks used to transport fracking water and produced water, discharges of produced water into surface waters, and contamination of groundwater aquifers that results from failed well casings and the upward migration of fracking fluid through cracks in the shale rock.

The oil and natural gas industry is the largest industrial source of Volatile organic compounds (VOCs) in the United States. The industry also emits nearly 40% of the nation's total methane. Methane is a greenhouse gas that is 20 times more potent for carbon dioxide. And while the direct health effects of methane on human health are not well known, its interaction with other fracking chemicals do produce compounds known to be toxic. The chart that follows depicts a long list of chemicals used in fracking and their known impacts on human health.

Not many studies have yet examined the health impacts of fracking. However, the initial evidence of human exposure to these hazardous substances is beginning to mount. Elevated concentrations of pollutants have been documented around oil and natural gas facilities in Wyoming, Colorado, New Mexico, and Texas.[1,2,3]

The US EPA investigated the impact of fracking on drinking water in Pavillion, Wyoming. EPA sampled a total of 42 private drinking water wells and found the presence of methane (10-800 ppb in 10 of 28 wells), widespread diesel and gasoline organics (10-100 ppb), specific petroleum-related compounds at ppb levels, 2-butoxyethanol phosphate (9 wells), phenols, naphthalene, BTEX (including benzene at 50x the MCL), and other chemicals. Robert Jackson, a professor at Duke University, found systematic evidence of methane contamination of drinking water associated with shale gas extraction in northeastern Pennsylvania and upstate New York. Jackson sampled 60 residential drinking water wells and found that wells near active drilling sites were contaminated with methane at levels 17 times higher than those found in wells in areas without drilling.[4]

It is not clear the extent to which this contamination comes from drilling well leaks versus the vertical migration of fracking fluids, a much more contentious potential source. But even if all of the contamination sources were from leaks, such leaks occur all too frequently. Based on a non-peer-reviewed survey of the five states that systematically report incidents at wells where fracking occurs and where complaints have spurred inspections, Ronald E. Bishop, a lecturer in chemistry and biochemistry at the State University of New York, Oneonta, estimates nearly 2% of such gas wells may end up contaminating groundwater with fracking fluids.[5] Dr. Anthony Ingraffea, a professor of engineering at Cornell reports that based on PA DEP data, Marcellus Shale well casings have failed at a rate of 6.2% in

[1] McKenzie LM, et al. Human health risk assessment of air emissions from development of unconventional natural gas resources. Sci Total Environ 424:79–87. 2012. http://dx.doi.org/10.1016/jscitotenv.2012.02.018

[2] EPA. AirData, Monitor Values Report [website]. Washington, DC:U.S. Environmental Protection Agency. Available: http://www.epa.gov/airdata/ad_rep_mon.html. [accessed 13 Jun 2012].

[3] City of Fort Worth. Natural Gas Air Quality Study (Final Report). Fort Worth, TX:Eastern Research Group and the City of Fort Worth (13 Jul 2011). Available: http://fortworthtexas.gov/gaswells/default.aspx?id=87074 [accessed 13 June 2012].

[4] Osborn SG, et al. Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing. Proc Natl Acad Sci USA 108(20):8172-8176. 2011. http://dx.doi.org/10.1073/pnas.1100682108

[5] Bishop RE. Chemical and Biological Risk Assessment for Natural Gas Extraction in New York. Oneonta, NY: State University of New York College at Oneonta; Cooperstown NY: Sustainable Otsego (28 Mar 2011). Available: http://tinyurl.com/5wp4ybg [accessed 17 June 2011].

Pennsylvania in 2010 and 2011, causing immediate fluid migration.[6] Even at a failure rate of 2%, how many people would be at risk given the half million operating wells?

Furthermore, a new study published in Ground Water several months ago, suggests that hydrofracking, which occurs at a depth far below drinking water aquifers, may result in the upward migration of contaminants through cracks caused in rock formations, directly resulting in the contamination of aquifers. Tom Myers, an independent hydrogeologist, reported computer modeling results that demonstrate fracking dramatically speeds up the movement of chemicals injected into the ground. Myers found that as a result of fracking pressures, fluids will travel underground at distances within 10-100 years that would take tens of thousands of years under natural conditions. Myers concluded that appears that underground shale rock formations are far more capable of transporting these chemicals than previously thought.

The health consequences of fracking are not limited to the direct consequence of exposure to toxic substances. New research out of the University of Colorado suggests that there are a broad range of psychological and social impacts that also affect public health.[7] The impact of round-the-clock drilling and trucking in previously rural areas can be profound. Our reprint of an article in this River Voices on the impacts of fracking on women's health describes some of these impacts well.

There is clearly much more that we still don't know when it comes to the health impacts of fracking. As disease clusters undoubtedly appear in regions of fracking (due to chance if nothing else), similar to cases of toxic exposure in the past, citizens will want to know if the high incidence of disease in their communities is related to fracking. One way to help answer these future challenging epidemiologic questions is for communities to collect baseline health data now, to which future data can be compared.

We also don't have to wait until the effects of fracking on public health are borne out. It makes sense to adopt a rationale precautionary approach to stop fracking efforts that will almost certainly have huge environmental and human health impacts, and instead encourage the continued positive development of renewable energy.

[6] Lecture by Ingraffea at "Marcellus Exposed" symposium, March 17th, 2012

[7] Witter, Roxana, Community Impacts of Natural Gas Development and Implications for Human Health, Roxana Witter. Presented at NIEHS Partnerships for Public Health Webinar Series, July 20, 2012

A partial list of known chemicals that can be used during hydrofracking, with their suspected health affects.

CHEMICAL	Skin, eye and sensory organ	Respiratory	Gastrointestinal and liver	Brain and nervous system	Immune	Kidney	Cardiovascular and blood	Cancer	Mutagen	Developmental	Reproductive	Endocrine disruptors	Other	Ecological
(2-BE) Ethylene glycol monobutyl ether	S	S	S	S	S	S	S	S	S	S	S	S	S	S
2,2',2"-Nitrilotriethanol	S	S	S	S	S	S	S	S	S		S	S	S	S
2-Ethylhexanol	S	S	S	S	S	S	S		S	S	S	S	S	S
Acetic acid	S	S	S	S	S	S	S						S	S
Acetic anhydride	S	S	S	S	S	S	S	S		S	S	S	S	S
Aluminum oxide	S	S		S										S
Aluminum tristearate (stearate)	S	S	S											S
Ammonium chloride	S	S	S	S	S	S	S			S	S	S	S	S
Ammonium persulfate	S	S	S		S		S							S
Aromatic naphtha, Type I (light) (Light aromatic solvent)	S	S	S	S						S				S
Asphaltite (Gilsonite, Hydrocarbon black solid)	S	S	S		S									
Attapulgite clay		S	S				S	S					S	S
Barite (BaSO4)	S	S			S								S	S
Bentonite	S	S	S		S			S						S
Butanol (N-butyl alcohol, Butan-1-OL, 1-Butanol)	S	S	S	S		S	S						S	S
Calcium chloride	S	S	S	S			S	S	S					S
Calcium hydroxide	S	S	S	S		S	S		S				S	S
Cellulose derivative (carboxymethylcellulose sodium salt)	S	S	S			S								S
Cement kiln dusts	S	S			S				S		S			S
Citric acid	S	S	S	S			S						S	S
Crystalline silica (silicon dioxide)	S	S	S		S									
Crystalline silica, cristobalite	S	S			S			S	S					
Crystalline silica, quartz	S	S			S	S		S	S			S		
Crystalline silica, tridymite		S						S	S					
Diesel 2	S	S	S	S		S	S	S	S				S	S
Diethanolamine	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Diethylene glycol	S	S	S	S		S	S			S	S	S	S	
Ethanol (Acetylenic alcohol)	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Ethoxylated alcohol	S	S	S											S
Ethylene glycol	S	S	S	S	S	S	S		S	S	S	S	S	S
Formaldehyde	S	S	S	S	S	S	S	S	S	S	S		S	S
Formic acid	S	S	S	S	S	S	S		S	S			S	S
Glutaraldehyde	S	S	S	S	S	S	S		S	S	S	S	S	S
Glycerin mist (Glycerol)	S	S	S	S		S	S							
Graphite	S	S	S				S							
Guar gum	S	S			S									
Guar gum, carboxymethyl ether, sodium salt		S		S										
Heavy aromatic petroleum naphtha (aromatic solvent)	S	S	S	S									S	

