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*HEARINGS SECTION*

# RAILROAD COMMISSION OF TEXAS

## OFFICE OF GENERAL COUNSEL

**OIL AND GAS DOCKET NO. 7B-0268629**

COMMISSION CALLED HEARING TO CONSIDER WHETHER OPERATION OF THE RANGE PRODUCTION COMPANY BUTLER UNIT WELL NO. 1H (RRC ID 253732) AND TEAL UNIT WELL NO. 1H (RRC ID 253729) IN THE NEWARK, EAST (BARNETT SHALE) FIELD, HOOD COUNTY, TEXAS, ARE CAUSING OR CONTRIBUTING TO CONTAMINATION OF CERTAIN DOMESTIC WATER WELLS IN PARKER COUNTY, TEXAS

Heard by: Donna K. Chandler, Technical Examiner  
Gene Montes, Hearings Examiner

**Appearances:**

**Representing:**

David Jackson  
Stephen Ravel  
John Riley  
Andrew Sims  
Mike Middlebrook  
Norman Warpinski  
John McBeath  
Mark McGaffrey  
Keith Wheeler  
Charles Kreidler  
Alan Kornacki  
Chris Hosek

Range Production Company

David Cooney

Railroad Commission staff

Barry Hageman

Enervest Operating Co, LLC

Bill Stevens

Texas Alliance of Energy Producers

**Procedural history:**

Notice of Hearing:	December 8, 2010
Hearing held:	January 19-20, 2011
Transcript date:	January 24, 2011
Record Closed:	February 17, 2011
PFD issued:	March 7, 2011

**EXAMINERS' REPORT AND PROPOSAL FOR DECISION**

**STATEMENT OF THE CASE**

This hearing was called by the Railroad Commission of Texas ("RRC") to determine whether the Butler Unit Well No. 1H ("Butler well") or the Teal Unit Well No. 1H ("Teal well"), both horizontal drainhole wells operated by Range Production Company ("Range") and producing from the Newark, East (Barnett Shale) Field, are causing or contributing to the contamination of certain domestic water wells in Parker County. The Notice of Hearing specifically states:

"...the Commission will consider the extent and causation of and responsibility for, any contamination that may have occurred, or which is likely to occur, in domestic water wells in the area of the Range Production Company Butler Unit, Well No. 1H (RRC No. 253732) and the Teal Unit, Well No. 1H (RRC No. 253779), and, more particularly, whether the operation of these wells has caused or contributed, or may cause or contribute, to any such contamination. The Commission may also consider whether there is any alternative cause or contributor to any contamination that may have occurred."

The RRC has had an ongoing investigation into the cause of gas being produced in the domestic water wells since August 2010. In October 2010, the Environmental Protection Agency ("EPA") began its own investigation into the cause of the contamination of the wells, and on December 7, 2010, the EPA issued an Emergency Administrative Order to Range. (See Attachment A, Range Exhibit No. 5). In the order, the EPA concluded that, "[Range] caused or contributed to the endangerment identified herein [inter alia, benzene and methane in two nearby domestic water wells.]" (See Attachment A, Conclusion of Law No. 46). The Order further described to Range "..... the action you must take to ensure the Butler Unit and Teal Unit production facilities pose no imminent and substantial endangerment to public health through methane contamination of an underground source of drinking water."

The Notice of this hearing was sent to Range, the owners of the two domestic water wells at issue and to three EPA officials. The Notice stated "The Commission encourages the participation of EPA in the hearing and presentation by EPA of evidence in its possession supporting the findings of fact and conclusions of law in the Emergency Administrative Order." Range appeared at the RRC hearing and presented evidence in support of its position that the operations of its Teal well and Butler well are not contributing to the production of methane in domestic water wells.

RRC staff appeared at the hearing and cross-examined Range's witnesses. Staff presented an exhibit summarizing the RRC's investigations in this matter, beginning August 6, 2010. (See Attachment B, Staff Exhibit 1).

There was no appearance at the hearing by any representative of the EPA or by owners of the water wells identified as contaminated.

### DISCUSSION OF THE EVIDENCE

#### Background

In August 2010, Mr. Steven Lipsky complained to the Abilene District Office of the RRC that his domestic water well contained natural gas. On August 17, 2010, the RRC collected water samples from the Lipsky well for analysis. On August 26, 2010, the RRC collected gas samples from the Lipsky well for analysis. At approximately the same time, the RRC requested Range to provide a gas analysis from both the bradenhead (the space between the surface casing and the production casing of the well) and from the production tubing of its Butler well.<sup>1</sup> The RRC further requested that Range test the mechanical integrity of the casing of its Butler well. The Butler well is the nearest producing well to the Lipsky well. The path of the Butler well comes within a horizontal distance of approximately 450 feet of the location of the Lipsky water well, but at that point, the Butler wellbore is more than 5,000 feet deeper than the Lipsky water well.

In a memo dated September 22, 2010, the RRC Abilene District Office staff stated "Each of the gas samples taken, the Lipsky water well, the Butler Unit production and the Butler Unit bradenhead gas had distinct characteristics from each of the others." Range conducted the requested production casing integrity test on its Butler No. 1 on October 14, 2010. The test, which was witnessed by RRC personnel, indicated no communication between the surface casing, production casing, or production tubing.

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<sup>1</sup> The Butler well is a horizontal drainhole well producing from the Newark, East (Barnett Shale) Field at a depth of approximately 5,700 feet.

On October 26, 2010, the EPA collected the following samples for its investigation:

1. water and gas samples from the Lipsky water well;
2. a water sample from the Rick Hayley domestic water well storage tank;
3. gas and water samples from the tubing of the Butler well; and
4. gas sample from the tubing of the Teal Unit Well No. 1H.<sup>2</sup>

The horizontal portions of the Teal well and Butler well are approximately 1,000 feet apart and the wells are drilled from the same surface location. The Rick Hayley domestic water well is on property adjacent to the Lipsky property to the north and is a horizontal distance of approximately 300 feet from the path of the Butler well. However, at that point, the Butler well is more than 5,000 feet deeper than the Hayley water well. (See Attachment C, portion of Range Exhibit No. 30).

