



COMPLIANCE / ENGINEERING / REMEDIATION



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#1976

RECEIVED

JAN 10 2008

COGCC

January 4, 2008

Mr. Steven R. Lindblom
Colorado Oil and Gas Conservation Commission
1120 Lincoln Street, Suite 801
Denver, Colorado 80203

RE: Additional ERF Gas Seep Investigation Report
Walter Goff #1 (API# 05-083-06089)
Montezuma County, Colorado

Dear Mr. Lindblom:

LT Environmental, Inc. (LTE) has been retained by the Colorado Oil and Gas Conservation Commission (COGCC) to conduct additional gas seep investigation activities in the vicinity of the Walter Goff #1 abandoned production well and a nearby house located approximately 900 feet southeast of the Walter Goff #1 in Montezuma, Colorado (Figure 1). LTE understands that this work is being conducted in response to methane gas seepage identified during the Environmental Response Fund (ERF) well investigation performed in April 2007. The following is a summary of the additional assessment activities conducted at the site.

PURPOSE

The purposes of this investigation are to confirm the presence of methane seepage at the Walter Goff #1, delineate the lateral extent of methane seepage at the ground surface, and assess the threat of methane seepage to impact nearby structures and water wells.

BACKGROUND

The ERF program has funded the plugging and abandonment (P&A) of over 200 orphan oil and gas production wells in Colorado. Only limited documentation regarding the completion and/or the P&A of these wells is available. In 2005, methane seepage from the Bryce 1-X orphan well in Bonadad, Colorado created increased awareness of the potential hazardous conditions associated with the integrity of the P&A of orphan wells.

In April 2007, LTE was retained by the COGCC to conduct gas seep surveys at 30 orphan wells in the southwest region of Colorado. Results of the initial ERF well investigations in April 2007 were submitted to the COGCC in a report dated June 2007. The initial investigation indicated the presence of methane seepage around the Walter Goff #1.



RESULTS

Landowner Identification

LTE used information provided on the Montezuma County Assessor's website to determine the landowner of the nearest residence to the Walter Goff #1. An access request letter with a return card was sent to the landowner. LTE was granted access to conduct a survey of the interior and exterior of the house and maintenance shed owned by Mr. Harvey Weiss.

Soil Gas Survey

LTE conducted a soil gas survey around Walter Goff #1 and the Weiss Residence on November 12, 2007. LTE also performed a limited soil gas survey in the vicinity of an abandoned well marker identified by Mr. Weiss located approximately 200 feet south-southeast of the house.

Prior to conducting the survey, LTE contacted the Utility Notification Center of Colorado (UNCC) to identify any buried facilities in the survey area. The subsurface soil gas probes were advanced to a depth of approximately 3 feet below ground surface (bgs) using a slide hammer to bore a 0.5-inch diameter hole into the surface soil. Polyethylene tubing (0.25-inch diameter), with the bottom 6 inches perforated, was inserted into each borehole to collect subsurface gas measurements. After subsurface concentration measurements were collected, the polyethylene tubing was removed from the ground and the borehole was backfilled with native soil. The four gases measured in each soil gas probe included oxygen, methane, carbon monoxide, and hydrogen sulfide.

Each soil gas probe location and pertinent site features were recorded using a Trimble GeoXT[®] GPS, which measures and records geographic position in accordance with COGCC Rule 215. At each soil gas probe, LTE recorded the geographic position by logging a minimum of 20 GPS positions. The GPS data were downloaded and differentially corrected using publicly available base station data to achieve sub-meter accuracy.

A total of 22 soil gas probes were advanced within a 50-foot radius around the Walter Goff #1 (Photo 1). Five of the 22 soil gas probes advanced around the Walter Goff #1 detected methane at concentrations ranging from 3,500 parts per million (ppm) to 40,000 ppm [4 percent (%)].

A total of 20 soil gas probes were advanced within a 50-foot radius of the abandoned well marker identified south of the Weiss Residence (Photo 2). No evidence of an abandoned well marker was observed at the time of the soil gas survey. Methane was not detected in any of the 20 soil gas probes. No stressed vegetation was observed during the survey.

An interior gas survey was conducted at the Weiss residence (Photo 3). The survey included ambient gas measurements throughout the first floor of the house as well as the garage. The house does not have a crawl space or basement due to a slab-on-grade foundation. LTE also



conducted an interior gas survey in the Weiss' maintenance shed (Photo 4). Methane was not detected inside the house and maintenance shed.

An exterior soil gas survey was conducted around the house and maintenance shed. Four soil gas probes were advanced around the house and maintenance shed to determine if methane was seeping around the foundations. Methane was not detected at any of the eight soil gas probes advanced. Figure 2 illustrates methane readings around the Walter Goff #1, the exterior portions of the house and maintenance shed, and the abandoned well marker.

