



May 20, 2010

Certified Mail Return Receipt Requested # 7008 3230 0003 3235 5398

Mrs. Angie Lizardy
20601 County Road 53.6
Trinidad, CO 81082-9648

RE: Complaint 200241120
Water Well Analysis
Well Permit 74063
NWSE 3 32S 65W Las Animas County, Colorado

Dear Angie:

In response to your concerns regarding possible impacts to water quality from coal bed methane (CBM) operations in the area near your home, the Colorado Oil and Gas Conservation Commission (COGCC) conducted a field visit to your property on May 4, 2010. Water samples were collected for general organic and inorganic water quality testing as well as for analysis of dissolved methane and BART kits. A summary of the results of the chemical analyses is presented below. The analytical results are also compared to published water quality standards and to results of prior testing of water from your well.

FIELD TESTING

I visited your property on May 4, 2010. We started water flowing from an outdoor spigot at 13:55. We collected samples from your well using the outdoor faucet installed after your pressure tank, after pumping the well for 12 minutes. I determined that there was no methane venting from the casing of your water well after the sampling. The samples for general inorganic, dissolved methane and volatile organic compound analysis were shipped to ALS Laboratory Group in Fort Collins, CO and received on May 5, 2010. The water was clear with no sediment visible and I did not note any odors associated with the water nor were effervescent bubbles present in the water.

COMPARISON OF INORGANIC ANALYTICAL RESULTS TO CDPHE INORGANIC STANDARDS

The Water Quality Control Commission (WQCC) of the Colorado Department of Public Health and Environment (CDPHE) has established "Domestic Use-Quality" human health standards and drinking water standards. Analytical data for the most recent samples from your water well was compared to these standards. This information is summarized in Table 1 which is located in Attachment 1 and discussed in narrative form below. Please keep in mind that these "Domestic Use-Quality Standards" were established for **municipal public** drinking water supplies and often people use and consume ground water from private wells that exceed these standards. A paper copy of the reports from ALS Laboratory Group is included as Attachment 2. Table 2 (Attachment 3) includes results from COGCC sampling and analyses of your well water in January of 2002 and October of 2007 and compares those results to the most recent results.

- **Antimony (Sb):** The CDPHE human health standard for antimony is 0.006mg/l. Antimony is a contaminate metal.

Antimony was not detected in the sample collected from your water well (2010).

- **Arsenic (As):** The CDPHE human health standard for arsenic is 0.05 mg/l. Arsenic is a highly poisonous metal.

Arsenic was not detected in the sample collected from your water well (2010).

- **Barium (Ba):** The CDPHE human health standard for barium is 2.0 mg/l. Barium is a contaminate metal.

Barium was not detected in the sample collected from your water well (2010).

- **Beryllium (Be):** The CDPHE human health standard for beryllium is 0.004mg/l. Beryllium is a contaminate metal.

Beryllium was not detected in the sample collected from your water well(2010).

- **Cadmium (Cd):** The CDPHE human health standard for cadmium is 0.005 mg/l. Cadmium is a contaminate metal.

Cadmium was not detected in the sample collected from your water well (2010).

- **Chromium (Cr):** The CDPHE human health standard for chromium is 0.1 mg/l. Chromium is a contaminate metal.

Chromium was not detected in the sample collected from your water well (2010).

- **Lead (Pb):** The CDPHE human health standard for lead is 0.05 mg/l. Prolonged exposure to this metal can result in serious health effects.

Lead was not detected in the sample collected from your water well (2010).

- **Nickel (Ni):** The CDPHE human health standard for nickel is 0.1mg/l. Nickel is a contaminate metal.

Nickel was not detected in the sample collected from your water well (2010).

- **Selenium (Se):** The CDPHE human health standard for selenium is 0.05 mg/l. Selenium is a contaminate metal.

Selenium was not detected in the sample collected from your water well (2010).

- **Silver (Ag):** The CDPHE human health standard for silver is 0.05 mg/l. Excess amounts of silver may cause a permanent gray discoloration of the skin.

Silver was not detected in the sample collected from your water well (2010).

