Shale Gas Development in Ohio

Ohio Environmental Council

Information and resources
for eastern Ohio residents

BRIEF HISTORY OF NATURAL GAS PRODUCTION & UTILIZATION

When Colonel Drake first successfully drilled for oil in Titusville, Pennsylvania, in 1859, natural gas was an unwanted byproduct that flowed from the "oil sands." By the end of the 1800s, natural gas was being used to fuel gas lights in cities across America. Soon natural gas was also used as a heat source.

To distribute the natural gas, an extensive pipeline system was built across the country – the length of which could stretch to the moon and back, twice. Today, natural gas heats homes, provides a feedstock to many industries, and provides fuel for electric generating plants (as an alternative to coal and nuclear sources).

What's Behind the Shale Gas "Rush"?

It comes down to two things – widespread application of horizontal well drilling technology and hydraulic fracturing techniques. With the application of an old drilling technology applied in a new way (horizontal drilling), in the 1990s it became economically feasible to extract natural gas, not only from the subsurface "sands" (sandstone), but also from deep shale rock.

Because natural gas will not freely flow from shale, the rock must be broken or "fractured" to provide pathways for the gas to migrate to the well. In "fracking," high pressure is used to pump water, sand, and chemicals down the wellbore and into the gas-bearing shale. The sand or ceramic pellets "prop" open the fractures in the rock, and oil and gas and much of the water "flows back" to the well and is recovered at the surface. Additional information on the fracking process can be found at http://bit.ly/1bW7LMJ.

Is Hydraulic Fracking New?

While hydraulic fracturing is not new, the use in horizontal shale drilling is a new application. Since 1949, hydraulic fracturing has been used in traditional vertical oil and gas wells drilled into sandstone to increase production. However, hydraulic fracturing was not used in horizontal shale gas wells until 1991 and not in Ohio until 2006.

The big difference in fracking a horizontal well (versus a vertical well) is that much more rock is fractured (as much as 10,000 lineal feet or more per well as compared to hundreds of feet in a traditional sandstone vertical well). The result is that more fluids and chemicals are needed for fracking each horizontal well because the lineal footage is so much greater.

Also, horizontal wells typically have more than one well extending in different directions from one drilling pad as opposed to one vertical well per location. Since 2003, fracking has become widespread with the drilling of many horizontal wells in the U.S. For a history of fracking, visit http://bit.ly/1h9c87v.

Ohio's Oil & Gas Exploration

Ohio has experienced oil and gas booms before. From 1895 to 1902, Ohio was the leading oil and gas producing state in the United States. In the early 1960's, Morrow County had more oil and gas wells than any county in the United States, primarily due to a lack of "town lot" spacing restrictions, which was rectified by the Ohio legislature in 1964. Today's exploration is centered on the Marcellus and Utica shale rock formations that underlie eastern Ohio (see map).

Why This Document?

The proliferation of shale gas wells using "unconventional" horizontal drilling methods (as opposed to "conventional" drilling methods used to drill vertical wells) has heightened concerns among scientists, landowners, and the public. Questions about leases, roadways and truck traffic, chemicals used in drilling, emergency response, water testing, and potential health effects have been raised.

The following sections provide basic information and resources for additional information for eastern Ohio residents.

LEASES & LANDOWNER PROTECTIONS

What Do I Need to Know About Leases & Landowner Protections BEFORE I Sign?

It is strongly recommended that you consult an attorney who specializes in representing landowners in oil and gas leasing. Specialized legal advice is important because oil and gas leases are complex and legally binding.

That said, remember that no document can fully protect you from harm; it can only give you legal rights in the event of a problem.

Many landowners are unaware that drilling activities can affect many different aspects of life on their property, such as:

- quality of water in a well;
- quality of water in a stream, spring, or pond;
- creation of potentially explosive conditions in a house or other structure;
- construction of a large drilling pad in an area close to a house or livestock;
- construction of a large drilling pad in an inconvenient location in a productive farm field;
- laying of pipelines underground or on the surface for gas or fluid transport on- or off-site;
- storage of chemicals and waste products on the surface of the land;
- interruption of sleep due to drilling and other activities that take place 24 hours a day;
- release of noxious chemicals into the air;
- creation of roads and significant truck traffic on the property;
- possible construction of stream crossings;
- possible removal of water from streams on the property;
- possible drilling and installation of large volume groundwater withdrawal wells;
- construction and operation of pits to store wastewater and other wastes;
- erection of fences around oil and gas facilities;
- sporadic, around-the-clock operation of compressors to ready gas for transport offsite;
- the long-term presence of separators to remove impurities from the gas prior to transport;
- the long-term presence of storage tanks or other structures on the property;
- high probability of re-fracking/treating a well multiple times in the ensuing years;
- restoration of the site to as close to original condition as possible;
- proliferation of leases that require the property owner (not the drilling company) to abandon the well and restore the site; and
- selling of leases to different companies through time.