KEY
S: Suspected of causing an adverse health effect
P: Suspected of causing cancer

CHEMICAL	Skin, eye and sensory organ	Respiratory	Gastrointestinal and liver	Brain and nervous system	Immune	Kidney	Cardiovascular and blood	Cancer	Mutagen	Developmental	Reproductive	Endocrine disruptors	Other	Ecological
Humic acid (Leonardite)	S										S	S		S
Hydrochloric acid (HCl)	S	S	S		S		S						S	S
Hydrogen sulfide	S	S	S	S	S	S	S			S	S	S	S	S
Hydroxyethylcellulose	S	S	S	S			S				S			
Iron oxide (Fe203, Diiron trioxide)	S	S	S					S						
Isopropanol (Propan-2-OL)	S	S	S	S	S	S	S			S			S	S
Limestone (Calcium carbonate)	S	S	S											
Magnesium oxide	S	S	S	S			S	S						
Methanol	S	S	S	S	S	S	S		S	S	S	S	S	S
Methyl-4-isothiazolin	S	S		S	S					S	S			S
Mica		S	S										S	
Modified polysaccharide or Pregelatinized cornstarch or starch	S	S	S											
Monoethanolamine	S	S	S	S	S	S	S		S	S		S	S	S
NaHCO3	S	S	S		S	S	S	P			S	S	S	S
Naphthalene	S	S	S	S	S	S	S	S	S	S		S	S	S
Nitrogen	S	S	S								S		S	
Petroleum distillate hydrotreated light	S	S	S	S									S	S
Phosphonium, tetrakis(hydroxymethly)-sulfate	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Polyacrylamide/polyacrylate copolymer (Copolyer of acrylamide & sodium acrylate, partially hydrolized polyacrylalmide)	S	S												
Polyethylene glycol (Polyethylene glycol mixture)	S	S	S		S	S								
Potassium carbonate	S	S	S			S	S	P						
Potassium chloride	S	S	S	S		S	S					S	S	
Potassium hydroxide	S	S	S					S	S				S	S
Propane-1,2-diol	S	S	S	S	S	S	S				S	S	S	S
Propargyl alcohol (Prop-2-YN-1-OL)	S	S	S	S		S	S		S				S	S
Sodium acid pyrophosphate	S	S	S		S									
Sodium carbonate (Soda ash)	S	S	S		S		S						S	
Sodium chloride	S	S	S	S		S	S	P					S	S
Sodium hydroxide	S	S	S										S	S
Sodium tetraborate decahydrate (Borax)	S	S	S	S		S	S			S	S	S	S	
Surfactant														
Tetrahydro-3,5-dimethyl-2H-1,3,5-thiadiazine-2-thione (Dazomet)	S	S	S	S	S	S	S		S				S	S
Tetramethyl ammonium chloride	S	S	S	S			S				S		S	S
Trisodium nitrilotriacetate	S		S			S	S	S						S
Xanthan gum	S	S	S										S	
Xylene	S	S	S	S	S	S	S			S	S	S	S	S

Disclaimer: While the format of this chart differs from the original, the data shown have not been altered. Only the original document on the website (www.endocrinedisruption.com/chemicals.multistate.php) is endorsed by TEDX.

At What Cost?:

The Fracking Frenzy s Impact on Women

by Sara Jerving

Center for Media and Democracy

www.prwatch.org

Hydraulic fracturing, or "fracking," has generated widespread media attention this year. The process has been shown to contribute significantly to air and water pollution and has even been linked to earthquakes. But little has been reported on the ways in which fracking may have unique impacts on women. Chemicals used in fracking have been linked to breast cancer and reproductive health problems and there have been reports of rises in crimes against women in some fracking "boom" towns, which have attracted itinerant workers with few ties to the community.

Toxins in Fracking Process Linked to Breast Cancer

Not only has the chemical cocktail inserted into the ground been shown to contaminate groundwater and drinking water, but fracking fluid also picks up toxins on its trip down to the bedrock and back up again that had previously been safely locked away underground. Chemicals linked to cancer are present in nearly all of the steps of extraction—in the fracking fluids, the release of radioactive and other hazardous materials from the shale, and in transportation and drilling related air pollution and contaminated water disposal.

Some reports indicate that more than 25 percent of the chemicals used in natural gas operations have been linked to cancer or mutations, although companies like Haliburton have lobbied hard to keep the public in the dark about the exact formula of fracking fluids. According to the U.S. Committee on Energy and Commerce, fracking companies used 95 products containing 13 different known and suspected carcinogens between 2005 and 2009 as part of the fracking fluid that is injected in the ground. These include naphthalene, benzene, and acrylamide. Benzene, which the U.S. EPA has classified as a Group A, human carcinogen, is released in the fracking process through air pollution and in the water contaminated by the drilling process. The Institute of Medicine released a report in December 2011 that links breast cancer to exposure to benzene.

Up to thirty-seven percent of chemicals in fracking fluids have been identified as endocrine-disruptors—chemicals that have potential adverse developmental and reproductive effects. According to the U.S. EPA, exposure to these types of chemicals has also been implicated in breast cancer.

The Marcellus Shale in the northeast part of the United States also naturally contains radioactive materials, including radium, which is largely locked away in the bedrock. The New York's Department of Environmental Conservation (DEC) analyzed 13 samples of water, contaminated by the fracking process, as a result of the hydraulic fracturing of the shale during the extraction process. The DEC found that the resulting water contained levels of radium-226, some as high as 267 times the limit for safe discharge into the environment and more than 3000 times the limit safe for people

to drink. One gas well can produce over a million gallons of contaminated water. A *New York Times* expose in 2011, released secret EPA documents that illustrated how this water is sometimes sent to sewage plants that are not designed to process the dangerous chemicals or radiation which in some instances are used in municipal drinking supplies or are released into rivers and streams that supply drinking water.

Emerging data points to a problem requiring more study. According to a 2011 report by the Centers for Disease Control and Prevention, in the six counties in Texas that have seen the most concentrated gas drilling, breast cancer rates have risen while over the same period the rates for this kind of cancer have declined elsewhere in the state. The average of the six counties' rates has risen from 58.7 cases per 100,000 people in 2005 to about 60.7 per 100,000 in 2008. Similarly, in western New York, where traditional gas drilling processes have been used for decades before hydrofracking came along, has been practiced for nearly two centuries, rural counties with historically intensive gas industry activity show consistently higher cancer death rates (PDF) than rural counties without drilling activity. For women, this includes breast, cervix, colon, endocrine glands, larynx, ovary, rectal, uterine, and other cancers.

Toxins linked to Spontaneous Abortion and Birth Defects

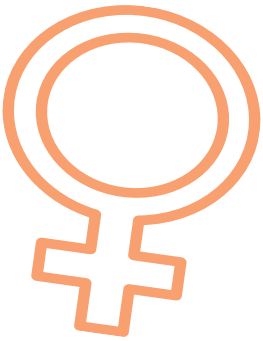
Certain compounds, such as toluene, that are released as gas at the wellhead and also found in water contaminated by fracking have the potential to harm pregnant women or women wishing to become pregnant. According to the U.S. EPA, studies have shown that toluene can cause an assortment of developmental disorders in children born to pregnant women that have been exposed to toulene. Pregnant women also carry an increased risk of spontaneous abortion from exposure to toluene. Wyoming, which contains some of the most active drilling fields in the country, failed to meet federal standards for air quality due to fumes containing toluene and benzene in 2009.

