



December 1, 2010

Certified Mail Return Receipt Requested # 7010 3230 0003 3193 4587

Mr. Ken Burge
PO Box 514
La Veta, CO 81055

RE: Complaint 200272771
Groundwater Quality Concerns
Well Permit 169043
NWSW 11 29S, 67W Huerfano County, Colorado

Dear Mr. Burge:

In response to your concerns regarding possible impacts to water quality from coal bed methane (CBM) and ongoing mitigation operations in the area near your home, a consultant working on behalf of the COGCC, Angela Bellantoni of Environmental Alternatives, conducted a field visit to your property on October 6, 2010. Water samples were collected for general organic and inorganic water quality testing as well as for analysis of dissolved methane and gas composition and isotopic analyses. 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

Ms. Bellantoni visited your property on October 6, 2010 to collect samples of groundwater from your domestic water well. You were present on this occasion. Ms. Bellantoni attempted to measure depth to water in your domestic water well but was unable to do so as the tape bound at 130 feet depth. She measured field parameters and collected water samples. On October 6, 2010, you turned on the pump at 10:50. The estimated flow was eight gallons per minute. Water was flowing for 35 minutes before Ms. Bellantoni collected samples of the water from your domestic well. Temperature of the water, pH and conductivity had stabilized when the samples were collected. The samples collected on this day were shipped to ALS Laboratory Group in Fort Collins, CO on October 7, 2010 after storage on ice for one day and received by them on October 10, 2010. Samples for gas composition and isotopic analysis were also shipped on October 9, 2010 and received by Isotech Laboratories, Inc. in Champaign, IL on October 10, 2010. Methane was not venting from the casing of your well on this day and was measured.

COMPARISON OF INORGANIC ANALYTICAL RESULTS TO CDPHE GROUNDWATER 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 samples from your water well was compared to these standards. This information is summarized in Table 1 which is located in Attachment 1. Please keep in mind that these "Domestic Use-Quality Standards" were initially established for **municipal public** drinking water supplies and are also applied to groundwater for domestic use and often people use and consume ground water from private wells that exceed these standards. The analytical reports from ALS Laboratory Group and are included with this letter as Attachment 2. The analytical report from Isotech Laboratories is included with

this letter as Attachment 3. A summary of available results from four sampling events is included as Table 2 in Attachment 4.

- **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 0.01 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 (2010) at a concentration of 0.00026mg/l which is below the CDPHE human health standard.

- **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 (2010) at a concentration of 0.55mg/l which is below the CDPHE human health standard.

- **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 (2010) at a concentration of 0.012mg/l which is below the CDPHE human health standard.

- **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 (2010) at a concentration of 41mg/l which is below the CDPHE drinking water standard.

- **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 (2010) at a concentration of 0.072mg/l which is above the CDPHE drinking water standard.

- **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 (2010) at a concentration of 260mg/l which is above the CDPHE drinking water standard.

- **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 (2010) with a value of 7.65 which is within the CDPHE drinking water and agricultural standards.

- **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 (2010) at a concentration of 710mg/l which is above the drinking water standard.

- **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 detected in the sample collected from your water well (2010) at a concentration of 0.022mg/l which is below the CDPHE drinking water standard.

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 (2010) at a concentration of 96mg/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 (2010) was 88mg/l.

- **Magnesium (Mg):**

The magnesium concentration in the sample collected from your well (2010) was 18mg/l.

- **Potassium (K):**

The potassium concentration detected in the sample collected from your well (2010) was 1.2mg/l.

- **Molybdenum (Mo):**

The concentration of molybdenum detected in the sample collected from your water well (2010) was 0.0021mg/l.

- **Bicarbonate (HCO₃):**

Bicarbonate alkalinity was measured in the sample collected from your well (2010) at a concentration of 220mg/l.

- **Bromide (Br):**

Bromide was detected in the sample collected from your water well (2010) at a concentration of 0.52mg/l.

- **Total Suspended Solids (TSS):**

The laboratory did not detect the presence of suspended solids in your well water (2010).

METHANE GAS ANALYSIS

Methane was detected in the sample collected from your well at a concentration of 1mg/l. The concentration of methane in the water produced from the well is below the threshold level of 1.1mg/l that theoretically could 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. One volatile tentatively identified compound was detected in the water samples from your well.

TOTAL EXTRACTABLE PETROLEUM HYDROCARBONS ANALYSIS

A sample from your house well and from your barn well were extracted and analyzed for the presence of petroleum hydrocarbons. The lab did not detect the presence of diesel range organics in the samples. This analysis also is a general scan for the presence of non-volatile organic compounds and no unusual peaks can be seen in the chromatogram included in the analytical report.

