



DEPARTMENT OF NATURAL RESOURCES  
*Bill Ritter, Jr., Governor*  
 1120 Lincoln St., Suite 801  
 Denver, CO 80203  
 Phone: (303) 894-2100  
 FAX: (303) 894-2109  
 www.cogcc.state.co.us

April 23, 2009

Mr. Ron Phillips  
 206 1<sup>st</sup> Street  
 Greeley, CO 80631

RE: Water Quality Analytical Results for Domestic Water Well (Permit #150855)  
 28999 Highway 257, Greeley, CO 80634  
 Section 10 – Township 5 North – Range 67 West  
 Weld County, Colorado; Complaint No. 200206882

Dear Mr. Phillips,

On March 24, 2009, the Colorado Oil & Gas Conservation Commission (COGCC) sampled the water well at your rental property located at 28999 Highway 257 in Greeley, and submitted the water samples for laboratory analysis. The purpose of the water sampling was to determine if oil and gas drilling and production activities in your area might have impacted your water well. The water samples were delivered to Evergreen Analytical Laboratory (Evergreen) in Wheat Ridge, Colorado for analysis of organic and inorganic compounds. Splits of the water sample were also delivered to Empact Analytical Systems (Empact) in Brighton, Colorado and Isotech Laboratories, Inc. (Isotech) in Champaign, Illinois for gas compositional analyses. Copies of the Evergreen, Empact and Isotech laboratory analytical reports are included in Attachments A, B and C.

The Water Quality Control Commission (WQCC) of the Colorado Department of Public Health and Environment (CDPHE) has established drinking water standards for the protection of human health. The analytical results from the water samples from your water well were compared to applicable ground water and/or drinking water standards and are summarized below. These water standards were established for public drinking water supplies. Often people use and consume ground water from private wells that can exceed these standards.

### **COMPARISON OF INORGANIC ANALYTICAL RESULTS TO STANDARDS**

**(Please see enclosed Evergreen Laboratory Report, Attachment A)**

- **Total Dissolved Solids (TDS):** CDPHE has established a TDS standard for human drinking water of 500 milligrams per liter (mg/l). The standard is called the secondary maximum contaminant level (SMCL) and is based on the aesthetic quality of the water (such as taste and odor) and is intended as a guideline for public water supply systems and is not an enforceable standard. Although CDPHE does not have an agricultural standard for TDS, other agencies recommend concentrations below 2,000 mg/l for irrigation, and below 5,000 mg/l for most livestock watering. TDS concentrations are related to the presence of naturally occurring elements and chemical compounds such as chloride, sodium, potassium, calcium, magnesium, and sulfate.

DEPARTMENT OF NATURAL RESOURCES: Harris Sherman, Executive Director

COGCC COMMISSION: Richard Alward - Thomas L. Compton - Mark Cutright - Michael Dowling - Joshua B. Epel - Kimberlee Gerhardt - Tréel Houpt - Jim Martin - Harris Sherman  
 COGCC STAFF: David Neelin, Acting Director - Debbie Baldwin, Environmental Manager - Patricia C. Beaver, Hearings Manager - David K. Dillon, Engineering Manager

**TDS was detected in the water sample from your water well at a concentration of 940 mg/l, which is greater than the CDPHE SMCL, less than the recommended maximum concentration for irrigation, and less than the recommended maximum concentration for most livestock watering.**

- Sodium (Na): Although CDPHE does not have a standard for sodium, people on salt restricted diets should be aware of the Na concentration in the water they drink. Drinking water with a concentration of sodium 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 at concentrations that exceed the recommended level.

**Sodium was detected in the water sample from your water well at a concentration of 360 mg/l, which is greater than the recommended level for people on salt restricted diets.**

- Fluoride (F): CDPHE has established a fluoride (F) standard for drinking water of 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 was detected in the water sample from your water well at a concentration of 2.7 mg/l, which is less than the CDPHE drinking water standard.**

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

**Chloride was detected in the water sample from your water well at a concentration of 334 mg/l, which is greater than the CDPHE drinking water standard.**

- Sulfate (SO<sub>4</sub>): The CDPHE sulfate standard for human drinking water is 250 mg/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 occurs naturally in the ground water in many areas in Colorado at concentrations that exceed the drinking water standard.

**Sulfate was detected in the water sample from your water well at a concentration of 14.6 mg/L which is less than the CDPHE drinking water standard.**

- Total Nitrate (NO<sub>3</sub>) + Nitrite (NO<sub>2</sub>) as Nitrogen (N): The CDPHE total nitrate (NO<sub>3</sub>) + nitrite (NO<sub>2</sub>) as nitrogen (N) standard for human drinking water is 10 mg/l. Nitrate and nitrite are common contaminants in ground water from agricultural sources, such as fertilizer

and animal wastes. They are known to cause infant cyanosis or “blue baby disease” in humans and, at concentrations greater than 100 mg/l as nitrogen (N), may be dangerous to livestock. High concentrations of nitrate and nitrite in ground water are known to occur in agricultural areas in Colorado.

**Total nitrate/nitrite, as N was not detected in the water sample from your water well.**

- **Iron (Fe):** The CDPHE iron standard for human drinking water is 0.3 mg/l. Small amounts of iron are common in ground water. Iron may produce 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 detected in the water sample from your water well at a concentration of 0.19 mg/L, which is less than the CDPHE standard for drinking water.**

- **Manganese (Mn):** The CDPHE manganese standard for secondary drinking water is 0.05 mg/l and for agricultural water it is 0.2 mg/l. Manganese rusts like iron but it is not magnetic.

**Manganese was detected in the recent water sample from your well at a concentration of 0.0083 mg/l which is within the secondary drinking water standard and within the agricultural standard.**

- Alkalinity, Bromide (Br), Calcium (Ca), Potassium (K), Magnesium (Mg), Bicarbonate ( $\text{HCO}_3$ ) and Carbonate ( $\text{CO}_3$ ) were also tested for in your water. There are no standards from CDPHE for these parameters. A complete summary of all of the analytical results is provided in Table 1. Please note that Primary standard (P) is the CDPHE Human Health Standard and the Secondary standard (S) is the CDPHE secondary maximum contaminant level (SMCL).

