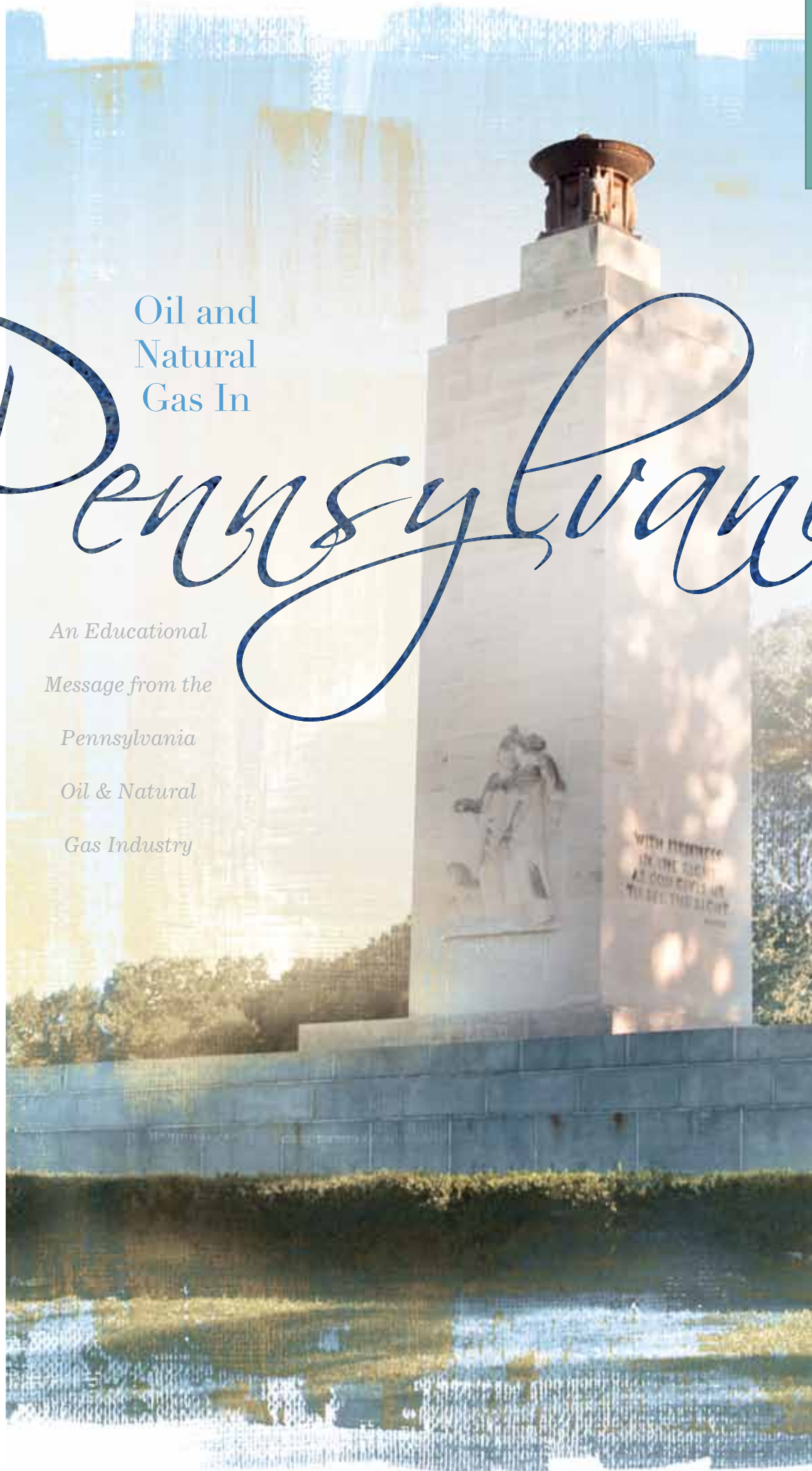




Oil and  
Natural  
Gas In

# Pennsylvania

*An Educational  
Message from the  
Pennsylvania  
Oil & Natural  
Gas Industry*



# Your Questions Answered

Advances in proven technologies are delivering new opportunities in oil and natural gas exploration and production around Pennsylvania.





Natural gas development continues to bring substantial economic and environmental opportunities to Pennsylvania. As with any development activity, local residents and elected officials have questions about oil and natural gas exploration and production.

As part of ongoing statewide educational efforts, the Pennsylvania oil and natural gas community has come together to provide factual information to the public, local leaders and elected officials to raise awareness about natural gas operations and the extensive precautions taken to maintain safety of workers, local communities and the environment.

This booklet aims to answer your questions and provide useful resources. Participating organizations include the American Petroleum Institute, ECHELON Applied Geoscience Consulting, the Marcellus Shale Coalition, the Pennsylvania Independent Oil & Gas Association, and America's Natural Gas Alliance.





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SECTION  
**one**

# Who

## Regulates Oil and Natural Gas Operations?

*An Educational Message from the Pennsylvania Oil & Natural Gas Industry*



Comprehensive regulations govern nearly every aspect of oil and natural gas exploration and production.

Pennsylvania agencies have the delegated authority to enforce a number of federal programs, and Commonwealth laws establish additional requirements to protect the environment and public health.



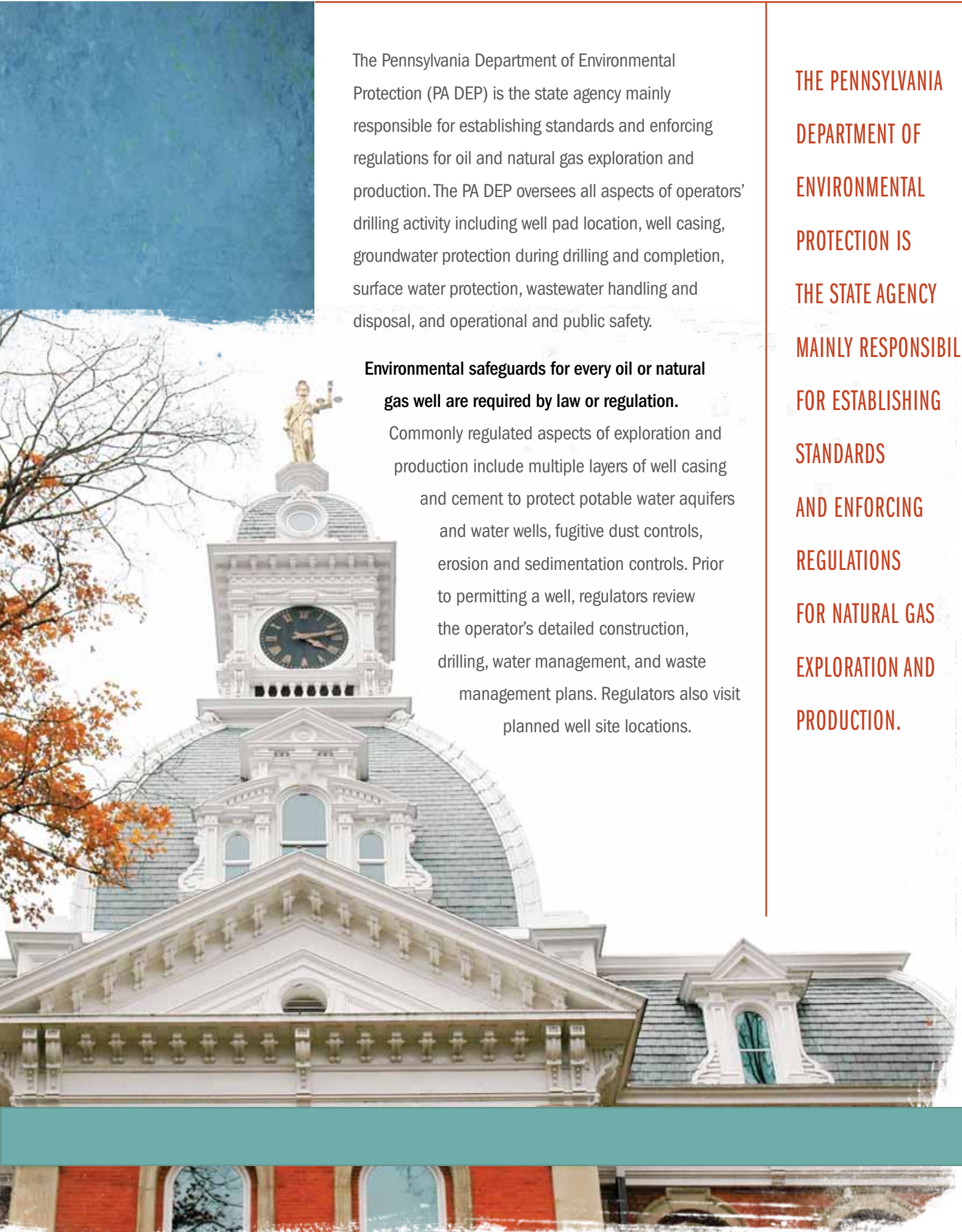


The Pennsylvania Department of Environmental Protection (PA DEP) is the state agency mainly responsible for establishing standards and enforcing regulations for oil and natural gas exploration and production. The PA DEP oversees all aspects of operators' drilling activity including well pad location, well casing, groundwater protection during drilling and completion, surface water protection, wastewater handling and disposal, and operational and public safety.

**Environmental safeguards for every oil or natural gas well are required by law or regulation.**

Commonly regulated aspects of exploration and production include multiple layers of well casing and cement to protect potable water aquifers and water wells, fugitive dust controls, erosion and sedimentation controls. Prior to permitting a well, regulators review the operator's detailed construction, drilling, water management, and waste management plans. Regulators also visit planned well site locations.

THE PENNSYLVANIA  
DEPARTMENT OF  
ENVIRONMENTAL  
PROTECTION IS  
THE STATE AGENCY  
MAINLY RESPONSIBLE  
FOR ESTABLISHING  
STANDARDS  
AND ENFORCING  
REGULATIONS  
FOR NATURAL GAS  
EXPLORATION AND  
PRODUCTION.