In a letter dated December 3, 2010, Range notified John Tintera, Executive Director of the RRC, that Range would continue to work with the RRC to demonstrate that both the Teal well and the Butler well were in compliance with all RRC regulations. In the same letter, Range offered to collect soil samples to investigate the possible source of gas production in the Lipsky well, provide gas monitoring equipment and alternative water sources to Mr. Lipsky, and install monitoring wells as directed by the RRC. The letter further indicated that Range's initial analyses indicated that the gas produced in the Lipsky water well had a different constituent analysis than gas from both the Butler well production tubing and from the Butler well bradenhead.

On December 7, 2010, the EPA issued an Emergency Administrative Order ("EAO") to Range. On December 8, 2010, the RRC issued its Notice of Hearing in this docket.

#### Range Operations

Michael Middlebrook, Vice President of Operations for the Barnett Shale and Northeast Marcellus Shale for Range, testified regarding Range's operations in the area, specifically concerning the Teal and Butler wells. The Teal well was drilled beginning in March 2009 and the Butler well was drilled beginning in June 2009. Both wells were put on production in August 2009. The wells are drilled from the same surface location, which is approximately 2,300 feet southeast of the Lipsky water well.

In August 2010, after Mr. Lipsky's complaint to the RRC about his water well, RRC staff inspected the Teal and Butler wells. Both wells were producing at the time of the inspection. The inspection revealed that the Teal well had no pressure on the bradenhead and the Butler well had 30 psi on the bradenhead. The pressure on the Butler well bled

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<sup>2</sup> The Teal Unit Well No. 1H is another horizontal drainhole well producing from the Newark, East (Barnett Shale) and operated by Range.

down to 0 psi within 10 seconds.<sup>3</sup> Pressure on the bradenhead of a well is an indication that formations behind uncemented production casing are seeping fluid into the space behind the production casing. Range was requested to collect and analyze gas samples from the production tubing and from the bradenhead of the Butler well.

The Butler well has surface casing set at 412 feet and cemented to surface. The well has production casing set from its total measured depth of 9,054 feet to surface, including a horizontal lateral approximately 3,300 feet in length. The top of cement behind the production casing is found in the vertical portion of the wellbore at approximately 4,850 feet, as verified by a cement bond log. There is no cement behind the production casing from a depth of 4,850 feet to surface. The gas sample taken from the tubing is therefore gas from the Barnett Shale producing interval. The gas sample taken from the bradenhead is gas from any formation open to the wellbore above 4,850 feet.

Because of the pressure found on the bradenhead of the Butler well, the RRC requested Range to perform a pressure test on the well to confirm the integrity of the production casing. This test was performed on October 14, 2010 and was witnessed by RRC personnel. In order to perform the test, Range placed a packer on the tubing to isolate the tubing from the casing/tubing annulus. The well held 845 psi on the annulus between the tubing and casing for 30 minutes, while the tubing pressure held at 540 psig. The bradenhead pressure was 28 psi during the entire test. These pressures demonstrate that the casing in the well has integrity, i.e. that there are no pathways for gas to migrate from the production tubing to the annulus or from the tubing/casing annular space to the back side of the production casing.

In late October, Range was contacted by the EPA, requesting that EPA be allowed to take gas samples from the Butler well. On October 26, 2010, the EPA collected a gas sample from the tubing of the Butler well. At the same time that the EPA was collecting its single sample, Range collected additional samples of gas from the Butler well tubing, the Butler bradenhead, and the Teal tubing. Because there was no bradenhead pressure on the Teal well, no gas sample could be collected from the bradenhead of that well at that time. Range also collected a sample of the gas that is being reinjected into the casing in both wells for gas lift purposes.

Approximately 30 days after the EPA had collected its sample, Range was notified by phone of the EPA's position that the gas in the Lipsky water well was the same as Range's production gas. Range requested the EPA's gas sampling data, but the EPA did not provide the data.

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<sup>3</sup> More recently, the bradenhead pressure in the Butler well builds only to about 5 psi and bleeds down to 0 psi immediately.

Geology and hydrogeology

Dr. Charles Kreitler was called by Range to testify regarding geology and aquifers in the area. The Trinity aquifer group (including the Paluxy, Glen Rose and Twin Mountains formations) is part of the Cretaceous system. In this area of Parker County, the Strawn, which is part of the Pennsylvanian system, directly underlies the Trinity. The base of the Cretaceous/top of Pennsylvanian is approximately 400 feet below surface. The base of the Pennsylvanian/top of Mississippian in the area of the Butler/Teal wells is approximately 5,700 feet. The Barnett Shale is part of the Mississippian system. The Cretaceous dips to the southeast while the Pennsylvanian section dips to the west. An erosional unconformity exists which allows a natural communication between the Cretaceous and the Pennsylvanian. The Pennsylvanian contains hydrocarbons and salt water, while the Cretaceous section contains fresh water. The unconformity is verified by seismic data. In summary, the area from the surface to a subsurface depth of about 400 feet is Cretaceous age rock containing fresh water. Immediately below this zone, from about 400 feet to about 5,700 feet is Pennsylvanian age rock containing natural gas, oil and salt water. Below that, starting at a depth of approximately 5,700 feet, is Mississippian age rock that includes the gas-bearing Barnett Shale formation.

A structure map of the area around the Butler well and Teal well was drawn based on 3-D seismic data. There is no indication of faulting in the vicinity of the wells and therefore no pathway to communicate the Barnett Shale all the way up, over 5,000 feet vertically, to the Cretaceous.

Most of the domestic water wells in the area are completed in the Twin Mountains. Some are completed in the shallower Paluxy. The two are separated by the Glen Rose aquitard, which retards the vertical movement of water between the Twin Mountains and Paluxy. The Twin Mountains is not a highly productive aquifer. As water wells are pumped, the water level in the Twin Mountains falls. Because the Twin Mountains is in communication with the Strawn due to the unconformity, gas and water from the Strawn can move to the Twin Mountains and mix.

