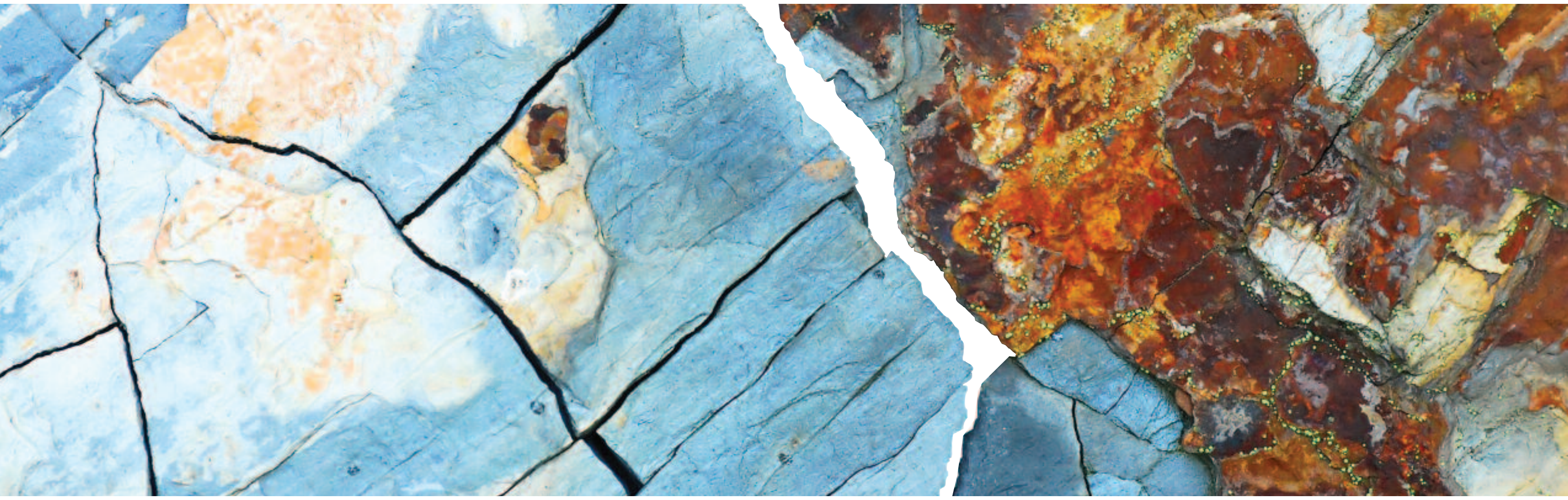
Freeing Up Energy



Hydraulic Fracturing:
Unlocking America's Natural Gas Resources

July 19, 2010

Technological innovation is opening the door to abundant new natural gas resources.

Hydraulic fracturing helps free up more energy.

Clean burning natural gas is critical to American manufacturing jobs, to farmers for fertilizer, to households for heating and cooking, to businesses for electricity and fuel for transportation needs, and to society to help address climate change concerns because of its low carbon-content.

But getting to the natural gas isn't always easy. That's where hydraulic fracturing plays an important role in America's energy supply.

Photo © 2009 Metropolitan Transportation Authority

Hydraulic fracturing is a proven technology used safely for more than 60 years in more than a million wells. It uses water pressure to create fissures in deep underground shale formations that allow oil and natural gas to flow.

First used in the U.S. in 1947, the technology has been continuously improved upon since that time.

Recent innovations combining this technology with horizontal drilling in shale formations has unlocked vast new supplies of natural gas, allowing the nation to get to the energy it needs today, and transforming our energy future.