Credit: wcn247's photostream

Marcellus Shale Gas Well in Pennsylvania.

Sandra Steingraber, an acclaimed ecologist and author of "Raising Elijah"—a book on how to raise a child in an age of environmental hazards, takes the strong stand that fracking violates a woman's reproductive rights. "If you want to plan a pregnancy and someone else's chemicals sabotage that—it's a violation of your rights as a woman to have agency over your own reproductive destiny," she said.

Steingraber sees banning fracking as an issue that both the pro-choice and anti-abortion camps can rally behind. She has been giving talks on why opposition to fracking should be considered a feminist issue. The author won a Heinz award—which recognizes individuals for their contributions in areas including the environment—for her work on environmental toxins. She dedicated the $100,000 prize to the fight against fracking.



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Crimes Against Women on the Rise in Some Energy Boom Towns

Beyond concerns about cancer and toxins are other societal ills related to fracking that disproportionately impact women. Some areas across the country where fracking has boomed have noted an increase in crime—including domestic violence and sexual assault. In Dickinson, North Dakota, there was at least a 300% increase in assault and sex crimes in 2011. The mayor has attributed the increase in crime to the oil and "natural" gas boom in their area.

The Executive Director of the Abuse & Rape Crisis Center in Bradford County, Pennsylvania, Amy Miller, confirmed that there has been an increase in unknown assailant rapes since the gas industry moved into the region—which are much harder to prosecute than acquaintance rape cases. Miller also noted that domestic abuse has spiked locally, with the cases primarily from gas industry families. The county has more than 700 wells drilled, with more than 300 of these operational, and another 2,000 drilling permits have been issued.

The Gas Industry's Pink Rig

Even though fracking and drilling are dependent on a potpourri of carcinogenic chemicals, big energy companies don't hesitate to slap on pink paint in PR campaigns championing breast cancer awareness.

In 2009, a "natural" gas drilling rig in Colorado was painted pink with a percentage of the daily profits from the unit going to the Breast Cancer Foundation. This and other showy gestures by the shale gas and oil industry appear to do little to alleviate concerns about the impact that fracking chemicals and practices may be having on public health and safety.

Strengthening Permit Conditions for Watershed Protection

When Fracking Comes to Your Watershed

by Trent Dougherty
&
Melanie Houston
Ohio Environmental Council
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Natural Gas was once thought of as a bridge fuel—a cleaner burning fossil fuel to get us off our addiction to dirty, coal-fired electricity and finally on to emission-free renewable energy and more energy efficiency. However, in shale boom states like Ohio, the bridge is being replaced with a rush to extract as much oil and gas as possible with little regard to the impact to the states' most important resource—water.

Watershed advocates usually can rely on local governments and local communities to use zoning, flood plain management, and other local police powers to assist in the protection of water resources. In Ohio, however, due to passage of House Bill 278 in 2004, local communities lost their voice in decisions concerning oil and gas drilling. Thus, these critical decisions that impact the lives and livelihoods of people in Ohio's eastern gasland communities will not be made by their city or county representatives, but rather in Columbus by the General Assembly and the Ohio Department of Natural Resources. While the magnificent efforts of local groups around Ohio have resulted in scores of local ordinances and decrees to ban horizontal hydraulic fracturing (or "fracking") in their jurisdictions, state laws are such that the ordinances would be invalidated if challenged.

So if you, as watershed advocates and river protectors, find yourselves in a state like Ohio, where the regulatory power over drilling is out of the hands of the local and put solely into the state government, fear not, this does not mean that all is lost in trying to protect local communities and local watersheds.

Individual permit terms and conditions also can be a great tool for mitigating impact. Below are three conditions that watershed groups can advocate to be incorporated in individual permits to protect water resources.

First, advocate to protect ecologically sensitive areas such as floodplains. During permitting, advocates should stress that oil and gas drilling operations should not be able to set up a drilling pad within a floodplain, leaving behind permanent above-ground oil and gas collection structures including tanks and pipes. The threats are two-fold. First is the physical contact of the pipes and tanks to rushing flood waters and the potential of compromising the structures, thereby releasing product into the flood waters. The second is the potential rupturing of the tanks and pipes from being hit by trees and other large objects carried by flood waters. It's nearly impossible to gain a permit to build anything permanent in a 100-year flood plain. No house, no garage, no shed...nothing. These are safety and ecological protections, as well as FEMA requirements—drilling should not be exempt. However, there have been instances, such as the case in Munroe Falls, Ohio, where permits have been granted for drilling in a 100-year flood plain.

Thus, river and watershed organizations should advocate for permits in their area to prohibit well pad construction within the 100-year flood plain. This most likely would have to occur on a permit-by-permit basis, however, a strong push in a local watershed, backed by local governments and local flood plain managers, could get a policy change for permits in the entire area. Such citing criteria can also be useful in protecting other ecologically sensitive areas such as designated high quality streams if your state has strong mechanisms to protect such waters.

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2 Second, advocate for conditions that protect public drinking water systems. Oil & gas drilling is a non-conforming, potentially polluting land use in a public drinking water system's source water protection area as designated by the Safe Drinking Water Act. In Ohio, for example, before the 2004 state legislation that removed local control, local communities could require additional safeguards at drilling sites. Now they cannot, but river advocates can still push for similar safeguards in each individual permit. To protect public water systems, advocates should require that drilling pads and storage tanks are constructed out of source-water protection areas. It is important for you to not only advocate for this protection with the state regulatory authority, but also with the local government to encourage them to request the permit restriction as well.

3 Third, advocate for inventory and protections for water quantity. Water consumption for horizontal high-volume hydraulic fracturing is substantial. Therefore, it is very important for state regulators to know how much water will be withdrawn and where permit holders are going to obtain their supply of water. Accordingly, permit applicants should identify the amount, source, and location of the ground and/or surface water they are going to use in order to assess effects on water levels, ecology and hydrology. To prevent harmful excess water withdrawals, ultimately, regulators should have to certify that such water withdraws will not cause harm for other water uses including public consumption, recreation, and agriculture.

In addition, there are a number of other permit terms and conditions that can help protect watersheds and local communities, including prohibiting permanent and temporary waste fluid pits and requiring closed loop systems. Scouring permits in your state and surrounding states could help immensely in giving you ideas for best protecting your area when a fracking company comes to your watershed. Of course, a great amount of lawmaker education, media outreach, and grassroots support is needed with any approach to minimize fracking's impact on your watershed. However, promoting strong permit terms and conditions will go a long way until we build and cross that new bridge away from fracking.

Shale-Gas Monitoring:

Combining the Power of Science and the Power of Communities

by Julie Vastine

Alliance for Aquatic Resource Monitoring

www.dickinson.edu/allarm

Getting Started

Pennsylvania has more stream miles per land area than any other state in the nation. Additionally it was documented in 2005 that there are over 580 organizations in Pennsylvania concerned with watershed health.[1] In short, there are active communities who care about Pennsylvania's streams. When fracking began in 2005 in the Marcellus Shale, landowners were leasing their land for as little as $50/acre (today leases are as high as $6,000/acre), operating under the misnomer that fracking was analogous to the conventional gas extraction practices that have taken place in Pennsylvania since 1800s. The Alliance for Aquatic Resource Monitoring (ALLARM), a project of the Environmental Studies department at Dickinson College, was first exposed to the myriad of potential issues that could accompany fracking in late 2008. This was a pivotal moment for ALLARM, an organization that has provided technical and programmatic assistance to community groups to conduct watershed assessments since 1986. We started asking ourselves "what is the role of volunteers in monitoring impacts from shale-gas extraction on Pennsylvania's small streams." As it turned out we were not the only ones asking that question, we started receiving phone calls from concerned citizens throughout the shale region on how they can best act as watchdogs of drilling activities.

