



October 20, 2022

CERTIFIED MAIL NO. [REDACTED]

[REDACTED]

Re: Request for Investigation 346646
Stray Gas Migrating into Water Well – Positive Determination
Boggs Township, Armstrong County

[REDACTED]

This letter is regarding the Pennsylvania Department of Environmental Protection’s (Department’s) investigation into the natural gas venting into your water well listed in Exhibit A (“Water Supply”). The Department’s investigation indicates that oil and gas activities impacted the Water Supply. This information is summarized below.

CASE INFORMATION:

Date of Complaint	Nature of Complaint (odor, taste, quantity, use, color)	Monitoring Results
November 19, 2019	Natural gas migrating into water well	Up to 100% methane by volume detected in headspace of the water well

On November 19, 2019, VEC Energy LLC (VEC) notified the Department of natural gas migrating into the Water Supply at [REDACTED] VEC responded to the complaint by venting the annulus on the Ellenberger 3, a nearby gas well. According to documents submitted by the operator, the Ellenberger 3 (005-20603) was vented on November 9, 2019, ten days prior to VEC notifying the Department of the stray gas incident. It was reported that within one day of the venting of the Ellenberger 3 the gas odor and fumes coming from the Water Supply were significantly reduced. In addition to venting the annulus of the Ellenberger 3, a vent was installed on the Water Supply and a combustible gas detector was installed in the basement of the home. The Water Supply is not equipped for production and no water samples were collected for the investigation.

VEC collected free gas samples from the Water Supply, the Ellenberger 3 (production and annulus), and from the gas pipeline located in your yard. The samples were submitted and

analyzed for molecular composition. Based on the molecular composition of the gases, it was determined that the gas from the Water Supply was a match to the pipeline gas. VEC purged and decommissioned the pipeline located in your yard.

The Department also collected gas samples from the Water Supply, the Ellenberger 3 (production and annulus), and from the pipeline located in the yard. The samples were sent to Isotech for molecular and isotopic analysis. The gas from the Water Supply shared similarities with the samples collected from the Ellenberger 3 and from the pipeline indicating a gas well or pipeline may be impacting the Water Supply. The Ellenberger 3 could not be eliminated as a potential source of gas based on the gas analysis.

In 1997-98 the Department investigated a complaint of natural gas migrating into the same water well. During the investigation, gas levels of 80% were observed and documented between the 7-inch surface casing and the 8 5/8-inch conductor of the Ellenberger 3. The 2 3/8-inch x 7-inch annulus of the Ellenberger 3 was shut in during this observation (April 9, 1998 PADEP inspection report). Based on the observed gas outside the surface casing the Department requested that the operator vent the 2 3/8-inch x 7-inch annulus of the Ellenberger 3. A subsequent inspection report documented that the venting of the Ellenberger 3 appeared to eliminate the gas in the Water Supply indicating a possible direct correlation between the two events. Based on these observations, it was requested that the operator submit a plan to address the defective casing or cementing of the Ellenberger 3 (August 20, 1998 PADEP inspection report). Based on a gas sample analysis, the operator at the time Range Resources, disagreed with the Department's assessment that the Ellenberger 3 was impacting the Water Supply. However, the operator agreed to continue venting the 2 3/8-inch x 7-inch annulus of the Ellenberger 3 (September 25, 1998 Response Letter from Range).

Based on the information collected during the 1997-1998 investigation, the most recent venting of the Ellenberger 3, and the gas sample results, the Ellenberger 3 was placed in violation for defective casing and cementing. VEC and Range elected to plug the Ellenberger 3 without further evaluating the well (Range maintained some responsibility for the Ellenberger 3). The plugging of the Ellenberger 3 occurred in March of 2021. After the plugging of the Ellenberger 3, continuous monitoring of the gas level in the Water Supply was conducted for a period of 13 months. The continuous monitoring data showed peak gas levels of 5.5% methane by volume in the headspace of the Water Supply.

The Department monitored the Water Supply for combustible gas from November 21, 2019 to June 17, 2022. Methane levels of 100% by volume were detected at the start of the investigation. Methane levels dropped below 100% methane by volume by December 4, 2019 and continued to decline until March 2020. From June 2020 until May 2022, gas levels ranged from non-detect to 3% methane by volume.