There are many ways to protect your land and quality of life in a lease. Available resources to further explore ways to word a lease or issues to consider include:

- "An Ohio Landowner's Guide to Hydraulic Fracturing, Addressing Environmental and Health Issues in Natural Gas Leases," Harvard Law School, June 16, 2011. http://bit.ly/16AeEi5
- "Protect Yourself If You Sign a Lease," NEOGAP. http://bit.ly/16rRuJM
- "A Landowners Guide to Oil and Gas Leasing in Ohio," Ohio Farm Bureau, 2011. http://bit.ly/19rX565
- Ohio Farm Bureau offers personal assistance to members. (614) 246-8294.

- The Ohio State University Extension Shale Fact Sheet Series (Three Fact Sheets). http://bit.ly/14xRsnj
- "Look Before You Lease, Negotiating the Lease" website has several links to helpful documents. http://bit.ly/1b5vSvp
- Ohio Department of Natural Resources has a fact sheet and several sample leases. http://bit.ly/15NMmEg

Can Oil & Gas Be Drilled on My Property Without Signing a Lease?

In some situations, the answer is yes. There are two circumstances where this can happen. The first is when the mineral rights have been severed from the land (by a previous owner). When mineral rights have been severed from the land, you do not own the right to develop or preserve the minerals under the land. The second is when you (the landowner) still own the mineral rights.

Although you may own your mineral rights, mandatory pooling or unitization laws may be applied to your land. Mandatory pooling is used to aggregate typically small tracts of land necessary to meet minimum spacing requirements between wells and property. In addition, mandatory pooling is used to meet minimum acreage requirements for a drilling unit (40 acres minimum for wells greater than 4,000 feet in depth).

Unitization is used to consolidate control over a specific portion of oil and gas reserves, such as in horizontal shale gas drilling where a drilling unit is typically hundreds of acres in size. Effective May 25, 2013, ODNR issued new rules on unitization requests.

These laws allow developers to submit a request to the Ohio Department of Natural Resources (ODNR) to force a property into a drilling unit if the majority of the drilling unit has been assembled from willing property owners and there is not another alternative for completing the drilling unit.

If a property is petitioned for mandatory pooling or unitization, the landowner must receive notice of the request and may testify at a hearing. If mandatory pooling is granted, the property owner will receive royalty payments, but typically no signing bonus because no lease was signed.

If unitization is granted, ODNR determines the terms of inclusion in the unit of the forced-in mineral owners. These could be landowners without a lease or other leaseholders (different from the petitioner).

ODNR determines royalty interest, working interest, and risk penalties, among others, on a case-by-case basis. In unitization orders issued thus far, ODNR has forced other leaseholders to share in risk penalties by requiring costs up front. In other orders, ODNR required the petitioner to pay mineral owners an upfront bonus in addition to royalties.

Additional information on mandatory pooling and unitization is available at http://bit.ly/1f9aoj7 and http://bit.ly/1f9arv5.

Fracking waste retention pond

ROAD USE MAINTENANCE AGREEMENTS

How Can My Local Community Protect its Roads & Infrastructure from Damage from Vehicles Associated with Drilling?

Fracking and drilling activities frequently result in a large increase in heavy truck traffic that can damage roads not designed to handle repetitive heavy truck traffic. In the absence of a Road Use Maintenance Agreement (RUMA) between drilling companies and local governments, repairs to these roads and road maintenance will fall to local taxpayers.

Township Trustees and County Engineers have jurisdiction over local roads in the state that may be used by vehicles associated with drilling and operating wells. Ohio Senate Bill 315 (effective September 10, 2012) encourages local governments and well owners to enter into a RUMA.

As part of the permit process, the law requires that either a RUMA be signed or an affidavit be submitted attesting that the well owner has negotiated with local officials in good faith, but that no agreement was executed.

A RUMA places the responsibility for road construction and repair on well operators. These agreements should also designate travel routes for heavy equipment to minimize impacts to local roads. The County Engineers Association of Ohio has a model RUMA available at www.ceao.org.