Protocol Development

Thankfully at the turn of 2010, ALLARM experienced an infusion of resources. Our founder and science advisor, Dr. Candie Wilderman, was on sabbatical from Dickinson College's environmental studies department; she devoted her sabbatical working with ALLARM's Jinnie Monismith and a team of ALLARM students to research and create *Shale-Gas Extraction: A study design and protocol for volunteer monitoring*.[2] There are an infinite number of parameters that can be analyzed for stream monitoring. When we developed our volunteer monitoring protocol, we had several considerations: we wanted the monitoring program to be feasible, affordable, scientifically-robust and result in meaningful data. The focus of our protocol is simple: to detect flowback water contamination and visual impacts from drilling activities in small wadable streams. Volunteers are trained to use monitoring tools to determine if there is a pollution event and to raise the "red flag" to regulatory agencies to respond to the event.

Credit: ALLARM

Ruby Stanmyer, ALLARM, trains a monitor how to use the conductivity meter.

Flowback water

When drilling for natural gas in the Marcellus and Utica Shale, the frack water mixes with a natural brine found in the shale and between 10-20% returns to the surface—that water is known as *flowback water*. Flowback water often contains high concentrations of chlorides, sodium and sulfates, metals, naturally occurring radioactive materials, methane and bacteria. According to a study of flowback water by the Environmental Protection Agency in Pennsylvania, the total dissolved content values ranged from 70,000mg/l-217,000 mg/l.[3] Therefore ALLARM focused on conductivity as an "indicator

[1] www.rural.palegislature.us/watersheds_higdon.pdf

[2] http://blogs.dickinson.edu/marcellusmonitoring/files/2012/08/Shale-Gas-Volunteer-Monitoring-Manual-2.0.pdf

[3] http://www.epa.gov/hfstudy/HF_Workshop_4_Proceedings_FINAL_508.pdf

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parameter"—the ol' canary in the coal mine. If flowback water makes its way into small streams, there will be a significant spike; we needed to identify "signature chemicals" to verify that the conductivity spike was from flowback water. We looked again at the flowback studies and chose barium and strontium as signature parameters from Marcellus and Utica shale because they were found consistently in flowback and are not typically associated with other industrial or nonpoint sources.

Physical Changes to Streams

Credit: ALLARM

Flaming methane instream

As a result of natural gas extraction, there are a number of physical changes to streams. When you total the size of drilling pads (which can range from 5-30 acres, on average), access roads, staging areas, pipelines, etc., there are large amounts of land disturbances associated with fracking. Volunteers are trained to determine if the erosion and sedimentation best management practices are being installed and maintained properly. Volunteers also look for spills, discharges and bentonite blowouts (from pipeline construction). Finally, volunteers document methane migration; they look for bubbling in the streams and verify that it is methane by flaring it.

Once we identified the monitoring parameters we had to determine the right equipment for conductivity monitoring. ALLARM purchased eleven conductivity meters under $200 then tested them for accuracy and precision; we recruited participants for usability studies before deciding on the LaMotte PockeTester meter for this protocol.

In addition to identifying monitoring parameters, ALLARM also worked with regulatory agencies to establish three pollution reporting decision trees for chemical, visual assessment and pipeline monitoring.[4] They help guide volunteer decision-making around potential pollution events and identify who volunteers should call. Finally, ALLARM developed several quality assurance measures to assure that volunteers are collecting the most credible data possible.

The actual monitoring process can be broken down into six main categories: **1)** well location research; **2)** determining site locations; **3)** baseline monitoring (ideally a year before fracking begins); **4)** monitoring during extraction; **5)** quality assurance/ quality control; and **6)** data management and analysis.

ALLARM's Shale-Gas Monitoring Protocol

Survey Type	Parameters	Methodology	Frequency
Chemical	• **Conductivity & total dissolved solids** • **Barium & strontium**	• **LaMotte PockeTester** • **Certified lab analysis**	• **Weekly** • **Twice a year & to confirm** contamination event
Physical	• Gas Related & Earth Disturbance • **Spills & Discharges** • **Gas Migration or Leakage** • **Pipelines**	• **Visual survey**	• **Weekly**
Water quality	• **Surrogate flow**	• **Stream stage**	• **Weekly**

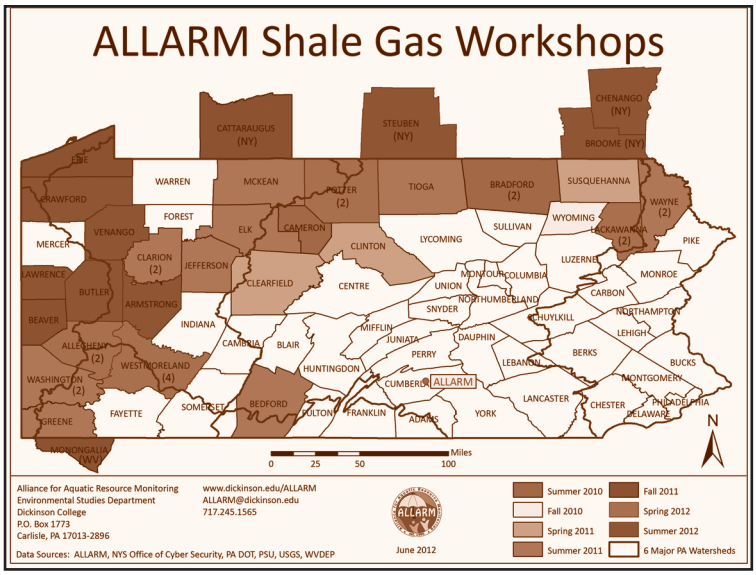
[4] http://blogs.dickinson.edu/marcellusmonitoring/files/2012/09/PA-Decision Trees.pdf

Training + Training + Training = Results

Once ALLARM put the finishing touches on its shale-gas monitoring manual, the next step was to develop training materials and pilot the first workshop in June 2010. Transitioning to the training phase proved to be an initial hurdle primarily because it had been almost a decade since ALLARM worked statewide in Pennsylvania and ALLARM is not located in the shale gas regions in the state. This meant that we needed to devote significant time to dusting off the rolodex, learning about monitoring initiatives throughout the state and building rapport with communities. Fortunately we were able to team up with other training and support organizations to help identify communities interested in monitoring, including the Pennsylvania Council of Trout Unlimited, Mountain Watershed Association, Delaware Riverkeeper Network, Pennsylvania Association for Sustainable Agriculture, Sierra Club Water Sentinels and the County Conservation District watershed specialists. To date, we have worked with community partners to implement 42 workshops in Pennsylvania, New York and West Virginia, training around 800 volunteers.

Tips for tailoring shale-gas monitoring to your state

One positive outcome of fracking has been learning about other states' volunteer monitoring initiatives and having the opportunity to collaborate with a number of new organizations. As fracking becomes prevalent in other states, there is the potential for increased volunteer monitoring around the issue.



However, there are a number of questions and considerations that have to be taken into account when tailoring a shale-gas monitoring protocol to your state:

- **Are the parameters applicable?** Is flowback water contamination in small streams a source of concern? If so, you should examine flowback water concentrations for your shale basin to confirm that it is briny enough to result in a spike in conductivity and to identify what "signature parameters" are appropriate to fingerprint flowback pollution.
- **How will you tailor your pollution reporting decision trees?** Who are the right agencies to respond to pollution events? It might take time to establish rapport with regulatory agencies so that they prioritize volunteers' calls.
- **How do you determine where the shale-gas wells are being built?** Here in Pennsylvania our Department of Environmental Protection has a query-database for finding shale-gas well pad locations.