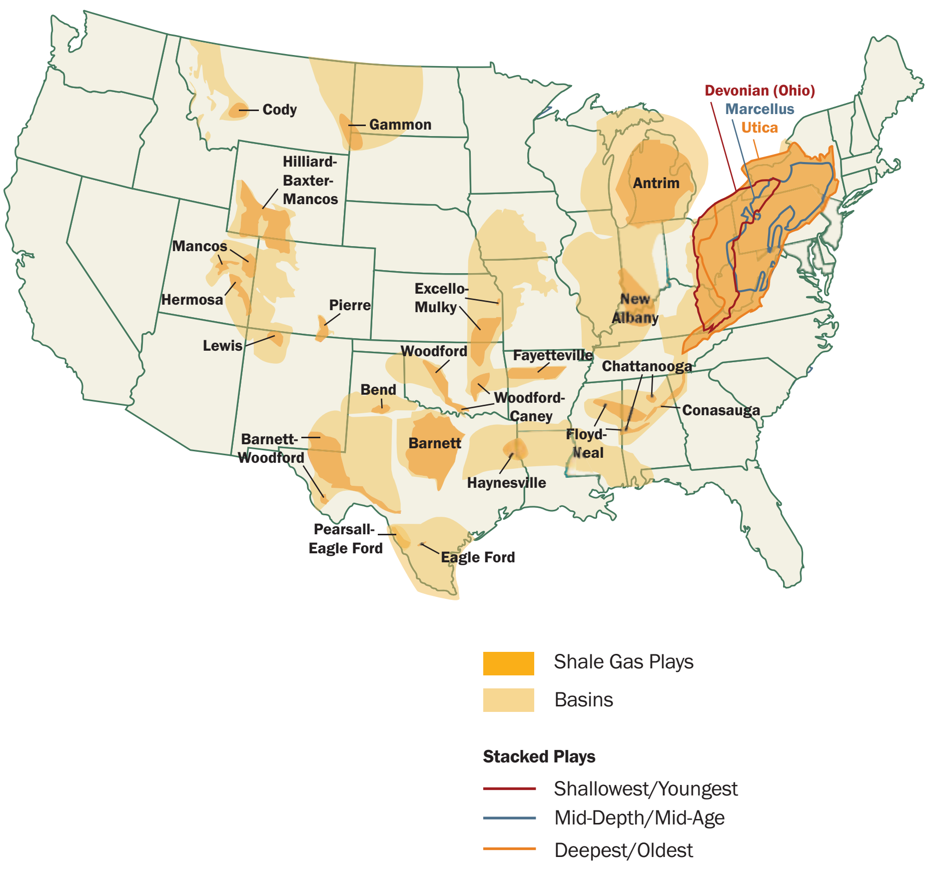
Hydraulic fracturing is so important that without it, we would lose 45 percent of domestic natural gas production and 17 percent of our oil production within five years.[1]

1 Global Insight, "Measuring the Economic and Energy Impacts of Proposals to Regulate Hydraulic Fracturing," 2009.

Unlocking shale gas now guarantees the U.S. more than a 100-year supply of clean-burning natural gas.

Having a new abundance of natural gas is changing the vision of our energy future.

Shale Gas Plays, Lower 48 States



Source: Energy Information Administration based on data from various published studies. Updated: May 28, 2009.

Although we've known for many years that natural gas was trapped in hard dense deposits of shale formed from ancient sea basins millions of years ago, we did not have the technology to access these resources economically until recently. As a result, previously uneconomic natural gas resources are now available for exploration and development.

In the last five years, natural gas reserves grew 30 percent and in the last few years alone we have increased onshore natural gas production by more than 20 percent – an accomplishment that most energy experts thought impossible a few years ago.

Shale gas "plays" are found throughout the Mountain West, the South and throughout the Northeast's Appalachian Basin. These plays are geographic areas where companies are actively looking for natural gas in shale rock. The Barnett core in Texas, for example, is 5,000 square miles and provides 6 percent of U.S. natural gas. The Marcellus fairway that blankets Pennsylvania, New York, Ohio and West Virginia covers ten times the square miles of the Barnett, but has only recently started to be developed.

The ability to access these resources has been called "the biggest energy innovation in a decade."

Daniel Yergin and Robert Ineson, The Wall Street Journal, November 2, 2009

Natural gas helps create new jobs and higher incomes and transforms how we use energy.

Having abundant, clean-burning, domestic, reliable supplies of natural gas means more affordable and more stable prices. It means that once net natural gas importers, like New York and Pennsylvania, could instead become natural gas exporters. It means energy-intensive manufacturing companies, which had been moving overseas for cheaper energy, can stay home. It means more jobs and higher incomes and a better energy future for all Americans.