This model RUMA was drafted in consultation with County Engineers and representatives from the oil and gas industry and has been reviewed by the legal office of the Ohio Department of Transportation (ODOT).

To learn about drilling activities in each county, search the ODNR database at http://bit.ly/16kBjVq and download the County Engineers list.

What Should Be Included in a Road Use Maintenance Agreement?

ODOT suggests the following items be addressed in the RUMA (the model RUMA at www.ceao.org also addresses these items):

- define routes to be used by drilling traffic;
- require maintenance of the route during drilling activities;
- require notification of the railroad industry if a crossing is involved;
- require an engineering report on the route prior to drilling activities;
- require a list of 24-hour emergency contacts; and
- require bonding unless the road is expected to withstand the required truck traffic, the drilling operator agrees to pay for upgrades to the route, or a bond or surety is already in place.

In addition to these items, Appendix A of the model RUMA is designed to include any other provisions agreed by both parties including requirements for schedules, well locations, list of contractors, list of equipment to be transported, notice of road closures, signage requirements, and dust control.

CHEMICAL DISCLOSURE

How Do I Find Out What Chemicals Are Being Used at Oil & Gas Wells in My County?

Current Ohio law exempts the oil and gas industry from complying with federal Emergency Planning and Community Right-to-Know Act (EPCRA) requirements. However, in June 2013, the U.S. EPA asserted that Ohio law does not supersede the federal EPCRA requirements.

As of September 2013, the Ohio Environmental Protection Agency (OEPA) now requires oil and gas companies to provide documentation under EPCRA to local emergency planning committees (LEPC). Contact your LEPC (see Table A on Page 6) for additional information on chemicals stored and used at drilling.

Currently, oil and gas companies must report chemicals stored and used in the drilling process to ODNR. ODNR maintains a website (http://bit.ly/17VIyAg) and database (http://bit.ly/16kBjVq) that contain information about types of chemicals used at wells.

To find information about chemicals used in fracking at individual wells in the ODNR database, the database should be searched for completion reports.

Some completion reports will contain lists of chemicals used at the well if submitted by the operator and will not necessarily include the quantities of chemicals used at the site. It is also possible to obtain information on chemicals used at wells at http://bit.ly/1eAPGHv.

It is important to note that some “proprietary” chemicals may be used in drilling and companies are protected from disclosure due to “trade secret” laws.

Table A. Local Emergency Planning Committees (LEPC) Contact Information (By County)

ASHTABULA COUNTY Information Coordinator Debbie Riley, Secretary, (440) 576-9148 Emergency Coordinator George Sabo, Director, (440) 576-9148	**GUERNSEY COUNTY** Information Coordinator Linnie Deeks, (740) 432-9292 Emergency Coordinator Gerry Beckner, (740) 432-9292	**MONROE COUNTY** Information & Emergency Coordinator Phillip Keevert (740) 472-0220
BELMONT COUNTY Information & Emergency Coordinator Dave Ivan, Director (740) 695-5984	**HARRISON COUNTY** Information & Emergency Coordinator Lorna Bower, Director (740) 942-3922	**MUSKINGUM COUNTY** Information Coordinator Kristie Howard, (740) 453-1655 Emergency Coordinator Bo Keck, (740) 453-1655
CARROLL COUNTY Information & Emergency Coordinator Tom Cottis (330) 627-0003	**HOLMES COUNTY** Information & Emergency Coordinator Gary Mellor, Director (330) 674-0989	**NOBLE COUNTY** Information Coordinator Denise Wells, (740) 732-7387 Emergency Coordinator Chasity Schmelzenbach, (740) 732-7387
COLUMBIANA COUNTY Information Coordinator Willie Brantingham, (330) 424-0861 Emergency Coordinator Luke Newbold, Director, (330) 424-9725	**JEFFERSON COUNTY** Information Coordinator Rob Herrington, (740) 266-4150 Emergency Coordinator John Parker, (740) 283-8600	**TRUMBULL COUNTY** Information & Emergency Coordinator Linda Beil, (330) 675-6602
COSHOCTON COUNTY Information & Emergency Coordinator James Van Horn (740) 622-1984	**MAHONING COUNTY** Information & Emergency Coordinator Clark Jones (330) 740-2200	**TUSCARAWAS COUNTY** Information & Emergency Coordinator Patty Levengood, Director (330) 308-6670

TESTING YOUR WATER SUPPLY

What Are the Risks from Shale Gas Drilling to My Water Supply?