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- **What are your quality assurance measures?** Who will help verify that volunteers are using the protocol and meters correctly? What certified laboratories will you use to analyze signature chemicals?
- **Who is going to provide training and follow-up support to volunteer monitors?**
- **How will your data be managed in your shale region?**

Credit: ALLARM

Julie Vastine, ALLARM, training volunteers on how to choose monitoring sites.

Lessons learned

Transitioning into shale-gas monitoring has been a wonderful (and at times, challenging) growing process for ALLARM, with a number of lessons learned along the way. The first lesson we learned was figuring out how to meet the community demand for training and providing ample follow-through support. When starting out, we did not have enough dedicated staff time to provide the necessary follow-up support to help volunteers be successful in their monitoring efforts. To help address this, ALLARM created an online toolkit with all of our training resources and material.[5] Also, we started fundraising for an additional staff position. While doing so, we also started exploring new ways to work with regional partners to make sure volunteers had access to professional resources. In short, no one organization can do it all, so collaborate, collaborate, collaborate.

The second largest hurdle/lesson learned concerned centralized data management. With no centralized data management tool in place prior to the start of our shale-gas monitoring program, ALLARM trained communities to do localized data management using Excel templates created by ALLARM.[6] We quickly have learned that that localized data management is not a long-term sustainable option and have been working with a number of database partners to address this need.

Finally, take the time to build the necessary relationships with the regulatory agencies to ensure that when a volunteer monitor finds a pollution event, they know who to call and that their calls are responded to.

Conclusion

Shale-gas extraction results in a myriad of environmental issues that volunteers can play a role in monitoring. With slashes in state budget cuts and the density of drilling pad locations, it is impossible for all stages of the fracking process to be amply monitored. Volunteer monitors can be trained to use science as a tool and to be the eyes, ears and voices of our environment.

[5] http://blogs.dickinson.edu/marcellusmonitoring/

[6] http://blogs.dickinson.edu/marcellusmonitoring/data-management/

No Fracking Way

New York State Residents Stand Firm

by Hilary Lambert

Cayuga Lake
Watershed Network
www.cayugalake.org

In August 2012, over two thousand impassioned anti-frack activists rallied outside NY DEC's headquarters in Albany NY, roaring their message to the Empire State's equivocating regulators that proposed gas drilling and fracking here will never be environmental business as usual. In brief speeches accompanying the march across downtown Albany, Bill McKibben of www.350.org said that Governor Andrew Cuomo's eventual decision to frack or not to frack will not just be historic—it will be *geologically* historic, due to the climate change implications of adding New York State's shale gas methane to our planet's already over-burdened greenhouse gas load.

Credit: Hilary Lambert

New York antifracktivists express their sentiments. August 27, 2012

Josh Fox of "Gasland" movie fame, a lifelong resident of the Delaware River Basin in New York, offered a jug of toxic brown water to thirsty marchers, fresh from the water taps of Dimock, Pennsylvania. Gas drilling and fracking have overwhelmed that state's communities and its regulatory capacity to control the rogue gas industry's negative impacts and careless behavior, during the past 5 years of a shale gas boom statewide. New York has had a ringside seat to the devastation taking place in the Pennsylvania gas fields.

From the posters, placards and chants at the August rally and elsewhere, it is evident that water is at the center of New York fracktivist concerns. While destruction of community, clean air, health concerns, truck traffic and noise are also major issues, it is the fear of the permanent loss and degradation of our abundant, clean water resources to fracking pollutants that has unified right and left, farmers, towns, urban hipsters and families, against allowing the nightmare that has overtaken Pennsylvania and so many other states to come across the border into New York.

Fracking for shale gas has not begun yet in New York State in large part because New Yorkers have the tragic example of Pennsylvania to observe up close and personal, just across the state line in the headwater streams, creeks and rivers of the Susquehanna River Basin. Additionally, New York does not have a long history of acquiescence to established energy interests: while energy companies may have New York City headquarters and loom large on Wall Street's Stock Exchange, the state itself is largely unmarked by large-scale mining and heavy resource extraction.

As a result, New York residents in the Marcellus Shale region were naïve about signing away their land rights on apparently lucrative leases to gas companies during the mid-'00s, as seductive landsmen fanned out across the Finger Lakes, Delaware River Basin, and Southern Tier counties in the upper Susquehanna River Basin, snapping up the

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New York Residents Stand Firm, cont.

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rights for energy companies to do as they pleased on thousands of properties. Many New York towns, such as Groton, now have 70% or more of private (and in some cases, town-owned) property locked up in gas leases.

Credit: Hilary Lambert

New Yorkers rally at the state legislature to say "NO" to gas drilling and fracking. August 27, 2012

However, that lack of long-term control by energy interests has fed an enormous backlash and led to the development of a massive political push-back movement. Thanks to early efforts by activists to provide information to the public, such as the map of leased properties in Tompkins County, online since 2010 at www.tcgasmap.org and followed by gas lease mapping by other groups, the leased public realized they had been duped, and responded in classic New York style, "You wanna do WHAT with my land and water? I don't think so!"

Key to New York's success in fending off the fracking industry has been the understanding that solidarity with Pennsylvania communities and with gas drilling and energy activists nationwide is necessary for success. Even inside the state, in the past four years, repeated attempts have been made to divide and conquer the anti-fractivists. For example, DEC and the Governor's office—with the support of several big environmental groups—promised that New York City's watershed would not be fracked, with the hope that New York City residents would shut up and stop complaining, allowing the rest of the state to be invaded by the gas rigs. This primitive strategy backfired: "*All* watersheds are sacrosanct," shout the activists, reminding Governor Cuomo of his election promises to the entire state.

Meanwhile, attorneys Helen and David Slottje of the Community Environmental Defense Council, Inc., (www.cedclaw.org) have been on a grueling work schedule statewide, enduring withering criticism and legal threats by the gas companies for their unceasing assistance in crafting town-level zoning ordinance bans and moratoria to out keep gas drilling and fracking. The state's populace is taking local action to keep out the drill rigs (yes, even in towns with leased properties). Over 120 towns now have laws in place, and at least 100 other towns have petition drives and citizen groups organizing to get laws passed. Lawsuits by gas companies and pro-frack residents against the towns of Dryden and Middlefield resulted in a lower court decision for town rights to exclude unwanted land uses via such actions; appeals may be pending.

The good news about fracking in New York State is that a massive political movement of active civic engagement is underway. New Yorkers have emerged from both privileged enclaves and impoverished situations to say "Don't Frack With NY" (www.dontfrackwithny.com), organizing to protect communities, water resources and the future from corporate invasion and exploitation. Over 3,000 New Yorkers have already signed a pledge to actively resist, if and when the trucks and rigs cross that southern border from Pennsylvania. Stay tuned!