In addition to the Pennsylvania Department of Environmental Protection, natural gas operators also work with several other state and federal agencies including:

- ◆ Pennsylvania Public Utility Commission
- ◆ PA Department of Conservation and Natural Resources
- ◆ PA Game Commission
- ◆ PA Fish and Boat Commission
- ◆ PA Department of Transportation
- ◆ Susquehanna River Basin Commission
- ◆ Army Corps of Engineers
- ◆ U.S. Fish and Wildlife Service
- ◆ U.S. Environmental Protection Agency
- ◆ Federal Energy Regulatory Commission

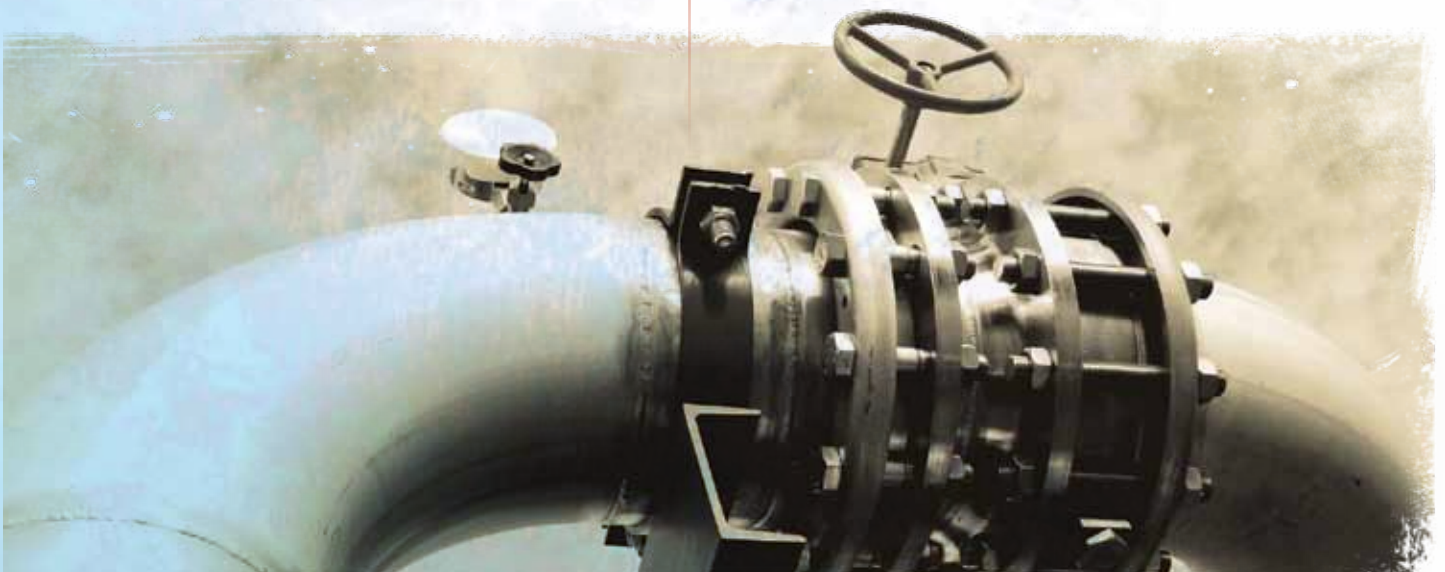
All of these controls and the regulating agencies assure that operators protect the environment while managing the safe development of natural gas reserves.

## IS PENNSYLVANIA DOING A GOOD JOB OF REGULATING HYDRAULIC FRACTURING?

*Yes!*

STRONGER Inc., a nonprofit organization that conducts voluntary state reviews of oil and natural gas environmental regulations, recently completed its review of Pennsylvania's program and concluded that, **"...the Pennsylvania program is, over all, well managed, professional and meeting its program objectives."** In fact, Pennsylvania's oil and natural gas regulations consistently achieve high rankings among the state programs reviewed by STRONGER.

To learn more about natural gas regulations, visit [www.depweb.state.pa.us](http://www.depweb.state.pa.us) (Click "Oil and Gas" link) and [www.strongerinc.org](http://www.strongerinc.org).





SECTION  
**two**

*Hydraulic*  
Fracturing

HYDRAULIC  
FRACTURING

*An Educational Message from the Pennsylvania Oil & Natural Gas Industry*



# What is...

## HYDRAULIC FRACTURING AND WHY IS IT IMPORTANT?

Hydraulic fracturing is a proven technology that has been used for more than 60 years to safely increase the production of oil and natural gas from over one million wells in the United States. It has been an essential part of onshore oil and natural gas production for decades.

For years, developing oil and natural gas deposits in certain rock formations, like Pennsylvania shale formations, was not commercially viable because these natural resources were trapped in extremely dense shale rock thousands of feet below ground. In part because the oil and natural gas could not be effectively accessed with mid-1950s technology, these deposits were termed “unconventional.”

By the 1980s, operators combined proven well completion technology like hydraulic fracturing with stronger motors and drill heads to develop these natural resources responsibly.

### HOW DOES WELL CONSTRUCTION PROTECT FRESHWATER SUPPLIES?

For decades, state regulators have imposed construction requirements for conventional oil and natural gas wells throughout the Commonwealth. These wells are drilled vertically and are much closer to the surface than the newer unconventional, horizontally drilled wells.

**WELL CASING REQUIREMENTS IN PENNSYLVANIA ARE AMONG THE STRONGEST IN THE NATION, PROVIDING MULTIPLE LAYERS OF STEEL AND CEMENT BETWEEN THE WELL BORE AND SURROUNDING GEOLOGY TO PROTECT GROUNDWATER.**

With the advent of Marcellus Shale development and the proliferation of unconventional wells, even more stringent and comprehensive standards and environmental safeguards have been promulgated for high pressure, unconventional wells. Each well must be encased in multiple layers of protective industrial grade steel casing, and each steel casing is surrounded by cement to create a safeguard for underground freshwater supplies.

The casing and cementing process is regulated by the Pennsylvania Department of Environmental Protection and operators must report all phases of casing installation. This highly regulated casing and cementing process – and thousands of feet of dense rock – keeps natural gas out of the freshwater and freshwater out of the natural gas.

### WHAT IS AN UNCONVENTIONAL GAS WELL?

**An unconventional gas well is a well that is drilled into a deep geologic formation (usually comprised of tight dense rock), where natural gas generally cannot be produced except by horizontal or vertical well bores stimulated by hydraulic fracturing.**



PENNSYLVANIA  
DEPARTMENT OF  
ENVIRONMENTAL  
PROTECTION  
REGULATIONS  
INCLUDE  
STRINGENT QUALITY  
AND MONITORING  
REQUIREMENTS  
FOR STEEL CASING  
AND CEMENT TO  
ENSURE THAT FRESH  
GROUNDWATER  
ZONES ARE  
PROTECTED.



# HOW DOES...

## HORIZONTAL DRILLING AND HYDRAULIC FRACTURING WORK?



Small hole, about 15" in diameter

The depth is equal to at least 19 Pennsylvania State Capitol buildings.  
The height of the PA Capitol building: 272 ft.



200 - 1,000 ft.

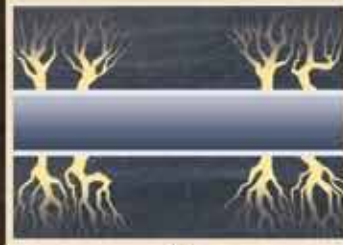
Surfacing casing 200 - 500 ft.

Groundwater Aquifers

Layers of steel encased in cement protect groundwater.

Protective steel casing

Shale Fractures: 1mm wide



Hydraulic fracturing occurs at a depth of approximately 5,000-8,000 ft.

Adapted with permission from the Texas Oil & Gas Association, © 2010



Hydraulic fracturing of unconventional natural gas wells occurs at great depths – generally about a mile underground, thousands of feet below freshwater supplies. With the safety system of steel casing and cement in place, operators drill vertically thousands of feet down to a targeted depth, following essentially the same process for drilling conventional oil and natural gas wells. For unconventional wells, once the desired depth is achieved, operators then turn the drill bit horizontally into the targeted rock formation like the Marcellus Shale to access vast natural gas deposits.

Once drilling is completed and production casing is installed and cemented, hydraulic fracturing fluid is pumped into the formation to create tiny, millimeter thick fissures. A propping agent in the fluid (typically silica sand) helps to prop open the fractures to facilitate the flow of oil and natural gas.

While the hydraulic fracturing technique has been used for decades, the process has been continuously refined to be even more safe and effective.

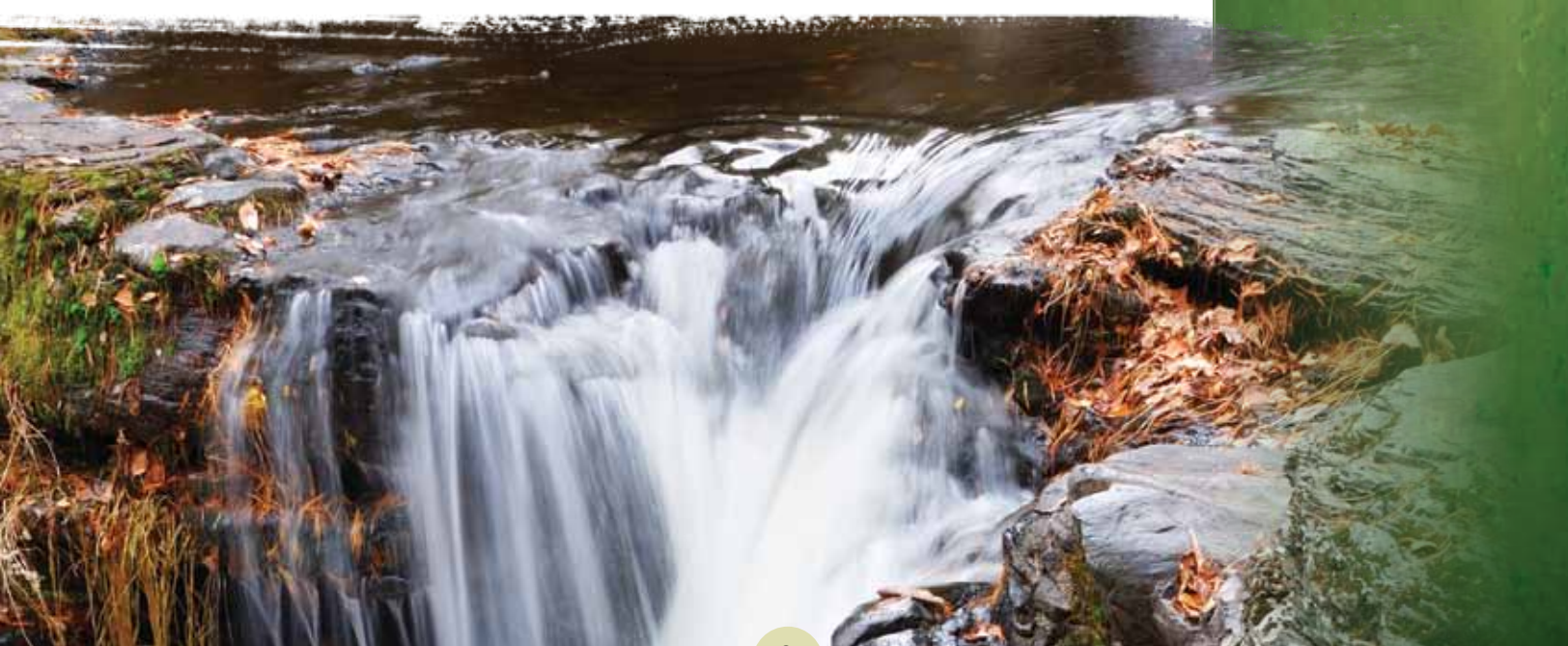
### IS HYDRAULIC FRACTURING SAFE?