Water wells within 3,000 feet of the Butler/Teal surface location were sampled to determine methane concentration. Some homeowners did not allow their wells to be sampled. In the samples, methane concentrations ranged from non-detect to almost 3 parts per million (ppm).<sup>4</sup> The Perdue water well had the highest methane concentrations, at 2.8 ppm. The Perdue well is the deepest water well in the area, extending about 100 feet into the Strawn. The Lipsky well had a methane concentration of 2.3 ppm, the second highest concentration found. The concentrations in the various water wells do not

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Some of the wells that indicated "non-detect" of methane were sampled at the outlet side of the treatment equipment and any gas which had been dissolved in the water would likely have already fallen out of solution.

demonstrate any type of plume, which would be expected if the gas was from a single source. Instead, the concentrations in the wells vary randomly over the area.

The water well samples also indicate variations in total dissolved solids from about 500 ppm to about 1,800 ppm. The normal range for total dissolved solids in the Trinity aquifer is 500-700 ppm. Chlorides in the water well samples varied from 20 ppm to 535 ppm. The total dissolved solids and chloride concentrations vary randomly over the area, just as the methane concentrations. Range believes that the methane, total dissolved solids and chlorides are all indications of communication between the Twin Mountains aquifer and the higher salinity waters of the underlying Strawn.

The United States Department of Interior ("USDI"), Office of Surface Mining, advises that owners of water wells with methane concentrations less than 10 ppm require no action other than periodic monitoring to make sure concentrations do not change. The USDI further advises that methane will not accumulate in the wellbore of a water well if it is properly vented to the air. The TCEQ requires that all public water supply wells be vented to prevent gas accumulations of any kind in the wellbores.

#### Microseismic Analysis and Hydraulic Fracturing

Norman Warpinski, the Director of Technology for Pinnacle-Halliburton Service, was called to testify regarding microseismic data and hydraulic fracturing in the Barnett Shale. In order to produce hydrocarbons, tight rocks such as the Barnett Shale, must be hydraulically fractured, thereby creating pathways for hydrocarbons to move to the wellbore. Fracture stimulations are designed to keep the injected fluid within the productive formation. Fracturing is effective in the Barnett Shale because the Barnett Shale is overlain by the Marble Falls and underlain by either the Viola or Ellenburger, all of which are carbonate rocks effective in preventing growth of fractures out of the intended zone.

Microseismic monitoring is used to monitor the results of hydraulic fracturing. During the hydraulic fracturing process, microseisms occur as a result of rock fracturing. These microseisms emit seismic energy which can be detected in geophones which have been placed in nearby wells. By mapping the microseisms, the geometry, dimension and growth behavior of a fracture can be determined.

Microseismic data is available for about 2,400 fracture stimulations in the Barnett Shale. In Parker County alone, data is available for more than 320 fracture stimulations. For the Parker County data, the greatest fracture height seen is about 400 feet, or to a vertical depth no higher than 4,500 feet. The separation between any drinking water source and the highest fracture height is more than 4,000 feet. Dr. Warpinski stated that it would be impossible to create a fracture height of such magnitude.

Range believes that the microseismic data available for wells in Parker County confirm that hydraulic fracturing of Barnett Shale wells is not the cause of natural gas production in the Lipsky well or any other water well in the area.

#### Geochemical Gas Fingerprinting

Mark McCaffrey, Senior Technical Advisor of Fluid Services for Weatherford Laboratories, was called by Range to testify regarding the various gas analyses. Dr. McCaffrey presented results of geochemical gas fingerprinting which demonstrate that gas from the Lipsky water well does not match gas from the Barnett Shale. Dr. McCaffrey believes that the EPA's geochemical gas fingerprinting study is flawed because the EPA did not attempt to identify other potential sources of gas in the Lipsky well besides the the Barnett Shale. Further, the geochemical parameter used in the EPA fingerprinting study was carbon isotope. This parameter does not differentiate between Barnett Shale gas and Pennsylvanian age rock such as the Strawn formation, but simply provides a determination that both gases are thermogenic. Gas found in the shallower Strawn formation (found at approximately 400 feet) would be expected to have similar carbon isotopic composition because the Barnett Shale is the source rock for all gas bearing zones in and above the Barnett Shale. Over geologic time, gas has migrated up from the Barnett Shale into other formations and it is not surprising that the gas samples collected by the EPA have similar methane isotopes and are both thermogenic.

Dr. McCaffrey believes that the appropriate geochemical parameters to use in this case are nitrogen and carbon dioxide (CO<sub>2</sub>). These two parameters are more useful when considering that the source of gas in the Lipsky well may be the Pennsylvanian age Strawn formation. Available publications provide data indicating that Pennsylvanian age reservoir gases typically have higher nitrogen and lower CO<sub>2</sub> than Barnett Shale gas.

For its fingerprinting study, Range used solution gas samples and headspace gas samples from 25 water wells within 3,000 feet of the surface location of the Butler and Teal wells. Solution gas is the gas which is dissolved in the water. Headspace gas is the gas above the water level in a well. Additionally, Range had samples from the Butler well tubing (Barnett Shale) gas, Butler well bradenhead gas, Teal well tubing and Teal well bradenhead. Range also had samples of gas being injected into both the Teal and Butler wells. Elevated nitrogen concentrations were found in the headspace gas of the Lipsky well, indicating that the gas is derived from a Pennsylvanian reservoir, and not the Barnett Shale. The Butler bradenhead gas is approximately 50% nitrogen enriched Pennsylvanian gas and 50% microbial gas. The Teal bradenhead sample was found to be almost entirely microbial. Neither bradenhead gas sample contained Barnett Shale gas. Further, Barnett Shale gas contains no microbial gas, as was found in the two bradenhead samples.

If Barnett Shale gas were migrating upwards and communicating to shallower zones, some component of Barnett Shale gas would have been present in the bradenhead samples of the Teal and Butler wells. Further, the gas found in most of the water well

samples has differing degrees of biodegradation, indicating that gas had seeped into the aquifer over geologic time, and not in a single event.

#### Petroleum Engineering

John McBeath, consulting petroleum engineer, was called by Range to testify regarding the history of gas in water wells and about the mechanical integrity of Range's wells. He also testified as to the extent of Range's investigation into the reason gas is found in the Lipsky well, as requested by the RRC.