**Table 1**  
**PHILLIPS WATER WELL SUMMARY**

Analytes	March 24, 2009 Sample Concentration Milligrams per liter [mg/L] unless otherwise noted.	CDPHE Water Quality Standard (P – Primary, S-Secondary)
Alkalinity (Total)	311	NS
Bicarbonate	278	NS
Carbonate	33.6	NS
Bromide (Br)	1.38	NS
Calcium (Ca)	5.2	NS
Chloride (Cl)	334	250 (S)
Fluoride (F)	2.7	4.0 (P)
Iron (Fe)	0.19	0.3 (S)
Potassium (K)	1.6	NS
Manganese (Mn)	0.0083	0.05 (S)
Magnesium (Mg)	1.1	NS
Nitrate (NO <sub>3</sub> -N)	ND	10.0 (P)
Nitrite (NO <sub>2</sub> -N)	ND	1.0 (P)
pH	8.74 (pH units)	NS
Sodium (Na)	360 B	NS
Specific Conductance	1590 µmhos/cm	NS
Sulfate (SO <sub>4</sub> )	14.6	250 (S)
Total Dissolved Solids	940	500 (S)

NS – no standard  
 ND – not detected in the sample  
 B – Analyte detected in blank

**ORGANIC COMPOUNDS ASSOCIATED WITH PETROLEUM HYDROCARBONS**

- Benzene: The CDPHE basic ground water standard for benzene is 5 micrograms per liter (µg/l). **Benzene was not detected in the sample from your water well.**
- Toluene: The CDPHE basic ground water standard for toluene is 1,000 µg/l. **Toluene was not detected in the sample from your water well.**
- Ethylbenzene: The CDPHE basic ground water standard for ethylbenzene is 680 µg/l. **Ethylbenzene was not detected in the sample from your water well.**
- Total Xylenes (sum of m,p, and o-xylene): The CDPHE basic ground water standard for total xylenes is 10,000 µg/l. **Total xylenes were not detected in the sample from your water well.**

## METHANE GAS CONCENTRATION

Methane gas alone is physiologically inert and non-toxic to humans. Normal breath exhalation contains 1 to 99 parts per million (ppm) of methane. The presence of methane in drinking water does not present a known health hazard to humans or other animals via ingestion. Methane gas dissolved in water “exsolves” when exposed to the atmosphere and dissipates rapidly because it is lighter than air. This is often responsible for the “fizzing” observed in water wells that may contain methane gas. If the methane occurs at a high enough concentration and if it is allowed to accumulate in a confined space, such as a well pit, crawl space, closet, etc., an explosion hazard can be established. In addition, if methane concentrations in well water are high, then pockets of free gas may form within the water that can cause the well pump to cavitate reducing the efficiency of the pump.

Methane gas is common in water wells in Colorado. It occurs naturally and the source of the methane is commonly from one or more of the sources listed below.

1. Methane is commonly found as a gas in coal or black shale seams in the subsurface.
  2. Methane is commonly found as a byproduct of the decay of organic matter and the presence of bacteria in water wells can provide the conditions favorable for the production of methane either from the activity or decay of bacteria.
- **Dissolved methane was detected in the sample from your water well at a concentration of 13 mg/l.**

**As the result of extensive testing for methane gas in water wells throughout Colorado, concentrations of methane gas below 1 mg/l are considered harmless, with concern for possible hazards from the methane increasing at concentration levels in well water at 7 mg/l and higher.**

## GAS COMPOSITION

The natural gas produced from oil and gas wells in proximity to the subject water well is thermogenic methane. Thermogenic methane gas is formed by the thermal breakdown of organic material in rocks resulting from high temperatures created by deep burial. Biogenic methane gas occurs in most near-surface environments and is a principal product of the decomposition of buried organic material. In Weld County many of the coal zones in the Laramie-Fox Hills aquifer contain biogenic methane gas.

The Empact laboratory results of the water sample collected from your water well indicated that only methane (C1) and ethane (C2) were detected (Attachment B). Typically, the naturally occurring biogenic gas in the Laramie-Fox Hills aquifer contains only C1, C2 and occasionally a trace of propane (C3). The presence of higher concentrations of propane (C3), iso-butane (iC4), normal butane (nC4), iso-pentane (iC5), normal pentane (nC5), and hexane (C6) would indicate a potential impact from thermogenic gas originating from deeper gas producing formations. Since

these constituents were not identified in the gas sample, it is unlikely that the dissolved methane in your well water has a thermogenic origin.

Another way to assess methane origin is to analyze the dissolved gas for the stable carbon isotopes ( $\delta^{13}\text{C}$  and  $\delta\text{D}$ ). As indicated on the isotope plot presented in Attachment C, the gas sample from your water well plotted between the Sub-Surface Microbial Gas and the Near Surface Microbial Gas regions.

Although not detected in the sample submitted to Empact, the sample submitted to Isotech did contain a trace of propane. The natural gas produced from the Codell and Niobrara formations in proximity to your water well commonly contains 4% to 5% propane in comparison to the sample collected from your well that contained 0.013%. In addition, if a thermogenic source of gas was present from the producing formations in the area, it would contain varying amounts of the other gas components including iso-butane (iC4), normal butane (nC4), iso-pentane (iC5), normal pentane (nC5), and hexane (C6). Refer to attachment D which provides a compositional comparison of the methane detected in your water well to natural gas produced in the area.

Because your water well is completed at a depth of 1170-feet and screened across over 400-feet of shales, the methane detected in your well is believed to be attributed to a mix of near surface and sub-surface microbial gas. The trace of propane may represent an early stage thermogenic gas naturally occurring in the Pierre Shale.

### **BACTERIA OCCURENCE**

COGCC also collected samples of your well water for the determination of the presence of bacteria using the Biological Activity Reaction Test (**BART<sup>TM</sup>**) for the following Iron Related Bacteria (IRB), Sulfate Reducing Bacteria (SRB), and Slime Forming Bacteria (SFB).

**Iron Related Bacteria:** Although not usually harmful, iron related bacteria (IRB) 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 may appear to be a oily sheen on standing water. In rare cases, IRB may cause sickness.

- **IRB bacteria was not detected in the water sample from your well.**

**Sulfate Reducing Bacteria:** Sulfate reducing bacteria (SRB) 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<sub>2</sub>S) gas as they grow. In turn, the hydrogen sulfide (H<sub>2</sub>S) gas is a nuisance because it smells like rotten eggs, it initiates corrosion on metal surfaces, and it reacts with dissolved metals such as iron to generate black sulfide deposits.

- **SRB bacteria were not detected in the water sample from your well.**

**Slime Forming Bacteria:** Although not usually harmful, Slime Forming Bacteria (SFB) also can become a nuisance by plugging well pumps and causing slimy accumulations on plumbing

fixtures and standing water. Slimes often are gelatinous in nature and may range in color from white, to red, to black. As slime bacteria mats grow they create an environment in which complex associations of other strains of bacteria can develop.

- **SFB bacteria were not detected in the water sample from your well.**

### **WATER WELL DISCUSSION/RECORDS REVIEW**

Colorado Division of Water Resources (DWR) records indicate that your water well is 1170-feet deep and is permitted as a Fox Hills well (reference DWR Permit No. 150855). The water well is located north of the north central boundary of the Laramie-Fox Hills aquifer. The well is completed in the Fox Hills Sandstone and the Pierre Shale.

During sample collection, the water from your well was clear with a slight sulfur-like odor. It also exhibited moderate effervescing. Although there are no other permitted water wells within a half mile of your well, COGCC has sampled several water wells in the vicinity. None of these wells are completed as deep, but many of them have similar water quality characteristics including relatively high concentrations of sodium, chloride and overall TDS.