CASE STUDY

Delaware River Watershed

Community Organizing for Human and Environmental Health

by Tracy Carluccio

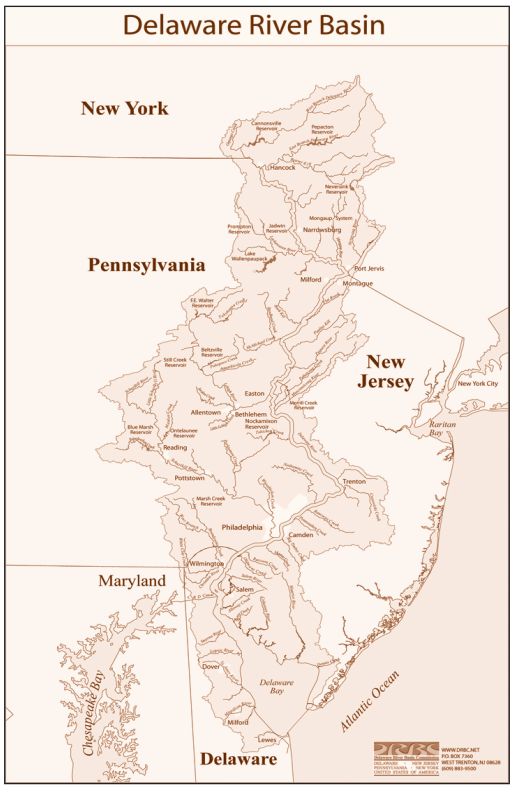
Delaware Riverkeeper Network

www.delawareriverkeeper.org

Some of the largest and most powerful interests in the world are behind the shale gas juggernaut. Exxon, Shell, Halliburton—huge corporations that are investing in shale gas development, driving forward natural gas as an energy source and an economic imperative. And then there are the politicians and government officials that are representing these interests. The story may begin here, but it doesn't end here. The story still being written is one about people standing up for their communities and the environment they depend on, insisting that decision makers listen to the public and work to fulfill their responsibilities faithfully.

The Moratorium

In the Delaware River Watershed, a remarkable broad-based effort has resulted in a gas drilling moratorium that has kept drilling and fracking at bay. The Delaware River Watershed contains portions of New York, Pennsylvania, New Jersey and Delaware and supplies water to 17 million people, 9 million of them outside of the watershed in New York City. The 13,000 square mile basin is overseen by the Delaware River Basin Commission (DRBC), who is responsible for managing its water resources. The DRBC, formed in 1961, has a body of regulation that trumps State regulations when stricter. In response to a Petition filed in 1990 by the Delaware Riverkeeper Network, the DRBC established a Special Protection Waters program that adds a layer of protection to the water quality of the river, a federally designated Wild and Scenic River. The entire nontidal portion of the Delaware is designated as Special Protection Waters, the longest anti-degradation stretch of river in the nation. This is the basis of the gas drilling moratorium.



Credit: Delaware River Basin Commission

Map of the Delaware River Basin

Concern about the practices used to extract gas—hydraulic fracturing ("fracking") and horizontal drilling—and the large footprint of this industrial activity on the Watershed began to grow in 2008, when the first "landmen" began knocking on doors and the first wells were being drilled in the Marcellus Shale in the western part of Pennsylvania and West Virginia. Public worry grew as the number of wells escalated and big out-of-state drilling companies arrived.

Over the next two years in western Pennsylvania, streams were being tapped for fracking fluid (with some going dry), truck traffic proliferated, industrial fields of wells emerged and wastewater was dumped into streams, clogging rivers with Total Dissolved Solids. This led to drinking water advisories affecting hundreds of thousands of people in the Pittsburgh region. Communities bearing the brunt began speaking up and those who were in the crosshairs became alarmed.

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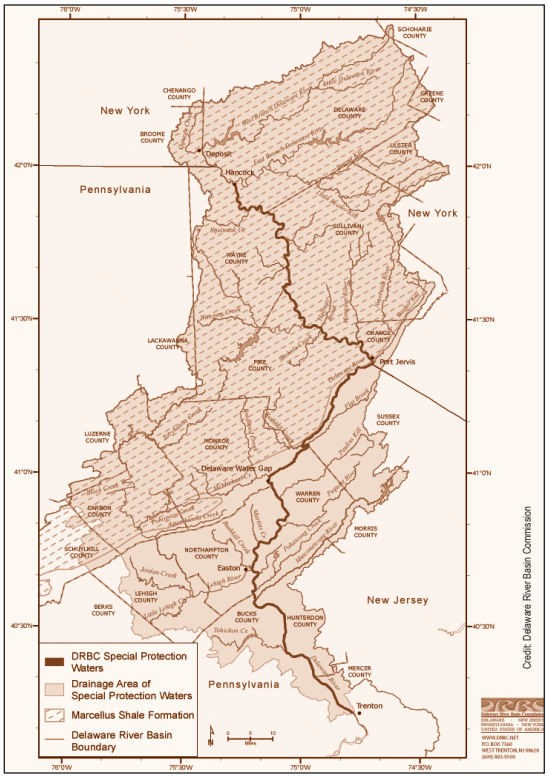
The Public Educational Campaign

Delaware Riverkeeper Network and other organizations called for a comprehensive environmental analysis of the possible impacts on the Delaware River and asked the question "is this industrial activity compatible with a drinking water supply watershed?" Every meeting of the DRBC during this time was attended by groups from throughout the watershed asking questions, advocating for scientific analysis and urging that drilling not be allowed to start. A public education campaign, with informational meetings and media outreach was mounted by concerned organizations and communities.



Marcellus Shale Distribution

In May 2010, the DRBC unanimously voted to prohibit drilling until they developed gas drilling-specific regulations, based on a finding that gas extraction had the potential for substantial adverse impacts to the Delaware's water resources. Since there had never been any natural gas development prior to the interest shown in the Marcellus Shale, which underlays about 1/3 of the Basin, they needed to adopt rules governing these activities.

"Gasland" was released in 2010, and in June, Delaware Riverkeeper Network, Damascus Citizens for Sustainability and Josh Fox hosted the theater premier of the award-winning documentary film. Using this exposé of the terrible impacts of gas development as a vehicle for educating and activating communities, the film has been shown hundreds of times in the region and the results have been electrifying. Probably more than any other medium, "Gasland" and the discussion panels that accompany it in libraries, community centers and churches has motivated people to get involved to influence decision makers.

The awareness of the issue grew exponentially when social media and mainstream news outlets started picking up stories of problems occurring in drilling regions—especially West Virginia, Pennsylvania and Ohio. Even though these problems existed for years in other parts of the nation, it wasn't until the more populated and politically powerful regions began to be affected that the issue seemed to really pick up steam. We here in the Delaware River Watershed fully exploited this interest. More environmental and conservation organizations became involved and grassroots groups began springing up in opposition. This all mattered in the year to come.

The Regulations

When the DRBC issued draft natural gas development regulations in December 2010, there was a storm of protest from thousands who had been advocating that an environmental analysis with a cumulative impact study be done first. But the voting members of the DRBC—the Governors of the four watershed states and a representative of the federal government, the Army Corps of Engineers - plowed ahead, some of them making statements that favored the industry.

By the time the public comment period closed in April 2011, 69,800 comments (a record-breaking number) were submitted, many of them opposed to the draft rules as premature and not protective enough to prevent pollution and degradation. This remarkable participation came from many different constituencies, elected officials, businesses and some government agencies. Dozens of organizations pulled together to inform people, spurring them to go on the record in writing, at hearings and rallies.

Unfortunately, the DRBC ignored this public concern. Lawsuits were filed and efforts redoubled at the grass roots level to stop the DRBC from moving ahead with the flawed draft regulations.

In November 2011, the DRBC issued revised regulations and announced a special meeting to consider approving the rules and lifting the moratorium. Stinging criticism erupted; public demonstrations were announced for the meeting and people mobilized. Then something truly extraordinary happened. Just 72 hours before the meeting, DRBC cancelled.

The Vote

Delaware Governor Jack Markell announced that he would vote against the regulations because they were not protective enough and needed more scientific review. The State of New York had already announced it would vote against the regulations while it was preparing its own environmental study on fracking in New York. Apparently, no other member of the DRBC wanted to be the "swing vote".

The stalemate remains in place, as does the moratorium. But this is all tentative and could change at any moment, requiring continued advocacy, outreach and community organization. If anything,

Credit: Paul A. Carluccio

Delaware River

awareness has grown and a true movement against natural gas and all fossil fuels, in support of clean and sustainable energy sources, has emerged regionally and nationally.