Based on oil and gas mapping, the isotopic and compositional analysis of the gas samples, free gas monitoring of the Water Supply, information from the 1997-98 investigation into the stray gas migrating into the Water Supply, and the venting and plugging of the Ellenberger 3, the Department determines that the Water Supply was impacted by oil and gas activities and that the Ellenberger 3 was likely contributing to the stray gas incident.

The continuous monitoring of the Water Supply showed that free gas was last detected just below 2% methane by volume on April 7, 2022, after which the continuous monitoring was discontinued. No gas was detected by Department during the months of April or May of 2022.

The Department recommends that the Water Supply remain vented. This will help alleviate the possibility of concentrating these gases in areas where ignition would pose a threat to life or property. Please note that it is not possible to eliminate the hazards of having natural gas in your Water Supply by simply venting your well. Please refer to the enclosed Fact Sheet: Methane Gas and Water Wells for additional information on venting water wells.

Although no gas was detected in the living space or basement of your home during the most recent investigation, please be aware that methane levels can fluctuate. This means that even with a relatively low level of methane, you should be vigilant of changes in your Water Supply that could indicate an increase in methane concentration. Changing conditions can allow gas to migrate to basements and crawlspaces. Consequently, there is a physical danger of fire or explosion due to the migration of natural gas into water wells or through soils into dwellings where it could be ignited by sources that are present in most homes/buildings. Natural gas can also cause a threat of asphyxiation, although this is extremely rare. The Department recommends that you continue to utilize the gas monitor installed in the basement of your home and that you maintain the gas monitor according to the manufacturer's instructions. Please refer to the enclosed Fact Sheet: Methane Migration into Occupied Buildings for additional details on methane migration.

If you have any questions about any of the above, please contact Aaron O'Hara at 814-308-3118.

Sincerely,



Richard L. Neville
Northwest District Oil and Gas Manager
District Oil and Gas Operations

Enclosures:

DEP Fact Sheet: Methane Gas and Water Wells
DEP Fact Sheet: Methane Migration into Occupied Buildings

c: Joe Lichtinger (email)
Steve Lencer (email)
Dave Adams (email)
Michael Braymer (email)
Kayla Despenes (email)
Aaron O'Hara (email)
Renea Isenberg
Todd Kunselman
Mark Kiel

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Exhibit A



Methane Gas and Water Wells

Residents of the coal and natural gas-producing regions of Pennsylvania need to be aware of the potential dangers resulting from the accumulation of microbial gas, coal bed methane or natural gas in their water wells.

High concentrations of methane in water wells, water well enclosures and other confined spaces could cause an explosion.

What is Methane?

Methane (CH₄) is a naturally occurring hydrocarbon gas found underground. It is present in shallow and deep coal beds as well as in other rock units, and it is the main hydrocarbon found in natural gas and coal beds. Methane can occur as a gas or dissolved in the groundwater, or as a gas in the soil and rock zones below the surface.

Methane migrates from areas of high pressure to areas of low pressure. Mining and well drilling operations can affect the pressure in the subsurface and cause the migration of methane to areas of lower pressure, such as shallow aquifers and water wells used as water supplies. Gas migration in the subsurface can also be influenced by an increase or decrease in the water level of an aquifer, atmospheric pressure changes and other natural processes.

Active underground mining operations can lower groundwater levels, reducing pressure in aquifers occurring above and adjacent to the area of coal extraction. This reduction in pressure can allow gases within the overlying rock layers to migrate into nearby water wells. Methane can also be released from abandoned deep mines and from active and/or abandoned gas wells that are prone to leakage. Additionally, improperly constructed operating gas wells may mobilize methane in the subsurface. Releases from these and other sources can also migrate into nearby water wells.

Methane can migrate into water wells in a gaseous phase or dissolved in the groundwater. At atmospheric pressure, methane is soluble in water between 26-35 milligrams per liter. It is sometimes recognizable as effervescent gas bubbles in water drawn from a faucet. In some cases, the release of methane in a water well may be recognized by a sound similar to that of boiling water. However, methane is a colorless and odorless gas, and it may accumulate undetected in water wellbores and water well enclosures that are not properly vented. Methane may also move into basements of homes and other structures through plumbing and piping containing electrical connections. These conditions could lead to an explosion.

What to Do?