### **SURROUNDING OIL AND GAS WELLS**

A total of 15 producing oil and gas wells operated by Petroleum Development Corporation (PDC) and Kerr-McGee Oil & Gas Onshore LP (Kerr-McGee) are located within a half-mile radius of your water well. Both companies voluntarily checked the bradenhead pressures on their wells in the vicinity of your water well. None of the wells had measurable or abnormally high bradenhead pressures that would indicate an operational problem with the well. A table of the bradenhead readings is attached for your reference as Attachment E.

The COGCC database includes produced water sample results from several oil & gas wells in the vicinity of your water well. When the water chemistry is compared, the relative concentrations of major anions/cations and total metals is generally much higher in produced waters than the concentrations detected in your water sample. Based on this review, it does not appear that your well has been impacted by produced water associated with oil and gas wells in the area.

### **CONCLUSION**

The water sample collected from your water well contained chloride and Total Dissolved Solids above the CDPHE secondary drinking water standards. None of the analyzed constituents exceeded the CDPHE primary drinking water standards.

The water sample did not contain the organic constituents benzene, toluene, ethyl benzene or xylenes, which are often associated with contamination from petroleum hydrocarbons.

Mr. Phillips  
April 23, 2009  
Page 8

Dissolved methane in the well water appears to be predominantly biogenic in origin and may originate from shale zones in the Pierre Shale. **The gas exists in sufficiently high concentrations that an explosion hazard could exist if the methane were able to accumulate in a confined space and an ignition source was present. Care should be taken to ventilate confined spaces where well water is used. For more information regarding monitoring and abatement of flammable gas, please contact your local fire prevention authority.**

Based on the available information gathered to date, there are no indications of oil & gas related impacts to your water well.

I have previously sent you background information on water wells and methane in water wells. If you have any questions or would like to discuss the sample results further, please contact me via e-mail ([john.axelson@state.co.us](mailto:john.axelson@state.co.us)) or by phone at (303) 637-7178.

Respectfully,



John Axelson, P.G.  
Environmental Protection Specialist, Northeast Region  
Colorado Oil and Gas Conservation Commission

Enclosure(s)

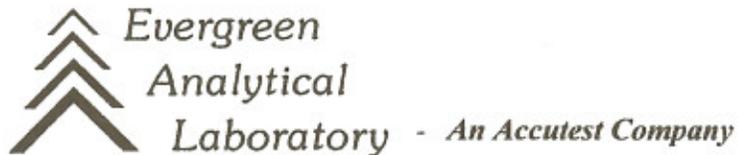
- Attachment A – Evergreen Analytical Report
- Attachment B – Empact Analytical Report
- Attachment C – Isotech Analytical Report and Isotopic Carbon Plot
- Attachment D – Compositional Gas Analysis Comparison
- Attachment E – Bradenhead Pressures

cc: Dave Neslin – COGCC Director  
Debbie Baldwin – COGCC Environmental Manager  
Joe Tingley – Tenant  
Randall Ferguson – PDC  
Paul Schneider – Kerr McGee

## REFERENCE

Ground Water Atlas of Colorado, Special Publication 53, 2003. Colorado Geological Survey, Department of Natural Resources, Denver, Colorado.

ATTACHMENT A  
EVERGREEN ANALYTICAL REPORT



April 07, 2009

John Axelson  
Colorado Oil & Gas Conservation Commission  
9203 E 155th Dr  
Brighton, CO 80602

Lab Work Order: 09-1967  
Client Project ID:

Dear John Axelson:

Enclosed are the analytical results for the samples shown in the Laboratory Work Order Summary. The invoice is included with this report or has been mailed to another party as indicated on the chain of custody.

The enclosed data for testing performed at Evergreen Analytical Laboratory (EAL) have been reviewed for quality assurance. A case narrative is included to describe any anomalies associated with the samples or data.

EAL will dispose of all samples 44 days from the sample receipt date. If you want samples returned, please advise us by mail or fax as soon as possible.

A copy of this project report and supporting data will be retained for a period of five years unless we are otherwise advised by you. A document retrieval charge will apply.

Thank you for using the services of Evergreen Analytical. If you have any questions concerning the analytical data, please contact me. Please direct other questions to Client Services.

Sincerely,



Joseph J Egry IV/ Carl Smits  
Quality Assurance

## WORK ORDER Summary

Evergreen Analytical, Inc.

09-1967

Rpt To: John Axelson

Email To: john.axelson@state.co.us

Colorado Oil &amp; Gas Conservation

Commission

9203 E 155th Dr

Brighton, CO 80602

(303) 637-7178

3/25/2009 9:34:07 AM

Client Project ID:

QC Level: LEVEL I

Comments: Purchase Order OE PHA 09000000001 Invoice in triplicate 6/30/08 to 6/30/09. PM

Sample ID	Client Sample ID	Matrix	Collection Date	Date Received	Test Code	Test Name	Hold	MS	Date Due	Hold Time
09-1967-01A	Phillips-WW	Groundwater	3/24/09 1030	3/24/09	8021_W *	8021: BTEX	<input type="checkbox"/>	<input type="checkbox"/>	3/27/09	4/07/09
09-1967-01B	Phillips-WW	Groundwater	3/24/09 1030	3/24/09	6010_WT *	6010: Total Metals	<input type="checkbox"/>	<input type="checkbox"/>	4/07/09	9/20/09
09-1967-01C	Phillips-WW	Groundwater	3/24/09 1030	3/24/09	ANIONS_NonDW *	300.0: Anions by IC	<input type="checkbox"/>	<input type="checkbox"/>	4/07/09	3/26/09
09-1967-01C	Phillips-WW	Groundwater	3/24/09 1030	3/24/09	C/A_BAL	Cation / Anion Balance calculation	<input type="checkbox"/>	<input type="checkbox"/>	4/07/09	
09-1967-01D	Phillips-WW	Groundwater	3/24/09 1030	3/24/09	F_W	Fluoride	<input type="checkbox"/>	<input type="checkbox"/>	4/07/09	4/21/09
09-1967-01E	Phillips-WW	Groundwater	3/24/09 1030	3/24/09	MEEP_W *	RSK175M: Methane	<input type="checkbox"/>	<input type="checkbox"/>	4/07/09	4/07/09
09-1967-01F	Phillips-WW	Groundwater	3/24/09 1030	3/24/09	ALK_WGRP *	Alkalinity	<input type="checkbox"/>	<input type="checkbox"/>	4/07/09	4/07/09
09-1967-01F	Phillips-WW	Groundwater	3/24/09 1030	3/24/09	COND_W	Specific Conductance @ 25°C	<input type="checkbox"/>	<input type="checkbox"/>	4/07/09	4/21/09
09-1967-01F	Phillips-WW	Groundwater	3/24/09 1030	3/24/09	PH_DW	E150.1 pH	<input type="checkbox"/>	<input type="checkbox"/>	4/07/09	3/25/09
09-1967-01F	Phillips-WW	Groundwater	3/24/09 1030	3/24/09	TDS_W	Total Dissolved Solids (TDS)	<input type="checkbox"/>	<input type="checkbox"/>	4/07/09	3/31/09



Evergreen Analytical, Inc.