*Yes*

Hydraulic fracturing has a 60 year track record and has been used safely in Pennsylvania since the early 1950s. The fracture process for unconventional wells takes place at depths between 5,000 to 8,000 feet below ground surface. Most groundwater aquifers are found between 100 to 200 feet below the surface, or typically more than a mile above the shale being fractured.

The PA Department of Environmental Protection has not identified any instances where groundwater has been affected by hydraulic fracturing. Similarly, the U.S. Environmental Protection Agency, the Groundwater Protection Council (composed of multiple state water pollution control officials) and the Interstate Oil and Gas Compact Commission all have studied hydraulic fracturing and found that existing regulations effectively address and mitigate potential risks.

THE CHANCE FOR  
CONTAMINATION OF  
DRINKING WATER  
SOURCES FROM  
HYDRAULIC  
FRACTURING IS ONE  
IN 200 MILLION,  
ACCORDING TO A  
2009 STUDY BY THE  
GROUNDWATER  
PROTECTION  
COUNCIL, A  
NON-PROFIT  
ORGANIZATION  
OF STATE  
GROUNDWATER  
REGULATORS.





# ADVANCES IN TECHNOLOGY



New technology significantly reduces the environmental impacts of drilling for oil and natural gas. Operators are constantly refining innovations to further reduce the industry's environmental footprint. Innovations include walking rigs capable of drilling multiple wells from one pad, biodegradable drilling mud products, ultraviolet lighting to kill bacteria, and ceramic beads used to prop open the fractures to facilitate the flow of oil and natural gas. These innovations, coupled with hydraulic fracturing, have helped to dramatically increase domestic natural gas supplies.



# Thanks TO HYDRAULIC FRACTURING.....

Horizontal drilling of an unconventional well from a multi-well pad allows for the most efficient extraction of natural gas from an area, significantly reducing total surface impact by 75 percent or more over conventional vertical drilling.

**UNCONVENTIONAL WELLS TODAY CAN ACCESS MORE OF THE PRODUCING FORMATION**

The average unconventional well site today can access more of the producing formation than was previously possible.

THESE INNOVATIONS, COUPLED WITH HYDRAULIC FRACTURING, HAVE HELPED TO DRAMATICALLY INCREASE DOMESTIC NATURAL GAS SUPPLIES.

**FEWER WELLS AND FEWER PADS**

Today, operators can drill as few as six to eight wells on a single unconventional well pad to access the same amount of natural gas that requires 16 or more conventional wells drilled from individual locations. Drilling multiple unconventional wells from one site also reduces the number of well pads, access roads and pipelines.

**REDUCED AIR EMISSIONS**

Greater equipment and engine efficiency, as well as improved technologies, mean less energy consumption -- thus lower air emissions -- per unit of energy produced.



# What IS IN HYDRAULIC FRACTURING FLUID?

**98%-99.5%**  
WATER & SAND

**0.5%-2%**  
ADDITIVES

According to the Ground Water Protection Council, the concentration of chemicals in most hydraulic fracturing fluids used in Pennsylvania is relatively consistent, ranging from 99.5 percent water and sand/0.5 percent additive to 98 percent water and sand/2 percent additives.

CHEMICALS  
ARE USED IN  
HYDRAULIC  
FRACTURING TO  
ENSURE THAT  
THE PROCESS IS  
SAFE, EFFECTIVE  
AND EFFICIENT.

## WHY ARE CHEMICALS USED IN HYDRAULIC FRACTURING?

Chemicals are used in hydraulic fracturing to ensure that the process is safe, effective and efficient. Each chemical serves a specific, engineered purpose such as limiting growth of bacteria and preventing well casing corrosion. Friction reducing additives, for example, significantly decrease pump engine emissions by reducing the fluid pressure required for hydraulic fracturing. Corrosion inhibitors protect pipe and help to maintain well integrity. The number and type of chemicals used in each hydraulic fracturing job depends on geology and the specific well to be fractured.

Hydraulic fracturing chemicals generally fall into four categories and are similar to many common household products. These include: a surfactant (like soap) to reduce friction; a biocide (similar to an anti-bacterial hand sanitizer) to keep the well bore free of bacteria; a scale inhibitor (comparable to products used in residential plumbing); and a lubricant (similar to vegetable oil) to make the water heavier and reduce friction.

These additives are highly diluted given that fracturing fluid is roughly 90 percent water.



# How ARE THE CHEMICALS USED IN HYDRAULIC FRACTURING DETERMINED?

The quantity and particular chemical additives used in a fracturing treatment are specifically tailored to each well and are based on local geology, weather conditions, and the equipment in use. Additives can vary significantly in different geographic areas, sometimes even within a single natural gas shale play.

## CHEMICALS COMMONLY USED IN HYDRAULIC FRACTURING AND CONSEQUENCES OF NOT USING THE CHEMICAL

CHEMICAL	USE	CONSEQUENCES OF NOT USING CHEMICAL
Acid	Removes near well damage	Higher treating pressure, slightly more engine emissions.
Biocides	Controls bacterial growth	Increased risk of souring the formation (H <sub>2</sub> S gas from sulfate reducing bacteria growth) and increasing corrosion.
Corrosion Inhibitor	Used in the acid to prevent corrosion of pipe	Sharply increased risk of pipe corrosion from acid. Well integrity compromised.
Friction Reducers	Decreases pumping friction	Significantly increases surface pressure and pump engines emissions.
Gelling Agents	Improves proppant placement	Increased water use.
Oxygen Scavenger	Prevents corrosion of well tubulars by oxygen	Corrosions sharply increased and well integrity (containment) compromised.

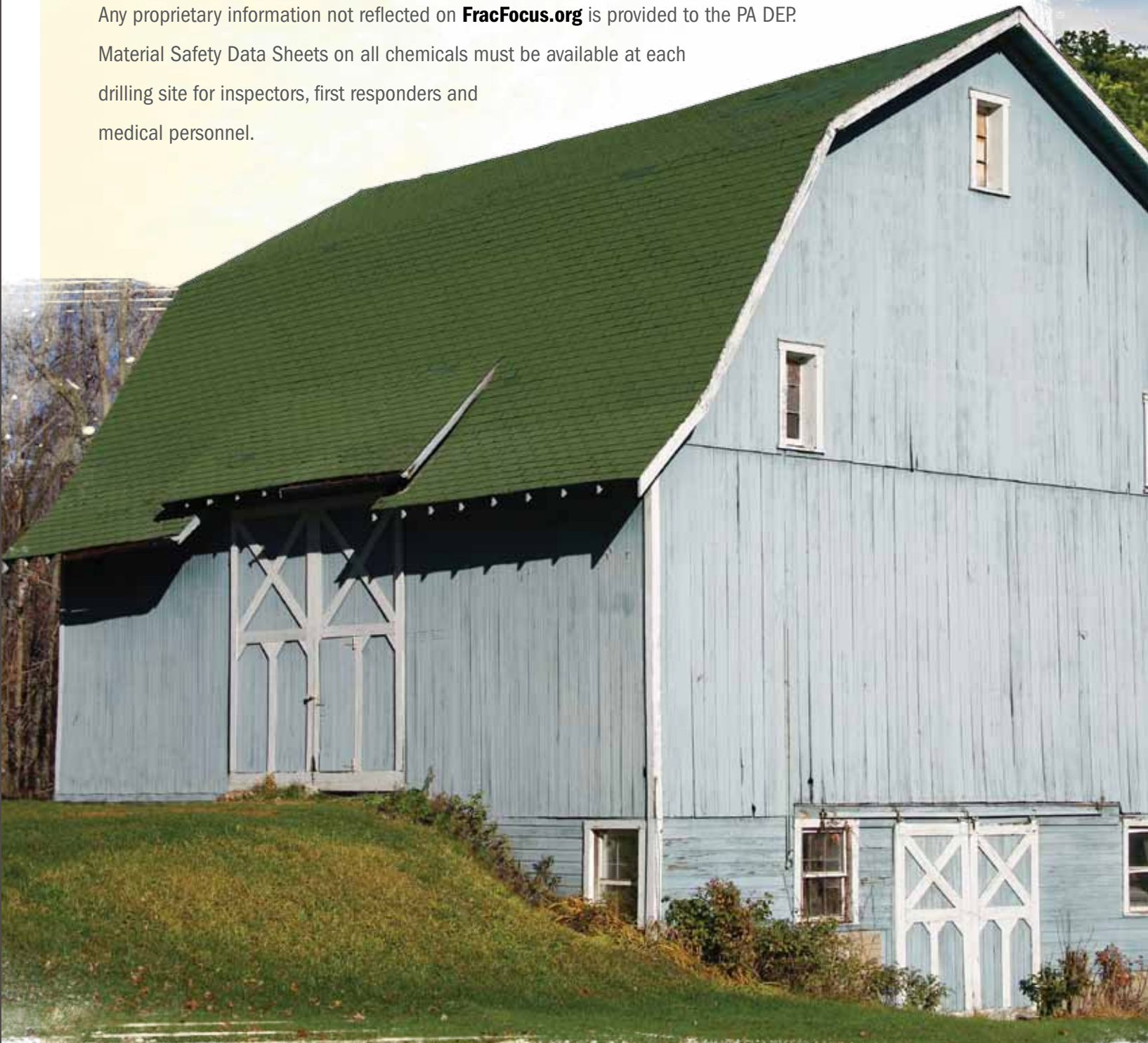
Once a customized formula for hydraulic fracturing fluid is determined, all chemicals are transported to and managed at the drilling location according to state and federal regulations. Pennsylvania requires Material Safety Data Sheets on all chemicals to be available on site for inspectors or for first responders if needed.