Gas production from water wells is not uncommon in this area, and has occurred for many years prior to Barnett Shale gas development. In October 2005, a water well was drilled on the Hurst property, slightly less than 900 feet west of the Lipsky well. The Hurst water well was drilled to a depth of 180 feet and flowed sufficient gas such that the well was flared when initially completed. The gas in the well depleted after a few months and the well is now used as an irrigation supply well. In 2007, a water well was drilled on the Ujesky property to a depth of 220 feet. This well, approximately 750 feet north of the Lipsky well, also flowed gas for a couple of months. The Lake Country Acres public water supply had five wells, the earliest drilled in 1995. These water supply wells are approximately 7,000 feet to the east of the Lipsky well. One of the wells, the No. 4, flowed 122 MCF (thousand cubic feet) of gas per day and was plugged shortly after drilling in 2003. The storage tanks for the remaining four Lake Country Acres water supply are aerated to de-gas the water and signs around the tanks warn of flammable gas.

The Lipsky well was drilled in 2005 to a depth of 200 feet. According to the Lipsky's deposition, there were no problems with his water well until August 2010 when the output from the well decreased. Lipsky had the pump in the well replaced with a smaller pump in an effort to prevent the water level from falling below the pump. The decreased output from the well continued. Range notes that Mr. Lipsky's home on the property was completed in early 2010, a very large home with extensive landscaping and a swimming pool, likely resulting in an increase in water consumption by Lipsky. Range believes the increased water consumption by Lipsky, in combination with increased development in the subdivision, may have drawn down water levels in area water wells such that gas could be drawn in from the Strawn formation.

Prior to the drilling of the Teal and Butler wells in 2009, there is significant evidence of shallow gas production within a 2½ mile radius of the wells. The Strawn formation directly underlies the Cretaceous formation, which is the aquifer in the area. Water well records indicate that numerous water wells penetrated the Strawn formation, while numerous others are completed within 25 feet of the top of the Strawn. In addition to gas produced in the numerous water wells, several gas wells were completed in the Center Mill (Strawn) Field approximately one mile to the southeast of the Butler and Teal wells.

These wells produced gas in the mid-1980's from the Strawn, with depths ranging from 358 feet to 426 feet. The Lake Country Acres water supply wells are drilled to depths ranging from 385 feet to 420 feet.

Range identified 74 oil/gas wells within 2½ miles of the surface location of the Butler and Teal wells, some of which are abandoned locations which were permitted but never drilled. Range studied the available drilling, completion and plugging records for the wells and found that 11 wells have potential to communicate to freshwater zones due to inadequate surface casing or improper plugging. However, the closest of the 11 wellbores is about one mile away in the area of the Center Mills (Strawn) Field. Range does not believe that any of the 11 wells have any connection to the Lipsky well problem, but Range cannot rule out the possibility that any of the 11 wells may have contributed to gas production in water wells in other areas, such as the Lake Country Acres water supply wells. Eight of the 11 wells are within about ½ miles of the Lake Country Acres water wells.

The surface casing for the Butler well is set at 394 feet and the surface casing for the Teal well is set at 409 feet. The surface casing on the Butler well was tested to 1,500 psi and the surface casing on the Teal was tested to 1,200 psi. The Texas Commission on Environmental Quality ("TCEQ") recommends that the interval from land surface to 20 feet below the base of the Cretaceous be protected, with the Cretaceous estimated to occur at 175 feet. Surface casing on both wells exceed the requirements of the TCEQ. Range's experience in the area is that the Cretaceous generally extends to approximately 320 feet.

The top of cement behind the production casing in the Butler No. 1 is 4,580 feet, based on a cement bond log. The production casing was pressure tested to 845 psig on October 15, 2010. The top of cement behind the production casing in the Teal No. 1 is 4,810 feet, also verified by a cement bond log. The production casing in the Teal No. 1 was pressure tested on December 28, 2010 to 705 psig. The production casings in both wells have mechanical integrity to prevent migration of Barnett Shale gas behind pipe.

#### Groundwater Investigation

Keith Wheeler was called by Range to testify regarding the groundwater investigation performed by Range per the RRC's December 16, 2010 letter to Range. In late December, ambient air samples were collected from different sources near the area water wells, such as near the wellhead or in the pump house. A headspace gas sample and a water sample was taken from each of the water wells. Additionally, 117 soil gas samples were collected from around the water wells.

The highest measured concentration found in any of the ambient air samples was 6 ppm for ethane, 13.9 ppm for methane, and 61 ppm for propane. The lower explosive limit is 30,000 ppm for ethane, 50,000 ppm for methane, and 21,000 ppm for propane. These ambient air samples indicate insignificant potential for any fire or explosion.

Each of the 25 water samples was field tested at the time of sampling for temperature, specific conductance, dissolved oxygen, pH, oxidation reduction potential and turbidity. Each sample was then sent to a lab for testing of more than 135 constituents. The constituents include 108 volatile organic compounds (VOC). Of this 108, 16 were detected in at least one of the water wells. However, no sample contained a level in excess of the Texas Risk Reduction Program Protective Concentration Level (PCL) established by the TCEQ. The PCL is the value at which the analyte does not present an unacceptable risk to human health. RCRA metals barium, chromium, and lead were detected in at least one water sample, but no sample had a level exceeding the PCL. Dissolved butane, ethane, isobutane, methane or propane was found in at least one water sample. However, there are no PCL levels for these dissolved gases because they are not toxic for ingestion of groundwater. Three other analytes (chloride, sulfate and total dissolved solids) were detected in all samples. These analytes do not have PCL levels but the concentrations of these three analytes are below the Secondary Maximum Contaminant Levels (MCL) established for drinking water in the State of Texas, as established by TCEQ pursuant to the EPA standards for the Safe Drinking Water Act. The presence of these three analytes indicates the aesthetic quality of the water such as odor and taste, and do not indicate risks to human health.

Soil gas samples were collected from 117 locations around the domestic water wells in the area of the Lipsky well. The samples were retrieved from depths between 1 and 3 feet below surface. Each gas sample was tested for presence of methane, ethane, propane and butane. The highest concentration of any of these gases was less than 0.2% of the lower explosive limit for each gas. As in the other analyses, the concentrations were randomly distributed over the area, with no indication of any single source.

#### EXAMINERS' OPINION

The examiners find that Range's evidence clearly demonstrates that its drilling and operations of the Teal and Butler wells have not contributed to contamination of any domestic water wells. The examiners further find that the most likely source of gas in the Lipsky well and other domestic water wells in the area is the shallow Strawn formation.