Date: 07-Apr-09

Lab Order: 09-1967

Client Project ID

CASE NARRATIVE

SAMPLE RECEIVING

Sample(s) were hand delivered to the laboratory by the client. Custody seals were not present. The temperature of the sample(s) upon arrival was 5.8°C. Sample(s) were received in good condition, in the proper container, and within holding times. Sample(s) were preserved properly. VOC sample(s) were marked as preserved on the bottle labels. VOC sample(s) were received with no headspace present. NJO

QUALITY ASSURANCE (QA)

Analyses performed on samples in this work order by EAL meet the requirements of the EAL Quality Assurance Program unless otherwise explained. Analyses of RCRA samples meet the requirements of NELAC and Utah Rule R444-14 unless otherwise explained. JE

CLIENT SERVICES

There are no anomalies to report. AE

GENERAL CHEMISTRY

Method E300.0: Sample Phillips-WW (09-1967-01C) has a high Chloride level, which required dilution of the sample to separate the Nitrite-N peak from the Chloride peak. This raised the reporting limit for Nitrite-N. There are no other anomalies to report. MM/JE

METALS ANALYSIS

Method SW6010B: Sodium was detected in the method blank (MB) at 0.92 mg/L. This amount was not subtracted from the sample result. The sample result was greater than five times the MB concentration so no further action was needed. There are no other anomalies to report. WKH/JE

GAS CHROMATOGRAPHY

Method 8021\_W: There are no anomalies to report. JCC

Method RSK-175: A sample duplicate (DUP) was prepared and analyzed instead of a matrix spike duplicate (MSD) due to limited sample. There are no other anomalies to report. VM

**Evergreen Analytical, Inc.**  
 4036 Youngfield Street, Wheat Ridge, Colorado 80033-3862  
 (303) 425-6021

Client Sample ID: Phillips-WW  
 Client Project ID:  
 Date Collected: 3/24/2009  
 Date Received: 3/24/2009

Lab Work Order 09-1967  
 Lab Sample ID: 09-1967-01A  
 Sample Matrix: Groundwater

**AROMATIC VOLATILE ORGANICS**

Method: SW8021B

Prep Method: SW5030B

Date Prepared: 3/25/2009

Lab File ID: 032509\TA025

Dilution Factor: 1

Date Analyzed: 3/25/2009

Method Blank: MB2032509

Analytes	CAS Number	Result	LQL	Units
Benzene	71-43-2	U	1.0	µg/L
Toluene	108-88-3	U	2.0	µg/L
Ethylbenzene	100-41-4	U	2.0	µg/L
m,p-Xylene	1330-20-7	U	2.0	µg/L
o-Xylene	95-47-6	U	2.0	µg/L
Surr: 1,2,4-Trichlorobenzene (S)	120-82-1	82	QC Limits: 60-140	%REC

*Jcc*

Analyst

*27*

Approved

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak. Confirmation analysis was not performed.

**Qualifiers:** B - Analyte detected in the associated Method Blank, value not subtracted from result  
 E - Extrapolated value. Value exceeds calibration range  
 H - Sample analysis exceeded analytical holding time  
 J - Indicates an estimated value when the compound is detected, but is below the LQL  
 S - Spike Recovery outside accepted limits  
 U - Compound analyzed for but not detected  
 X - See case narrative

**Definitions:** LQL - Lower Quantitation Limit  
 Surr - Surrogate

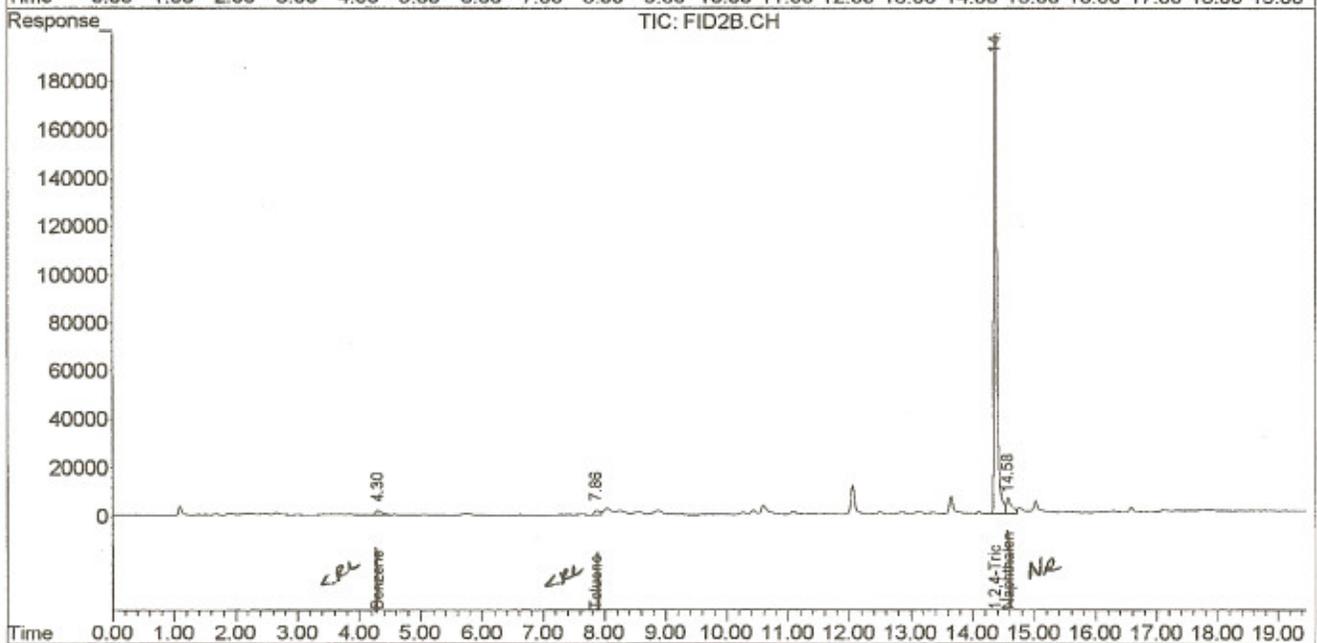
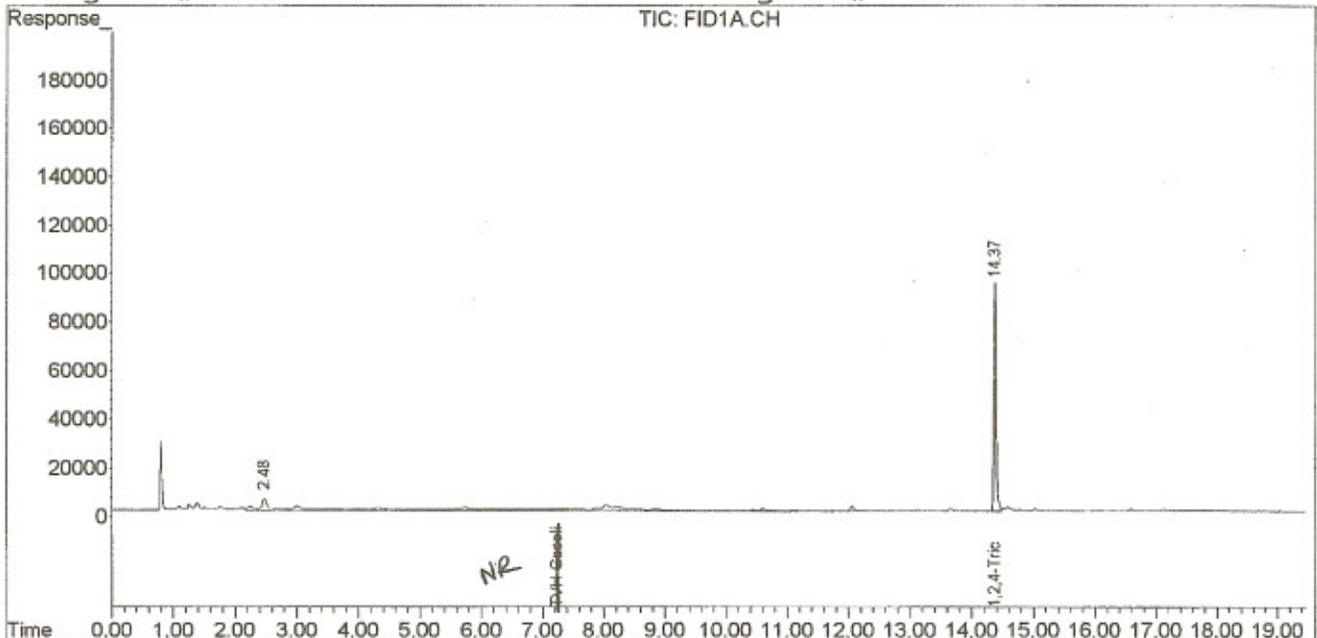
\* - Value exceeded the Maximum Contamination Level (MCL), TCLP limit, or if compound is undetected, LQL exceeds MCL.

