



April 26, 2006

Ms. Debbie Baldwin  
Colorado Oil and Gas Conservation Commission  
1120 Lincoln Street, Suite 801  
Denver, Colorado 80203

RE: April 6, 2006 Methane Seep Survey  
Bondad, Colorado

Dear Ms. Baldwin:

LT Environmental, Inc. (LTE) is pleased to provide the Colorado Oil and Gas Conservation Commission (COGCC) with this letter summarizing the results of the seventh methane seep survey conducted at the Bondad Gas Seep Site (Site) located in Bondad, Colorado on April 6, 2006.

## **BACKGROUND**

At the request of the COGCC, LTE conducted an initial methane gas seep survey on the Site in February 2005. The initial methane seep survey was performed in response to an explosion of a residence located at 4034 US Highway 550 (the former Yoakum Residence). During the period from February 21 through February 24, 2005, LTE conducted soil gas survey activities in the project area extending approximately 3,000 feet in all directions from the Bryce 1-X production well (Figure 1). The results of the initial soil gas survey are presented in the *Methane Seep Survey Report* (March 2005). Additional soil gas surveys were performed on April 19, 2005, June 10, 2005, November 1, 2005, December 2, 2005, and January 30, 2006. All project reports are available on the COGCC website at [www.oil-gas.state.co.us](http://www.oil-gas.state.co.us).

LTE conducted a geophysical survey of the seep area in April 2005 which identified several areas suspected of containing buried structures (such as abandoned wells or pipelines) with the potential to act as conduits for methane gas. Exploratory excavation activities were conducted in these suspect areas in August 2005 and the abandoned Bryce 1-X well was uncovered in the main gas seep area. In November, 2005, LTE provided oversight during the complete excavation, inspection, and initial remediation of the Bryce 1-X well and sandstone bedrock surface. Reports summarizing the geophysical survey, exploratory excavation activities, and the Bryce 1-X well remediation activities are also available on the COGCC website.

Recent activity at the site has included continued operation and maintenance (O&M) of the methane detection systems located at the Fire Station, Weston well house, Weston residence, Wilson residence, Buddhue residence, Bandy (former Grant) residence, and health and safety monitoring during well pad construction activities at the Bryce 1-X well.

LT Environmental, Inc.

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## **SITE DESCRIPTION**

The Site is located in Bondad, Colorado, approximately 20 miles south of Durango, Colorado (Figure 1). The Site is located approximately 0.25 miles north of the confluence of the Animas River to the west and the Florida River to the east. The Site consists of several tracts of land covering more than 100 acres. The project area land use consists of residential properties, agricultural properties, a fire station, US Highway 550, the Animas River, and the Florida River. The majority of land is privately owned. Figure 1 displays the Site layout.

## **METHANE GAS SEEP SURVEY**

### **Methodology**

On April 6, 2006, LTE was on site to conduct a seventh methane gas seep survey of the Site. This survey is the third survey since venting work on the Bryce 1-X well began. The scope of the survey was similar to the previous surveys conducted at the Site. During the soil gas survey, tubing was lowered into each borehole and gas measurements were collected directly from the shallow surface soil approximately three feet below ground surface (bgs). LTE measured the concentration of methane, oxygen, hydrogen sulfide, and carbon monoxide at each sampling location.

LTE created a sampling grid to cover the mapping area systematically and to provide a means to delineate the extent of the gas seepage. The grid consisted of approximately 140 squares, each measuring approximately 10,000 square feet in area. LTE collected a soil gas measurement at the corners of each square in the grid. Each sample location was recorded using a Trimble GeoXT<sup>®</sup> global positioning system (GPS). When methane was detected along the edges of the grid, additional measurements were collected outside of the grid to define the extent of the seep area more completely.

LTE also measured the methane concentration in the soil around the exterior of the Fire Station and all five houses in the mapping area, near the water wells associated with each of the structures, and along the valley floor of both the Animas and Florida Rivers.

### **Soil Gas Survey Results**

LTE personnel advanced a total of 199 subsurface probes across the project area. Results of this survey indicate that elevated methane gas was detected in an elliptically-shaped area around the Bryce 1-X well and covering approximately eight acres. The distribution of the methane gas in this area extended approximately 640 feet north of, 140 feet south of, 210 feet west of, and 200 feet east of the Bryce 1-X well. Detected methane concentrations in the elliptically-shaped seep area ranged from 1,500 parts per million (ppm) (0.15% methane) to 90%.

Methane was detected in the vicinity of the Wilson and Buddhue residences. Methane was detected north, west, and south of the Wilson residence at concentrations of 5%, 12,500 ppm (1.25%), and 5%, respectively. Methane was detected near the Wilson water well at a concentration of 22,000 ppm (2.2%). Methane was detected at a concentration of 6,500 ppm



(0.65%) approximately 20 feet west of the Buddhue residence. Methane was detected near the Buddhue water well at a concentration of 90%. Methane was not detected around the Weston, Bandy, or Williams residences nor near the water wells associated with these structures.