- **Thallium (Tl):** The CDPHE human health standard for thallium is 0.002 mg/l. Thallium is a contaminate metal.

Thallium was not detected in the sample collected from your water well (2010).

- **Uranium (U):** The CDPHE human health standard for thallium is 0.03 mg/l. Uranium can be present due to erosion of natural deposits of this element.

Uranium was detected in the sample collected from your water well at a concentration of 0.00069mg/l which is below the CDPHE human health standard (2010).

- **Fluoride (F):** The CDPHE human health standard for fluoride is 4.0 mg/l. Where fluoride concentrations are in the range of 0.7 mg/l to 1.2 mg/l health benefits such as reduced dental decay have been observed. Consumption of fluoride at concentrations of greater than 2.0 mg/l can result in mottling of teeth. Consumption of fluoride at concentrations greater than 4.0 mg/l can increase the risk of skeletal fluorosis or other adverse health effects. Fluoride occurs naturally in the ground water in many areas in Colorado at concentrations that exceed the drinking water standard.

Fluoride was detected in the sample collected from your water well at a concentration of 0.22mg/l which is below the CDPHE human health standard (2010).

- **Nitrate (NO₃):** The CDPHE human health standard for nitrate is 10.0 mg/l. Nitrate can cause cyanosis in infants; a household water supply should not contain nitrate concentration in excess of 10 mg/l.

Nitrate was not detected in the sample collected from your water well (2010).

- **Nitrite (NO₂):** The CDPHE human health standard for nitrite is 1.0 mg/l. Nitrite concentrations exceeding 1.0 mg/l should not be used for feeding infants.

Nitrite was not detected in the sample collected from your water well (2010).

- **Copper (Cu):** The CDPHE secondary drinking water standard for copper is 1 mg/l.

Copper was detected in the sample collected from your water well at a concentration of 0.016mg/l which is below the CDPHE human health standard (2010).

- **Chloride (Cl):** The CDPHE secondary drinking water standard for chloride is 250mg/l. Chloride concentrations in excess of 250 mg/l usually produce a noticeable taste in drinking water.

Chloride was detected in the sample collected from your water well at a concentration of 18mg/l which is below the CDPHE drinking water standard (2010).

- **Iron (Fe):** The CDPHE secondary drinking water standard for iron is 0.3mg/l. Small amounts of iron are common in ground water. Iron produces a brownish-red color in laundered clothing, can leave reddish stains on fixtures, and impart a metallic taste to beverages and food made with it. After a period of time iron deposits can build up in pressure tanks, water heaters, and pipelines, reducing the effective flow rate and efficiency of the water supply.

Iron was not detected in the sample collected from your water well (2010).

- **Manganese (Mn):** The CDPHE secondary drinking water standard for manganese is 0.05mg/l. Manganese produces a brownish color in laundered clothing, may stain fixtures and affect the taste of coffee or tea.

Manganese was detected in the sample collected from your water well at a concentration of 0.32mg/l which is above the CDPHE secondary standard (2010).

- **Sulfate (SO₄)**: The CDPHE sulfate secondary standard for human drinking water is 250mg/l. Although CDPHE does not have an agricultural standard for sulfate, other agencies recommend a concentration below 1,500 mg/l for livestock watering. Waters containing high concentrations of sulfate, typically caused by the leaching of natural deposits of magnesium sulfate (Epsom salts) or sodium sulfate (Glauber's salt), may be undesirable because of their laxative effects.

Sulfate was detected in the sample collected from your water well at a concentration of 240mg/l which is below the CDPHE drinking water standard (2010).

- **pH**: pH is the measure of the hydrogen ion concentration in water. The pH of water in its natural state is generally from 5.5 to 9.0. The CDPHE standard for domestic and agricultural water is a range of 6.5 to 8.5. Seven (7) represents neutrality, while values less than 7 indicate increasing acidity and values greater than 7 indicate increasing alkalinity.

pH was measured in the water sample from your well with a value of 7.5 which is within the CDPHE drinking water and agricultural standards (2010).