Gas Sampling

LTE collected a subsurface soil gas sample in the area of the highest methane concentration to determine the origin of the gas (biogenic or thermogenic). The sample was collected using a hand pump to transfer gas from the subsurface soils exhibiting methane seeps into a mylar sample bag. The gas sample was packaged per the Federal Department of Transportation (DOT) regulations with a completed COC form and submitted to Isotech Laboratories, Inc. (Isotech) in Champaign, Illinois. The gas sample was submitted for the following parameters:

- **Fixed Gas Chromatography:** Hydrogen (H₂), Argon (Ar), Nitrogen (N₂), Oxygen (O₂), Carbon Dioxide (CO₂), and Hydrogen Sulfide (H₂S);
- **Hydrocarbon Gas Chromatography:** Methane, Ethane, Propane, i-Butane, n-Butane, i-Pentane, and Hexane+; and
- **Stable Isotopic Analysis:** Carbon and Hydrogen isotopes of Methane.

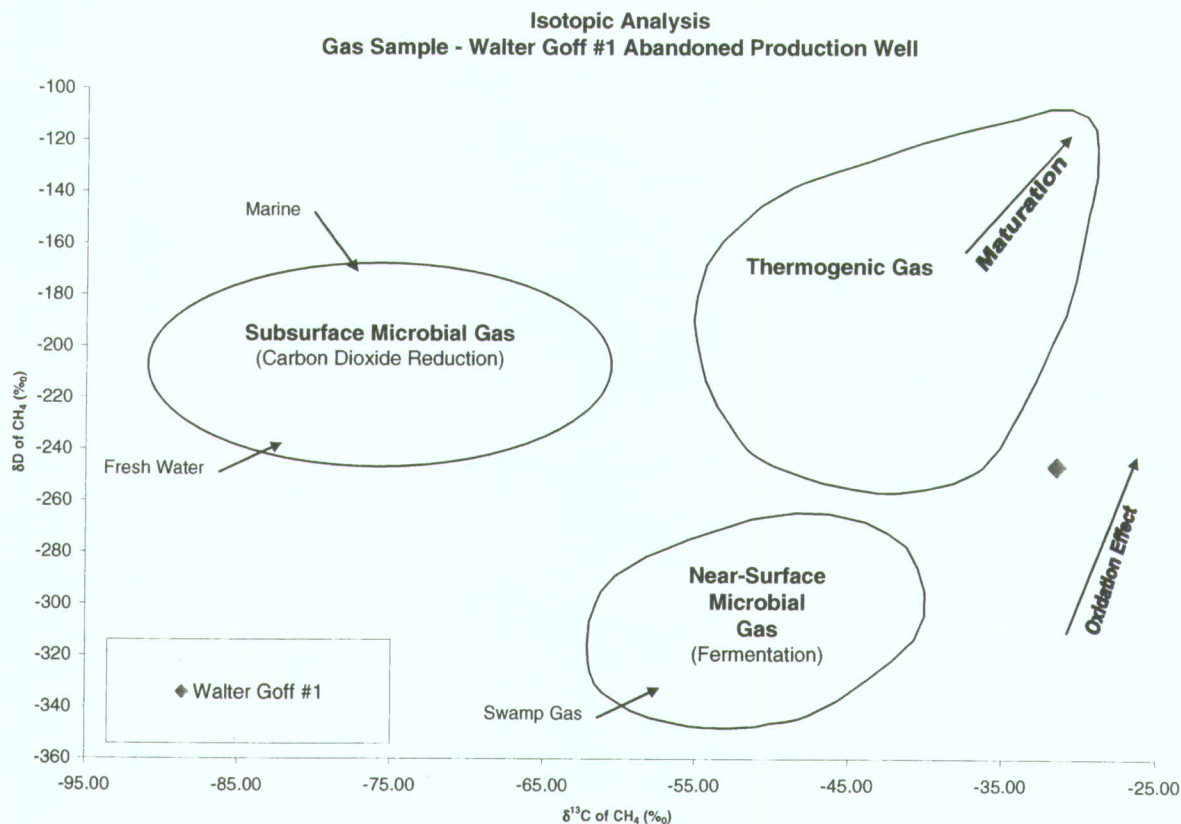
To determine the origin of the gas, the analytical results were plotted using a chart from the 1995 paper entitled *Isotopic Identification of Landfill Methane* by Coleman, et al. Additionally, the gas wetness ratio was calculated for the sample.

Results of the laboratory analysis indicated that methane was detected in the Walter Goff #1 sample at a concentration of 4.37 percent (%). The gas sample had a gas wetness ratio of 96.28%.