Most of the domestic water wells in this area are completed in the Twin Mountains formation within the Cretaceous. Some are completed in the shallower Paluxy formation. The Cretaceous and the Pennsylvanian are in direct communication as a result of an erosional unconformity between the two systems of rock. The Strawn is the shallowest formation within the Pennsylvanian and is found at a depth of about 400 feet. There was gas production in the mid-1980's from the shallow Strawn formation in the Center Mills (Strawn) Field. Water wells records show that some water wells in the area were actually drilled into the Strawn formation.

Domestic water wells in the area of the Lipsky water well have contained methane gas for many years. The nearby Hurst water well produced sufficient gas to flare when it was initially completed in 2005. The Oujesky well also produced gas for a couple of months just after completion in 2007. One water well in the Lake Country Acres water supply produced 122 MCF of gas per day upon completion, so much gas that it had to be abandoned as a water supply well. All of these wells were drilled prior to the drilling of both the Butler and Teal wells by Range in 2009.

The EPA's investigation compared gas produced from the tubing of the Butler well (Barnett Shale gas) to gas found in the Lipsky water well. The carbon isotopic fingerprint analysis of the gases were found to be very similar and both gases were determined to be thermogenic. Range demonstrated that use of the carbon isotope in the EPA analysis was inappropriate because the Barnett Shale is the source rock for all gas bearing zones above the Barnett Shale, including the much shallower Strawn formation. All gas produced from the same source rock would be expected to have a similar carbon isotope. The EPA did not attempt to identify any other potential source of the gas produced from the Lipsky well. Range further showed the appropriate geochemical parameters to use for fingerprinting in this case are nitrogen and carbon dioxide. Published literature confirms that Pennsylvanian age gases, including the Strawn, have higher nitrogen and lower carbon dioxide than Barnett Shale gas.

For its gas fingerprinting analysis, Range collected samples of headspace gas and solution gas from 25 water wells within 3,000 feet of the surface location of the Butler/Teal wells. Range also collected samples from the tubing of the Butler well, tubing of the Teal well, bradenhead of the Butler well, bradenhead of the Teal well, and injection gas used in both the Teal and Butler wells. The fingerprinting analyses performed by Range demonstrates that gas found in all of the water wells had elevated nitrogen concentrations, indicating Pennsylvanian gas, not Barnett Shale gas. Additionally, gas produced from the Barnett Shale in the Butler and Teal wells contained no microbial gas, but the bradenhead samples from each well did contain microbial gas. These differentials confirm that the Barnett Shale is not in communication with any other zone, including the much shallower Strawn.

In addition to the fingerprinting analysis, additional testing for the presence of 135 constituents was performed on water samples from the 25 water wells. The constituents include 108 volatile organic compounds. No sample contained a level in excess of the Texas Risk Reduction Program Protective Concentration Level (PCL) established by the TCEQ. The PCL is the value at which the analyte does not present an unacceptable risk to human health. The water samples were also tested for RCRA metals. Barium, chromium, and lead were detected in at least one water sample, but no sample had a level exceeding the PCL. Dissolved butane, ethane, isobutane, methane or propane was found in at least one water sample but these gases are not toxic for ingestion of groundwater and

there are no PCL levels for these gases. Three other analytes (chloride, sulfate and total dissolved solids) were detected in all samples. However, the presence of these three analytes affects only the aesthetic quality of the water such as odor and taste, and are not indications of risks to human health. There are no PCL's for these three analytes, but all samples are below the Secondary Maximum Contaminant Levels (MCL) established for drinking water in the State of Texas, as established by TCEQ pursuant to the EPA standards for the Safe Drinking Water Act.

Ambient air samples were collected from various areas around the wellbores and pump houses of the water wells. These ambient air samples were tested for ethane, methane and propane. All samples were far below the lower explosive limit for the three gases, meaning there is insignificant potential for explosion for fire. Additionally, 117 soil gas samples were tested for presence of methane, ethane, propane and butane. The highest concentration of any of these gases was less than 0.2% of the lower explosive limit for each gas.

Range also presented extensive microseismic data to demonstrate that hydraulic fracturing has not caused communication between the Barnett Shale and Cretaceous aquifers in the area. Microseismic data is available for 320 fracture stimulations for wells in Parker County. For these 320 stimulations, the greatest fracture height is about 400 feet. Given that the separation between the Barnett Shale and the aquifer is about 5,000 feet, it is evident that hydraulic fracturing of the Barnett Shale has not caused any communication with the aquifer.

The Butler and Teal wells have mechanical integrity which will prevent any migration of gas out of the Barnett Shale. The surface casing in each well is set below the base of the Cretaceous and is cemented to surface. The surface casings and production casings of both wells were tested when set during the drilling process. Further, Range performed a mechanical integrity test on the Butler well at the request of the RRC to demonstrate that the low bradenhead pressure on the well was not related to any type of casing problem. The cement behind the production casing is verified by a cement bond log in both wells.

Based on the evidence, the examiners conclude that gas produced in the Lipsky water well and other area water wells is from the Strawn formation which is in direct communication with the Cretaceous aquifer in which the water wells are completed. Some of the water wells even penetrated the Strawn formation. There is no evidence to indicate that either the Teal well or the Butler well is the source of gas production in area water wells. When the appropriate parameters are used in a fingerprinting study, it is clear that the gas produced from the water wells is from Pennsylvanian rock (Strawn) which is significantly different in composition than Barnett Shale gas.