According to economists and industry experts at Penn State,[2] for example, the development of the Marcellus Shale has the potential to be the second largest natural gas field in the world. A recent study estimates that in 2009, the development of this resource added over 44,000 new jobs in Pennsylvania, $389 million in state and local tax revenue, over $1 billion in federal tax revenue, and nearly $4 billion in value-added to the state's economy. Similarly, in West Virginia it created over 13,000 new jobs, and contributed over $220 million in federal, state, and local tax revenue and $939 million in value added to the state's economy.[3]

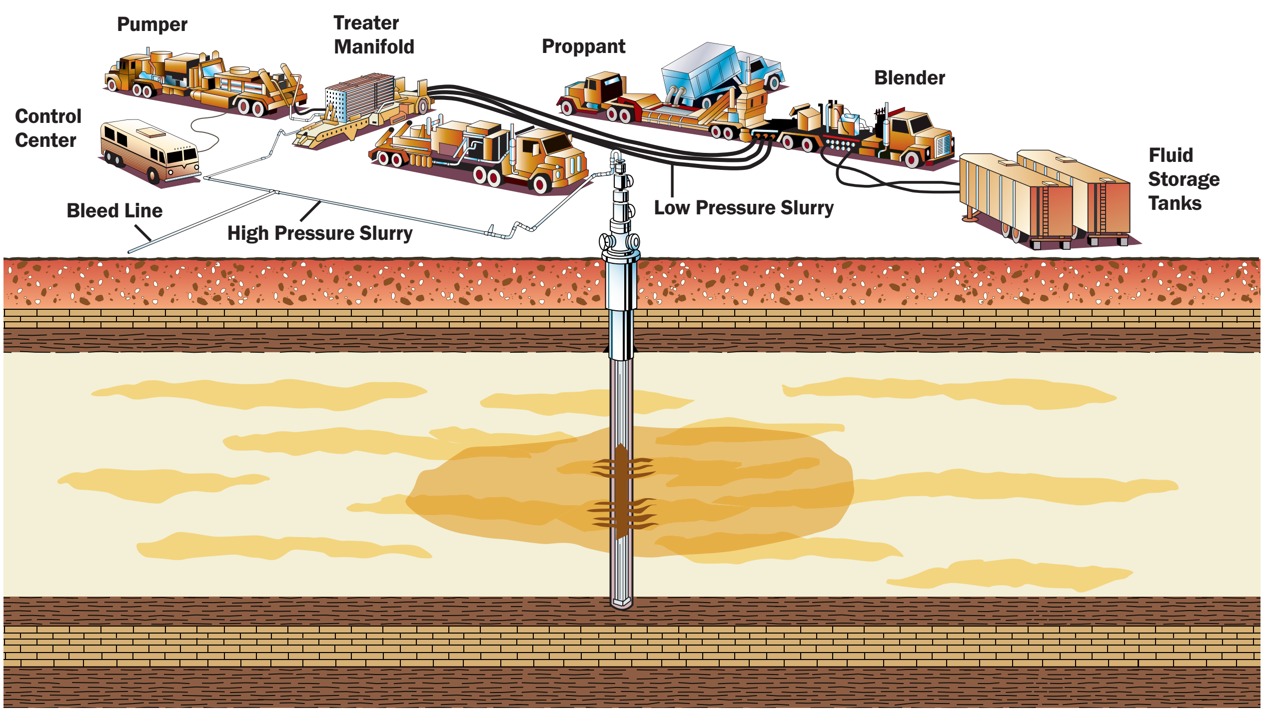
According to the study, over the next decade, the development of Marcellus shale could generate nearly 300,000 new jobs, over $6 billion in federal, state, and local tax revenue and nearly $25 billion in value added to the economy by 2020.

2 Timothy J. Considine, Robert Watson, Seth Blumsack, "The Economic Impacts of the Pennsylvania Marcellus Shale Natural Gas Play: An Update," Pennsylvania State University, May 24, 2010.

3 Timothy J. Considine, "The Economic Impacts of the Marcellus Shale: Implications for New York, Pennsylvania, and West Virginia," Natural Resources Economics, Inc., July 14, 2010.

Hydraulic fracturing is a proven technology used for more than 60 years in more than a million wells.

Exactly what is hydraulic fracturing?



Source: U.S. Department of Energy.