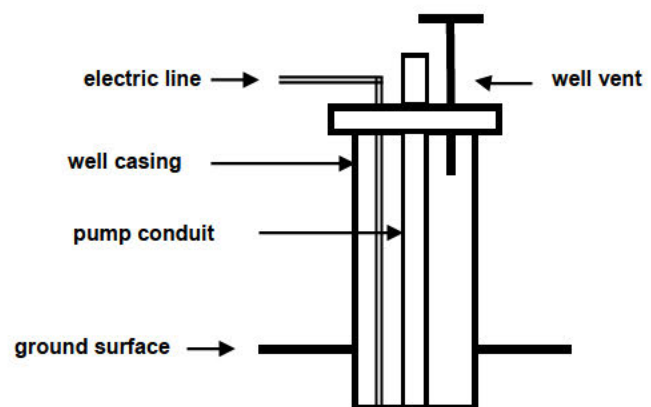
Methane gas is lighter than air with a specific gravity of 0.555, so it will not accumulate in the water wellbore if the water well is adequately vented to the atmosphere. Venting is an inexpensive and effective way to mitigate methane accumulation in water wells, water well enclosures and other confined spaces, such as basements. Proper venting reduces the potential for methane gas to seep into homes or structures from water wells.

Recommended Venting Procedures

Proper design is extremely important. Water well vents should be installed by a qualified water well driller or plumber.

The vent should extend above any possible flood level, potential ignition sources and areas of exposure (above the roof line for water wells adjacent to buildings), and it should have watertight connections to prevent surface water from entering. The well vent should be at least one (1) inch diameter or larger to facilitate gas flow. The end of the vent pipe should have a down-turned "gooseneck" or "T" and be capped with corrosion-resistant screening. If the vent is not screened, it can become a potential entry point for debris and small animals.

If concentrations in a vent pipe happen to exceed the lower explosive limit for methane (5 percent methane in air), installation of a spark-arresting cap at the end of the pipe should be considered. In addition, conduits from the water well that carry electrical lines or waterlines into the building should be sealed so that the air in the conduit



does not vent into the building. Venting of wells will not adequately remove methane dissolved in the groundwater, but properly designed water aeration systems are one effective way to lower the concentration of methane dissolved in the water.

Enclosed Wells

When the top of the water well is buried in a covered pit or enclosed in a basement, the vent pipe must vent gas to the outside air, as shown in the diagram at right.

The vent pipe should be screened and extend above any possible flood level, roof line, potential ignition sources and areas of exposure.

In cases where the water well is located in an enclosure, it should have a tight-fitting well cap, and all openings through the cap should be properly sealed to prevent methane from escaping into the water well enclosure.

Play It Safe

When a water well is no longer in service, the plumbing connections should be disconnected and sealed to prevent methane from entering the home or building.

NOTE: Water wells may differ considerably from the wells depicted in the diagrams. Also, well-venting requirements may vary from place to place because of differences in local plumbing codes. Therefore, water well owners are encouraged to contact a professional water well specialist or a local building code enforcement officer to determine the proper venting procedures required under the local plumbing code.

For more information on methane and water wells, please contact the local DEP office:

Southwest Regional Office

400 Waterfront Drive
Pittsburgh, PA 15222-4745
Telephone: 412-442-4000

Counties Served: Allegheny, Armstrong, Beaver, Cambria, Fayette, Greene, Indiana, Somerset, Washington and Westmoreland

South-central Regional Office

909 Elmerton Ave.
Harrisburg, PA 17110-8200
Telephone: 877-333-1904

Counties Served: Adams, Bedford, Berks, Blair, Cumberland, Dauphin, Franklin, Fulton, Huntingdon, Juniata, Lancaster, Lebanon, Mifflin, Perry and York

Southeast Regional Office

2 E. Main St.
Norristown, PA 19401-4915
Telephone: 484-250-5900

Counties Served: Bucks, Chester, Delaware, Montgomery and Philadelphia

Northwest Regional Office

230 Chestnut St.
Meadville, PA 16335-3481
Telephone: 814-332-6945

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North-central Regional Office