**To learn more about hydraulic fracturing fluid visit [www.fracfocus.org](http://www.fracfocus.org)**

## HYDRAULIC FRACTURING DISCLOSURE

Pennsylvania oil and natural gas operators must report the chemicals used in hydraulic fracturing fluids and the amount of water used in hydraulic fracturing to the Pennsylvania Department of Environmental Protection (PA DEP) and must post this information on a free, publicly accessible website: **www.FracFocus.org**. **FracFocus.org** is a joint project of the Ground Water Protection Council (a group of state water regulators) and the Interstate Oil and Gas Compact Commission (a group of governors and appointed representatives in oil and gas producing states). FracFocus provides a searchable database by operator, well or location.

Any proprietary information not reflected on **FracFocus.org** is provided to the PA DEP. Material Safety Data Sheets on all chemicals must be available at each drilling site for inspectors, first responders and medical personnel.









# UNDERSTANDING DRILLING AND WELL CONSTRUCTION

## HOW DO COMPANIES CHOOSE LOCATIONS FOR WELLS?

Before a company drills a well, geologists and engineers study the size, structure and thickness of the rock formations to scientifically determine how and where drilling should occur. Operators must obtain information on the depth and location of all freshwater zones to ensure that protections for the entire zone of freshwater are in place.

## CAN OPERATORS BEGIN DEVELOPMENT BEFORE OBTAINING ALL NECESSARY PERMITS?

**No.** Operators must have all necessary permits in hand before any development begins.

## HOW LONG DOES IT TAKE TO PREPARE TO DRILL A WELL?

It takes several weeks to prepare the well site before drilling can take place. This time includes pad site construction and moving equipment on site. The rig and the equipment are temporary and are removed once the well is drilled. The well is then hydraulically fractured to produce the gas. With drilling complete, a production site is typically about 300 by 600 feet. An individual well can produce for 30 to 50 years or more, providing long-term local jobs and tax revenue.

## WHAT HAPPENS IF THERE'S AN INCIDENT LIKE SOMETHING SPILLED ON THE DRILL PAD?

Natural gas companies place a high priority on safety and constantly monitor operations. In the event of an incident, each site is required by the Pennsylvania Department of Environmental Protection to have an emergency response plan in place that complies with state regulations. The plan details the proper steps needed to immediately “contain and clean” the area, minimize any impact on the environment, and notify proper authorities.

**To learn more about hydraulic fracturing or drilling, visit the PA DEP website: [www.depweb.state.pa.us](http://www.depweb.state.pa.us) (Click “Oil and Gas” link).**





SECTION  
three

# Water

WATER

*An Educational Message from the Pennsylvania Oil & Natural Gas Industry*



# WHO OVERSEES THE RULES NATURAL GAS OPERATORS MUST FOLLOW TO PROTECT THE WATER IN PENNSYLVANIA?

The Pennsylvania Department of Environmental Protection has wide ranging regulations to protect the surface and subsurface waters of Pennsylvania during natural gas drilling, completion and production operations. Any operator with plans to drill or produce natural gas in Pennsylvania must apply for a permit from the Department of Environmental Protection. The drilling permit application provides the Department with detailed well construction information before a well is drilled and includes a water management plan.

All water withdrawal plans must be approved by the PA DEP and the applicable river basin commission such as the Susquehanna River Basin Commission (SRBC) or the Delaware River Basin Commission (DRBC). In the case of the Ohio River Basin Commission, the PA DEP approves water withdrawal plans. Each water management plan is designed so that withdrawal under drought conditions will not adversely impact the Commonwealth waterways or public/private water sources.

In addition to water withdrawal plans, Pennsylvania law requires every natural gas operator to conduct pre-drill water well testing. Results of the tests are shared with the PA DEP and with the landowner. In Pennsylvania, there are no regulatory construction standards for private water wells and so residents are often unaware of the quality or content of their well water until they receive their pre-drill test results.

# HOW MUCH WATER ARE NATURAL GAS OPERATORS USING?

Natural gas operations account for a small percentage of water usage statewide. Natural gas and oil operators in Pennsylvania typically use about three to five million gallons of water to drill and fracture a horizontal well. Of this, about 20 to 30 percent of the produced water is returned to the surface shortly after drilling. Recent advances in technology to treat and reuse produced water for multiple fracturing operations are significantly reducing water use and the need for off-site treatment. Many drilling companies have been successful in reusing 100 percent of produced water and natural gas operators continue to work closely with state regulators and water management experts to develop innovative ways to reduce, recycle and reuse the water.







## WHAT HAPPENS TO WATER AFTER IT'S USED FOR HYDRAULIC FRACTURING?

Hydraulic fracturing fluid in the Commonwealth is being increasingly reused for future unconventional natural gas well operations. Operators have the option to use wastewater treatment facilities licensed by the Department of Environmental Protection should they no longer need the water or the water cannot be reused. (See Waste Management section for more information.)



# PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION OIL AND GAS REGULATIONS EXPRESSLY PROHIBIT POLLUTION OF SURFACE AND SUBSURFACE WATERS FROM NATURAL GAS DRILLING, COMPLETION AND PRODUCTION ACTIVITIES.

DOES PENNSYLVANIA HAVE  
SPECIFIC RULES THAT  
PROHIBIT WATER POLLUTION?

*Yes*

Pennsylvania  
Department of  
Environmental Protection

Oil and Natural Gas Regulations  
expressly prohibit pollution of  
surface and subsurface waters from  
natural gas drilling, completion and  
production activities. This rule applies  
to water sources including rivers,  
streams, creeks, lakes, reservoirs,  
wetlands and surface drainage. See  
58 Pa. C.S. §§ 2301-3504.







## WHAT ABOUT TESTING OF NATURAL GAS WELL CONSTRUCTION?

Companies may be required by the Pennsylvania Department of Environmental Protection to conduct cement bond logs and submit copies to state regulators. These logs are diagnostic and provide graphic evidence that the steel and cement well casings are sound.

## WHAT HAPPENS TO INACTIVE OR “ORPHANED” WELLS?

According to the PA DEP, Pennsylvania has thousands of oil and gas wells drilled since 1859. Operators of active wells are responsible for plugging them when they reach the end of their useful life. Abandoned wells that don't have a responsible party are addressed by the Commonwealth's Abandoned and Orphaned Well Plugging Program. The program was created to plug abandoned wells that have the potential to cause health, safety, or environmental concerns.

The Oil and Gas Act established surcharges to permit fees (paid in addition to permit application fees) to fund the Abandoned Well Plugging Fund and the Orphaned Well Plugging Program. The 2012 Oil and Gas Act, Section 3271, continued the provision for surcharges. A \$50 surcharge goes into the Abandoned Well Plugging Fund. Surcharges of \$100 for oil wells and \$200 for natural gas wells go into the Orphan Well Plugging Fund.

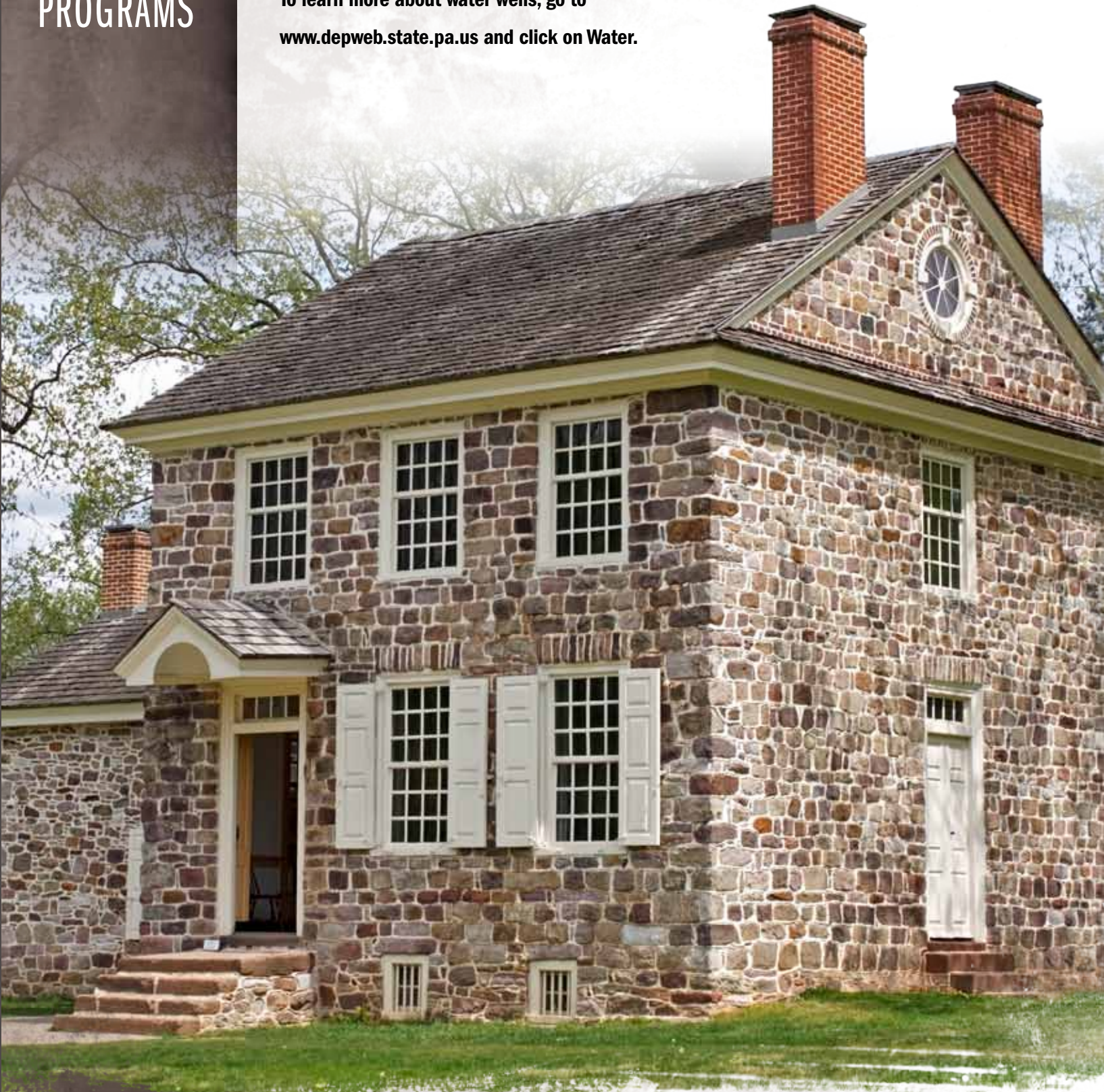
EACH WELL  
MUST BE  
ENCASED IN  
MULTIPLE  
LAYERS OF  
PROTECTIVE,  
INDUSTRIAL  
GRADE STEEL  
CASING AND  
EACH IS  
SURROUNDED  
BY CEMENT  
TO CREATE A  
REDUNDANT  
SAFEGUARD  
FOR  
UNDERGROUND  
FRESHWATER  
SUPPLIES.



