Hydraulic Fracturing for Natural Gas in Virginia

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What is “hydraulic fracturing?”

- An industrial process in which reservoir rocks are fractured using high-pressure fluid
- Used to extract gas and oil from “tight” reservoirs such as shale
- Typically associated with horizontal drilling
- Also know as:
  - “Hydrofracking”
  - “Fracking”
  - “Fracing”
Horizontal Shale Gas Well
Step 1:
Drill through aquifers; set and cement water protection casing
Step 2:
Drill down to target reservoir and turn well horizontal; usually requires intermediate casing strings.
Step 3: Drill horizontal leg of well; set and cement production casing (steel pipe)
Step 4: Perforate casing with shaped charges
Step 5: Hydraulically fracture the reservoir by pumping water, sand, and additives through casing perforations.
How long has hydraulic fracturing been used?

- Earliest use was ~1900 in shallow oil wells in PA, NY, KY and WV
- Stanolind Oil and Gas Company (now AMOCO) first developed ‘modern’ method in 1940s
- Halliburton Oil Well Cementing Company performed the first two test fracs in 1949
- By 1955, more than 100,000 wells completed in the U.S.
- By 2014, more than 1.5 million wells completed with hydraulic fracturing in the U.S.
Has hydraulic fracturing been used in Virginia?

- There are about 8,000 producing natural gas wells in Virginia, most drilled since 1990
- All are in the southwest part of the state
- Most of these wells were hydraulically fractured
Types of Wells in Virginia

- Coalbed Methane
  - About 80% of Virginia’s gas production

- Tight Gas Reservoirs
  - Sandstone, limestone, and shale

- Horizontal Wells
  - About 100 wells in tight reservoirs
What laws and regulations govern oil and gas drilling in Virginia?
Virginia Gas and Oil Program Requirements

- The Virginia Gas and Oil Act of 1990
  - [http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+TOC4501000002200001000000](http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+TOC4501000002200001000000)

- Virginia Gas and Oil Regulation
  - [http://leg1.state.va.us/000/reg/TOC04025.HTM#C0150](http://leg1.state.va.us/000/reg/TOC04025.HTM#C0150)

- Virginia Gas and Oil Board Regulations
  - [http://leg1.state.va.us/000/reg/TOC04025.HTM#C0160](http://leg1.state.va.us/000/reg/TOC04025.HTM#C0160)

- State Water Control Law
  - [https://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+TOC6201000000300001000000](https://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+TOC6201000000300001000000)

- Virginia Pollution Discharge Elimination System Regulations

- Additional requirements for the Tidewater Region
  - [http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+62.1-195.1](http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+62.1-195.1)
Has hydraulic fracturing ever contaminated groundwater in Virginia?

There have been no documented cases of surface or groundwater degradation from hydraulic fracturing in Virginia.
Has hydraulic fracturing caused problems elsewhere in the USA?

Surprisingly, it’s not that easy to get a clear answer.
Hydraulic fracturing is happening in most of the pink areas.
Groundwater contamination?

- Dimock, PA
  - The EPA found high levels of methane, manganese, and other elements in water wells. Duke University linked the methane to the deep gas reservoir. No fracking fluid ingredients were found.

- Pavillion, WY
  - The EPA found fracking fluid constituents in water wells. The contamination path could have been from poor well construction or the zone of fracking being too close to aquifers.

- Weatherford, TX
  - The EPA found high levels of methane and benzene in some water wells. Fracking may have been the cause; EPA settled with a nearby well operator.
"So far there is no evidence that any water well contamination has been caused by fluids from shale gas wells leaking."

Hydraulic fracturing, commonly known as *fracking*, is used to extract shale gas by injecting fluids into the ground to drill and *frack* a well. This method of obtaining energy has raised environmental concerns and is challenging some existing regulatory regimes. What does the science say? Geoscientist Ian Duncan is a research scientist at the Bureau of Economic Geology at the University of Texas at Austin. His current research focuses on the scientific, environmental and public policy aspects of hydraulic fracturing. He talked to EarthSky about what the science says so far about fracking’s environmental impact. To learn more about the basics of fracking, see this interview with geoscientist Eric Potter. These interviews are part
In 2009, the Groundwater Protection Council, the US Environmental Protection Agency and the US Geological Survey testified before Congress that hydraulic fracturing does not pose a risk to groundwater quality.
What’s in “frack fluid,” anyway?

- Water and/or nitrogen – about 98%
- Detergent
- Antibacterial agents
- Acids
- Clay-swelling inhibitors
- Antifreeze
- Sand
- Possibly others...
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Looking for information about a
well site near you?

Search for nearby well sites that have been hydraulically fractured to see what chemicals were used in the process.

TOTAL WELL SITES REGISTERED

3 3 2 7 7

FAQs
Hydraulic Fracturing and Earthquakes

- Recent earthquake activity in Ohio, Texas, Colorado, and Arkansas has raised concerns

- Seismic activity related to Underground Injection Control (UIC) wells pumping liquid waste from industrial processes deep underground may possibly reactivate existing fault zones

- VA DMME study in the 1990’s did not detect vibrations on the ground from hydraulic fracturing
At what depth are the formations in Virginia that are targets for fracking, especially in the Triassic basins? How do those depths compare to the depths of drinking water wells?

At this point, only the Taylorsville Basin is attracting attention from the oil and gas industry. The other Triassic basins are either non-prospective or are too small to be attractive at this time. Geologically, depths below 5000’ appear most prospective in the Taylorsville Basin.