- **Total Dissolved Solids (TDS)**: CDPHE's TDS standard for human drinking water is 500 milligrams per liter (mg/l). Although CDPHE does not have an agricultural standard for TDS, other agencies recommend concentrations below 1500 mg/l for irrigation, and below 5,000 mg/l for most livestock watering. TDS occurs naturally in the ground water in many areas of Colorado at concentrations that exceed the drinking water standard.

TDS was measured in the water sample collected from your well at a concentration of 720mg/l which is above the drinking water standard (2010).

- **Zinc (Zn)**: CDPHE's Zn standard for human drinking water is 5 milligrams per liter (mg/l) and the agricultural standard is 2mg/l.

Zinc was not detected in the sample collected from your water well (2010).

The following parameters were also measured as part of the laboratory analysis although there are no CDPHE standards.

- **Sodium (Na)**: People on salt restricted diets should be aware of the sodium concentration in the water they drink. A concentration of less than 20 mg/l is recommended by some for people on salt restricted diets or for people suffering from hypertension or heart disease. Sodium occurs naturally in the ground water in many areas of Colorado at concentrations that exceed this health advisory level.

Sodium was detected in the water sample from your well in 2010 at a concentration of 68mg/l which is above the recommended level.

- **Boron (B)**:

Boron was not detected in the sample collected from your water well (2010).

- **Calcium (Ca)**:

The calcium concentration in the sample collected from your well in 2010 was 110mg/l.

- **Magnesium (Mg):**

The magnesium concentration in the sample collected from your water well in 2010 was 38mg/l.

- **Potassium (K):**

The potassium concentration in the sample collected from your water well in 2010 was 4.2mg/l.

- **Molybdenum (Mo):**

Molybdenum was not detected in the sample collected from your water well in 2010.

- **Bicarbonate (HCO₃):**

Bicarbonate alkalinity was measured in the sample collected from your well in 2010 at a concentration of 340mg/l.

- **Bromide (Br):**

Bromide was not detected in the sample collected from your water well (2010).

METHANE GAS ANALYSIS

Methane was detected in the sample collected from your well (2010) at a concentration of 0.018mg/l. The concentration of methane in the water produced from the well and entering your house is below the threshold level of 1.1mg/l that could theoretically allow methane to accumulate in confined, unventilated spaces and potentially be explosive.

VOLATILE ORGANIC COMPOUND ANALYSIS

A target list of sixty-nine volatile organic compounds (VOC) was utilized during analysis of water from your well. None of the 69 target compounds were detected in water samples from your well. No volatile tentatively identified compounds were detected in the water samples from your well.

BACTERIAL ANALYSIS

The COGCC collected samples to analyze for the presence of iron, slime and sulfur bacteria in your water well. Samples from your water well were tested for the presence of iron-related (IRB), sulfate reducing (SRB) and slime forming (SLYM) bacteria using Biological Activity Reaction Test (BART) kits. In addition to detecting the presence of bacteria the BART Kits allow for an estimation of the size of the population and/or the rate at which they can metabolize and/or grow through an observable change or reaction. This reaction rate is referred to as the “aggressivity” of the bacterial population. The aggressivity levels of the bacteria are described as **Not Detected, Background, Moderately Aggressive, Very Aggressive, or Extremely Aggressive Levels**. The results of the tests are provided below and documented in Photographs 1, 2 and 3. The progress of the bacterial growth one day after the cultures were started is seen in Photograph 1. Photograph 2 shows the progress of the bacterial tests six days after the cultures were started and Photograph 3 shows the progress of the bacterial tests eight days after the cultures were started.

- **Iron-Related Bacteria (IRB):** Although not harmful, iron-related bacteria can become a nuisance by plugging the well pump, causing red staining on plumbing fixtures and laundered clothing, building up red, slimy accumulations on any surface the water touches, and causing

what appears to be a sheen on standing water. Signs that may indicate an iron bacteria problem include “yellowish, red or orange colored water, rusty deposits in toilet tanks and strange smells resembling fuel oil, cucumbers or sewage. Sometimes the odor will only be apparent in the morning or after other extended periods of non-use” (CDPHE, Laboratory Services Division).