# OPERATOR CLEANUP PROGRAMS

Although operators maintain performance based procedures to prevent incidents like surface spills, the Pennsylvania Department of Environmental Protection provides direction and oversight in the event that an environmental cleanup project is necessary.

**To learn more about water wells, go to [www.depweb.state.pa.us](http://www.depweb.state.pa.us) and click on Water.**





SECTION  
**four**

# Methane

Migration

METHANE  
MIGRATION

*An Educational Message from the Pennsylvania Oil & Natural Gas Industry*



# METHANE GAS MIGRATION

Methane gas is readily formed from organic matter in the subsurface by microbial or thermogenic (or heat producing) processes. Its occurrence in groundwater is often the result of natural processes; however, it can also be due to human activity. Methane migrates from areas of high pressure to areas of low pressure. Groundwater wells represent areas of lower pressure and therefore a natural migration pathway for methane regardless of its origin.

## NO STANDARDS FOR PRIVATE WATER WELL CONSTRUCTION, TESTING OR VENTING

Pennsylvania and Alaska are the only two states without private water well construction standards so residents are often unaware of the quality or content of their well water. Owners of private water wells are not required to test for or vent methane from their wells.

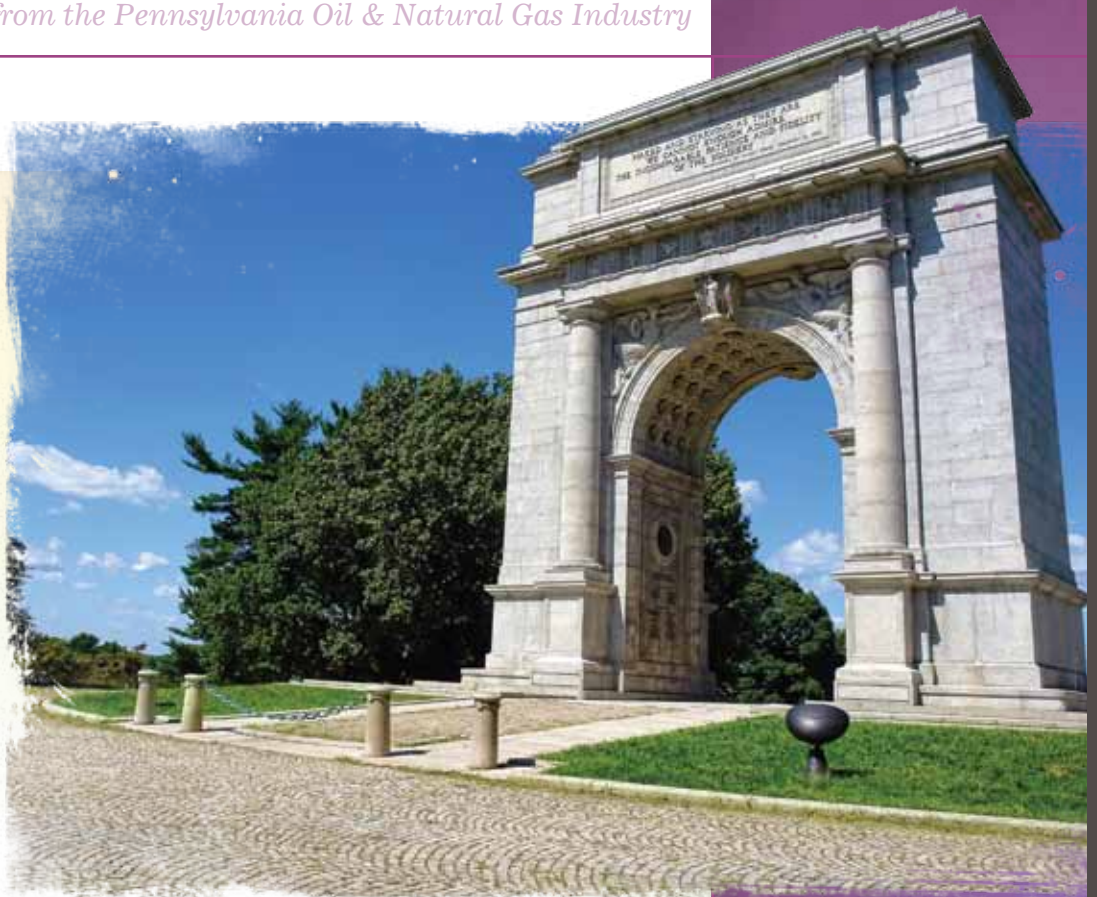
In areas of Pennsylvania experiencing oil and natural gas production, there is much discussion about methane gas migration and groundwater supply wells. The conversation about methane in water may be new, but the presence of methane in Northeastern Pennsylvania drinking water aquifers is not new and drinking water that contains methane is not an ingestion hazard. More than 200 years of records show that quantities of methane have been present at shallow depths in Northeastern Pennsylvania, long before natural gas development began. In fact, the occurrence of methane in aquifer systems is common in coal and petroliferous basins across Pennsylvania and around the world.





## NEW RESEARCH: NATURALLY OCCURRING METHANE IN WATER WELLS

A robust study,<sup>1</sup> which sampled more than 11,300 water wells in northeastern Pennsylvania - before any drilling activity occurred - detected naturally occurring methane in 24 percent of the water wells. The study showed that high concentrations of methane in water wells are rare. Only 1.1 percent of wells where methane was detected contained levels considered to be high.



## STUDY: OCCURRENCES OF METHANE GASES IN SOME SHALLOW AQUIFER SYSTEMS ARE A NATURAL CONDITION THAT “PRE-DATE MARCELLUS FORMATION DRILLING ACTIVITY.”

A second study<sup>2</sup> by researchers that included the Pennsylvania Geologic Survey determined through “genetic fingerprinting” analyses that methane detected in water wells is different in origin than the natural gas produced from the Marcellus Shale. The study found that occurrences of methane gases in some shallow aquifer systems are a natural condition that “pre-date Marcellus Formation drilling activity.”

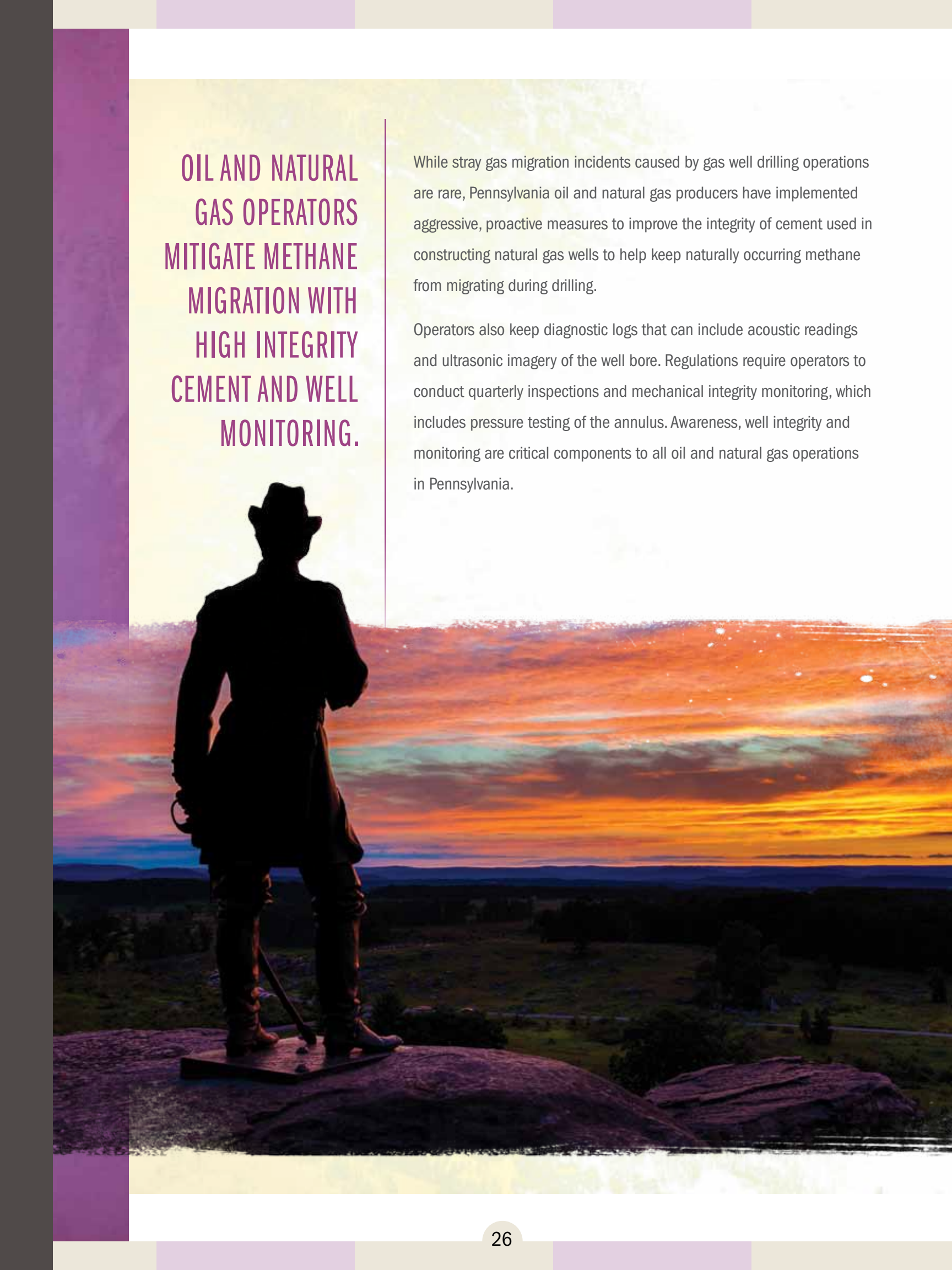
Additional research by the Center for Rural Pennsylvania found no significant relationship of methane concentrations in water wells and correlated distance from natural gas production operations.