Isotopic analysis of the samples indicated that the methane seeping from the area is thermogenic gas. Thermogenic gas is defined as gas derived from heat and pressure exerted on organic matter as opposed to biogenic gas which is derived from biological activity. The table below summarizes the methane concentration and isotope analytical results. The laboratory analytical report is included in Attachment 1.

Sample Name	Methane %	$\delta^{13}\text{Methane}$ ‰	$\delta\text{DMethane}$ ‰
Walter Goff #1	4.37	-31.47	-246.4

LTE plotted the data from the isotopic analysis of the gas sample. The plotted data fell outside of the thermogenic area; however the results indicate that the gas sample collected is near the thermogenic region and would be categorized as thermogenic. The chart below illustrates how thermogenic methane gas is identified using isotopes of carbon and hydrogen of methane.



CONCLUSIONS

Methane seepage has been confirmed at the Walter Goff #1. It appears that the plugging of the well may be insufficient and the well casing is providing a conduit for subsurface gas to migrate vertically to the ground surface.

Based on the survey data and the distance from the methane seep to the Weiss residence, the potential for the methane seepage to impact the structures appears to be low at this time. The residence is on municipal water and does not use a water well for drinking water.



LTE appreciates the opportunity to provide environmental services to the COGCC. If you have any questions, please contact me at (303) 433-9788.

Sincerely,

LT ENVIRONMENTAL, INC.

A large, stylized signature in black ink, consisting of several overlapping loops and a long horizontal stroke.

Daniel R. Moir, G.I.T.
Staff Geologist

A signature in black ink, appearing to be 'K. G. Siesser' with a stylized flourish at the end.

Kyle G. Siesser
Project Geologist

PHOTOS



Photo 1: Walter Goff #1 abandoned production well marker.



Photo 2: Abandoned production well vicinity observed by Mr. Weiss, view southwest.



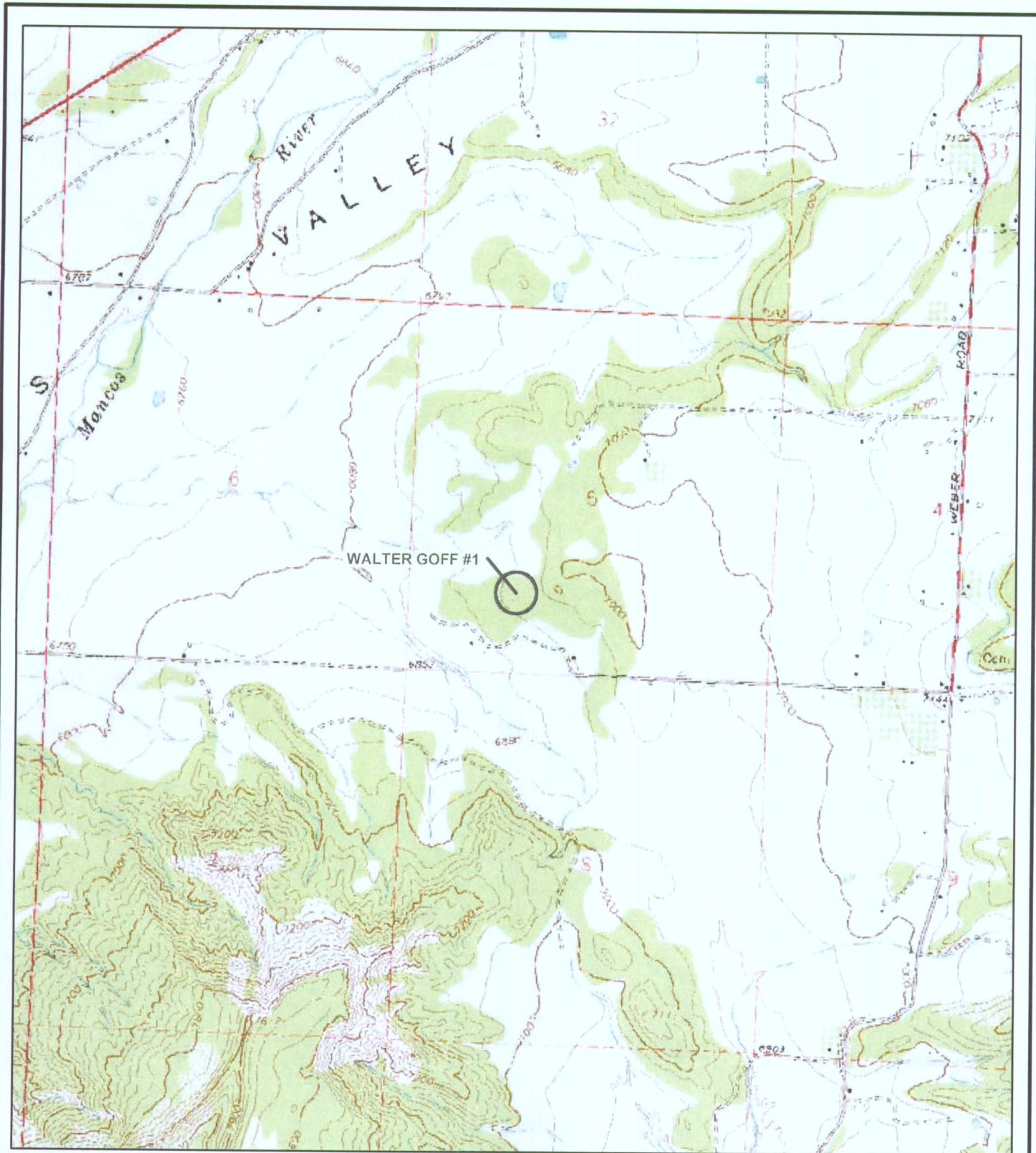
Photo 3: Weiss residence, southeast of the Walter Goff #1 abandoned production well, view northwest.