IRB bacteria were detected in the water sample collected at this well at Moderately Aggressive levels. IRB are present when an orange cloudy layer, at the bottom of the IRB tube (red cap) and foam at the top develop. The development of a foamy layer can be seen in Photograph 2 after six days.



Photograph 1. BART Kits May 5, 2010

- **Sulfate Reducing Bacteria (SRB):** Sulfate reducing bacteria are serious nuisance organisms in water since they can cause severe taste and odor problems. These bacteria reduce sulfate that occurs naturally in the water and generate hydrogen sulfide (H_2S) gas as they grow. In turn, the hydrogen sulfide (H_2S) gas is a nuisance because it smells like rotten eggs, initiates corrosion on metal surfaces and reacts with dissolved metals such as iron to generate black sulfide deposits.

SRB were not detected in your well water as shown by the lack of development of black particulates at the bottom of the black capped vial in Photograph 3. The culture turns black if SRB are present.

- **Slime Forming Bacteria (SLYM):** Although not usually harmful, Slime Forming Bacteria (SFB) can become a nuisance by plugging well pumps and causing slimy accumulations on plumbing fixtures and standing water. Slimes are often gelatinous in nature and may range in color from white, to red, or black. As slime bacteria mats grow they create an environment in which complex associations of other strains of bacteria can develop.

SLYM bacteria were detected at Background levels in the water sample collected from this well as indicated by the cloudy yellow liquid seen in the green capped vial in Photograph 3 after eight days.

The BART tests indicate the presence of at least two types of nuisance bacteria in your well system. Once bacterial colonies are established they are difficult to eliminate; therefore, you may need to establish a schedule for periodic disinfection of your well system to help control the bacteria present in it. The chlorination process is more easily accomplished if you have a frost-proof hydrant near the well head that you can use to remove the chlorinated water from the well. One technique that water well professionals use is to re-circulate the chlorine solution down the sides of the well shortly after adding the chlorine. This helps to kill bacteria on the sides of the well and on the pipes in the well. Odor and taste problems with water wells are frequently caused by the presence of bacteria in the system.

Pamphlets published by the CDPHE that provide more information concerning water well iron and sulfur bacteria and shock chlorination treatment of bacteria are included as Attachment 3. You may also want to contact a licensed water well contractor for additional information or for help in disinfecting your well and distribution system. Additional information and assistance can be provided through the State of Colorado Health Department. Contact information for the agency is provided below.

Colorado Department of Public Health and Environment
Colorado Drinking Water Program
4300 Cherry Creek Drive South
Denver, CO 80246-1530
Phone: 303-692-3500
Fax: 303-782-0390



Photograph 2. BART Kits May 10, 2010



Photograph 3. BART Kits May 12, 2010

CONCLUSIONS

The inorganic chemistry of water from your well is not similar to coal bed methane (CBM) produced water and does not appear to have been impacted by CBM operations in the vicinity of your home. CBM produced water is typically much higher in sodium content than your well water is. CBM produced water typically has greater levels of total dissolved solids than water from your well. The major ion chemistry of water in your well (sodium, potassium, magnesium, calcium, chloride, sulfate, bicarbonate) has remained relatively constant since sampled in 2002. The limits of laboratory precision and accuracy typical of analyses for these ions are in the range of $\pm 10\%$. The concentration of total dissolved solids present in water from your well is greater than the upper limit concentration for public drinking water supplies. The previous samples collected in 2007 and 2002 contained similar concentrations of TDS. Many water wells in the region naturally have TDS concentrations above the drinking water guidance concentration. The concentration of manganese dissolved in water from your well exceeds that groundwater standard established by the Water Quality Control Commission of the Colorado Department of Public Health and the Environment in all samples collected since 2002. The groundwater standard for this metal is based on effects such as taste, odor, or color of groundwater and not on health effects of consuming well water with this concentration of manganese.