CONCLUSIONS

Table 1 shows a comparison of results from the sample collected from your well in 2010 to groundwater standards established by the Water Quality Control Commission. Three of the parameters tested exceed the groundwater standards (manganese, sulfate and total dissolved solids). The concentration of dissolved manganese (Mn) has exceeded the groundwater standard in all four sampling and analysis events. The measured TDS has also exceeded the drinking water standard in all four sampling and analysis events. Sulfate (SO₄) concentrations exceeded the groundwater standard in the most recent sampling and analysis but the other three analyses of sulfate are within 10% of the most recent sample and no trend of increase can be inferred at this time. The presence of bacterial colonies in a well can oftentimes create conditions that cause manganese oxides present in an aquifer to dissolve. Shock chlorination of the well and water distribution system can help to reduce the activity of bacterial colonies and at the same time reduce the concentrations of manganese in your well water. Total dissolved solids measurements are a general water quality parameter and many sources of groundwater in Colorado exceed the standard. You mentioned that you had the water tested previously and if you have any prior results you should compare the results of the four sampling events summarized in this letter to any results that you may have.

In general the water pumped from your domestic well is of acceptable quality. Table 2 (Attachment 4) compares the results from four sets of samples collected from the domestic water well between 2008 and 2010. The major ion chemistry results of the all available data are very similar. The general water quality data for the 2010 sampling and analysis does not show any impacts from nearby CBM mitigation activities. The major ion chemistry of water in your well (sodium, potassium, magnesium, calcium, chloride, sulfate, bicarbonate) has remained relatively constant over Phase 1 and now Phase 2 of the MIMMP as illustrated in Table 2. Variations in the major ion chemistry seen in samples collected from your domestic well since 2007 are within the limits of sampling and analytical variability. The limits of laboratory precision and accuracy typical of analyses for these ions are in the range of $\pm 10\%$. Greater variability is typically attributed to sampling variability than from laboratory variability. Your well is used infrequently as you do not have a permanent residence on your property. Hydrogen sulfide has been detected in water from your well in previous sampling events. The conditions that favor microbial production of hydrogen sulfide in wells also are conducive to enhanced release of manganese from the aquifer by microbial activity. Infrequent use of your well can also result in the presence of turbid or cloudy water when use resumes as you have noted and discussed with me.

A plot of methane isotopic composition from samples collected from your well, nearby CBM wells and nearby water wells is included as Attachment 5. The results of the isotopic analysis indicate a trend upwards and to the right in hydrogen and carbon isotopic ratios of the gas dissolved in groundwater accessed by your well since 2008. The changes in carbon and hydrogen isotope ratios in the methane dissolved in groundwater accessed by your well are typically attributed to bacterial degradation of methane in groundwater.

The concentration of methane dissolved in groundwater pumped from your well in September 2010 was less than any previous sampling event results as seen in Table 2. The decrease in free gas and in dissolved gas in aquifers of the Poison Canyon Fm. is a major objective of the MIMMP plan adopted by the Commission in January 2008. Attachment 6 illustrates the decrease on measured gas concentration at your well since the

summer of 2007 to present. More than 100 monitoring events have taken place in that time even though when we spoke in September 2010 you indicated to me that your well was not being checked or monitored regularly if at all. The water in your well has been sampled on four occasions since we were first able to locate you in 2008. More than 70% of those measurements have indicated 0% methane was detected at your well. Only one monitoring event since December of 2007 indicated the presence of methane at >10% by volume. All of the monitoring events with greater than 50% methane occurred prior to December 2007 and prior to the initiation of the MIMMP by Petroglyph. None of the data available indicates that that groundwater accessed by your well has been negatively impacted by the ongoing mitigation process. The decrease in dissolved methane concentrations and the continued absence of high levels of methane gas at your well are likely indicators of positive changes in your well and the groundwater it accesses.

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 - Isotech Laboratories Analytical Report
 Attachment 4 - Table 2 - Summary of Analytical Results (2008 -2010)
 Attachment 5 - Plot of Methane Isotopic Composition
 Attachment 6 - Plot of Wellhead Methane Monitoring Results

cc: David Neslin, COGCC Director w/o attachments
 Debbie Baldwin, COGCC Environmental Manager w/o attachments
 Steve Lindblom, COGCC Environmental Supervisor w/o attachments
 Valois Shea, US EPA w/o attachments
 Tom Melland, Petroglyph