Today, as drilling and fracking speeds ahead right next to the Delaware River Watershed in Pennsylvania and the nation's other shale regions, communities are suffering the human health, environmental and community impacts that accompany shale gas extraction. Coalitions have formed and grassroot and grass top groups have emerged, forged by the battles we are fighting as gas infrastructure such as pipelines, compressor stations, ethane crackers, processing plants and Liquified Natural Gas Facilties spread out across every corner of the country, whether or not they have gas wells.

So the story is nowhere near complete. With the future of our water, air, and communities at stake, this has shaped up to be epic and transformative in every way, and its ending will define our future.

Voices From the Field

Fracking is a growing practice across the country and numerous watershed organizations are facing the challenges it presents. We asked our Partners working on the issue to share their best advice; here is what they said:

Friends of the Cheat has had to learn a lot very quickly about unconventional natural gas extraction and production. Last year one of our most precious sub-watersheds was threatened by a proposed oil field waste landfill. Absolutely no environmental logic to the siting at all. Currently, West Virginia is accepting this waste at Class A municipal facilities as "special waste", and in some instances, still allowing companies to bury waste pits on site.

Our Advice: Develop an objective education and volunteer engagement initiative with a clear methodology and focus. Collect data on water quality (conductivity) and quantity (velocity headrod or other gaging method), note changes in sedimentation, air quality if applicable (bucket brigade method), photos, continuous data loggers, other applicable areas that might be impacted. Use the data you gather to inform citizens and land-owners at meetings or symposia on issues related to fracking, and look for interested volunteers at these events. Be careful to stress the objectivity of your efforts and those of your "citizen scientists, otherwise, you may just fuel opposition arguments that say environmentalists are waging a "War on Coal/Jobs/Gas/etc." Maintain credibility and let the science speak for itself, looking at short term changes and long-term trends captured over all seasons and different types of weather.

West Virginia's Department of Environmental Protection offers an e-mail alert for permits too, which helps with general notifications (proposed permit received, permit awarded, etc.), but you still have to dig deeper on their site to find details (reclamation plan approved, well casing approved, fracking commenced, etc.). Other production needs such as transmission pipelines, gathering lines, compressor stations, etc. have additional permitting requirements and regulations from other agencies in our state. Learning who regulates what is half the battle. One friendly reminder: do not assume that all pipelines are regulated by the Federal Energy Regulatory Commission. We have seen a gathering line here built to FERC standards, with the intention of going as far as possible without involving FERC until they need a ruling on imminent domain.

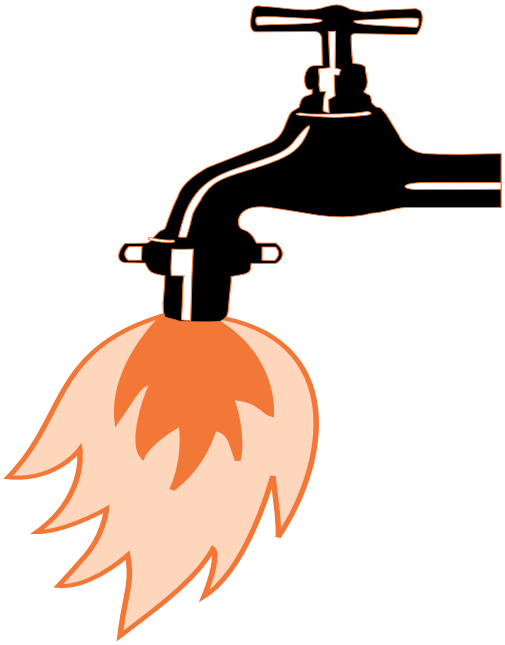
Friends of the Cheat (WV)

www.cheat.org

We have a geologist who used to work for industry helping us figure out what to do in Tennessee. While other policy groups were spending eons looking at other states and attempting to cut and paste their regulations into our regulations, he could tell us immediately what was possible given our geologic constraints. This connection saved TCWN hours and hours of time pouring over other state's regulations and trying to decide what to include. In the end we settled on just getting the state up to API standards. Sad, I know.

Tennessee Clean Water Network (TN)

www.tcwn.org



Clean Water Action is working on hydraulic fracturing on the local, state and federal levels. Several of our state offices have been working for several years with impacted communities, particularly in Pennsylvania where the rush to drill in the Marcellus Shale has been fast and furious. We are engaging in state policy debate in a number of states as well. Because of our history and expertise, and the obvious impacts of this technology on water resources, our focus includes water issues. For example, in Pennsylvania, several years ago we began mobilizing state-wide water pollution and watershed organizations around the growing threats from hydraulic fracturing and identified the problems with surface water disposal of wastewater in the state as the early wells came online. On the federal level, we are working with other national organizations to make sure that all applicable federal authority is being exercised and exercised strongly and we are playing a lead role in questions of drinking water policy. For example, in May the U.S. Environmental Protection Agency published draft Safe Drinking Water Act Underground Injection Control Program permitting Guidance for hydraulic fracturing operations using diesel. Hydraulic fracturing is exempt from the Safe Drinking Water Act except when diesel is used, so this is a necessary and important step in using our federal water protection laws to address the risks of hydraulic fracturing. Clean Water Action is working to mobilize our members, other NGOs, elected officials and others around EPA's comment period and is also working on technical comments with several other organizations.

We have a lot of advice! In a recent blog post, *Putting Drinking Water First: It's Not Just a Talking Point*," I argued that if we start putting drinking water protection first when we look at our activities and the pollution and other problems they cause, we would start making more sustainable choices about how we get our energy, how we grow our food, how we build our communities and how we make the products we use. We all talk about how important drinking water is but in the end we let things threaten it and hope we can fix that in the treatment plant. That's what we will keep pushing for—implementing the laws and policies we do have, strengthening them and getting new ones if we have to—to make sure that the rush to drill does not cause problems we can't fix later.

Water resource threats aren't the only problem with "fracking;" we have to think about climate change, air pollution, health, impact on community quality of life, economic issues and our overall energy policy. "Follow the water" is an important part of the puzzle.

Clean Water Action (DC)

www.cleanwateraction.org

Voices From the Field

We don't have the shale formations under our watershed to worry too much about drilling – but we are concerned waste disposal wells into our aquifer. The Ohio Department of Natural Resources has opened up our State's waste disposal rules (by Executive order) to address seismic activity concerns. Because Ohio's rules do not mention protection of water resources, we have decided to ask for a ban on the construction of wells on or near hydrogeologically-sensitive areas including federally-designated Sole Source Aquifers. If the language is not include in the rules revision, we intend to work with legislators on a bill that will do the same. Many communities around here have also testified with the same request.

The Miami Conservancy District (OH)

www.miamiconservancy.org

Get coordinated at the statewide level. Within your state, try to bring all of the organizations working on the issue at the table together and reach some common ground so that your efforts do not look divided and so you can speak from the same talking points. This will also assist with funding and to prevent duplication of efforts.

Ohio Environmental Council (OH)

www.theoec.org

Western Organization of Resource Councils' (WORC) central piece of advice would be, "By all means call it fracking, but remember that there are a lot more problems with oil and gas development than just the process of injecting fracking fluids into a hole."

Take a look at WORC's position statement, Cleaning up the Oil and Gas Industry, for ideas about the kinds of measures that should be required—but aren't, with few exceptions—of oil and gas companies drilling, fracking and developing oil and gas resources. You can view a brief or full version at: www.worc.org/oil-gas-coalbed-methane.