Print Date: 3/26/2009

Signal #1 : E:\DATA\032509\TA025.D\FID1A.CH Vial: 25  
 Signal #2 : E:\DATA\032509\TA025.D\FID2B.CH  
 Acq On : 25 Mar 2009 11:22 pm Operator: Jennifer C  
 Sample : 09-1967-01A Inst : TVHBTEX2  
 Misc : , SAMP, 8021\_W, TVH\_W, 1, Multiplr: 1.00  
 IntFile Signal #1: TVH1.E IntFile Signal #2: FB2.E  
 Quant Time: Mar 26 9:15 2009 Quant Results File: TW20314D.RES

Quant Method : C:\MSDCHEM\1\METHODS\TW20314D.M (Chemstation Integrator)  
 Title : 8015B/8021B TVH/BTEX  
 Last Update : Wed Mar 18 11:41:15 2009  
 Response via : Multiple Level Calibration  
 DataAcq Meth : TVB2.M

Volume Inj. :  
 Signal #1 Phase : DB-624 Signal #2 Phase: DB-624  
 Signal #1 Info : 0.53 mm Signal #2 Info : 0.53 mm



JCC 03/26/09

## Evergreen Analytical, Inc.

4036 Youngfield Street, Wheat Ridge, Colorado 80033-3862  
(303) 425-6021

Client Sample ID: Phillips-WW

Lab Work Order: 09-1967

Client Project ID:

Lab Sample ID: 09-1967-01

Date Collected: 3/24/09

Sample Matrix: Groundwater

Date Received: 3/24/09

### TOTAL METALS

Method: SW6010B

Prep Method: E200.7/SW3010A

Date Prepared: 3/26/09

Lab File ID: 032709AM

Dilution Factor: 1

Date Analyzed: 3/27/09

Method Blank: MB-18584

Lab Fraction ID: 09-1967-01B

Analytes	CAS Number	Result	LQL	Units
Calcium	7440-70-2	5.2	0.39	mg/L
Iron	7439-89-6	0.19	0.070	mg/L
Magnesium	7439-95-4	1.1	0.15	mg/L
Manganese	7439-96-5	0.0083	0.0050	mg/L
Potassium	7440-09-7	1.6	0.34	mg/L
Sodium	7440-23-5	360 B	0.40	mg/L



Analyst



Approved

**Qualifiers:** B - Analyte detected in the associated Method Blank, value not subtracted from result  
 E - Extrapolated value. Value exceeds calibration range  
 H - Sample analysis exceeded analytical holding time  
 J - Indicates an estimated value when the compound is detected, but is below the LQL  
 S - Spike Recovery outside accepted limits  
 U - Compound analyzed for but not detected  
 X - See case narrative  
 \* - Value exceeded the Maximum Contamination Level (MCL), TCLP limit, or if compound is undetected, LQL exceeds MCL.

**Definitions:** NA - Not Applicable  
 LQL - Lower Quantitation Limit  
 Surr - Surrogate

Print Date: 4/6/2009

## Evergreen Analytical, Inc.

4036 Youngfield Street, Wheat Ridge, Colorado 80033-3862  
(303) 425-6021

Client Sample ID: Phillips-WW  
Client Project ID:  
Date Collected: 3/24/09 1030  
Date Received: 3/24/09

Lab Work Order: 09-1967  
Lab Sample ID: 09-1967-01  
Sample Matrix: Groundwater

### ANIONS BY IC

Method: E300.0

Prep Method:

Date Prepared: 3/25/09  
Date Analyzed: 3/25/09 1153

Lab File ID: 09  
Method Blank: MB 03/25/09

Dilution Factor: 1  
Lab Fraction ID: 09-1967-01C

Analytes	CAS Number	Result	LQL	Units
Bromide	7647-15-6	1.38	0.20	mg/L
Nitrate-N		U	0.045	mg/L
Sulfate	7778-80-2	14.6	0.50	mg/L

Date Prepared: 3/25/09  
Date Analyzed: 3/25/09 1423

Lab File ID: 13  
Method Blank: MB 03/25/09

Dilution Factor: 10  
Lab Fraction ID: 09-1967-01C

Analytes	CAS Number	Result	LQL	Units
Chloride	7647-14-5	334	5.0	mg/L
Nitrite-N		U	0.61	mg/L

  
Analyst

  
Approved

**Qualifiers:** B - Analyte detected in the associated Method Blank, value not subtracted from result  
E - Extrapolated value. Value exceeds calibration range  
H - Sample analysis exceeded analytical holding time  
J - Indicates an estimated value when the compound is detected, but is below the LQL  
S - Spike Recovery outside accepted limits  
U - Compound analyzed for but not detected  
X - See case narrative  
\* - Value exceeded the Maximum Contamination Level (MCL), TCLP limit, or if compound is undetected, LQL exceeds MCL.