The primary risks to a water supply are associated with:

- drilling and completion of the well itself (primarily casing and cementing problems leading to escape of gas and/or fluids at shallow levels);
- hydraulic fracturing; and
- flowback and production waters.

In regard to drilling of gas wells in Ohio, ODNR has adopted regulations for the drilling and completion of these wells. A discussion of the technical issues relating to these construction standards, inspection, and operation of these wells is beyond the scope of this document.

According to industry, hydraulic fracturing of a typical deep horizontal shale gas well in the Marcellus shale formation will require an average of 5.5 million gallons of fluid per well; wells in the Utica shale formation reportedly require less fluid for fracking.

Approximately 98 percent of the fluid is water, while the remaining two percent is chemicals and a propping agent (sand and ceramic pellets). Handling this volume of fluid for each well poses challenges at the surface. If the fluids are not adequately handled, surface spills and subsequent contamination can result.

There are a variety of chemicals that are added to the fracking fluid to enhance the fracking process, such as a dilute acid solution, a biocide or disinfectant, a scale inhibitor, iron control agents, friction reducing agents, corrosion inhibitors, gelling agents, and cross-linking agents.

More than 600 different chemicals have been used, including some "proprietary" chemicals for which a company may claim trade secrecy, depending on the drilling company and conditions.

Flowback water is typically defined as the water that "flows back" to the surface after fracking. Approximately 10 to 30 percent of the volume of fluid used in fracking returns to the surface (between 0.5 million and 1.5 million gallons of fluid). The quality of the flowback water includes not only the chemicals added during fracking, but also the salt (brine), hydrocarbons, and other constituents that occur naturally in the shale.

Production water is similar in quality to flowback water, but occurs after the initial fracking process and comes to the surface during production. These "waters" need to be contained and properly disposed. The largest threat from these fluids is from surface spills, leaks, or indiscriminate (and illegal) disposal to surface waters.

A secondary risk is from previous oil and gas drilling activities. Improperly plugged and abandoned wells and/or previous contamination from improper well construction can result in the migration of methane gas. It is not uncommon in many areas to find "background" levels of methane associated with previous (historical) drilling activities. In addition, old unlined pits can cause contamination by salt and petroleum constituents. Improper disposal of drilling cuttings and/or fluids, or surface leaks and spills can also result in contamination.

Why Should I Have My Water Supply Tested?

Before any new drilling activity starts, it is important to document the existing water quality in the water supply. This information provides a baseline upon which you can compare any impact to your water supply from the new drilling activities.

In the event that your surface or groundwater supply (including domestic, agricultural, industrial, or other legitimate use) is substantially disrupted by contamination, diminution, or interruption from oil and gas operations, Section 1509.22 (F) of the Ohio Revised Code gives ODNR the authority to order the owner/operator of an oil and gas well to replace the water supply.

Who Will Test My Water Supply Before Drilling Activities Begin?

According to Ohio Senate Bill 315 (effective September 10, 2012), gas drilling companies must test some water wells prior to the initiation of gas drilling activities as a condition of their permit application process. ODNR does allow testing of water wells to be completed after the submission of a permit, provided the results are submitted to ODNR prior to beginning drilling.

Ohio law specifies that all water wells located within 300 feet of any oil and gas well (vertical and/or horizontal) drilled in an urban area must be tested by gas drilling companies.

An urban area is defined as an incorporated area or township with a population of 5,000 individuals or more as determined by the last 10-year U.S. census. In addition, water wells within 1,500 feet of a new horizontal gas wellhead – regardless of the location (urban or rural) – also must be tested by gas drilling companies.

Testing of water wells is contingent upon the landowner granting permission. The law however does not require water well testing associated with a vertical gas wellhead in a rural area.

The law requires that wells must be tested (at a minimum) for the list of water quality parameters developed and provided by ODNR, which may be updated from time to time. The current list can be found at http://bit.ly/GBouut and is highlighted in red on Table B on Page 8.

Although this list is considered the minimum, it is in the best interests of the landowner as well as the drilling company to test a longer list of constituents.

Bottom line: Whether it is during or after lease negotiations, always request as long a list of tested constituents as possible. Also, remember to keep the sample results in a safe place for the future. The results provide a snapshot of the water quality in your water supply.