Methane was detected at one location near the base of the cliffs along the floodplain of the Florida River at a concentration of 23,000 ppm (2.3%). Methane was not detected at any other location along the floodplain of the Florida River during the April 2006 gas survey.

Methane was detected along the flood plain of the Animas River at a location to the west of Spring 2 and at a location to the south of Spring 1 at concentrations of 17,500 ppm (1.75%) and 14%, respectively (Figure 1).

Methane was detected in an isolated area along the abandoned pipeline on the east side of US Highway 550 approximately 200 feet north of the primary seep area. The methane concentration reported at this sampling point was 6%. This is the third survey event during which methane has been detected in this area. It is possible that the abandoned pipeline is acting as a conduit for the horizontal migration of methane gas beneath the subsurface.

Figure 1 shows all methane concentrations recorded during the April 2006 methane seep survey.

#### **Methane Seep Survey Comparison**

With the exception of the February 2005 survey event which included the collection of 372 subsurface gas measurements, the number of subsurface measurements collected during the April 2005, June 2005, November 2005, December 2005, January 2006, and April 2006 survey remained relatively consistent, ranging from 134 to 201 points. The grid created for the April 2005 methane seep survey and used during the past six survey events allowed LTE to conduct field activities more efficiently and more systematically.

The areal extent of the gas seep around the Wilson and Buddhue residences appears to be relatively consistent with the January 2006 survey. The magnitude of the methane concentrations at these locations has also remained consistent with previous survey events with the highest concentration recorded near the Buddhue water well. The Buddhue water well is a possible conduit for the methane seepage detected.

LTE prepared a map illustrating the areal extent of methane seepage identified during the gas survey events (Figure 2). Comparison of the April 2006 data indicates that the areal extent of the primary seep area (area around the abandoned Bryce 1-X well) is relatively consistent with the January 2006 survey and remains smaller than the areal extent of the seep area mapped prior to the venting of the Bryce 1-X well in November 2005.

The average methane concentration detected within the primary seep area during the April 2006 survey was higher than the average concentrations detected during the previous two surveys. However, with the exception of the most recent survey, data indicates that the concentrations within the primary seep area have been declining since the Bryce 1-X well was uncovered and allowed to vent in November 2005. The increase in the average methane concentration detected



during the April 2006 survey may be related to saturated ground conditions at the time of the survey or affected by an elevated water table due to early spring run-off conditions.

<b>Survey Date</b>	<b>Number of Survey Points</b>	<b>Average Subsurface Methane (%)</b>
Feb-05	112	23
Apr-05	45	33
Jun-05	37	21
Nov-05	45	32
Dec-05	25	21
Jan-06	31	10
Apr-06	32	29

## **CONCLUSIONS AND RECOMMENDATIONS**

The results of the April 6, 2006 survey indicate that the areal extent of activity in the primary seep area has decreased since the November 2005 survey. However, the methane concentration in the primary seep area increased from the January 2006 survey, most likely affected by saturated ground conditions and/or an elevated water table at the time of the survey. Seep activity continues to be detected around the Fire Station and the Buddhue and Wilson residences, but not in the vicinity of the other residences within the mapping area. Methane seeps were detected in the area between the Buddhue residence and the Bandy residence for the second time since inception of the survey program. Methane seepage continues to be detected along the flood plain of the Animas River and near the base of the cliffs along the floodplain of the Florida River.

The primary seep activity appears to be associated with the Bryce 1-X abandoned well. Since the work performed on the Bryce 1-X during December 2 through December 4, 2005, the Bryce 1-X is venting gas to the atmosphere. The well appears to be acting as the preferential pathway for methane gas migration. The preferential flow through the Bryce 1-X well may be reducing the lateral migration of methane gas beneath the sandstone layer, thereby reducing the areal extent of the surface gas seep. LTE recommends continued monitoring of the methane seep at the Site as a safety precaution for the people living in the area.

The grid mapping system will continue to be used during future seep surveys in an effort to remain consistent with the previous monitoring events. The next soil gas survey event is scheduled for June 2006. LTE also recommends continued O&M of the existing methane detection systems in the four houses and the Fire Station located within the project area. The monthly O&M will continue to be conducted by Standby Safety of Cortez, Colorado.





LTE recommends continuous health and safety monitoring during upcoming well drilling operations. While the drilling company likely has experience in drilling oil and gas wells, they may not have experience in drilling within a gas seep area covering approximately eight acres of land. Special care should be taken to monitor site activities during placement and operation of drilling equipment across the entire well pad location. The potential for explosive vapors to accumulate in confined space of buildings, trailers, cabins, and break rooms used during drilling activities is high. It may be necessary to design and implement ventilation controls for confined spaces during the site work.

LTE appreciates the opportunity to provide environmental services to the COGCC. If you have any questions regarding this report or would like additional information, please contact us at (303) 433-9788.

Sincerely,

LT ENVIRONMENTAL, INC.

A handwritten signature in black ink that reads "Kyle G. Siesser". The signature is written in a cursive, slightly slanted style.