**Definitions:** NA - Not Applicable  
LQL - Lower Quantitation Limit  
Surr - Surrogate

Print Date: 3/27/2009

## Evergreen Analytical, Inc.

4036 Youngfield Street, Wheat Ridge, Colorado 80033-3862  
(303) 425-6021

Client Sample ID Phillips-WW  
Client Project ID  
Date Collected: 3/24/09 1030  
Date Received: 3/24/09

Lab Work Order 09-1967  
Lab Sample ID: 09-1967-01  
Sample Matrix: Groundwater

### ALKALINITY

Method: SM2320B

Prep Method:

Date Prepared: 3/25/09  
Date Analyzed: 3/25/09

Lab File ID: 98  
Method Blank: MBLK 3/25/09

Dilution Factor: 1  
Lab Fraction ID: 09-1967-01F

Analytes	CAS Number	Result	LQL	Units
Total Alkalinity		311	5.0	mg/L CaCO <sub>3</sub>
Bicarbonate		278	5.0	mg/L CaCO <sub>3</sub>
Carbonate		33.6	5.0	mg/L CaCO <sub>3</sub>

### SPECIFIC CONDUCTANCE @ 25°C

Method: SM2510 B

Prep Method:

Date Prepared: 3/25/09  
Date Analyzed: 3/25/09

Lab File ID: 77

Dilution Factor: 1  
Lab Fraction ID: 09-1967-01F

Analytes	CAS Number	Result	LQL	Units
Specific Conductance		1590	1.00	µmhos/cm

### FLUORIDE

Method: SM 4500-F C

Prep Method:

Date Prepared: 3/27/09  
Date Analyzed: 3/27/09

Lab File ID: 59  
Method Blank: MBLK 032709

Dilution Factor: 1  
Lab Fraction ID: 09-1967-01D

Analytes	CAS Number	Result	LQL	Units
Fluoride	16984-48-8	2.7	0.20	mg/L

### E150.1 PH

Method: E150.1

Prep Method:

Date Prepared: 3/24/09  
Date Analyzed: 3/24/09 1535

Dilution Factor: 1  
Lab Fraction ID: 09-1967-01F

Analytes	CAS Number	Result	LQL	Units
pH		8.74	1.00	pH Units

  
\_\_\_\_\_  
Analyst

  
\_\_\_\_\_  
Approved

**Qualifiers:** B - Analyte detected in the associated Method Blank, value not subtracted from result  
E - Extrapolated value, Value exceeds calibration range  
H - Sample analysis exceeded analytical holding time  
J - Indicates an estimated value when the compound is detected, but is below the LQL  
S - Spike Recovery outside accepted limits  
U - Compound analyzed for but not detected  
X - See case narrative  
\* - Value exceeded the Maximum Contamination Level (MCL), TCLP limit, or if compound is undetected, LQL exceeds MCL.

**Definitions:** NA - Not Applicable  
LQL - Lower Quantitation Limit  
Surr - Surrogate

Print Date: 4/1/2009

## Evergreen Analytical, Inc.

4036 Youngfield Street, Wheat Ridge, Colorado 80033-3862  
(303) 425-6021

Client Sample ID Phillips-WW  
 Client Project ID  
 Date Collected: 3/24/09 1030  
 Date Received: 3/24/09

Lab Work Order 09-1967  
 Lab Sample ID: 09-1967-01  
 Sample Matrix: Groundwater

### TOTAL DISSOLVED SOLIDS (TDS)

Method: SM 2540C

Prep Method:

Date Prepared: 3/26/09  
 Date Analyzed: 3/26/09

Lab File ID: 7  
 Method Blank: MBLK 03/26/09

Dilution Factor: 1  
 Lab Fraction ID: 09-1967-01F

Analytes	CAS Number	Result	LQL	Units
Total Dissolved Solids		940	10.0	mg/L

  
 \_\_\_\_\_  
 Analyst

  
 \_\_\_\_\_  
 Approved

**Qualifiers:** B - Analyte detected in the associated Method Blank, value not subtracted from result  
 E - Extrapolated value. Value exceeds calibration range  
 H - Sample analysis exceeded analytical holding time  
 J - Indicates an estimated value when the compound is detected, but is below the LQL  
 S - Spike Recovery outside accepted limits  
 U - Compound analyzed for but not detected  
 X - See case narrative  
 \* - Value exceeded the Maximum Contamination Level (MCL), TCLP limit, or if compound is undetected, LQL exceeds MCL.

**Definitions:** NA - Not Applicable  
 LQL - Lower Quantitation Limit  
 Surr - Surrogate

Print Date: 4/1/2009

**Evergreen Analytical, Inc.**  
 4036 Youngfield Street, Wheat Ridge, Colorado 80033-3862  
 (303) 425-6021

Client Project ID

Lab Order: 09-1967

Units: mg/L

**RSKSOP-175M Headspace  
 Methane**

Method: RSKSOP175M

Prep Method: RSKSOP175M

Lab ID	Client ID	Matrix	Date Received	Collection Date	Date Prepared	Date Analyzed	Results	LQL	DF
09-1967-01E	Phillips-WW	Groundwater	3/24/09	3/24/09	3/30/09	3/30/09	13	0.040	50

Comments:

VM

Analyst



Approved

**Qualifiers:** J - Indicates an estimated value when the compound is detected, but is below the LQL  
 H - Sample analysis exceeded analytical holding time  
 U - Compound analyzed for but not detected  
 X - See case narrative  
 \* - Value exceeds Maximum Contamination Level(MCL), TCLP limit, or if compound is undetected, LQL exceeds MCL.

**Definitions:** DF - Dilution Factor  
 LQL - Lower Quantitation Limit

Print Date: 3/30/2009

**EVERGREEN ANALYTICAL, INC.**  
4036 Youngfield St., Wheat Ridge, CO 80033  
(303)425-6021

**Anion-Cation (Ion) Balance - Method 1030, Standard Methods, 20th Ed.**

EAL Sample ID	09-1967-01C		09-		09-		09-		09-	
Client Sample ID	Phillips-WW									
Sample Result	mg/L	Meq/L	mg/L	Meq/L	mg/L	Meq/L	mg/L	Meq/L	mg/L	Meq/L
<i>Anions</i>										
Cl	334	9.421		0.000		0.000		0.000		0.000
SO <sub>4</sub>	14.6	0.304		0.000		0.000		0.000		0.000
HCO <sub>3</sub> as CaCO <sub>3</sub>	311	6.214		0.000		0.000		0.000		0.000
CO <sub>3</sub> as CaCO <sub>3</sub>		0.000		0.000		0.000		0.000		0.000
NO <sub>3</sub>		0.000		0.000		0.000		0.000		0.000
NO <sub>3</sub> as N		0.000		0.000		0.000		0.000		0.000
Bromide	1.38	0.128		0.000		0.000		0.000		0.000
<b>Anions Total</b>		<b>16.067</b>		<b>0.000</b>		<b>0.000</b>		<b>0.000</b>		<b>0.000</b>
<i>Cations</i>										
Ca	5.2	0.259		0.000		0.000		0.000		0.000
Mg	1.10	0.091		0.000		0.000		0.000		0.000
K	1.60	0.041		0.000		0.000		0.000		0.000
Na	360	15.659		0.000		0.000		0.000		0.000
Other		0.000		0.000		0.000		0.000		0.000
<b>Cations Total</b>		<b>16.050</b>		<b>0.000</b>		<b>0.000</b>		<b>0.000</b>		<b>0.000</b>
<b>Ion Balance</b>										
<b>% Difference</b>	<b>0.05</b>									

$$\% \text{ difference} = 100 \times \frac{(\text{sum cations} - \text{sum anions})}{(\text{sum cations} + \text{sum anions})}$$