In addition to the parameters tested, the frequency of testing is also an issue. The drilling company typically will offer to test your well one time prior to the initiation of their drilling activities (because

only one sample is required by ODNR). If you are signing a new lease, you should try to negotiate additional testing of your well as a condition of the lease (before, during, and after drilling). Ohio EPA recommends that two or three samples should be collected in different calendar seasons to allow you to establish the normal variability in groundwater quality over time.

What Parameters Should Be Tested in My Water Supply Prior to Drilling?

As mentioned above, ODNR currently has a list of constituents that must be tested in some water wells by gas drilling companies prior to some oil and gas drilling (highlighted on Table B).

Ohio EPA also has a list of recommended sampling parameters focused towards potential oil and gas drilling impacts at http://bit.ly/1b5wd16. (See Table B.) The Ohio EPA-recommended testing parameters have been divided into three "tiers." Ohio EPA recommends that all three tiers be tested, if possible. However, if testing is cost prohibitive, Ohio EPA suggests Tier 1 plus methane (from Tier 3) at a minimum. It is important to note that the ODNR list is much shorter than the Ohio EPA list and does not include any organic parameters (BTEX) or methane.

In addition to the parameters recommended by Ohio EPA, you should consider analyzing at least two samples (prior to drilling) for radium 226, radium 228, gross alpha, gross beta, and radon-222 (see discussion of radioactive components in the Public Health Concerns Section).

Why Should I Have a Professional Collect & Analyze the Water Samples?

It is important that the water samples be collected with approved methods so that the samples are scientifically valid for later use. Further, there are some special collection and handling procedures that must be followed for some parameters. It is best to hire a professional to collect the samples.

Some local health districts or soil and water conservation offices offer sample collection. A directory of local health districts in Ohio can be found at http://1.usa.gov/14xS2Bs. A directory of soil and water conservation districts can be found at http://bit.ly/15NMO5m.

Some laboratories will collect the samples for you. Other professional companies also offer collection services. Samples that are not collected properly with documented chain-of-custody procedures can result in unreliable results and a waste of money.

All samples should be analyzed by an Ohio EPA-certified laboratory. The listing can be found at http://1.usa.gov/1fs2XRy. Remember to keep all testing results in a safe place.

Who Will Test My Water Supply After Drilling Activities Have Begun?

Unless you have negotiated for the drilling company (or owner/operator) of the shale gas well to sample your water supply during and/or after drilling activities, future collection and testing of your water supply is your responsibility.

Table B. Ohio EPA Recommended Water Quality Sampling Parameters

Tier 1 Parameters	Tier 2 Parameters	Tier 3 Parameters
Barium Chloride Magnesium Potassium Sodium Strontium Sulfate Total dissolved solids Specific conductivity	Tier 1 Parameters plus: Calcium Hardness Total alkalinity pH Iron Manganese Total suspended solids Bromide	Tier 1 and 2 Parameters plus: BTEX (benzene, toluene, xylene, ethylbenzene) Methane (dissolved)

ODNR list of required testing parameters are highlighted in red.

Sampling during and after drilling should be for the same parameters recommended to be tested prior to drilling.

If, however, there should be a sudden change in your water, you may wish to contact ODNR by filling out an online form at http://bit.ly/19vv8Jt for possible investigation.

You may also want to contact an environmental professional to assist in your investigation. An environmental professional may also recommend testing for drilling-specific additives or constituents.

My Water Supply Results Are Here. What Do They Mean?

Interpreting water supply results can be complicated and confusing. However, the first place to start is with any health-based standards. In Ohio, private water systems (regulated by the Ohio Department of Health) have the same health-based standards as public water systems (regulated by the Ohio EPA) at http://1.usa.gov/18k4iqr. Find more information at http://1.usa.gov/1f9bhYT.

If parameters in your water supply are near or higher than a health-based standard, or there is a detectable level of methane in your water supply, you may wish to seek the advice of a water quality professional to determine the potential source(s) of the contaminant(s).

POTENTIAL PUBLIC HEALTH CONCERNS WITH OIL & GAS DRILLING OPERATIONS

What Are the Concerns About Drinking Water that Has Been Affected by Oil & Gas Drilling?

There is much public debate about whether oil and gas operations, specifically fracking, have been documented to affect local water supplies. The ways for contaminants to move to water wells from compromised oil and gas wells, improperly abandoned wells, unlined pits, and surface spills have been well-documented for more than thirty years.

The new horizontal drilling technology has many of the same potential problems as vertical drilling operations. However, the potential for surface spills is greater because of the larger amount of fluids handled at the surface.