TABLE 1
ANALYTICAL SUMMARY
Complaint 200272771
Burge Water Well

Parameter	Water Sample		CDPHE Standards		
	Sample Date				
	08-Oct-10				
	Result	Unit	Domestic	Agriculture	Unit
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	88	mg/l	NS	NS	
Chromium	ND	mg/l	0.1	0.1	mg/l
Cobalt	ND	mg/l	NS	0.05	mg/l
Copper	ND	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	ND	mg/l	NS	NS	
Magnesium	18	mg/l	NS	NS	
Manganese	0.072	mg/l	0.05	0.2	mg/l
Molybdenum	0.0021	mg/l	0.035	NS	mg/l
Nickel	ND	mg/l	0.1	0.2	mg/l
Potassium	1.2	mg/l	NS	NS	
Selenium	ND	mg/l	0.05	0.02	mg/l
Silver	ND	mg/l	0.05	NS	mg/l
Sodium	96	mg/l	NS	NS	
Strontium	1.9	mg/l	NS	NS	
Thallium	ND	mg/l	0.002	NS	mg/l
Uranium	0.00026	mg/l	0.03	NS	mg/l
Zinc	0.022	mg/l	5	2	mg/l
Chloride	41	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	0.55	mg/l	4.0	NS	mg/l
Total Dissolved Solids	710	mg/l	400	*1500	mg/l
pH	7.65	No units	6.5 - 8.5	6.5 - 8.5	No units
Sulfate	260	mg/l	250	NS	mg/l
Bromide	0.52	mg/l	NS	NS	
Total Alkalinity	220	mg/l	NS	NS	
Bicarbonate	220	mg/l	NS	NS	
Carbonate	ND	mg/l	NS	NS	
Conductivity	1040	umhos/cm	NS	NS	
methane	1	mg/l	NS	NS	
Total Organic Carbon	1.7	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 sources.
mg/l	milligrams per liter (ppm or parts per million).
umhos/cm	micromhos per centimeter
NA	Not analyzed.
ND	Not detected.
NS	No Standard.
**	Health Advisory.
	Human health standard.
	Secondary standard.

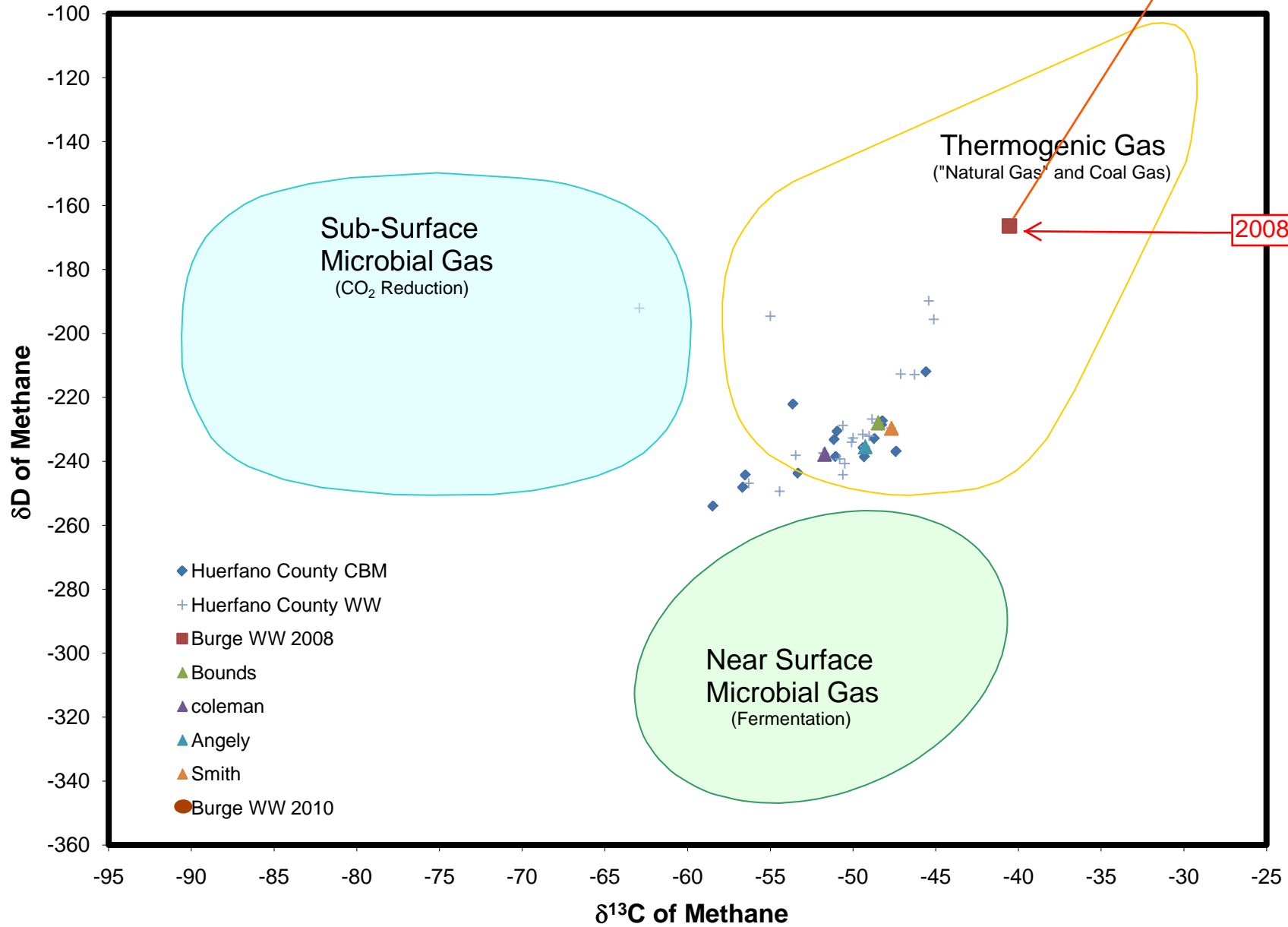
TABLE 2
SUMMARY of 2008-2010 Results
Complaint 200272771
Burge Water Well

