

Drilling for Natural Gas in the Marcellus and Utica Shales: Environmental Regulatory Basics

December 2010

Introduction

This fact sheet provides a basic overview of natural gas drilling in the Marcellus and Utica Shale regions of Ohio and the potential environmental issues associated with these activities. It also summarizes the regulatory authority of the Ohio Environmental Protection Agency (Ohio EPA) and Ohio Department of Natural Resources, Division of Mineral Resources Management (ODNR-DMRM) over drilling activity and wastewater management.

What is Marcellus Shale?

The Marcellus Shale extends across New York, Pennsylvania, Maryland, West Virginia, eastern Ohio and portions of Kentucky and Tennessee. The formation is thinnest on its western edge in Ohio with an average thickness of about 50 feet and thickest in eastern Pennsylvania with a maximum thickness of close to 800 feet. The Marcellus Shale formation is between 7,000 and 12,000 feet below ground.

The Marcellus Shale is an important geologic formation because it holds large reserves of natural gas. Researchers estimate the Marcellus Shale could contain as much as 363 trillion cubic feet of natural gas, enough to satisfy U.S. energy demands for about 14 years.

Most Marcellus Shale drilling is now occurring primarily in Pennsylvania, with growing interest in West Virginia and New York. Because the deposit is much thinner here, Ohio is experiencing far less Marcellus Shale drilling than other states. However, Ohio will likely see a significant increase in future drilling, as much of the state sits over the Utica Shale formation, which experts also predict holds large natural gas reserves.

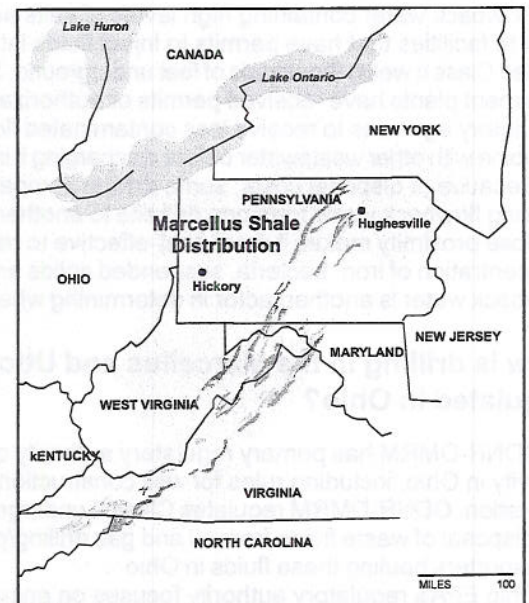
How is natural gas extracted from a shale formation?

Natural gas is extracted from the shale through a two-step process of horizontal drilling and hydraulic fracturing. To start, a production well is drilled

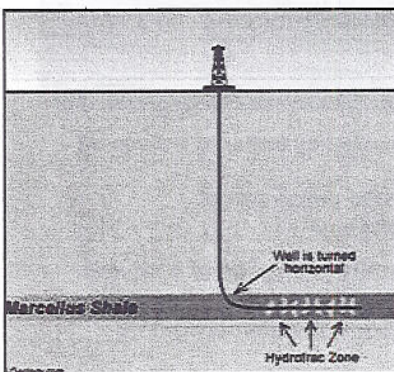
thousands of feet downward and then gradually angled out horizontally through the shale deposit. The well is drilled horizontally to maximize the ability to capture natural gas once the shale is hydraulically fractured.

After the well is drilled, a mixture of water, sand and chemical additives is injected at very high pressure to fracture the shale. This part of the process, called hydraulic fracturing (or "fracing") is a technique used in the oil and gas industry since the 1950s. The sand (called a "proppant") keeps the fractured shale open and serves as a conduit for extracting the natural gas. The chemical additives reduce potential problems in drilling and gas production, such as bacterial build-up and the formation of scale, mineral deposits and rust.

It can take up to four million gallons of fresh water to hydraulically fracture a single Marcellus Shale well. The water used in the fracturing process usually comes from a stream, river, reservoir or lake close to the drill site, or in some cases, from a local municipal water plant.