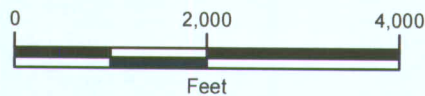
Photo 4: Weiss's maintenance shed, view north.

FIGURES





Map Source:
 USDA, Natural Resources Conservation Service
 National Cartography & Geospatial Center, 1999-Present



LEGEND

○ SITE LOCATION

FIGURE 1
 SITE LOCATION MAP
 WALTER GOFF #1
 API #05-083-06089

MONTEZUMA COUNTY, COLORADO
 COLORADO OIL AND GAS CONSERVATION COMMISSION





Map Source: USDA, National Agriculture Imagery Program Mosaic, 2005 & 2006

LEGEND

SUBSURFACE METHANE MEASUREMENTS

- | | |
|-------------------|--------------------------------|
| ○ 0 ppm | ✚ GAS SAMPLE LOCATION |
| ● 1 ppm - 500 ppm | COGCC OIL & GAS WELL (API NO.) |
| ● 501 ppm - 5% | ⊕ DRY AND ABANDONED |
| ● 6% - 15% | |
| ● 16% - 25% | |
| ● 26% - 50% | |
| ● 51% - 75% | |
| ● 76% - 100% | |

GAS SAMPLE COLLECTED ON 11/12/07
SOIL GAS SURVEY PERFORMED ON 11/12/07

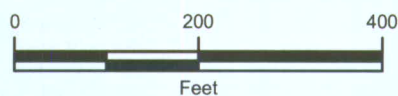


FIGURE 2
SITE MAP
WALTER GOFF #1
API #05-083-06089
MONTEZUMA COUNTY, COLORADO
COLORADO OIL AND GAS CONSERVATION COMMISSION



ATTACHMENT 1
ANALYTICAL LABORATORY REPORT





ISOTECH®

Web Page www.isotechlabs.com Email mail@isotechlabs.com

Isotech Laboratories, Inc. 1308 Parkland Court, Champaign IL 61821-1826 Telephone (217) 398-3490 Fax (217) 398-3493

Lab #: 127708 Job #: 9104
Sample Name/Number: Walter Goff #1
Company: LT Environmental
Date Sampled: 11/12/2007
Container: Cali-5-Bond Bag
Field/Site Name: OGCC0705.02
Location: SW Colorado
Formation/Depth:
Sampling Point:
Date Received: 11/21/2007 Date Reported: 12/19/2007

Component	Chemical		Delta 13C per mil	Delta D per mil	Delta 15N per mil
	Chemical mol. %	Air Free vol. %			
Carbon Monoxide -----	nd	nd			
Hydrogen Sulfide -----	nd	nd			
Helium -----	nd	nd			
Hydrogen -----	nd	nd			
Argon -----	0.90	0.34			
Oxygen -----	19.74				
Nitrogen -----	74.56	16.75			
Carbon Dioxide -----	0.26	4.49			
Methane -----	4.37	75.52	-31.47	-246.4	
Ethane -----	0.038	0.66			
Ethylene -----	nd	nd			
Propane -----	0.050	0.86			
Iso-butane -----	0.030	0.52			
N-butane -----	0.023	0.40			
Iso-pentane -----	0.017	0.29			
N-pentane -----	0.0044	0.076			
Hexanes + -----	0.0052	0.090			

Total BTU/cu.ft. dry @ 60deg F & 14.7psia, calculated: 49

Specific gravity, calculated: 0.983

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. %