There are historical cases of groundwater contamination associated with drilling activities,

Utica Shale Drilling in Carroll County

but some of the more recent, higher profile cases have been investigated by the U.S. EPA and include an evaluation of health effects.

These include Pavillion, Wyoming, (located in a historical and current gas drilling area) where 89 percent of the water wells tested contained detections of total petroleum hydrocarbons as well as other constituents at elevated levels, including adamantane (www2.epa.gov/region8/pavillion).

Adamantane was presumed to be an additive in drilling fluids and residents were advised to use alternate or treated water supplies after completion of a study by the federal Agency for Toxic Substances and Disease Registry (ATSDR). See http://1.usa.gov/194074q.

Due to state and industry criticisms about the methodology and conclusions of the U.S. EPA study, the U.S. EPA placed finalization of the study on hold. Meanwhile, the United States Geological Survey (USGS) conducted parallel tests in one well and confirmed the presence of organic constituents in groundwater. The state and industry are conducting further tests and their report is due in 2014.

Additional information on approximately 1,000 chemical additives in drilling operations and potential health effects can be found at http://bit.ly/15qOXUb. Currently, the U.S. EPA is conducting a retrospective study of drinking water impacts from drilling activities in Pennsylvania, Colorado, North Dakota and Texas (www2.epa.gov/hfstudy). This report is due to be completed in 2014.

In addition to studies on human health effects, a 2012 study looked at impacts of gas drilling on human and animal health due to both horizontal and vertical gas wells. The study focused on livestock and documented 24 cases of health outcomes including death of livestock. Read more at http://1.usa.gov/18PWkBq.

What Are the Health Concerns Where Methane & Other Hydrocarbon Gases Are Present in Water?

Methane is a colorless, odorless gas that is explosive in certain mixtures with air. Despite videos of homeowners lighting water at their kitchen faucet, if you suspect the presence of methane, DO NOT introduce a flame. The result can be an explosion that could not only set the house on fire, but also result in serious injury or death. In general, the risk from methane can be immediately dangerous to life and health if methane is present in explosive concentrations and an ignition source is introduced.

As a result of historic gas drilling in Ohio, there are areas where methane is present in groundwater due to leaks in and around casings and improperly abandoned oil and gas wells. However, the same potential from current operations exist. ODNR recently documented that a vertical well drilled in Bainbridge Township (Geauga County) in 2007 had a problem with the cement used to seal the casing.

When the well was fracked and the cement failed, methane accumulated in a nearby resident's basement causing an explosion and also contaminated several nearby private water wells. The ODNR report on this incident can be accessed at http://bit.ly/15k85Fw.

Another study, conducted by the ATSDR along Cady Road in Cuyahoga County, investigated numerous health complaints by residents with private water wells where gas had been noticed since the water wells were drilled in the 1950's. Read more at http://1.usa.gov/194074q.

The ATSDR concluded that the greatest concerns were due to explosion hazards associated with the combustible gases that were released from the water. The presence of hydrogen sulfide at the levels detected indicated that adverse health effects could result from intermittent or chronic exposure. Hydrogen sulfide, particularly when liberated from water in a shower scenario, can cause problems for individuals with respiratory problems or asthma.

What Are the Health Concerns About Air Quality in the Vicinity of Oil & Gas Operations?

To date, the primary concerns about air quality are related to the release of non-methane hydrocarbons (that are present with methane in raw natural gas)

during drilling, venting, and operation of equipment at a drilling site (including ethane, propane, and other alkanes linked to natural gas operations).

Additional air concerns are related to volatile organic compounds (VOCs), including BTEX, and also nitrogen oxides (NOx), carbon monoxide (CO), and particulate matter (PM) in exhaust and evaporation from mobile and stationary equipment.

To address one area of concern, the U.S. EPA has adopted new air regulations that will become effective in 2015. Referred to as New Source Performance Standards, these rules were adopted for natural gas fracking operations to help reduce smog-forming air pollution and harmful air toxins (http://1.usa.gov/16K770g).

A 2012 study in Garfield County, Colorado, identified potentially toxic organic compounds in the air near fracking operations. One conclusion of the study is that residents within one-half mile from the wells were likely to have a greater risk for respiratory and neurological effects based on their exposure to air pollutants. The complete report can be accessed at http://bit.ly/16AgjV3.

Should I Be Concerned About Radioactive Materials Associated with Drilling Operations?