Drinking water wells in the area are much shallower, with most being less than 2000’ feet deep. The deepest freshwater aquifer over the Taylorsville Basin is about 2500’ deep.
ADDITIONAL REQUIREMENTS FOR DRILLING IN TIDEWATER REGION

- Found in 62.1-195.1 of the Code of Virginia
  - Prohibits drilling in the Chesapeake Bay or its tributaries.
  - This prohibition also extends to the greater distance of:
    - Bay Resource Protection Areas
    - 500 feet from the shoreline of the waters of the Bay.
Before drilling can occur, an environmental impact assessment must be submitted to DMME and reviewed by DEQ.

EIA must be submitted to all appropriate state agencies for their review.

DMME must consider DEQ’s findings before a permit can be issued.
For directional drilling, the operator must obtain the permission of all affected surface owners.

Casing is set and pressure grouted from the surface to a point at least 2500 feet below the surface or 300 feet below the deepest known ground water, whichever is deeper.

Multiple blowout preventers must be employed.
An oil discharge contingency plan must be submitted to and approved by the State Water Control Board.

Operator must also demonstrate financial responsibility to implement plan.
Before an oil well can be placed into production:

- DMME must find that oil production is likely and imminent.
- DMME must then notify the Secretaries of Commerce and Trade and Natural Resources.
- The Secretaries shall produce a report to the Governor and General Assembly.
Before an oil well can be placed into production:

- The Governor may recommend legislative and regulatory changes.
- The General Assembly may accept those legislative changes or implement its own.
- DMME cannot issue a permit for an oil production well until all of the above steps are completed.
For abandoned (exploratory) wells that reached the depth of formations with tight gas, how accurately and completely are those wells mapped in Virginia? What is the backlog for the Orphaned Well Fund to plug such wells?

Virginia has very good mapping of its abandoned wells. Most have GPS locations and are tracked in a database. DMME maintains an orphaned well fund supplied by a surcharge on drilling permit fees. Orphaned wells are prioritized according to their condition and potential threat to public safety and are plugged as funding becomes available.
Other Questions Submitted by Master Naturalists

- What, if any, state or federal legislation is pending to require companies to specify the chemicals they use in the fracking process? What known chemicals currently in use are considered toxic and/or pollutants?

  There is no pending state legislation but DMME, the agency that regulates oil and gas drilling in Virginia, initiated a regulatory action in 2013 aimed at requiring disclosure of chemicals used in well drilling and completion. See following slides.

  On the federal side, several bills have been introduced (Google “FRAC Act) but none have made it to the floor.
Last fall, DMME initiated a regulatory action to review its requirements for drilling.

- Chemical disclosure requirements
- Review of current industry best practices
- Review to determine if additional requirements are necessary for different regions of the Commonwealth
DMME will utilize a Regulatory Advisory Panel to assist in reviewing regulations.

These meetings will be open to the public.

At least one public hearing will be held after proposed regulations are published in the Virginia Register of Regulations.
What history do we have of the effects of fracturing? How long ago was the earliest site of record fractured, so that we might assess the long-term environmental impact of this method?

Oil and gas wells have been hydraulically fractured in Virginia since the 1960s. Virginia’s oil and gas laws and regulations do not require long-term monitoring.
What is the status of the idea of fracking in George Washington National Forest? If we want to write in, to what person/agency/website would that be?

In March 2010, the George Washington National Forest announced its intent to revise its land management plan and requested public comments. In May 2011, they released a Draft Plan that proposed a ban on horizontal drilling, but not hydraulic fracturing.

Comments submitted on the Draft Plan were overwhelmingly in favor of upholding the ban, but the House Natural Resources Committee questioned the decision. Public comment period ended in Oct 2011. The long-awaited Final version of the plan has not yet been released.
What are good websites for information to convince people of the dangers of fracking, or at least give them information to consider?

There is a wealth of information online, much of it biased one way or the other. The EPA site represents progress on the federal study and is probably the most trustworthy source of factual information:

http://www2.epa.gov/hfstudy
Please describe the different types of pipelines that are used for fracked natural gas, including a description of the source-to-end-destination process through the different types of pipelines and the potential hazards at each stage of the process.

In terms of handling the gas, there is no difference between “fracked” gas and conventional gas. They are often mingled together in the pipeline system.

Basically, there are three types of pipelines: gathering lines, transmission lines, and distribution lines. Gathering lines are small, often low-pressure lines that gather the gas from various wells within a gas field and direct them to a compressor station, where the gas is compressed and “pushed” into a larger transmission line.
Pipelines, Part 2

While gathering lines are often laid right on the ground, transmission lines are typically buried and go long distances, often crossing state lines. Transmission lines take the gas to utility companies in areas of dense population, where the gas is decompressed and placed into distribution pipelines going to homes and businesses.

The primary hazard of any pipeline is damage due to outside disturbance, such as excavation. Buried pipelines are subject to rigorous mechanical inspection designed to detect defects and deterioration.
Information Resources

- FracFocus
  - www.fracfocus.org

- Association of American State Geologists

- EarthSky Magazine feature on fracking

- Virginia Gas and Oil Act – Title 45.1, Ch. 22
  - http://leg1.state.va.us/cgi-bin/legp504.exe?000+cod+TOC45010000022000010000000

- Virginia Gas and Oil Regulation – 4VAC25-150
  - http://leg1.state.va.us/000/reg/TOCo4025.HTM#C0150
Thank you

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