<sup>1</sup>“Long-Term Variability in Methane in Domestic Water Wells in Northeast Pennsylvania,” Richard Wardrop, PG, et. al. Groundwater & Environmental Services, Inc., Groundwater Protection Council Stray Gas Forum, Dallas TX, July, 2013

<sup>2</sup>“A Geochemical Context for Stray Gas Investigations in the N. Appalachian Basin: Implications of Analyses of Natural Gases from Neogene-through-Devonian-Age Strata,” Fred Baldassare, ECHELON Applied Geochemistry Consulting; Mark McCaffrey, PhD, Weatherford Laboratories John A. Harper, PhD; Pennsylvania Geological Survey, AAPG Bulletin, February, 2014

RESEARCH BY  
THE CENTER  
FOR RURAL  
PENNSYLVANIA  
FOUND NO  
SIGNIFICANT  
RELATIONSHIP  
OF METHANE  
CONCENTRATIONS  
IN WATER WELLS  
AND CORRELATED  
DISTANCE FROM  
NATURAL GAS  
PRODUCTION  
OPERATIONS.





## OIL AND NATURAL GAS OPERATORS MITIGATE METHANE MIGRATION WITH HIGH INTEGRITY CEMENT AND WELL MONITORING.

While stray gas migration incidents caused by gas well drilling operations are rare, Pennsylvania oil and natural gas producers have implemented aggressive, proactive measures to improve the integrity of cement used in constructing natural gas wells to help keep naturally occurring methane from migrating during drilling.

Operators also keep diagnostic logs that can include acoustic readings and ultrasonic imagery of the well bore. Regulations require operators to conduct quarterly inspections and mechanical integrity monitoring, which includes pressure testing of the annulus. Awareness, well integrity and monitoring are critical components to all oil and natural gas operations in Pennsylvania.



SECTION  
five

*Air*

AIR

*An Educational Message from the Pennsylvania Oil & Natural Gas Industry*



Who regulates air  
quality associated with  
oil and natural gas  
operations?





The Pennsylvania Department of Environmental Protection has primary authority and jurisdiction to ensure that natural gas operations comply with state and federal air quality rules and regulations. The Pennsylvania Department of Environmental Protection administers rules and programs designed to implement the requirements of the Pennsylvania and Federal Clean Air Acts.





TOOLS TO  
INSPECT  
EQUIPMENT  
FOR LEAKS  
INCLUDE  
INFRARED  
CAMERAS  
AND  
HANDHELD  
EMISSION  
DETECTION  
DEVICES.

## WHAT ARE NATURAL GAS OPERATORS DOING TO PROTECT THE AIR?

All natural gas operators must strictly comply with Pennsylvania Department of Environmental Protection regulations established to control air emissions. Depending on the nature of the operation and the potential to emit, operators may be subject to specific permitting requirements. Companies also must comply with regulations that cover emissions from engines and generators at well sites.

Companies closely monitor pressures of wells and distribution systems to detect leaks. The pressure in pipelines and other production equipment can be monitored from remote sites using computerized systems.

Additional tools to inspect equipment for leaks include infrared cameras and handheld emission detection devices. Operators have a proven track record for quickly identifying and repairing faulty equipment. They may install additional air quality equipment to reduce the risk of leaks. In addition to protecting the air, operators are vigilant in repairing leaks to avoid loss of product and therefore revenue.

## HOW DOES THE STATE KEEP TRACK OF AIR EMISSIONS?

All natural gas facilities in Pennsylvania with emissions above a minimum threshold must submit an annual air emissions inventory to state regulators. The annual air emissions inventory allows the state to review air quality conditions and trends and provides a basis for focusing regulations and manpower on high priority areas. State regulators also use air monitors, handheld air monitoring equipment, mobile laboratory equipment and windshield surveys to assess air emissions at oil and natural gas operations across the state.

**To learn more about  
air quality regulation,  
visit the PA DEP website:  
[www.depweb.state.pa.us](http://www.depweb.state.pa.us)  
(Click “Oil and Gas” link).**





SECTION  
**SIX**

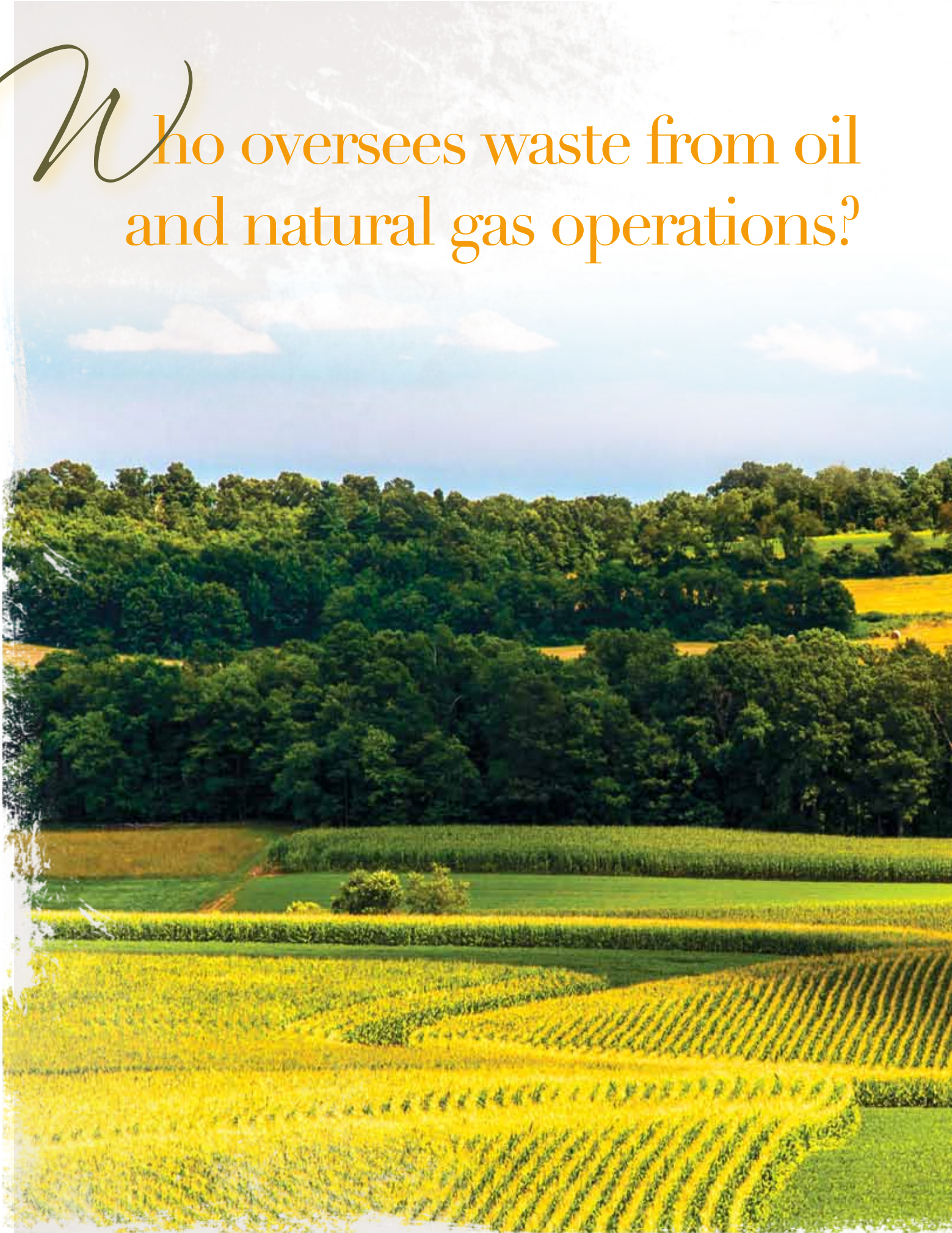
*Waste*  
Management

WASTE  
MANAGEMENT

*An Educational Message from the Pennsylvania Oil & Natural Gas Industry*



# Who oversees waste from oil and natural gas operations?





The Pennsylvania Department of Environmental Protection oversees the management of exploration and production waste at oil and natural gas operation sites, such as produced water, salt water or drill cuttings (the soil and rock that come out of the ground when a well is drilled).

Operators in Pennsylvania must apply for a waste management permit prior disposing of any wastes.