Marcellus Shale Distribution



Horizontal drilling process.

Graphic reprinted with permission of www.Geology.com

What happens to water after hydraulic fracturing is complete?

Most of the water used to fracture the shale remains trapped thousands of feet underground after it is injected. However, internal pressure in the geologic formation forces some of the water (around 15-20 percent of the total volume injected) back to the surface through the well bore. This is called "flowback" or "frac" water.

Flowback water picks up minerals from the shale formation including iron, calcium, magnesium, barium, sulfur, suspended solids and a significant concentration of soluble salts. Flowback water may also contain low levels of naturally occurring radioactive elements such as radium, carried up from the shale.

Most of the flowback water comes back to the surface within seven to ten days after it is pumped into the well. It is stored temporarily in lagoons or tanks before it is shipped off-site for disposal. Flowback water is usually transported off-site by truck, although some companies are exploring rail transportation as an option.

Flowback water containing high levels of salts and other contaminants is sent to facilities that have permits to inject fluids into deep injection wells (called Class II wells) thousands of feet underground. Some municipal sewage treatment plants have received permits or authorization from their state regulatory agencies to receive less contaminated flowback water, which they combine with other wastewater before discharging it into a stream, river or lake.

Because of disposal costs, some drilling companies are recycling and reusing flowback water from one drill site to another. Having multiple drill sites in close proximity makes it more cost-effective to reuse flowback water. The concentration of iron, bacteria, suspended solids and other contaminants in flowback water is another factor in determining whether it can be reused.

How is drilling in the Marcellus and Utica Shales regulated in Ohio?

ODNR-DMRM has primary regulatory authority over oil and gas drilling activity in Ohio, including rules for well construction, siting, design and operation. ODNR-DMRM regulates Class II underground injection wells used for disposal of waste fluids from oil and gas drilling/production operations and transporters hauling these fluids in Ohio.

Ohio EPA's regulatory authority focuses on ensuring wastewater from drilling activity is properly managed to protect water resources. Ohio EPA's water quality certification requirements help reduce impacts to wetlands, streams, rivers or other waters of the state from the construction of a drill site. Drill cuttings removed from the drill site meeting the definition of solid waste must be disposed in accordance with applicable regulations. See table on page 4.

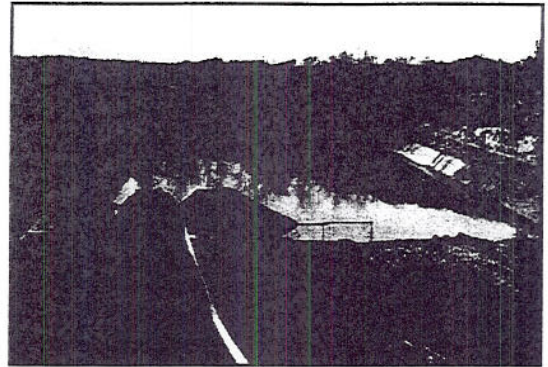
What are the environmental concerns with drilling and hydraulic fracturing?

With media coverage of shale drilling occurring in other states, citizens are becoming more aware and concerned about potential impacts of drilling activity on them, the environment and their communities.

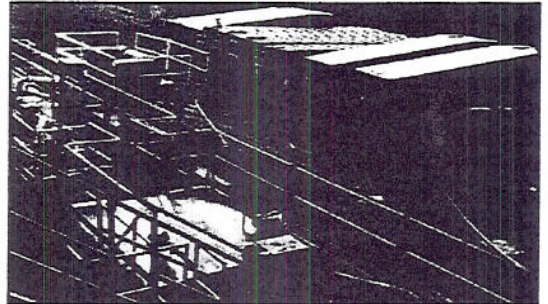
Because Ohio has a significant number of Class II underground injection control wells with permits to dispose of flowback water, many drilling companies have been transporting flowback water into Ohio for deep-well disposal. In addition, there's a growing interest from drilling companies in taking less contaminated flowback water to municipal sewage treatment plants around Ohio.