Most shale formations targeted during horizontal drilling contain radioactive uranium and thorium, although the amount of radiation varies by the formation and within the formation. The radioactive decay products include radium and radon.

Drilling activities bring radioactive materials to the surface in the form of flowback and production waters, drilling cuttings and muds, sludges, and slimes. Radioactivity can also concentrate in pipe scale, storage tanks, or other equipment.

Radionuclides in these waste materials are primarily radium-226, radium-228, and radon gas. Radium can cause anemia, cataracts, and cancer. The radium-laden fluids typically are placed in pits, ponds, or storage tanks prior to re-use, recycling, or disposal.

If there is a construction defect in the well, a spill, or a leaking pit, the liquids can migrate to groundwater and/or surface waters.

Radon is formed from the decay of radium. Specifically, alpha and gamma radiation is released during the decay of radium-226, while gamma and beta particles are released by the decay of radium-228.

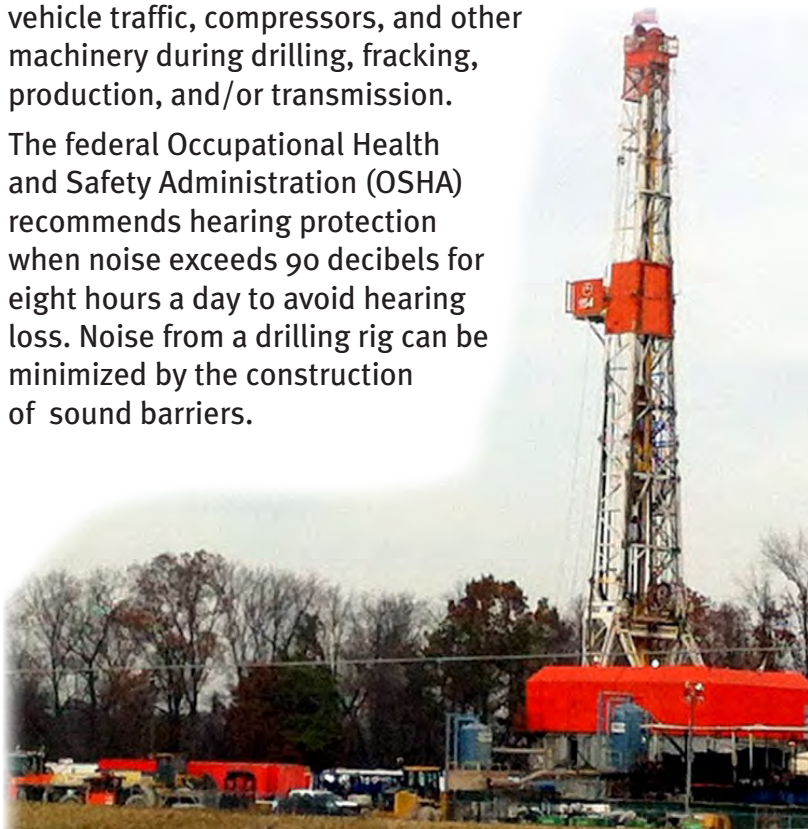
Radon is a gas that may enter basements if well casings or cement fail. Radon is the leading cause of lung cancer in non-smokers. Radon frequently occurs naturally in basements in Ohio, so detections of radon in basements are not necessarily indicative of radon derived from deeper shale deposits. To protect residents from radon, if radon is present at levels greater than 4 pCi/L, a radon mitigation system should be installed.

Further information on radioactivity in oil and gas wastes can be found at http://1.usa.gov/19y7v27.

Are There Other Potential Health Effects Associated with Gas Drilling & Production?

There has been very limited research on noise and light pollution from drilling sites. Light pollution is a potential problem if drilling operations require lighting during the overnight hours. Noise pollution can occur as a result of drilling, vehicle traffic, compressors, and other machinery during drilling, fracking, production, and/or transmission.

The federal Occupational Health and Safety Administration (OSHA) recommends hearing protection when noise exceeds 90 decibels for eight hours a day to avoid hearing loss. Noise from a drilling rig can be minimized by the construction of sound barriers.



Utica shale drilling in Carroll County

CREDITS

Linda Aller, Kerry Zwierschke, Ph.D., and Julie Weatherington-Rice, Ph.D., Bennett & Williams Environmental Consultants, Inc.

Melanie Houston, Trent Dougherty, Jack Shaner, and Nathan Johnson, Ohio Environmental Council.

