

April 27, 2009

Robert Degnegaard  
21962 Weld County Road 22  
Hudson, Colorado 80642

RE: Stable Isotope and Gas Composition Analytical Results for Your Water Well  
Section 15– Township 2 North – Range 65 West  
Weld County, Colorado

Dear Mr. Degnegaard:

On March 24, 2009 LT Environmental, Inc. (LTE) sampled your water well, under the Direction of Noble Energy, and submitted these samples for laboratory analysis. The purpose of this water sampling was to determine if natural gas drilling and production activities in your area might have impacted your well water. The Colorado Oil & Gas Conservation Commission (COGCC) has recently been provided with the gas composition sample results for your sampled well and a copy has been attached. The other water quality samples results for your water well have not yet been received. We anticipate receiving those results within the next few weeks and will submit those results under another cover letter. The collected a sample of gas from your water well for compositional analysis and submitted to Isotech Laboratories, Inc. (Isotech) in Champaign, Illinois. A discussion of these sample results and a copy of the Isotech report is enclosed.

### **GAS COMPOSITION**

The gas produced from the oil/gas wells around your home 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. With the methane are other higher carbon number compounds (“heaver”) such as propane (C3), iso-butane (iC4), normal butane (nC4), iso-pentane (iC5), normal pentane (nC5), and hexane (C6). 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, in which your water well is completed, contain biogenic methane gas.

Laboratory results of the gas sample collected from your water well show that methane (66.27 percent) and ethane (0.047 percent) were detected along with nitrogen (32.67 percent), oxygen (0.17 percent), argon (0.50 percent), helium (0.16 percent), and carbon dioxide (0.18 percent). The nitrogen, oxygen, argon, helium, and carbon dioxide are components of air and the presence of methane (C1) with ethane (C2) is typical of the naturally occurring biogenic gas in the Laramie/Fox Hills aquifer. No “heaver” carbon compounds (those C3 through C6 gasses discussed above) are present that would indicate the presence of thermogenic gas.

### **Isotopic Analysis of Methane**

- The deuterium/hydrogen isotope ratio for the methane in the water sample from your water well is  $-277.4$  parts per mil (‰).
- The carbon-13/carbon-12 isotope ratio for the methane in the water sample from your water well is  $-72.86$  ‰.

### **Isotopic Cross-Plot**

I have included a cross-plot of the stable methane isotopes for your water well sample to help discuss the sample results for your well. On the cross-plot you will notice the area near the top right corner as defined a "Thermogenic Gas". This is the area of the cross-plot that the natural gas produced by the gas wells in the Denver Basin and where the production gas sample plot. Your well plots in the area to the left defined as "Sub-surface/ Near Surface Microbial Gas" which is methane gas of a biogenic origin.

### **CONCLUSION**

Based on the analysis of the gas content and stable isotopes of methane for the gas from your water well, the methane gas present is the product of natural bacteriological activity and unrelated to any oil & gas activities in your area.

The presence of methane in drinking water does not present a known health hazard to humans or other animals via ingestion; however, methane in domestic water supplies can be associated with undesirable and potentially serious side effects. 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 form within the water and cause the well pump to cavitate and no longer bring water to the surface. You should be aware that the methane gas in your water well may be at a high enough concentration that precautions should be taken to adequately vent your water system to avoid potential gas accumulations.

I have attached several "fact sheets" regarding several simple, cost effective measures that you may consider installing on your water system to vent your well of any contained methane gas. The information ranges from some simple well venting caps to a more involved cistern type of a system.

The additional water quality sample results for your well are anticipated to be finished within the next few weeks. As discussed above, the COGCC will send you those sample results under a separate cover letter. If you have any questions or would like to discuss these matters further, please contact me at the COGCC in Denver via e-mail ([robert.chesson@state.co.us](mailto:robert.chesson@state.co.us)) or by phone at 303-894-2100, extension 5112.

Respectfully,

A handwritten signature in black ink, appearing to read 'Robert H. Chesson', with a large, stylized flourish extending to the right.

Robert H. Chesson, C.P.G., P.G.  
Environmental Protection Specialist

Enclosures

cc: Dave Neslin – COGCC w/o enclosures  
Debbie Baldwin – COGCC w/o enclosures  
Mikel Cox – Noble Energy  
Paul Schneider – Kerr McGee/Anadarko

Lab #: 159181 Job #: 11200  
 Sample Name/Number: Robert Degnegaard  
 Company: LT Environmental  
 Date Sampled: 3/24/2009  
 Container: Dissolved Gas Bottle  
 Field/Site Name:  
 Location:  
 Formation/Depth:  
 Sampling Point:  
 Date Received: 3/26/2009 Date Reported: 4/01/2009

Component	Chemical		Delta 13C per mil	Delta D per mil	Delta 15N per mil
	Chemical mol. %	Air Free vol. %			
Carbon Monoxide -----					
Hydrogen Sulfide -----	nd	nd			
Helium -----	0.16	0.16			
Hydrogen -----	nd	nd			
Argon -----	0.50	0.50			
Oxygen -----	0.17				
Nitrogen -----	32.67	32.30			
Carbon Dioxide -----	0.18	0.18			
Methane -----	66.27	66.81	-72.86	-277.4	
Ethane -----	0.047	0.047	-48.79		
Ethylene -----	nd	nd			
Propane -----	nd	nd			
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: 672  
 Specific gravity, calculated: 0.695

Remarks:

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. %

**Typical Compositional Ranges of Methane - Degnegaard Water Well**