RAK

Approved

**ATTACHMENT B**  
**EMPACT ANALYTICAL REPORT**



# EMPACT ANALYTICAL SYSTEMS, INC

365 S. MAIN STREET  
BRIGHTON, CO 80601  
(303) 637-0150

## NATURAL GAS WITH AIR ADJUSTED

PROJECT NO. : 200903120 ANALYSIS NO. : 01  
COMPANY NAME : COLORADO OIL & GAS ANALYSIS DATE MARCH 24, 2009  
CUSTOMER ID #:  
PRODUCER : SAMPLE DATE : MARCH 24, 2009  
LOCATION : CANISTER #: GLASS JAR  
NAME/DESCRIP : PHILLIPS WW COMPLAINT @ 10:30  
DEPTH (FT.):  
\*\*\*FIELD DATA\*\*\*  
SAMPLED BY : JOHN AXELSON  
SAMPLE PRES. : SAMPLE TEMP. :  
INJECTED VOLUME 98.2%  
COMMENTS : SPOT; CORRECT FOR AIR - COGCC

\*\*SAMPLE CONTAINED AIR; AND, NORMALIZE MOLE PERCENTS WERE ADJUSTED

<u>COMPONENTS</u>	<u>NORM. MOLE%</u>	<u>AIR ADJUSTED MOLE%</u>
HELIUM	0.12	0.38
HYDROGEN	0.00	0.00
OXYGEN/ARGON	14.91	0.00
NITROGEN	64.20	34.49
CO2	0.05	0.09
METHANE	20.67	64.88
ETHANE	0.05	0.16
PROPANE	0.00	0.00
ISOBUTANE	0.00	0.00
N-BUTANE	0.00	0.00
ISOPENTANE	0.00	0.00
N-PENTANE	0.00	0.00
HEXANES+	0.00	0.00
<u>TOTAL</u>	<u>100.00</u>	<u>100.00</u>

BTU @ 60 DEG F

GROSS DRY BTU	210.3	660.5
GROSS WET BTU	206.6	649.0
Z FACTOR	0.9994	0.9988
RELATIVE DENSITY (AIR=1 @14.696 PSIA	0.9019	0.6972

NOTE: REFERENCE GPA 2261, 2145, & 2172 CURRENT PUBLICATIONS

ATTACHMENT C  
ISOTECH ANALYTICAL REPORT  
ISOTOPIC CARBON PLOT

Lab #: 159615 Job #: 11226  
 Sample Name/Number: Phillips Water Well  
 Company: Colorado Oil & Gas Conservation  
 Date Sampled: 3/24/2009  
 Container: Dissolved Gas Bottle  
 Field/Site Name:  
 Location:  
 Formation/Depth:  
 Sampling Point:  
 Date Received: 3/31/2009 Date Reported: 4/11/2009

Component	Chemical mol. %	Chemical Air Free vol. %	Delta 13C per mil	Delta D per mil	Delta 15N per mil
Carbon Monoxide -----					
Hydrogen Sulfide -----	nd	nd			
Helium -----	0.048	0.21			
Hydrogen -----	nd	nd			
Argon -----	0.81	0.39			
Oxygen -----	16.20				
Nitrogen -----	66.36	26.30			
Carbon Dioxide -----	0.06	0.26	-9.11		
Methane -----	16.48	72.64	-70.90	-264.1	
Ethane -----	0.042	0.19	-41.96		
Ethylene -----	nd	nd			
Propane -----	0.0029	0.013			
Iso-butane -----	nd	nd			
N-butane -----	nd	nd			
Iso-pentane -----	nd	nd			
N-pentane -----	nd	nd			
Hexanes + -----	nd	nd			

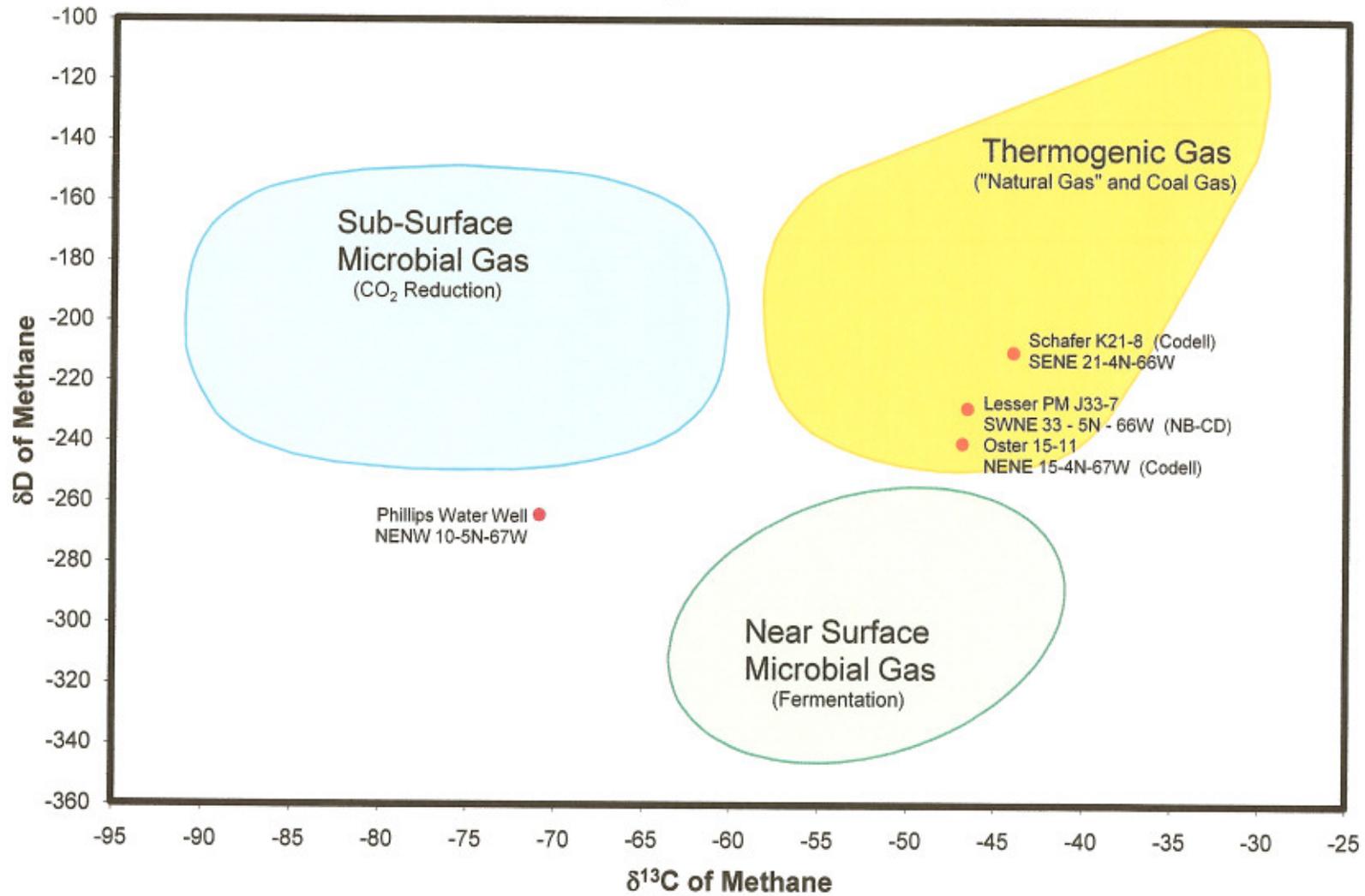
Total BTU/cu.ft. dry @ 60deg F & 14.7psia, calculated: 168  
 Specific gravity, calculated: 0.925

Remarks:

Delta C-13 of DIC = -0.25 per mil relative to VPDB  
 Ethane and CO2 isotopes obtained online via GC-C-IRMS.