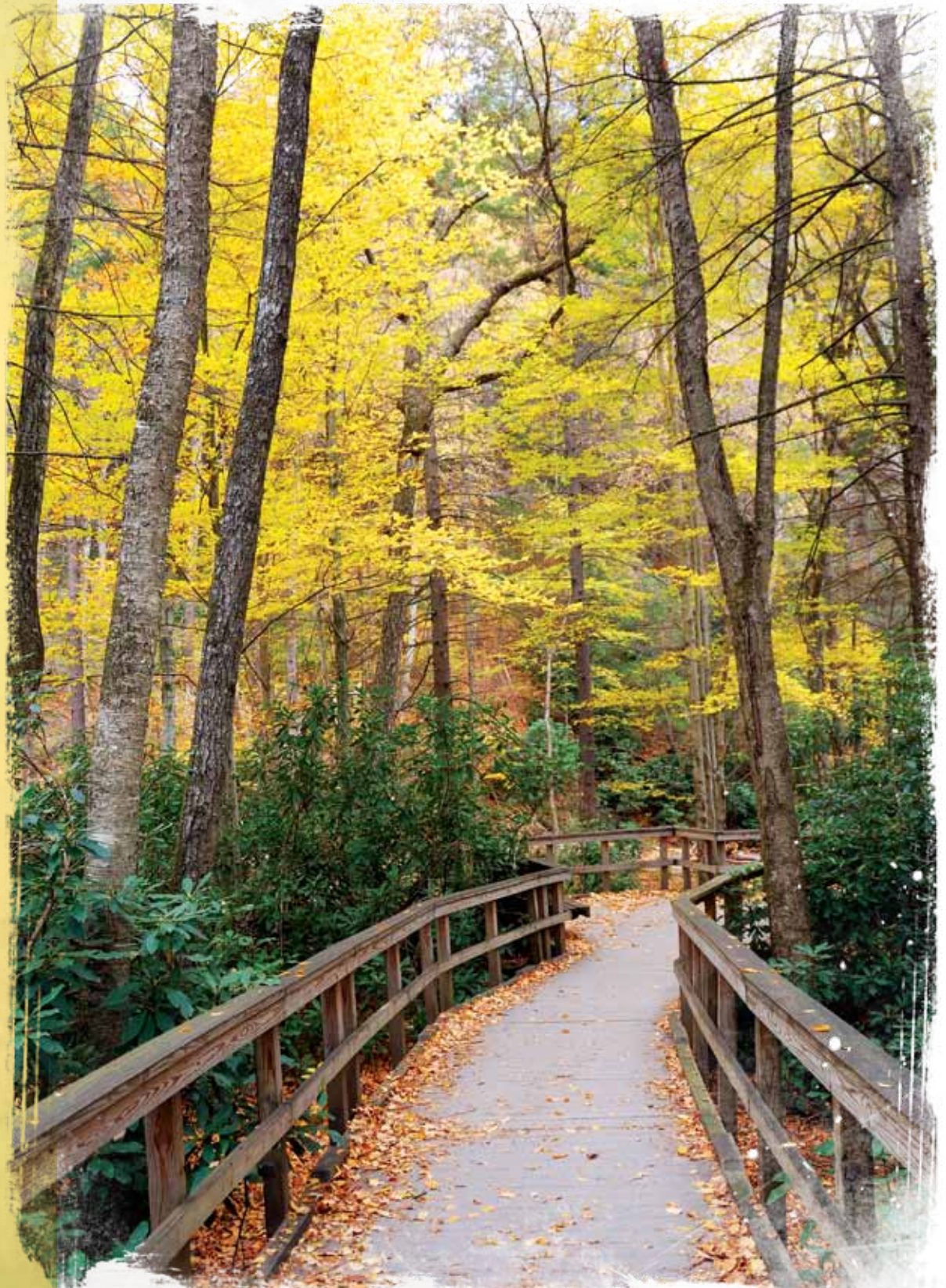


## HOW IS WASTE REGULATED?

The Pennsylvania Department of Environmental Protection requires the operator to be responsible for the proper handling and transportation of exploration and production waste taken off-site to ensure that the waste is delivered to an approved and permitted facility. Each shipment must be documented and waste disposal documentation is submitted to the PA DEP.

## WHAT HAPPENS TO WATER FROM OIL AND NATURAL GAS OPERATIONS THAT CAN NO LONGER BE REUSED?

When water from oil and natural gas operations can no longer be reused, operators have the option to use wastewater treatment facilities licensed by the Department of Environmental Protection or to use permitted injection wells for disposal. The PA DEP regulates the transportation and disposal of waste fluids removed from the well location.





SECTION  
seven

# Pipelining

Safety

*An Educational Message from the Pennsylvania Oil & Natural Gas Industry*



WHAT CAN YOU  
DO TO PROMOTE  
PIPELINE SAFETY?

**CALL 811**  
before you dig.

**WAIT**  
the time required –  
3 business days – to  
receive the locations  
of any underground  
pipelines and  
other facilities.

**RESPECT**  
the marks.

**DIG**  
with care.

# What is *Pennsylvania* One Call?

It is very important for anyone planning an excavation project to know the location of pipelines and other underground facilities before digging begins. In Pennsylvania, anyone digging near a pipeline is required to take specific safety measures before and during excavating.



**Know what's below.  
Call before you dig.**







The first requirement is to call Pennsylvania One Call at least three business days before excavation begins. This applies to anyone who will be digging such as homeowners, commercial contractors, fence builders and road maintenance crews. The One Call center serves as a clearinghouse for digging or excavation activities near pipelines or other underground facilities.

Underground facility operators will then mark their facilities using paint, flags or stakes to designate the location of the buried facility. **In Pennsylvania, dial 811 to reach the One Call notification center or submit a Web ticket online at [www.pa1call.org](http://www.pa1call.org).**

**THE FIRST  
REQUIREMENT  
IS TO CALL  
PENNSYLVANIA  
ONE CALL**



## WHAT ARE PIPELINE OPERATORS DOING TO PROMOTE SAFETY?

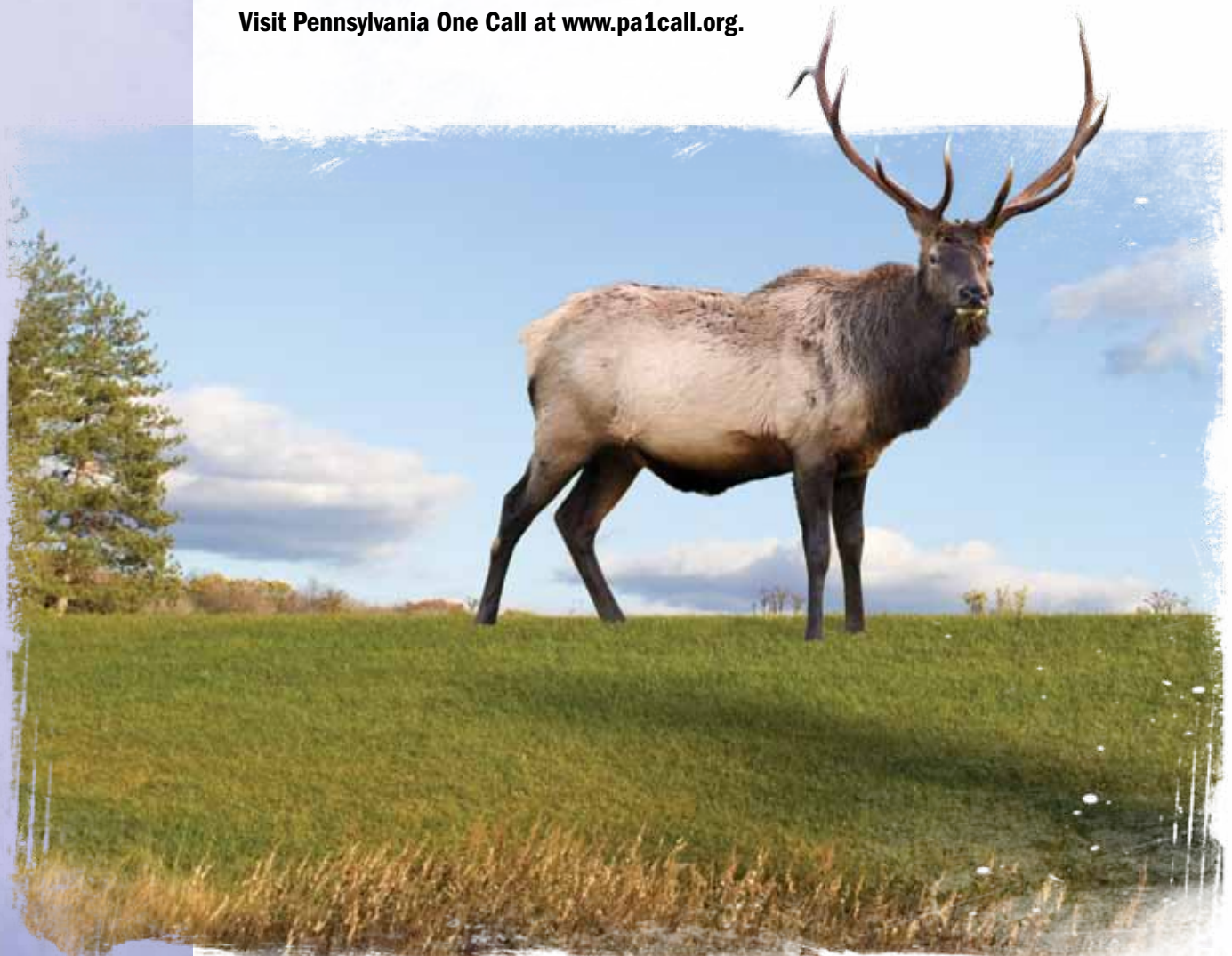
Pipelines are constructed or buried at different depths depending on the type and location of the line, with the majority of pipelines being at least three feet deep when initially built. Pipeline operators take extensive steps to protect the integrity of their systems and the safety of the communities where they operate.

This includes building pipelines to specific construction standards, taking measures to prevent internal and external corrosion, monitoring the pipeline rights-of-way, and conducting public awareness efforts in the communities where they operate.