Western Organization of Resource Councils (MT)

www.worc.org

The most important thing is to describe individuals/families who have suffered loss in the form of being unable to live on their property, perhaps for good, and have had financial ruin as well as health problems. The thing we are not getting in the news media from either side is a quantification of how much damage is being caused to how many people and what percentage. It should not be a shock to anyone to realize that if there are 10 people affected nationwide who need to be reimbursed for their loss, that the argument against fracking is much weaker than if there are 10,000 people undergoing this kind of trauma. All we have now is the old game of name calling from both sides with little in the way of facts, including, of course, the contents of the chemical solution being used in fracking.

Nepessing Group of Michigan (MI)

michigan.sierraclub.org/nepessing

Credit: Trip Jennings/Lighthawk

The proposed LNG pipeline would cross the Rogue River near important spawning grounds for chinook salmon.

Connecting Community Struggles Strengthens Everyone

Many communities in the United States have been threatened in recent years by an increase in natural gas fracking. While southwest Oregon and our streams are not directly threatened by fracking, we are threatened by the other side of the same coin: exporting that fracked gas from the Oregon coast. Energy companies aim to get even richer by exporting cheap American natural gas to countries willing to pay much more than we currently do. While different companies may be behind sourcing the gas and export proposals, exporting natural gas would incentivize increased fracking and make gas companies rich at the expense of many.

Rogue Riverkeeper has been working for nearly 7 years to stop the Jordan Cove and Pacific Connector LNG project in southern Oregon that would build the infrastructure needed on the continental west coast to ship U.S. natural gas to other countries, and in doing so, harm our rivers, salmon, communities, and U.S. gas rates, among other things including the threat of eminent domain for hundreds of property owners. This effort has brought together varied interests—salmon and property rights advocates for example—that has diversified and strengthened our campaign.

Similarly, to build and strengthen a national movement for a better energy future, we need communities working to stop LNG export woven together with communities working to protect themselves and the environment from the impacts of fracking. While it can sometimes feel like we are in isolated struggles to protect our watersheds and communities from the threats they face, we are connected not only in our passion for clean water, but in this case, by the industry itself. Because corporations want to isolate and marginalize us, it is all the more important that we connect the dots and stand together.

Rogue Riverkeeper (OR)

rogueriverkeeper.org

Resources and References

A small glimpse at some of the ever-growing fracking resources available online.

ARTICLES, REPORTS & RESOURCES

The Fracking Resource Guide provides a collection of bibliographic resources, government documents, letters and videos. http://frack.mixplex.com

The official website of Gasland, includes a list of organizations fighting the natural gas industry from destroying our neighborhoods, our water and our health. **www.gaslandthemovie.com/take-action/organizations-fighting-fracking**

The Huffington Post has a collection of news article and videos related to fracking. **www.huffingtonpost.com/news/fracking**

Natural Gas Flowback: the Dark Side of the Boom (2011) is an investigative report that seeks to determine if Texas adequately protecting its citizens and its resources. The report includes compiled and collected data on the serious health effects of gas drilling, hydraulic fracturing (e.g., fracking) and production on Texans throughout the Barnett Shale; water contamination and depletion; air pollution and other impacts. **www.earthworksaction.org/library/detail/natural_gas_flowback**

Propublica, Journalism in the Public Interest, has an investigative series on fracking. **www.propublica.org/series/fracking**

ORGANIZATIONS AND SUPPORT

Earthworks is a nonprofit organization dedicated to protecting communities and the environment from the impacts of irresponsible mineral and energy development while seeking sustainable solutions. Earthworks stands for clean water, healthy communities and corporate accountability. Earthworks website includes a great primer on fracking: *Hydraulic Fracturing 101*. **www.earthworksaction.org/issues/detail/hydraulic_fracturing_101**

The Endocrine Disruption Exchange (TEDX) is the only organization that focuses primarily on the human health and environmental problems caused by low-dose and/or ambient exposure to chemicals that interfere with development and function, called endocrine disruptors. Dr. Theo Colborn has delivered her talk What You Need to Know About Natural Gas Production many times across the country She calls for full public disclosure of all chemicals used during drilling and fracturing and raises the issues of ground-level ozone and air pollution that have been almost completely ignored. TEDX has produced a video of this lecture, complete with photos and data slides to illustrate the fact that natural gas is not the 'clean energy' that industry is touting it to be. View it online or order a free copy. **www.endocrinedisruption.com/chemicals.video.php**

Food & Water Watch works to ensure the food, water and fish we consume is safe, accessible and sustainably produced. Their website has a variety of downloadable tools to help you fight against fracking, including:

- A guide on How to Get Your Resolution Passed to Ban Fracking
- Informational flyers on fracking
- Postcards to send to elected officials
- A sample town/city resolution to ban fracking
- "Ban Fracking Now" stickers
- Dozens of helpful reports and Fact Sheets

Visit **www.foodandwaterwatch.org/water/fracking/fracking-action-center** and click on "Activist Tools" in the left navigation bar.

FracFocus is the national hydraulic fracturing chemical disclosure registry. FracFocus is managed by the Ground Water Protection Council and Interstate Oil and Gas Compact Commission, two organizations whose missions both revolve around conservation and environmental protection. The site was created to provide the public access to reported chemicals used for hydraulic fracturing within their area. http://fracfocus.org

The Fracking Regulatory Action Center is a resource for activists to help secure strong safeguards for fracking. It tracks state efforts to update their rules to stay ahead of the fracking boom, and to blunt its most dangerous effects. It also collects a growing library of technical comments and reports on these rules, which activists can use in their own work. The library includes comments, and rules, addressing casing and cementing for wells, standards for drilling pit construction, air permitting rules, wastewater discharge and water quality rules, and disclosure requirements, along with notes on federal efforts to address some of these issues. **www.sierraclub.org/naturalgas/rulemaking/**

FracTracker is dedicated to providing a common portal for understanding issues and impacts related to the global shale gas industry through the sharing of data, images, video, and relevant stories, and by facilitating the creation of maps, graphs and charts that deepen that understanding. **www.fractracker.org**

The Tomkins County Council of Governments' Task Force on Gas Drilling seeks to network municipalities within Tompkins County, New York to manage the large amount of information surrounding drilling for natural gas in the Marcellus and Utica shales using the technique called hydraulic fracturing. The Task Force will explore avenues for municipalities to exert local control over gas drilling activities that affect the health, safety and well-being of their residents and resources. **www.tompkins-co.org/tccog/Gas_Drilling/Index_GasDrilling.html**

U.S. EPA had numerous hydraulic fracturing resources, fact sheets and press releases available online, including: Providing regulatory clarity and protections against known risks; Improving our scientific understanding of hydraulic fracturing and Promoting transparency and conducting outreach. **www.epa.gov/hydraulicfracture**

River Network Partnership

A Co-op of River & Watershed Organizations

www.rivernetwork.org/programs/partnership-program

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- Sell Products through our Marketplace

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- Global Water Monitoring Equipment
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- Orion Magazine
- ProMotive.com
- Watergrass Database Design
- Wish Lists

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- *eStream*
- One-on-One Assistance
- Publications
- Resource Library
- River Rally Conference

Build Community

- Quarterly Webinars
- Listserv
- River Network Partner Logo
- Share Success Stories

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Partnership Benefit Highlight

WATERSHED WEDNESDAYS

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We focus on one Partner group's activity, success, milestone event or just plain cool idea and promote it the best that we can nationally. We tweet about it, blog on it, feature it on our website and do whatever other social network bragging that we can about your excellent work.

Send us yours using this page: **www.rivernetwork.org/forms/watershed-wednesdays**

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Nonprofit Organizations & Local, State & Tribal Government Partners	
Annual Budget	*Annual Partner Dues*
<$25,000	*$150*
$25,000 - $100,000	*$200*
$100,001 - $250,000	*$275*
$250,001 - $500,000	*$375*
$500,001 - $1,000,000	*$500*
$1,000,001 - $2,000,000	*$675*
>$2,000,000	*$900*
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>$1,000,000	*$1,000*

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