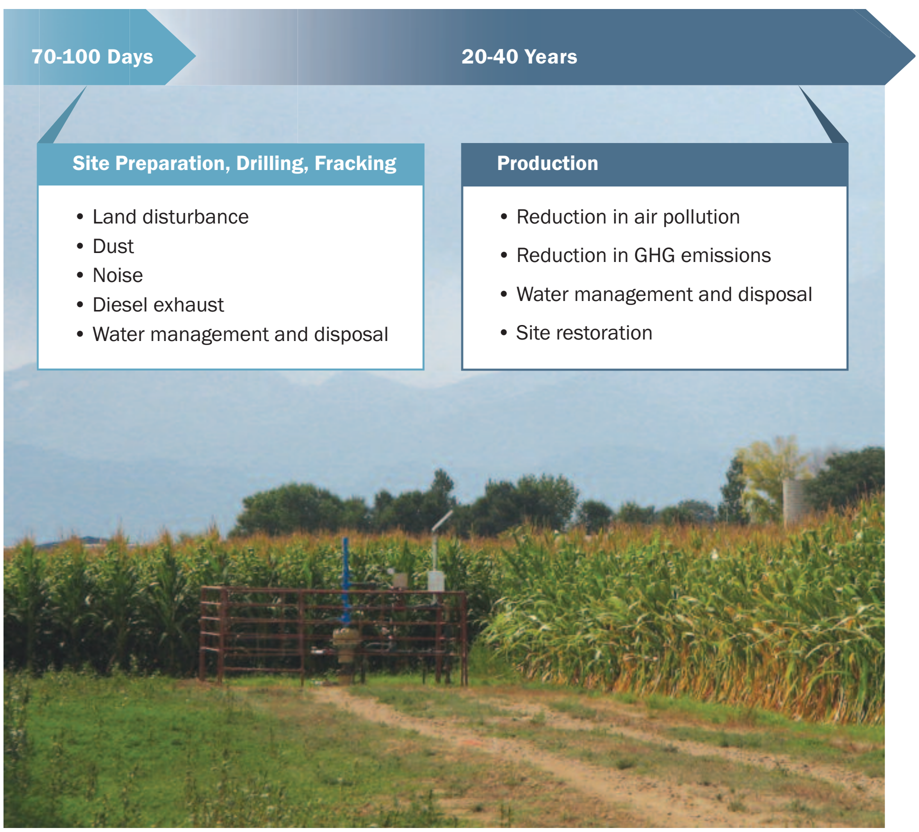
Hydraulic fracturing is a technology that was developed in the 1940s and has since helped produce more than 600 trillion cubic feet of natural gas and 7 billion barrels of oil. The technique is used to create spaces in the rock pores deep underground to release oil and natural gas so it can be brought to the surface.

In a hydraulic fracturing job, “fracturing fluids” or “pumping fluids” consisting primarily of water and sand are injected under high pressure into the producing formation, creating fissures that allow resources to move freely from rock pores where it is trapped.

The benefits of a shale gas well can last for decades.

What is involved in completing a well for production?