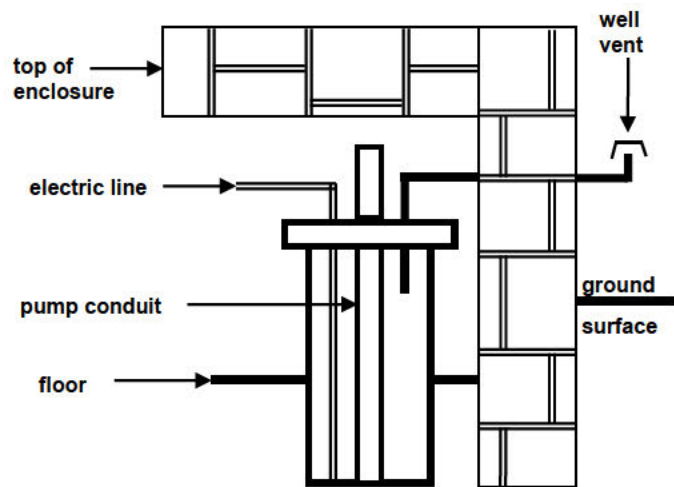
208 W. Third St., Suite 101
Williamsport, PA 17701-6448
Telephone: 570-327-3636

Counties Served: Bradford, Cameron, Centre, Clearfield, Clinton, Columbia, Lycoming, Montour, Northumberland, Potter, Snyder, Sullivan, Tioga and Union

Northeast Regional Office

2 Public Square
Wilkes-Barre, PA 18701-1915
Telephone: 570-826-2511

Counties Served: Carbon, Lackawanna, Lehigh, Luzerne, Monroe, Northampton, Pike, Schuylkill, Susquehanna, Wayne and Wyoming



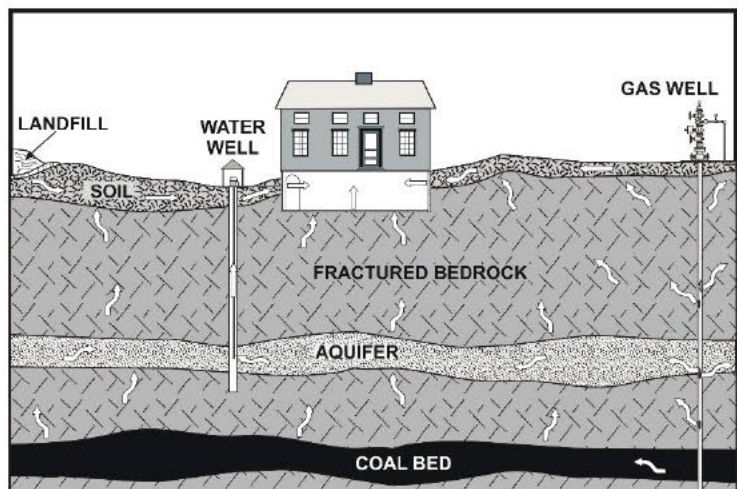
For more information, visit www.dep.state.pa.us, keyword: Wells.

Methane Migration into Occupied Buildings

Recovery and utilization of Pennsylvania's mineral resources by mining and drilling for oil and gas has a long history that continues today with the extraction of natural gas from the Marcellus Shale and other formations. These activities can directly or indirectly increase levels of methane gas in buildings from deeper sources such as coalbed methane or other geologic formations, or shallower sources in soil and groundwater. Although modern mining and well drilling practices have reduced the risk of environmental impacts; releases from wells, pipelines, and deep mines can and do occur. Methane migration can also occur naturally or in response to other human activities such as water well drilling or landfilling. The prevalence and amount of methane in the subsurface varies across the state depending on many factors. When gases migrating in the soil or water come into contact with man-made structures, the resulting accumulation of gas can cause unsafe conditions for building occupants.

What is Methane and How Is It Mobilized?

Methane (CH₄) is a naturally-occurring hydrocarbon gas found underground. It is lighter than air, colorless, odorless, and flammable. Methane is present in shallow organic-rich deposits and deep coal beds as well as other rock units, and is the primary hydrocarbon found in natural gas and coalbed gas. Gas migration may cause methane to accumulate undetected inside basements of homes and other structures. Mobilized gas can enter man-made structures through utility connections, porous surfaces, and basement walls. These conditions may present a life-threatening safety hazard and could lead to an explosion.