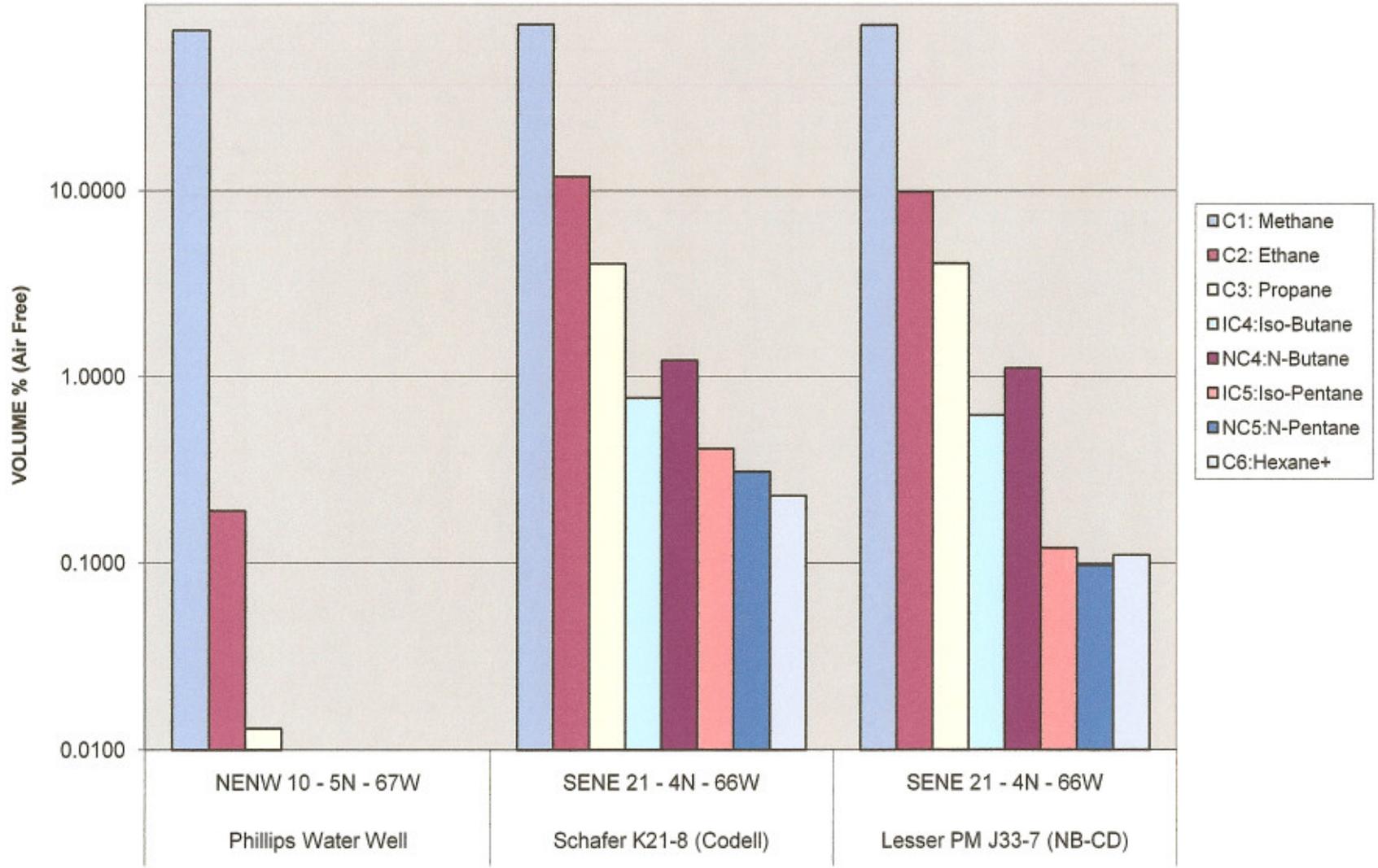
nd = not detected. na = not analyzed. Isotopic composition of carbon is relative to VPDB. Isotopic composition of hydrogen is relative to VSMOW. Calculations for BTU and specific gravity per ASTM D3588. Chemical compositions are normalized to 100 percent. Mol. % is approximately equal to vol. %

Attachment C  
Typical Compositional Ranges of Methanes from Different Sources



ATTACHMENT D  
COMPOSITIONAL GAS ANALYSIS COMPARISON

**Attachment D  
PHILLIPS vs. NB-CDL GAS COMPOSITION**



ATTACHMENT E  
BRADENHEAD PRESSURE

<u>Well Name</u>	<u>QTR/QTR</u>	<u>SECTION</u>	<u>TWN</u>	<u>RANGE</u>	<u>Bradenhead Pressure</u>	<u>DATE</u>
<b><u>PDC</u></b>						
B&B 10-11	NWNE	10	5N	67W	0	3/23/09
HONDO 1	NENW	10	5N	67W	0	3/23/09
B&B 10-31	NWNW	10	5N	67W	0	3/23/09
PHILLIPS 1	NENE	10	5N	67W	0	3/23/09
B&B 10-12	SWNW	10	5N	67W	0	3/23/09
STEPHEN FOE 10-2	SENW	10	5N	67W	0	3/23/09
STEPHEN FOE 10-3	SWNE	10	5N	67W	0	3/23/09
WARREN 10-1	SENE	10	5N	67W	25 PSI	3/23/09
<b><u>KERR-MCGEE</u></b>						
HSR KNOX 11-3	NESW	3	5N	67W	0	4/21/2009
HSR KNOX 12-3	NWSW	3	5N	67W	0	4/21/2009
HSR KNOX 13-3	SWSW	3	5N	67W	0	4/21/2009
HSR KNOX 14-3	SESW	3	5N	67W	0	4/21/2009
HSR KNOX 15-3	SWSE	3	5N	67W	0	4/21/2009
HSR KNOX 16-3	SESE	3	5N	67W	45 PSI	4/21/2009
SHUR VIEW 23-3	NWSE	3	5N	67W	0	4/21/2009
SHUR VIEW 20-3	SWSE	3	5N	67W	0	4/21/2009