Timeline and Impacts for Shale Gas Development and Production – Single Well



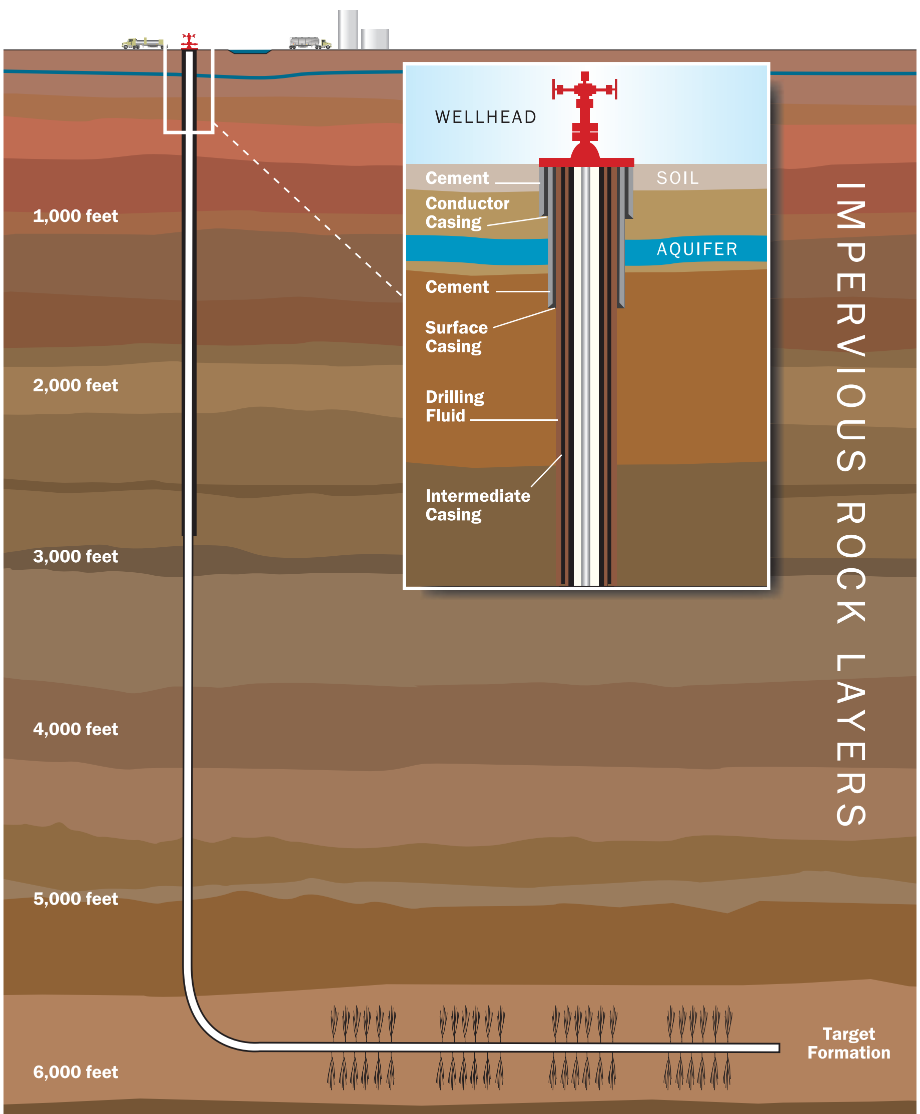
Source: IHS/CERA. Photo by Richard Ranger.

The process of bringing a well to completion is generally short-lived, taking a few months for a single well, after which the well can be in production for 20 to 40 years. The process for a single horizontal well typically includes four to eight weeks to prepare the site for drilling, four or five weeks of rig work, including casing and cementing and moving all associated auxiliary equipment off the well site before fracturing operations commence, and two to five days for the entire multi-stage fracturing operation.

Local impacts, such as noise, dust, and land disturbance, are largely confined to this initial phase of development. Once completed, the production site is reduced to about the size of a two-car garage. The remainder of the site is restored to its original condition and the environmental benefits, such as reduced air and greenhouse gas emissions, last for decades.

There are zero confirmed cases of groundwater contamination connected to the fracturing operation in one million wells hydraulically fractured over the last 60 years.

Proper well construction provides groundwater protection.



Example of hydraulic fracturing for shale development

Typically, steel pipe known as surface casing is cemented into place at the uppermost portion of a well for the explicit purpose of protecting the groundwater. The depth of the surface casing is generally determined based on groundwater protection, among other factors. As the well is drilled deeper, additional casing is installed to isolate the formation(s) from which oil or natural gas is to be produced, which further protects groundwater from the producing formations in the well.

Casing and cementing are critical parts of the well construction that not only protect any water zones but are also important to successful oil or natural gas production from hydrocarbon bearing zones.

Industry well design practices protect sources of drinking water from the other geologic zone of an oil and natural gas well with multiple layers of impervious rock.[4]

4 Industry has developed equipment-specific and operating practices for use in drilling and production activities. Examples include: API 5 Series Publications: Tubular Goods; API 7 Series Publications: Drilling Equipment; API 10 Series Publications: Oil Well Cements; API 11 Series Publications: Production Equipment; API 13 Series Publications: Drilling Fluid Material.