All photos by Ted Auch, FracTracker.org. Cover photo: Carroll County. Map on page 2 from www.epa.ohio.gov.

Printed on recycled paper.

12/2013

1207 Grandview Avenue, Suite 201
Columbus, OH 43212
(614) 487-7506 · OEC@theOEC.org
www.theOEC.org/Fracking

LINKS

Here are all the "short links" in this guide, followed by the original web addresses. Note: the links are case sensitive.

Page 2
- http://bit.ly/1bW7LMJ — http://fracfocus.org/hydraulic-fracturing-how-it-works/hydraulic-fracturing-process
- http://bit.ly/1h9c87v — www.spe.org/jpt/print/archives/2010/12/10Hydraulic.pdf

Page 3
- http://bit.ly/16AeEi5 — http://oeffa.org/documents/HarvardOHLeasingGuide.pdf
- http://bit.ly/16rRuJM — www.neogap.org/neogap/wp-content/uploads/2011/08/Protect-Yourself-if-You-Sign-A-Lease.doc
- http://bit.ly/19rX565 — www.portagefb.org/wp/wp-content/uploads/2011/02/Oil-Gas-Brochure.pdf

Page 4
- http://bit.ly/14xRsnj — http://serc.osu.edu/extension/leasing-your-mineral-rights
- http://bit.ly/1b5vSvp — http://lookbeforeyoulease.org/landowner-toolkit
- http://bit.ly/15NMmEg — http://oilandgas.ohiodnr.gov/citizens/leasing-information
- http://bit.ly/1f9aoj7 — http://oilandgas.ohiodnr.gov/industry/mandatory-pooling
- http://bit.ly/1f9arv5 — http://oilandgas.ohiodnr.gov/industry/unitization

Page 5
- www.ceao.org
- http://bit.ly/16kBjVq — http://oilandgas.ohiodnr.gov/well-information/oil-gas-well-database
- http://bit.ly/17VIyAg — http://oilandgas.ohiodnr.gov/well-information/emergency-response
- http://bit.ly/1eAPGHv — www.fracfocusdata.org/DisclosureSearch

Page 7
- http://bit.ly/GBouut — http://oilandgas.ohiodnr.gov/portals/oilgas/pdf/BMP_PRE_DRILLING_WATER_SAMPLING.pdf

Page 8
- http://bit.ly/1b5wd16 — www.epa.state.oh.us/MarcellusandUticaShale.aspx
- http://1.usa.gov/14xS2Bs — www.odh.ohio.gov/local-HealthDistricts/lhdmain.aspx
- http://bit.ly/15NMO5m — http://ohiodnr.com/tabid/9093/Default.aspx
- http://1.usa.gov/1fs2XRy — http://epa.ohio.gov/ddagw/labcert.aspx

Page 9
- http://bit.ly/19vv8Jt — http://oilandgas.ohiodnr.gov/resources/investigations-reports-violations-reforms
- http://1.usa.gov/18k4iqr — www.epa.ohio.gov/ portals/28/documents/DWStandardsList.pdf
- http://1.usa.gov/1f9bhYT — http://water.epa.gov/drink/contaminants/basicinformation/index.cfm

Page 10
- www2.epa.gov/region8/pavillion
- http://1.usa.gov/194074q — www.atsdr.cdc.gov/hac/PHA/Pavillion/Pavillion_HC_Well_Water_08312010.pdf
- http://bit.ly/15qOXUb — www.endocrinedisruption.org/chemicals-in-natural-gas-operations/chemicals-and-health
- www2.epa.gov/hfstudy
- http://1.usa.gov/18PWkBq — www.ncbi.nlm.nih.gov/pubmed/22446060
- http://bit.ly/15k85Fw — www.dnr.state.oh.us/Portals/11/bainbridge/report.pdf
- http://1.usa.gov/17VHpc4 — www.atsdr.cdc.gov/HAC/pha/pha.asp?docid=631&pg=1

Page 11
- http://1.usa.gov/16K770g — www.epa.gov/airquality/oilandgas
- http://bit.ly/16AgjV3 — www.garfield-county.com/public-health/documents/1._COMMUNITY_HEALTH_RISK_ANALYSIS-(Complete_Report_16MB).pdf
- http://1.usa.gov/19y7v27 — www.epa.gov/radiation/tenorm/oilandgas.html

 This guide was made possible by a grant from the United States Environmental Protection Agency. The views expressed herein do not necessarily represent those of the U.S. EPA.