Table 2 shows a comparison of results from a baseline sample collected from your well in 2002 by the COGCC, from a follow-up sample collected in 2007 and the most recent samples collected by the COGCC (May, 2010). The overall chemistry of the water from your well has not changed during the eight years for which data is available. The water is predominantly of a calcium-sulfate-bicarbonate character. TDS is a good indicator of overall inorganic water quality and it has remained stable over the last eight years as seen in Table 2. The water quality data for the 2010 sampling and analysis does not show any impacts from nearby CBM drilling and production activities.

If you have any questions or would like to discuss these matters further, please contact me at 719-846-3091 or by email at peter.gintautas@state.co.us .

Sincerely,
Colorado Oil and Gas Conservation Commission

Peter Gintautas
Environmental Protection Specialist

Attachments: Attachment 1 - Table 1 - Analytical Summary
 Attachment 2 - ALS Laboratory Group Analytical Reports
 Attachment 3 - Table 2 – 2002 to 2010 Summary
 Attachment 4 - CDPHE domestic well pamphlets

cc: David Neslin, COGCC Director w/o attachments
 Debbie Baldwin, COGCC Environmental Protection Manager w/o attachments
 Steve Lindblom, COGCC Environmental Protection Supervisor w/o attachments

TABLE 1
ANALYTICAL SUMMARY
Complaint 200241120
Lizardy Water Well

Parameter	Water Sample		CDPHE Standards		
	Sample Date				
	04-May-10				
	Result	Unit	Domestic	Agriculture	Units
Antimony	ND	mg/l	0.006	NS	mg/l
Arsenic	ND	mg/l	0.01	0.1	mg/l
Barium	ND	mg/l	2.0	NS	mg/l
Beryllium	ND	mg/l	0.004	0.1	mg/l
Boron	ND	mg/l	NS	0.75	mg/l
Cadmium	ND	mg/l	0.005	0.01	mg/l
Calcium	110	mg/l	NS	NS	
Chromium	ND	mg/l	0.1	0.1	mg/l
Cobalt	ND	mg/l	NS	0.05	mg/l
Copper	0.016	mg/l	1	0.2	mg/l
Iron	ND	mg/l	0.3	5	mg/l
Lead	ND	mg/l	0.05	0.1	mg/l
Lithium	0.014	mg/l	NS	NS	
Magnesium	38	mg/l	NS	NS	
Manganese	0.32	mg/l	0.05	0.2	mg/l
Molybdenum	ND	mg/l	0.035	NS	mg/l
Nickel	ND	mg/l	0.1	0.2	mg/l
Potassium	4.2	mg/l	NS	NS	
Selenium	ND	mg/l	0.05	0.02	mg/l
Silver	ND	mg/l	0.05	NS	mg/l
Sodium	68	mg/l	NS	NS	
Strontium	2.7	mg/l	NS	NS	
Thallium	ND	mg/l	0.002	NS	mg/l
Uranium	0.00069	mg/l	0.03	NS	mg/l
Zinc	ND	mg/l	5	2	mg/l
Chloride	18	mg/l	250	NS	mg/l
Nitrite	ND	mg/l	1.0	10	mg/l
Nitrate	ND	mg/l	10.0	100	mg/l
Total Nitrite/Nitrate	ND	mg/l	10.0	100	mg/l
Fluoride	0.22	mg/l	4.0	NS	mg/l
Total Dissolved Solids	720	mg/l	400	*1500	mg/l
pH	7.5	No units	6.5 - 8.5	6.5 - 8.5	No units
Sulfate	240	mg/l	250	NS	mg/l
Bromide	ND	mg/l	NS	NS	
Total Alkalinity	340	mg/l	NS	NS	
Bicarbonate	340	mg/l	NS	NS	
Carbonate	ND	mg/l	NS	NS	
Conductivity	1080	umhos/cm	NS	NS	
methane	0.018	mg/l	NS	NS	

Notes

CDPHE

Domestic

Agriculture

mg/l

umhos/cm

NA

ND

NS

Colorado Department of Public Health and the Environment.

Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41 - The Basic Standards For Groundwater.

* Standards for agriculture complied from CDPHE and other of sources.

milligrams per liter (ppm or parts per million).

micromhos per centimeter

Not analyzed.