A typical sewage treatment plant is not designed to treat all of the pollutants in flowback water, specifically total dissolved solids (TDS), including chlorides, sodium and sulfates. The plant relies on mixing flowback water with other wastewater and the capacity of the receiving stream, river or lake to dilute the concentration of these pollutants. High levels of TDS in streams, rivers and lakes can impair water quality and kill aquatic life.

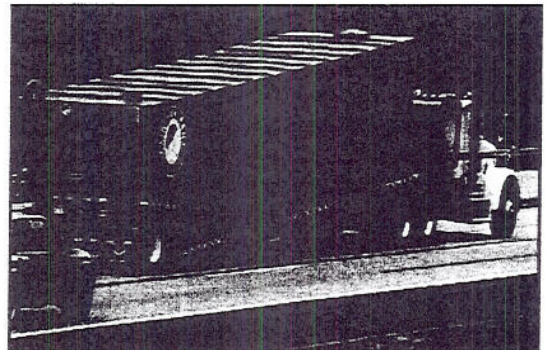
Because of this, Ohio EPA will not authorize sewage treatment plants in the state to receive any brine or flowback water with a high concentration of TDS (more than 50,000 mg/l). In Ohio, these fluids must be disposed of at permitted Class II deep



An on-site lagoon is one option for temporary storage of drill cuttings/fluids and flowback water.



As an alternative to a lagoon, some drill sites use a series of frac tanks to collect flowback water.



Frac tanks are hauled by trailer to a disposal location.

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Total Dissolved Solids (TDS)

A general term for organic and inorganic particles suspended in a liquid which easily pass through a small membrane filter system.

Total dissolved solids in frac water include minerals, metals and soluble salts such as sodium, chlorides and sulfates.

injection wells. Before any sewage treatment plant in Ohio can accept lower-salinity flowback water (50,000 mg/l or less TDS), it must have a permit from Ohio EPA authorizing this activity. Approval to receive flowback water, if granted, is done on a case-by-case basis with individual treatment plants through a modification of their National Pollutant Discharge Elimination System (NPDES) permit. Modified NPDES permits will include limits on the quantity of flowback water and concentration of TDS that can be received, along with additional monitoring to ensure that the plant will not be negatively impacted and that water quality and aquatic resources will not be impaired.

In addition, any facility that wants to construct a centralized wastewater treatment or collection system to handle flowback water must obtain a permit-to-install from Ohio EPA's Division of Surface Water.

Who regulates issues such as truck traffic and road maintenance at a drill site?

There is usually a short-term, but significant level of activity at a drill site. For example, moving drilling equipment on and off site, and hauling production water, flowback water and drill cuttings from the site can create significant truck traffic. Issues such as truck traffic are not covered under Ohio EPA's or ODNR-DMRM's regulations. Check with your community officials on local regulations.

Will drilling for natural gas contaminate my drinking water well?

The Ohio EPA, ODNR-DMRM and other technical experts familiar with hydraulic fracturing do not have data showing a risk of ground water contamination from flowback water migrating thousands of feet from the Marcellus or Utica Shale fractures up into drinking water aquifers much closer (hundreds of feet) to the earth's surface. There is the potential, although unlikely, for contamination of drinking water wells because of problems occurring closer to the surface. Gas and oil can migrate from a production well into an aquifer if a well casing is damaged, leaking or poorly constructed. Natural gas can also enter aquifers from old, abandoned oil and gas wells that are unplugged or poorly plugged. A new water well that is drilled can penetrate gas-rich organic shales or coal seams at shallow depths, allowing gas to enter the well. Buried organic deposits from old swamps or landfills may also release natural gas into soils overlying aquifers.

It's important to know that there have been thousands of oil and gas production wells drilled throughout Ohio with no significant adverse impacts to local wells or drinking water supplies, and while there remains a potential for subsurface-related problems, there is no greater risk of contamination now because of Marcellus or Utica Shale drilling activity than throughout the state's long history of oil and gas drilling.