**FINDINGS OF FACT**

1. Notice of this hearing was given on December 8, 2010 to all parties entitled to notice, including Range Production Company, the owners of the two domestic water wells at issue, and three official of the Environmental Protection Agency.
2. The hearing was called by the Railroad Commission of Texas to consider the extent and causation of and responsibility for, any contamination that may have occurred, or which is likely to occur, in domestic water wells in the area of the Range Production Company Butler Unit, Well No. 1H (RRC No. 253732) and the Teal Unit, Well No. 1H (RRC No. 253779), and, more particularly, whether the operation of these wells has caused or contributed, or may cause or contribute, to any such contamination. The call of the hearing was also to consider whether there is any alternative cause or contributor to any contamination that may have occurred.
3. Range Production Company presented evidence in support of its position that neither its Butler Unit Well No. 1 or its Teal Unit Well No. 1 has caused or contributed to contamination of any domestic water wells in the area. The EPA did not appear at the hearing. Neither owner of the two domestic water wells appeared at the hearing.
4. The Teal Unit Well No. 1H was drilled beginning in March 2009 and the Butler Unit Well No. 1H was drilled beginning in June 2009. The wells are horizontal drainhole wells completed in the Newark, East (Barnett Shale) Field.
5. The Butler Unit Well No. 1H and the Teal Unit Well No. 1H were drilled from the same surface location, which is approximately 2,300 feet southeast of the domestic water well on Steven Lipsky's property in Parker County.
6. Both the Teal Unit Well No. 1H and the Teal Unit Well No. 1H have sufficient surface casing to protect usable quality water as recommended by the Texas Commission on Environmental Quality.
  - a. The Texas Commission on Environmental Quality recommends that the interval from land surface to 20 feet below the base of the Cretaceous be protected, with the Cretaceous estimated to occur at 175 feet.

- b. The surface casing for the Butler Unit Well No. 1H is set at 394 feet and cemented to surface.
    - c. The surface casing for the Teal Unit Well No. 1H is set at 409 feet and cemented to surface.
- 7. Both the Teal Unit Well No. 1H and the Butler Unit Well No. 1H have production casing cemented in a manner to prevent migration of fluids behind pipe.
  - a. The top of cement behind the production casing in the Butler Unit Well No. 1H is 4,580 feet, based on a cement bond log. The production casing was pressure tested to 845 psig on October 15, 2010.
  - b. The top of cement behind the production casing in the Teal Unit Well No. 1H is 4,810 feet, based on a cement bond log. The production casing in the Teal No. 1H was pressure tested on December 28, 2010 to 705 psig.
- 8. The Lipsky water well was drilled in 2005 to a depth of 200 feet. The horizontal drainhole of the Butler Unit Well No. 1H comes within a horizontal distance of approximately 450 feet of the Lipsky well, but is more than 5,000 feet deeper than the Lipsky water well.
- 9. Mr. Lipsky's first complaint to the District Office of the Railroad Commission in Abilene regarding natural gas in his water well was in August 2010. The Railroad Commission collected a water sample from the Lipsky well on August 17, 2010 and collected a gas sample from the well on August 26, 2010.
- 10. The Rick Hayley domestic water well is on property adjacent to the Lipsky property to the north. The horizontal drainhole of the Butler Unit Well No. 1H comes within a horizontal distance of approximately 300 feet of the Hayley well, but is more than 5,000 feet deeper than the Hayley water well.
- 11. On October 26, 2010, the EPA collected water and gas samples from the Lipsky water well, a water sample from the Rick Hayley domestic water well storage tank, gas and water samples from the tubing of the Butler Unit Well No. 1 and a gas sample from the tubing of the Teal Unit Well No. 1H.

12. On December 7, 2010, the EPA issued an Emergency Administrative Order to Range Resources Company. Range was advised of the EPA's determination that Range's oil and gas production operations related to the Butler Unit Well No. 1H and the Teal Unit Well No. 1H "...were directly related to imminent and substantial endangerment to a public drinking water aquifer."
13. In the subject area of Parker County, the Pennsylvanian age Strawn directly underlies the Trinity aquifer group which is composed of the Paluxy, Glen Rose and Twin Mountains. The Trinity is Cretaceous age.
14. The depth of the base of the Cretaceous/top of Pennsylvanian occurs at a depth of approximately 400 feet in this area. An erosional unconformity exists which allows communication between the Cretaceous and the Pennsylvanian.
15. The Barnett Shale occurs at a depth of approximately 5,700 feet in the area of the Butler Unit Well No. 1H and Teal Unit Well No. 1H.
16. The Barnett Shale is Mississippian age rock, but is the source rock for all gas-bearing formations in the Fort Worth Basin including the subject area.
17. Gas production in water wells in Parker and Hood Counties has occurred since at least 2003, several years before the drilling and production of both the Teal Unit Well No. 1H and the Butler Unit Well No. 1H.
  - a. A domestic water well on the Hurst property, approximately 900 feet west of the Lipsky water well, was completed in October 2005 and flowed gas sufficient to flare for a few months. The well is 180 feet deep.
  - b. in 2007, a domestic water well on the Oujesky property approximately 750 feet to the north of the Lipsky property, flowed gas upon completion which continued for a couple of months. The well is 220 feet deep.
  - c. Well No. 4 of the Lake Country Acres water supply flowed 122 MCF per day upon completion in 2003 and was plugged. This well is approximately 7,000 feet to the east of the Lipsky water well and was drilled to a total depth of approximately 400 feet.

18. Production from the Strawn formation occurred in the mid-1980's from the Center Mills (Strawn) Field approximately one mile to the southeast of the surface location of the Butler/Teal wells. The Strawn in this field was productive from depths as shallow as 358 feet.
19. Lipsky first reported gas production from his water well after construction of a home, extensive landscaping and pool construction on his property in 2010.
20. Samples from 25 water wells within 3,000 feet of the Butler/Teal surface location were analyzed for 135 constituents, including 108 volatile organic compounds, three RCRA metals, and dissolved gases. None of the samples had levels of any of the constituents which exceed the Texas Risk Reduction Program Protective Concentration Level established by the TCEQ or MCL standards.
21. Ambient air samples taken from various areas around the 25 water wells contained concentrations of methane, ethane and propane far below the lower explosive limit for the gases. The highest concentration of any of the gases was 0.29% of the lower explosive limit.
22. Soil gas samples from 117 sites were tested for methane, ethane, propane and butane, and the concentrations of these gases were far below the lower explosive limits for each gas. The highest concentration of any of the gases was 0.176% of the lower explosive limit.
23. Because the Barnett Shale is the source rock for shallower gas-bearing formations, the carbon isotopic fingerprint for Barnett Shale gas is expected to be similar to Strawn gas, as determined by the EPA's analysis.
24. The appropriate geochemical parameters for fingerprinting to distinguish Strawn gas of Pennsylvanian age from Barnett Shale gas of Mississippian age, are nitrogen and carbon dioxide, not carbon. Gas from Pennsylvanian age rock, including the Strawn, has higher nitrogen concentration and lower carbon dioxide concentration than Barnett Shale gas.
25. Gas found in the 25 water wells, including the Lipsky and Hayley water wells, does not match the nitrogen isotropic fingerprint of Barnett Shale gas. The gas found in the water wells matches Pennsylvanian gas.
26. Bradenhead gas samples from both the Teal Unit Well No. 1H and the Butler Unit Well No. 1H do not match Barnett Shale gas, confirming that gas is not migrating up the wellbores and that the Barnett Shale producing interval in the wells is properly isolated.