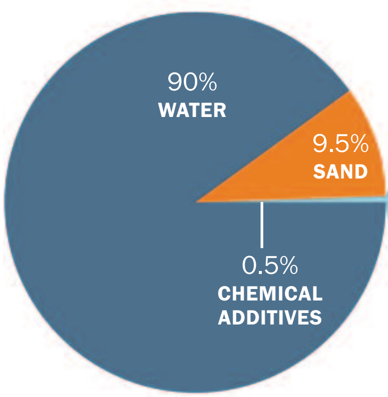
The fracturing mixture consists primarily of fresh water mixed with some sand and a small proportion of common chemicals.

What are the fracturing fluids used in hydraulic fracturing?

Water accounts for about 90 percent of the fracturing mixture and sand accounts for about 9.5 percent.

Chemicals account for the remaining one half of one percent of the mixture.

Typical Shale Fracturing Mixture Makeup



Typical Chemical Additives Used in Frac Water

Compound	Purpose	Common application
Acids	Helps dissolve minerals and initiate fissure in rock (pre-fracture)	Swimming pool cleaner
Sodium Chloride	Allows a delayed breakdown of the gel polymer chains	Table salt
Polyacrylamide	Minimizes the friction between fluid and pipe	Water treatment, soil conditioner
Ethylene Glycol	Prevents scale deposits in the pipe	Automotive anti-freeze, deicing agent, household cleaners
Borate Salts	Maintains fluid viscosity as temperature increases	Laundry detergent, hand soap, cosmetics
Sodium/Potassium Carbonate	Maintains effectiveness of other components, such as crosslinkers	Washing soda, detergent, soap, water softener, glass, ceramics
Glutaraldehyde	Eliminates bacteria in the water	Disinfectant, sterilization of medical and dental equipment
Guar Gum	Thickens the water to suspend the sand	Thickener in cosmetics, baked goods, ice cream, toothpaste, sauces
Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice
Isopropanol	Used to increase the viscosity of the fracture fluid	Glass cleaner, antiperspirant, hair coloring

Source: DOE, GWPC: Modern Gas Shale Development in the United States: A Primer (2009).

Fracturing fluid management is key to protecting the environment.

What happens to the fracturing fluids used in hydraulic fracturing?

There are several ways oil and natural gas companies manage the use of fracturing fluids, depending on what specifically is in them, the presence of usable groundwater or surface waters, geography, and local, state, and federal regulations.

Spent or used fracturing fluids are normally recovered at the initial stage of well production and recycled in a closed system for future use or disposed of under regulation, either by surface discharge where authorized under the Clean Water Act or by injection into Class II wells as authorized under the Safe Drinking Water Act. Regulation may also allow recovered fracturing fluids to be disposed of at appropriate commercial facilities.

Not all fracturing fluid returns to the surface. Over the life of the well, some is left behind and confined by thousands of feet of rock layers.

Existing regulations covering well design requirements and hydraulic fracturing operations are specifically formulated to protect groundwater.

Protective measures are in place.

A comprehensive set of federal, state, and local laws addresses every aspect of exploration and production operations. These include well design, location, spacing, operation, water and waste management and disposal, air emissions, wildlife protection, surface impacts, and health and safety.

In addition to government oversight, new industry standards advance operations and practices. The industry has created a number of guidance documents and other initiatives relating to hydraulic fracturing, including recommended practices for environmental protection for onshore oil and natural gas production and leases, well construction and well integrity, water use management, and surface environmental considerations.[5]

New industry standards are continuously evaluated to advance sound operations and practices.

5 For free downloads of the API guidance documents, go to www.api.org/standards/epstandards/index.cfm.

Photovoltaic solar panels transmitting well data

Photo by Richard Ranger.

State regulations of hydraulic fracturing began more than 50 years ago. These regulations created a control system that has protected groundwater and drinking water sources.

Studies demonstrate the effectiveness of current regulations.

Studies by the Ground Water Protection Council (GWPC),[6] an association of state regulators, and the Environmental Protection Agency (EPA)[7] have clearly demonstrated the effectiveness of current state regulations in protecting water resources.

When the GWPC studied the environmental risk of hydraulic fracturing, they found one complaint in the more than 10,000 coalbed methane wells reviewed – an Alabama well where problems were not related to fracturing according to the EPA.

The EPA initiated its own study of coalbed methane hydraulic fracturing environmental risks and released its completed study in June 2004. Again, no significant environmental risks as a result of proper hydraulic fracturing were identified.