If you do, however, suspect any problems with your drinking water well during or as a result of any oil/gas drilling activities in your area, contact the Ohio Department of Natural Resources, Division of Mineral Resources Management at (614) 265-6633.

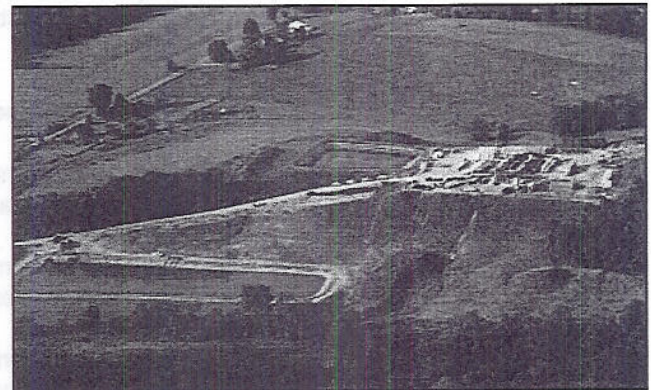
What about leasing rights if someone wants to drill on my property?

The process of drilling a well begins with a lease agreement between the producing company and one or more landowners that make up a drilling unit. It is important for a landowner approached for a mineral rights lease to be aware of all the conditions of the lease that allow the producer to drill on their land.

Ohio EPA's and ODNR-DMRM's regulations DO NOT cover private property lease agreements, and we cannot provide homeowners with any specific guidance on this topic. As a starting point for general information on leases, see ODNR's website, "Landowners and Leasing for Oil and Gas in Ohio," at www.ohiodnr.com/oil/oil_landowner/tabid/17732/Default.aspx.

Where can I get more information?

- Ohio Department of Natural Resources, Division of Mineral Resources Management, Oil and Gas website: www.ohiodnr.com/mineral/oil/tabid/10371/default.aspx.
- Ohio Environmental Protection Agency, Marcellus Shale website: www.epa.state.oh.us/dsw/pretreatment/marcellus_shale/index.aspx.



A Marcellus Shale drill site in Pennsylvania.

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**Summary of ODNR-DMRM and Ohio EPA Regulatory Authority
Over Drilling and Management of Flowback Water**

	Ohio Department of Natural Resources, DMRM	Ohio Environmental Protection Agency
Drilling in the shale deposits	<p>Issues permits for drilling oil/gas wells in Ohio.</p> <p>Sets requirements for proper location, design and construction requirements for wells.</p> <p>Inspects and oversees drilling activity.</p> <p>Requires controls and procedures to prevent discharges and releases.</p> <p>Requires that wells no longer used for production are properly plugged.</p> <p>Requires registration for facility owners with the capacity to withdraw water at a quantity greater than 100,000 gallons per day.</p>	<p>Requires drillers to obtain authorization for construction activity where there is an impact to a wetland, stream, river or other water of the state.</p>
Wastewater and drill cutting management at drill sites	<p>Sets design requirements for on-site pits/lagoons used to store drill cuttings and flowback water.</p> <p>Requires proper closure of on-site pits/lagoons after drilling is completed.</p> <p>Sets standards for managing drill cuttings and flowback derived sediments left on-site.</p>	<p>Requires proper management of drill cuttings and flowback derived sediments that are shipped off-site for disposal.</p>
Flowback water disposal	<p>Reviews specifications and issue permits for Class II wells used to inject oil/gas-related waste fluids into deep underground formations.</p> <p>Sets design/construction requirements for Class II underground injection wells.</p> <p>Oversees the operation of Class II underground injection wells.</p>	<p>Issues permits to install for centralized wastewater collection and treatment facilities.</p> <p>Approves and issues discharge permits for municipal sewage plants that want to accept flowback water for disposal.</p>
Flowback water hauling	<p>Registers transporters hauling brine and oil/gas drilling-related wastewater in Ohio.</p>	