27. Hydraulic fracturing of the Barnett Shale in the Teal Unit Well No. 1H and the Butler Unit Well No. 1H did not result in communication of the Barnett Shale with shallow aquifers from which water wells in the area produce.
  - a. Based on available 3D seismic, there is no evidence of faulting in the area of the Butler/Teal wells.
  - b. Microseismic data available for more than 320 fracture stimulations in Parker County indicate a maximum fracture height of approximately 400 feet, meaning that almost one mile of rock exists between the highest fracture and the shallow aquifer.

**CONCLUSIONS OF LAW**

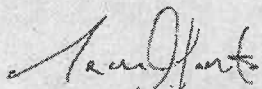
1. Proper notice was issued in accordance with applicable statutory and regulatory requirements.
2. All things have occurred to give the Railroad Commission jurisdiction to consider this matter.
3. Specifically, the Commission has jurisdiction over the issues in this proceeding pursuant to Title 3, Oil and Gas, Subtitles A, B, and C of the Texas Natural Resources Code, Chapter 26, 27 and 29 of the Texas Water Code, and Tex. Gov't Code Ann. §§ 2001 et seq. (2010).
4. No person conducting activities subject to regulation of the Commission may cause or allow pollution of surface or subsurface water in the state. 16 *Tex. Admin. Code Ann.* § 3.8(b).
5. Pursuant to 16 *Tex. Admin. Code* § 1.47, in response to a written complaint or on the Commission's own motion, the Commission may issue a notice commanding a person or agency subject to the Commission's jurisdiction to appear at a public hearing and show cause why the person or agency should not be compelled to do the act required or refrain from doing an act.
6. The Railroad Commission has acted appropriately in its investigation of, and actions with regard to, the Lipsky complaint.
7. The Environmental Protection Agency (EPA) through the following individuals, were provided notice of this hearing: Dr. Alfredo Almendariz, Regional Administrator, Tucker Henson, Office of Regional Counsel, John Blevins, Office of Compliance Assurance and Enforcement Tex. Gov't Code Ann. § 2001.051 et seq. and 16 *Tex. Admin. Code* § 1.45.


8. Steven Lipsky and Rick Hayley were provided notice of this hearing pursuant to Tex. Gov't Code Ann. § 2001.051 et seq. and 16 Tex. Admin. Code § 1.45.
9. The EPA, Mr. Lipsky and Mr. Hayley did not to appear or participate in the evidentiary hearing.
10. Range has met its burden of proof as to the matters considered in this proceeding and has established that none of its activities in the subject wells are in violation of Statewide Rule 8.
11. The Protective Concentration Levels (PCLs) are the default cleanup standards in the Texas Risk Reduction Program, found at 30 *Tex. Admin. Code* § 350 et seq. and the water well sampling results established that PCLs were not exceeded for any of the wells sampled.
12. Section 30 *Tex. Admin. Code* § 290 set the maximum contaminate levels (MCLs) for drinking water in the State of Texas and the purpose of those standards is to assure the safety of public water supplies with respect to microbiological, chemical and radiological quality and to further efficient processing through control tests, laboratory checks, operating records and reports of public water supply systems. Those standards were written to comply with the requirements of the Federal "Safe Drinking Water Act," 42 USC §300f et seq., and the "Primary Drinking Water Regulations" which have been promulgated by the United States Environmental Protection Agency. The water well sampling results established that MCLs were not exceeded for any of the wells sampled.

#### EXAMINERS' RECOMMENDATION

Based on the evidence preented and summarized in the above findings of fact and conclusions of law, the examiners recommend that a Final Order be issued which finds that the operations of the Teal Unit Well No. 1H and the Butler Unit Well No. 1H by Range Resources Company have not contributed and are not contributing to contamination of any domestic water wells.

Respectfully submitted,

  
Gene Montes  
Hearings Examiner

  
Donna K. Chandler  
Technical Examiner

# Attachment A



## UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 6  
1445 Ross Ave., Suite 1200  
Dallas, TX 75202

December 7, 2010

CERTIFIED MAIL - RETURN RECEIPT REQUESTED (7007 0710 0002 1385 1927)

Mr. Mike Middlebrook  
Vice President of Operations  
Range Resources Corporation and  
Range Production Company  
100 Throckmorton Street, Suite 1200  
Fort Worth, TX 76102

Exhibit No. **5**  
Operator: Range Resources  
Docket No. 7B-0268629  
Date: January 19, 2011

Re: Findings and Emergency Order  
Docket No. SDWA-06-2011-1208  
Butler Unit, Lease No.: 253732, Well # 1-H  
Teal Unit, Lease No.: 253779, Well #1-H

Dear Mr. Middlebrook:

As a result of investigatory work performed, the U.S. Environmental Protection Agency (EPA) Region 6 has determined that an imminent and substantial endangerment to a public drinking water aquifer has occurred (or may occur) through methane contamination which is directly related to oil and gas production facilities under your operation. The Agency has data to indicate that two private drinking water wells, and potentially more, have been significantly impacted by the methane contamination which presents a potential threat of explosion due to high levels found dissolved in the drinking water and methane vapors present in the headspace of the drinking water wells, and therefore presents a potential imminent endangerment to the health of persons using those private drinking water wells.

Due to these conditions, I am enclosing an Emergency Order (Order) issued to Range Resources Corporation and Range Production Company (Range or Respondents) pursuant to Section 1431 of the Safe Drinking Water Act (Act), 42 U.S.C. § 300i. This Order is issued to Range as owner and/or operator of the referenced oil and gas production facilities. Presently, the operation of these facilities presents, or may present, an imminent and substantial endangerment to public health. The Order describes the actions you must take to ensure the Butler Unit and Teal Unit production facilities pose no imminent and substantial endangerment to public health through methane contamination of an underground source of drinking water.