Not detected.

No Standard.

Health Advisory.

Human health standard.

Secondary standard.

TABLE 2
ANALYTICAL SUMMARY 2002 to 2010
Complaint 200241120
Lizardy Water Well

Parameter	Water Sample				CDPHE Standards		
	Sample Date		Sample Date				
	17-Jan-02	17-Oct-07	04-May-10				
	Result	Result	Result	Unit	Domestic	Agriculture	Unit
Antimony	NA	ND	ND	mg/l	0.006	NS	mg/l
Arsenic	ND	ND	ND	mg/l	0.01	0.1	mg/l
Barium	0.026	ND(<0.1)	ND	mg/l	2.0	NS	mg/l
Beryllium	NA	ND	ND	mg/l	0.004	0.1	mg/l
Boron	NA	ND	ND	mg/l	NS	0.75	mg/l
Cadmium	ND	ND	ND	mg/l	0.005	0.01	mg/l
Calcium	96.4	120	110	mg/l	NS	NS	
Chromium	ND	ND	ND	mg/l	0.1	0.1	mg/l
Cobalt	NA	NA	ND	mg/l	NS	0.05	mg/l
Copper	ND(<0.02)	ND(<0.01)	0.016	mg/l	1	0.2	mg/l
Iron	0.051	ND(<0.1)	ND(<0.1)	mg/l	0.3	5	mg/l
Lead	ND	ND	ND	mg/l	0.05	0.1	mg/l
Lithium	ND	NA	0.014	mg/l	NS	NS	
Magnesium	34.4	43	38	mg/l	NS	NS	
Manganese	0.4	0.41	0.32	mg/l	0.05	0.2	mg/l
Molybdenum	0.0025	ND(<0.001)	ND	mg/l	0.035	NS	mg/l
Nickel	NA	ND	ND	mg/l	0.1	0.2	mg/l
Potassium	3	4.6	4.2	mg/l	NS	NS	
Selenium	ND	ND	ND	mg/l	0.05	0.02	mg/l
Silver	ND	ND	ND	mg/l	0.05	NS	mg/l
Sodium	67	71	68	mg/l	NS	NS	
Strontium	NA	NA	2.7	mg/l	NS	NS	
Thallium	NA	ND	ND	mg/l	0.002	NS	mg/l
Uranium	NA	NA	0.00069	mg/l	0.03	NS	mg/l
Zinc	ND	ND	ND	mg/l	5	2	mg/l
Chloride	16	21	18	mg/l	250	NS	mg/l
Nitrite	ND	ND	ND	mg/l	1.0	10	mg/l
Nitrate	ND	ND	ND	mg/l	10.0	100	mg/l
Total Nitrite/Nitrate	ND	ND	ND	mg/l	10.0	100	mg/l
Fluoride	0.3	0.3	0.22	mg/l	4.0	NS	mg/l
Total Dissolved Solids	645	740	720	mg/l	400	*1500	mg/l
pH	5.9	7.72	7.5	No units	6.5 - 8.5	6.5 - 8.5	No units
Sulfate	220	270	240	mg/l	250	NS	mg/l
Bromide	ND	ND	ND	mg/l	NS	NS	
Total Alkalinity	341	330	340	mg/l	NS	NS	
Bicarbonate	341	330	340	mg/l	NS	NS	
Carbonate	ND	ND	ND	mg/l	NS	NS	
Conductivity	666	1170	1080	µmhos/cm	NS	NS	
methane	0.00388	0.038	0.018	mg/l	NS	NS	

Notes

CDPHE	Colorado Department of Public Health and the Environment.
Domestic	Water Quality Control Commission 5 CCR 1002-41, Regulation No. 41 - The Basic Standards For Groundwater.
Agriculture	* Standards for agriculture complied from CDPHE and other of sources.
mg/l	milligrams per liter (ppm or parts per million).
µmhos/cm	micromhos per centimeter
NA	Not analyzed.
ND	Not detected.
NS	No Standard.
**	Health Advisory.
	Human health standard.
	Secondary standard.