Additionally, transmission and distribution operators are required to implement integrity management programs to assess the greatest risks to the integrity of their systems. To inspect for leaks and confirm the integrity of the pipe, pipeline operators routinely walk and fly over the pipeline rights-of-way, and conduct other testing on a periodic basis.

Pipeline operators often mark the route of a pipeline with signs or markers that list the name of the operator, the type of product being transported, and an emergency phone number to contact the operator.

**Visit Pennsylvania One Call at [www.pa1call.org](http://www.pa1call.org).**





SECTION  
eight

# Benefits

*An Educational Message from the Pennsylvania Oil & Natural Gas Industry*







# OIL AND NATURAL GAS INDUSTRY FACTS

## FACT

**Horizontal drilling of an unconventional well from a multi-well pad allows for the most efficient extraction of natural gas from an area, significantly reducing total surface impact by 75 percent or more over conventional vertical drilling.**

FACTS CONTINUED  
ON NEXT PAGE





# PENNSYLVANIA OIL AND NATURAL GAS INDUSTRY FACTS

CONTINUED

## FACT

Pennsylvania's oil and natural gas regulations consistently achieve high rankings among the state programs reviewed by the State Review of Oil and Natural Gas Environmental Regulations (STRONGER), an independent monitor of environmental programs.

## FACT

Well casing requirements in Pennsylvania are among the strongest in the nation, providing multiple layers of steel and cement between the well bore and surrounding geology to protect groundwater.

## FACT

A 2009 study by the Groundwater Protection Council, a non-profit organization of state groundwater regulators, found the chance for contamination of drinking water sources from hydraulic fracturing to be one in 200 million.

## FACT

Hydraulic fracturing has been used to produce oil and natural gas in the U.S. since 1947, without a reported incident of groundwater contamination.

## FACT

By 2020, the industry will provide a total economic impact of \$18.8 billion and 211,000 jobs for the Commonwealth, along with nearly \$1.8 billion in state and local tax revenues.

## FACT

Pennsylvania is projected to become a net exporter of natural gas, a stark contrast to 2008, when the state imported 75 percent of the natural gas used by businesses and consumers.



# THE PENNSYLVANIA NATURAL GAS INDUSTRY RESPONSIBLE FOR \$3.5 BILLION IN REVENUE FOR STATE AND LOCAL GOVERNMENTS

**\$1.4  
BILLION**  
PAID IN STATE TAXES AND FEES

The natural gas industry paid directly to the state nearly **\$1.4 billion** in state taxes and fees in fiscal year 2012. By conservative estimate, the natural gas industry paid an additional **\$298 million** in property taxes to local governments in 2012.

**\$1.125  
BILLION**  
PAID IN STATE TAXES AND FEES

More significantly, due to the household incomes generated by the natural gas industry, state government collected an additional **\$1.125 billion** in taxes and local governments collected an additional **\$707 million** in local taxes.

Exceeded **\$5  
BILLION**  
PAID IN PA WAGES

In 2012, there were **62,417** workers employed directly in the Pennsylvania natural gas industry with wages of more than **\$5 billion**.

Industry employees in the Commonwealth have an average annual income of about **\$80,000**, which ranks these jobs among Pennsylvania's highest paying employment opportunities.

THE PA NATURAL GAS INDUSTRY PRODUCES  
**HIGH-QUALITY  
JOBS**

PA NATURAL GAS INDUSTRY  
EMPLOYS  
**62,417**

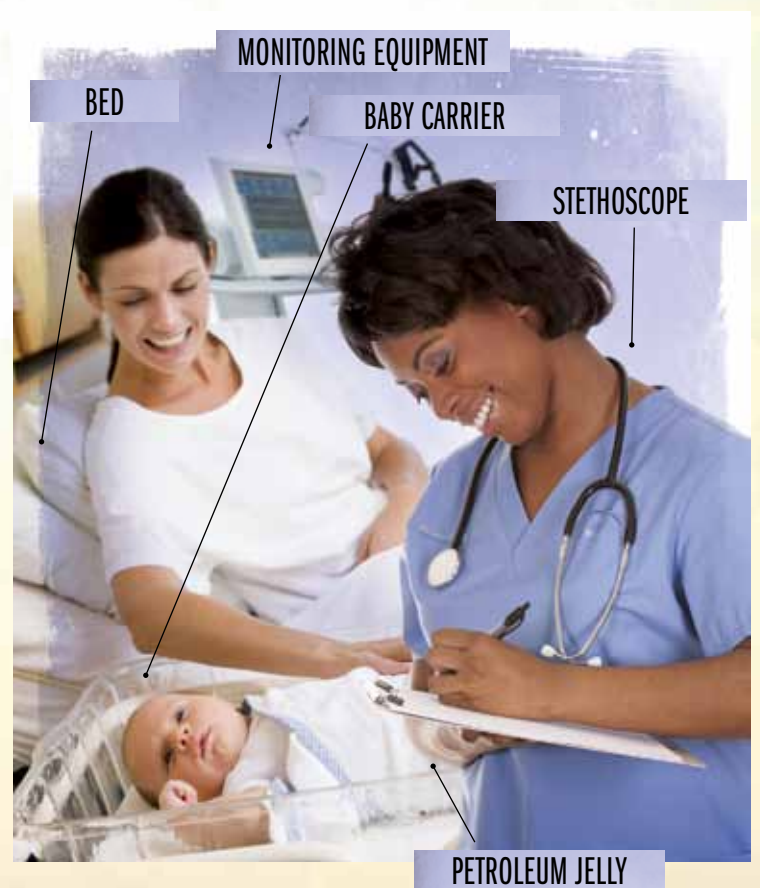
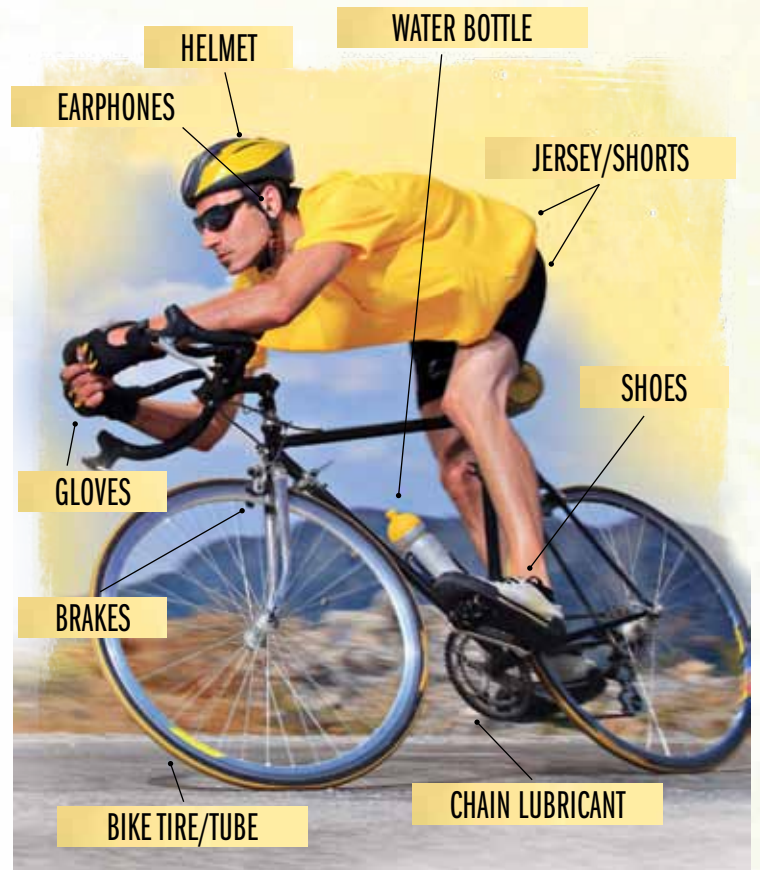
## JOBS CREATING JOBS

GIVEN THE LARGE CAPITAL OUTLAYS AND OTHER EXPENDITURES THAT ACCOMPANY NATURAL GAS JOBS, AN ECONOMIC RIPPLE EFFECT OCCURS AS EACH JOB TENDS TO GENERATE MANY OTHER JOBS IN PENNSYLVANIA.



# Petroleum:

## ESSENTIAL FOR PENNSYLVANIANS' WAY OF LIFE





## HELPFUL RESOURCES

America's Natural Gas Alliance: [www.anga.us](http://www.anga.us)

American Petroleum Institute: [www.api.org](http://www.api.org)

Marcellus Shale Coalition: [www.marcelluscoalition.org](http://www.marcelluscoalition.org)

PA Independent Oil & Gas Association: [www.pioga.org](http://www.pioga.org)

Federal Energy Regulatory Commission: [www.ferc.gov](http://www.ferc.gov)

Pennsylvania Department of Conservation and Natural Resources: [www.dcnr.state.pa.us](http://www.dcnr.state.pa.us)

Pennsylvania Department of Environmental Protection: [www.depweb.state.pa.us](http://www.depweb.state.pa.us)

Pennsylvania Fish and Boat Commission: [www.fish.state.pa.us](http://www.fish.state.pa.us)

Pennsylvania Game Commission: [www.pgc.state.pa.us](http://www.pgc.state.pa.us)

Pennsylvania Public Utility Commission: [www.puc.state.pa.us](http://www.puc.state.pa.us)

Susquehanna River Basin Commission: [www.srbc.net](http://www.srbc.net)

U.S. Environmental Protection Agency: [www.epa.gov](http://www.epa.gov)

U.S. Fish and Wildlife Service: [www.fws.gov](http://www.fws.gov)







Oil and  
Natural  
Gas In  
*Pennsylvania*

*An Educational Message from the Pennsylvania Oil & Natural Gas Industry*



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# NATURAL GAS SYSTEM IN THE STATE OF PENNSYLVANIA

The natural gas system is comprised of many components including wells that produce natural gas, gathering lines, compressor stations, transmission lines (or pipelines), processing plants, underground storage, liquid natural gas plants and distribution mains. This system delivers natural gas, in its various forms, to local municipalities, large consumers like power generation plants, and residential customers.

Techniques associated with natural gas production, like hydraulic fracturing, are but one step in a multi-faceted system that delivers the benefits of natural gas to all Pennsylvanians.