Specifically, the Order requires Range to:

- A) Within twenty-four (24) hours of receipt of this Order, Respondents shall notify EPA in writing whether they intend to comply with this Order.
- B) Within forty-eight (48) hours of receipt of this Order, Respondents shall provide replacement potable water supplies for the consumers of water from Domestic Well 1 and Domestic Well 2.
- C) Within (48) forty-eight hours of receipt of this Order, Respondents shall install explosivity meters, approved by EPA, in the dwellings served by Domestic Wells 1 and 2.
- D) Within five (5) days of receipt of this Order, Respondents shall submit to EPA a survey listing and identifying the location description (latitude and longitude) of all private water wells within 3,000 feet of the Butler wellbore track and 3,000 feet of the Teal wellbore track and all of the Lake Country Acres (TX1110059) public water supply system wells. This submittal shall include a plan for EPA's approval, to sample those wells identified in Order to determine if any of those wells have been impacted. The plan shall include head space (air) and dissolved constituent (water) sampling. The head space sampling shall commence no later than five (5) days after submittal of the plan.
- E) Within fourteen (14) days of receipt of this Order, Respondents shall submit to EPA, for approval, a plan to conduct soil gas surveys and indoor air concentration analyses of the properties and dwellings served by Domestic Wells 1 and 2.


Within sixty (60) days of receipt of this Order, Respondents shall develop and submit to EPA for approval, a plan to: 1) identify gas flow pathways to the Trinity Aquifer; 2) eliminate gas flow to the aquifer if possible, and 3) remediate areas of the aquifer that have been impacted.

Effective upon receipt of the Order, Range shall immediately comply with all of the provisions specified in the "ORDER" Section of the enclosed Order.

Additional requirements will be set forth by the EPA after plans are reviewed.

If your staff has questions specific to the Order, please contact Mr. Chris Lister at (214) 665-6672 for technical questions or Tucker Henson at (214) 665-2718 for legal questions. We urge your prompt attention to this matter.

Sincerely,

  
John Blevins  
Director  
Compliance Assurance and  
Enforcement Division

Enclosure



### FINDINGS OF FACT

1. Range Resources Corporation ("RRC") is a Fort Worth, Texas based independent natural gas company engaged in the exploration, development and acquisition of primarily natural gas properties in the Southwestern and the Appalachian regions of the United States. RRC is a Delaware corporation with its common stock listed and traded on the New York Stock Exchange under the symbol "RRC."
2. Range Production Company ("RPC") is a wholly-owned subsidiary of Range Resources Corporation operating in the State of Texas.
3. At all times relevant to this Order, RRC and RPC (hereinafter "Respondents") owned or operated the natural gas production facilities (collectively, "Gas Wells") identified as the Butler Unit Well 1-H ("Butler Well") (permitted at Atwood, JB Survey, Abstract #802, Hood County, 660 feet from the N line and 986 feet from the SE line) and the Teal Unit Well 1-H ("Teal Well") (permitted at Atwood, JB Survey, Abstract #802, Hood County, 703 feet from NE line and 948 feet from SE line).
4. Respondents contracted for and directed the drilling of the Butler Well in June 2009 and completed hydraulic fracture stimulation operations in August 2009. Gas production began from the Butler Well in August 2009.
5. Respondents contracted for and directed the drilling of the Teal Well in March and April of 2009 and completed hydraulic fracture stimulation operations in April 2009. Gas production began from the Teal Well in August 2009.
6. The Trinity Aquifer exists under twenty Texas counties, including Parker and Hood counties where the Gas Wells and the private drinking water wells described below are located.
7. As set forth more fully below, two domestic drinking water wells ("Domestic Well 1" and "Domestic Well 2"), located near the Gas Wells and utilizing the Trinity Aquifer, have been shown to contain methane, benzene, toluene, ethane, propane, and hexane. Some of these contaminants are at levels that may endanger the health of persons.
8. Domestic Well 1 lies approximately 120 feet in horizontal distance to the east-northeast from the track of the horizontal section of the Butler Well bore.
9. Domestic Well 2 lies approximately 470 feet in horizontal distance to the southeast from the track of the horizontal section of the Butler Well bore.
10. Domestic Wells 1 and 2 provide drinking water to nine people including both adults and children.

11. The Gas Wells are the only gas production facilities within approximately 2,000 feet of Domestic Wells 1 and 2.
12. Domestic Well 1 (32.56312 latitude, -97.79144 longitude) was drilled in April 2005 and was immediately used for human consumption, building construction, and landscape irrigation.
13. Neither the consumer, nor the well drilling service, observed or reported that the water from Domestic Well 1 contained any noticeable natural gas at the time of its drilling.
14. In late December 2009, approximately four months after the Gas Wells began producing gas, the owner of Domestic Well 1 first noticed that the water had begun to effervesce.
15. On July 26, 2010, the down-hole pump in Domestic Well 1 began experiencing mechanical problems soon identified by a water well service company as "gas locking."
16. "Gas locking" is a condition sometimes encountered in a down-hole pump when dissolved gas is released from solution by the action of the pump and prevents the pump from moving water.
17. In addition, on July 26, 2010, the gas in Domestic Well 1 was determined to be flammable.
18. On August 8, 2010, the owner contracted for water samples to be taken from Domestic Well 1. The samples showed the presence of benzene (3.1 µg/L), toluene (2.0 µg/L), dissolved methane (7,810 µg/L) and dissolved ethane (1,580 µg/L).
19. On August 17, 2010, TRRC took water samples from Domestic Well 1 that showed the presence of benzene (6.84 µg/L) and toluene (6.12 µg/L).
20. The consumer and well owner removed Domestic Well 1 from service during the first week of September 2010 due to the rising gas content within the drinking water and concerns with water quality, indoor air quality and potential explosivity.
21. EPA took samples of the gas from Domestic Well 1 and the Butler Well production stream on October 26, 2010 to perform compositional analysis and isotopic fingerprinting.
22. Isotopic fingerprinting is a method for determining the ratio of different isotopes of a particular element in an investigated material. Understanding this ratio helps scientists know the source of the investigated material.
23. Methane is a molecule comprised of one carbon atom for every four hydrogen atoms. Its chemical formula is CH<sub>4</sub>.