In short, no instance of groundwater contamination from hydraulic fracturing was identified in either of these thorough studies.

6 Ground Water Protection Council, "State Oil and Gas Regulations Designed to Protect Water Resources," May 27, 2009.

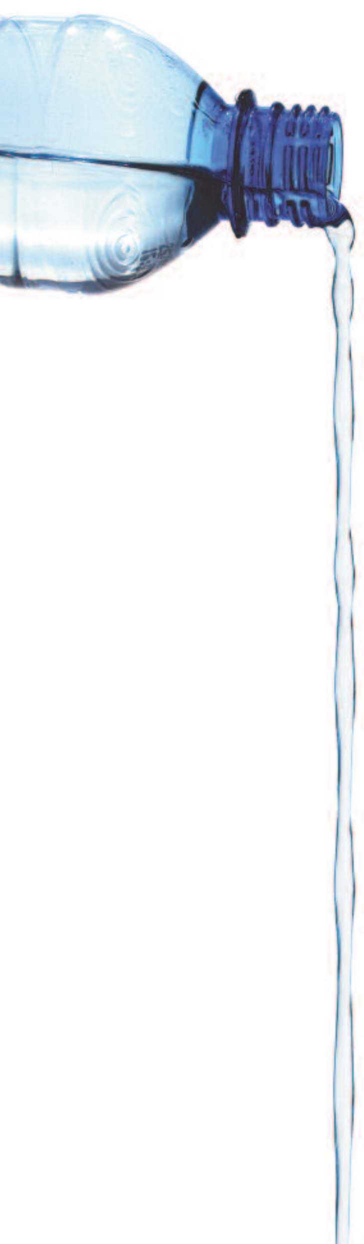
7 Environmental Protection Agency, "Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs; National Study Final Report," PEA 816-F-04-17, June 2004.

Example of a completed well

Photo by Richard Ranger.

Congress enacted the Safe Drinking Water Act (SDWA) in 1974, years after state regulation of hydraulic fracturing was implemented.

Taking a look at the history of the SDWA helps clarify the issue.



By the time Congress enacted the SDWA, hydraulic fracturing had been used for 27 years with no environmental problems. Under the SDWA, states developed extensive underground injection control (UIC) programs to manage liquid wastes and the reinjection of produced waters. These programs addressed liquids intended to be periodically injected, continuously injected, and those intended to remain in underground geologic formations.

By 1980, Congress – recognizing the fact that many state-administered injection programs were in place and well established, creating a need for further state flexibility – modified the SDWA to give states the option of gaining federal "primacy" for existing injection programs based on the demonstrated effectiveness of state oil and natural gas UIC programs.

At no time during these debates was there any suggestion that hydraulic fracturing was considered covered under the UIC waste management requirements. Regardless, litigation in the 1990s and subsequent rulings left the federal statutory and regulatory arenas unsettled with regard to hydraulic fracturing.

The U.S. can count on hydraulic fracturing to unlock the natural gas and oil resources our nation needs to meet our growing energy requirements in an environmentally responsible manner.

Taking a look at the history of the SDWA continues.

Recognizing the need to provide legislative clarity, Congress addressed the issue of hydraulic fracturing under the SDWA in the Energy Policy Act of 2005 (EPAct) by preserving the state regulatory system that has worked so effectively for the past half century.

EPAct clarified that the SDWA was not the appropriate law for regulating hydraulic fracturing with one exception. During the previous referenced analysis of environmental risk from hydraulic fracturing, EPA hypothesized that the use of diesel fuel as a solvent in the fracturing process of coalbeds might pose a risk.[8]

While no incidents of actual damage were identified, Congress preserved the option for the application of the SDWA for regulation of hydraulic fracturing if diesel fuel was utilized.

The current balanced management approach serves the nation well. As reaffirmed by state regulators in October 2007,[9] the current approach retains the effective state regulatory programs that protect the environment. And, it provides for a structure that allows for the essential development of the nation's oil and natural gas.

8 Prior to enactment of the Energy Policy Act, primary providers of hydraulic fracturing had agreed not to use diesel in coalbed fracturing.

9 GWPC Letter to the House Oversight and Government Reform Committee Chair, Henry Waxman, on October 30, 2007.

To find out more about hydraulic fracturing please visit

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