Methane migrates from high-pressure to low-pressure areas through available pathways. Migration through rock is typically slow. Fractures in the rock provide faster migration pathways. Mining and well drilling operations can affect the pressure as well as increase the pathways in the subsurface, allowing the migration of methane to areas of lower-pressure such as shallow aquifers and water wells. Gas migration in the subsurface can also be influenced by an increase or decrease in the water level of an aquifer. Active underground mining operations can lower groundwater levels, reducing pressure in aquifers occurring above and adjacent to the area of coal extraction. This reduction in pressure can allow gases within the overlying rock layers to migrate into nearby water wells or enclosed structures. Methane can also be released from abandoned deep mines and abandoned gas wells. The Department of Environmental Protection (DEP) has no evidence that the well completion process of hydraulic fracturing alone creates a pathway for methane to communicate with groundwater.

Gas Migration Investigations

DEP Oil and Gas Well regulations (25 Pa. Code, Chapters 78 and 78a) and DEP policy require a timely investigation into complaints alleging impacts to water supplies from oil and gas drilling. All complaint information reported to DEP is kept confidential. The purpose of the investigation is to determine the nature of the incident, assess the potential for hazards to public safety, and mitigate any hazard posed by concentrations of stray natural gas. When investigations are conducted by DEP and/or by an oil or gas operator, they typically include a site visit and interview; a field survey; and, if necessary, monitoring at potential sources, potentially impacted structures, and the subsurface. DEP uses multiple sources of evidence to determine if methane migration or other impacts to water supplies are attributable to drilling. This includes working to identify the origin of the gas through various methods which may include chemical

and isotopic gas analysis, evaluating nearby gas well integrity through pressure and well logging, tests and understanding the local geology and its relationship to the water supply in question.

Detailed investigations to confirm the source(s) of impacts to water supplies or the interior of a structure are time consuming and often require soil, water, and air sample collection for chemical analysis. DEP reviews the results of investigations conducted by oil and gas operators, consultants, and others; provides technical assistance and may conduct an independent investigation. When investigations indicate the need for engineering controls to mitigate impacts, DEP works with all involved parties to ensure that timely, effective solutions are implemented. DEP will also issue temporary water supply replacement orders as necessary during investigations.

Public Health and Safety

If methane gas infiltrates any enclosed structure, it can build up to dangerous levels. Concentrations of methane at five percent in air constitute an explosion hazard. A spark from a furnace or a faulty wire, a cigarette or a lit match can cause the gas to explode. Oil and gas industry professionals, local fire departments, and DEP staff are trained in the use of methane gas meters and explosimeters that measure airborne gas concentrations. As a safety precaution, DEP recommends that occupants vacate any building that has methane concentrations at 10 percent or greater of the lower explosive limit (0.5 percent methane in air). There are no known health impacts from drinking water that contains methane, nor is there an established federal safe drinking water level for methane.

Protections of Private Water Supplies

In cases where water supplies near oil and gas wells have been impacted by gas migration, there are significant enhanced protections for those water supply owners, including a presumption that the operator of the nearby oil or gas well is liable for the impact. This presumption applies if the water supply is within 2,500 feet of the vertical wellbore and the pollution occurs within one year from unconventional well drilling and completion of hydraulic fracturing. For conventional well drilling, the presumption of liability applies within 1,000 feet of the well and six months of the completion of drilling or alteration. Operators may rebut the presumption of liability by raising one of several defenses, including demonstrating the impact was pre-existing or not due to drilling-related activities.

Should DEP determine that an operator has impacted a water supply (regardless of the distance or time limitations of the presumption), the law requires those operators to restore or replace the water supply to its pre-existing condition or to federal safe drinking water standards, whichever is of higher quality.

DEP encourages you to report any cases of suspected water contamination that may be associated with the development of oil and gas resources or any other environmental complaint, please call toll-free 1-866-255-5158. For more information on methane gas migration, please contact the DEP office in your area.

Southwest Regional Office

400 Waterfront Dr.
Pittsburgh, PA 15222-4745
Telephone No. 412-442-4000

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909 Elmerton Avenue
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230 Chestnut Street
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Telephone No. 814-332-6945

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208 West Third Street, Suite 101
Williamsport, PA 17701-6448
Telephone No. 570-327-3636

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2 Public Square
Wilkes-Barre, PA 18701-1915
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For more information, visit www.dep.pa.gov.

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