Parameter						CDPHE Standards		
	Sample Date	Sample Date	Sample Date	Sample Date				
	18-Dec-08	18-Dec-08	09-Jun-09	08-Oct-10				
	Result	Result	Result	Result	Unit	Domestic	Agriculture	Unit
Antimony	ND	ND	ND	ND	mg/l	0.006	NS	mg/l
Arsenic	ND	ND	ND	ND	mg/l	0.01	0.1	mg/l
Barium	ND	ND	0.021	ND	mg/l	2.0	NS	mg/l
Beryllium	ND	ND	ND	ND	mg/l	0.004	0.1	mg/l
Boron	ND	ND	0.051	ND	mg/l	NS	0.75	mg/l
Cadmium	ND	ND	ND	ND	mg/l	0.005	0.01	mg/l
Calcium	74	70	72	88	mg/l	NS	NS	
Chromium	ND	ND	0.00068	ND	mg/l	0.1	0.1	mg/l
Cobalt	ND	ND	NA	ND	mg/l	NS	0.05	mg/l
Copper	ND	ND	0.0099	ND	mg/l	1	0.2	mg/l
Iron	ND	ND	0.79	ND	mg/l	0.3	5	mg/l
Lead	0.0013	0.00088	0.0031	ND(<0.0005)	mg/l	0.05	0.1	mg/l
Lithium	0.013	0.013	NA	ND(<0.01)	mg/l	NS	NS	
Magnesium	15	14	14	18	mg/l	NS	NS	
Manganese	0.083	0.078	0.072	0.072	mg/l	0.05	0.2	mg/l
Molybdenum	0.0018	0.0017	0.0012	0.0021	mg/l	0.035	NS	mg/l
Nickel	ND	ND	ND	ND	mg/l	0.1	0.2	mg/l
Potassium	1.7	1.7	0.75	1.2	mg/l	NS	NS	
Selenium	ND	ND	0.0016	ND	mg/l	0.05	0.02	mg/l
Silver	ND	ND	ND	ND	mg/l	0.05	NS	mg/l
Sodium	110	100	120	96	mg/l	NS	NS	
Strontium	1.8	1.7	1.7	1.9	mg/l	NS	NS	
Thallium	ND	ND	ND	ND	mg/l	0.002	NS	mg/l
Uranium	0.00021	0.0002	NA	0.00026	mg/l	0.03	NS	mg/l
Zinc	0.025	0.042	ND(<0.005)	0.022	mg/l	5	2	mg/l
Chloride	38	38	37.5	41	mg/l	250	NS	mg/l
Nitrite	ND	ND	ND	ND	mg/l	1.0	10	mg/l
Nitrate	ND	ND	ND	ND	mg/l	10.0	100	mg/l
Total Nitrite/Nitrate	ND	ND	ND	ND	mg/l	10.0	100	mg/l
Fluoride	0.59	0.54	0.81	0.55	mg/l	4.0	NS	mg/l
Total Dissolved Solids	640	620	640	710	mg/l	400	*1500	mg/l
pH	7.82	7.82	7.67	7.65	No units	6.5 - 8.5	6.5 - 8.5	No units
Sulfate	240	250	236	260	mg/l	250	NS	mg/l
Bromide	0.46	0.47	0.518	0.52	mg/l	NS	NS	
Total Alkalinity	210	210	NA	220	mg/l	NS	NS	
Bicarbonate	210	210	NA	220	mg/l	NS	NS	
Carbonate	ND	ND	ND	ND	mg/l	NS	NS	
Conductivity	931	921	NA	1040	umhos/cm	NS	NS	
methane	4.4	4	3.3	1	mg/l	NS	NS	
Total Organic Carbon	2.4	NA	NA	1.7	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 sources.
mg/l	milligrams per liter (ppm or parts per million).
umhos/cm	micromhos per centimeter
NA	Not analyzed.
ND	Not detected.
NS	No Standard.
**	Health Advisory.
	Human health standard.
	Secondary standard.

Isotopic Composition of Methane Huerfano County



Burge Water Well CH₄ (Volume %)