Kyle G. Siesser  
Staff Geologist

A handwritten signature in black ink that reads "John D. Peterson". The signature is written in a cursive, slightly slanted style.

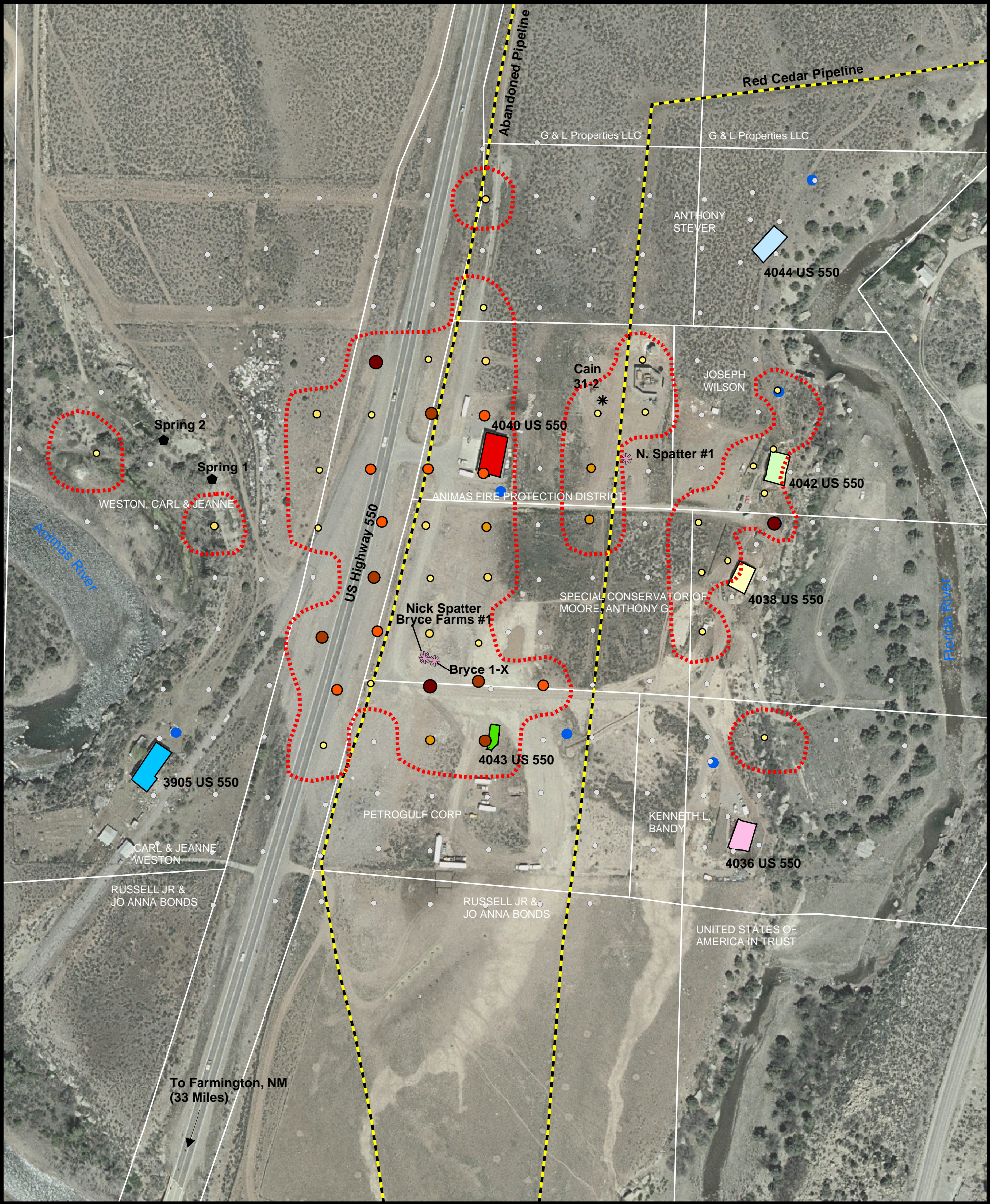
John D. Peterson, P.G.  
Project Manager

Attachments

## FIGURES







Legend

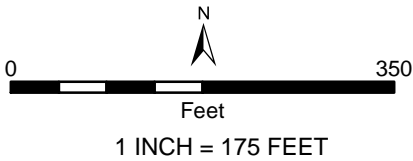
- Water Supply Wells
- Springs
- Gas Well
- Former Oil and Gas Well
- Extent of Methane Seepage
  - April 2006
- Utilities
  - Buried Gas Pipeline

Structures

- Williams Residence
- Fire Station
- Wilson Residence
- Buddhue Residence
- Bandy (former Grant) Residence
- Former Yoakum Residence
- Weston Residence

Subsurface Methane Measurements

- 0 ppm
- 500 ppm - 5%
- 6% - 15%
- 16% - 25%
- 26% - 50%
- 51% - 75%
- 76% - 100%

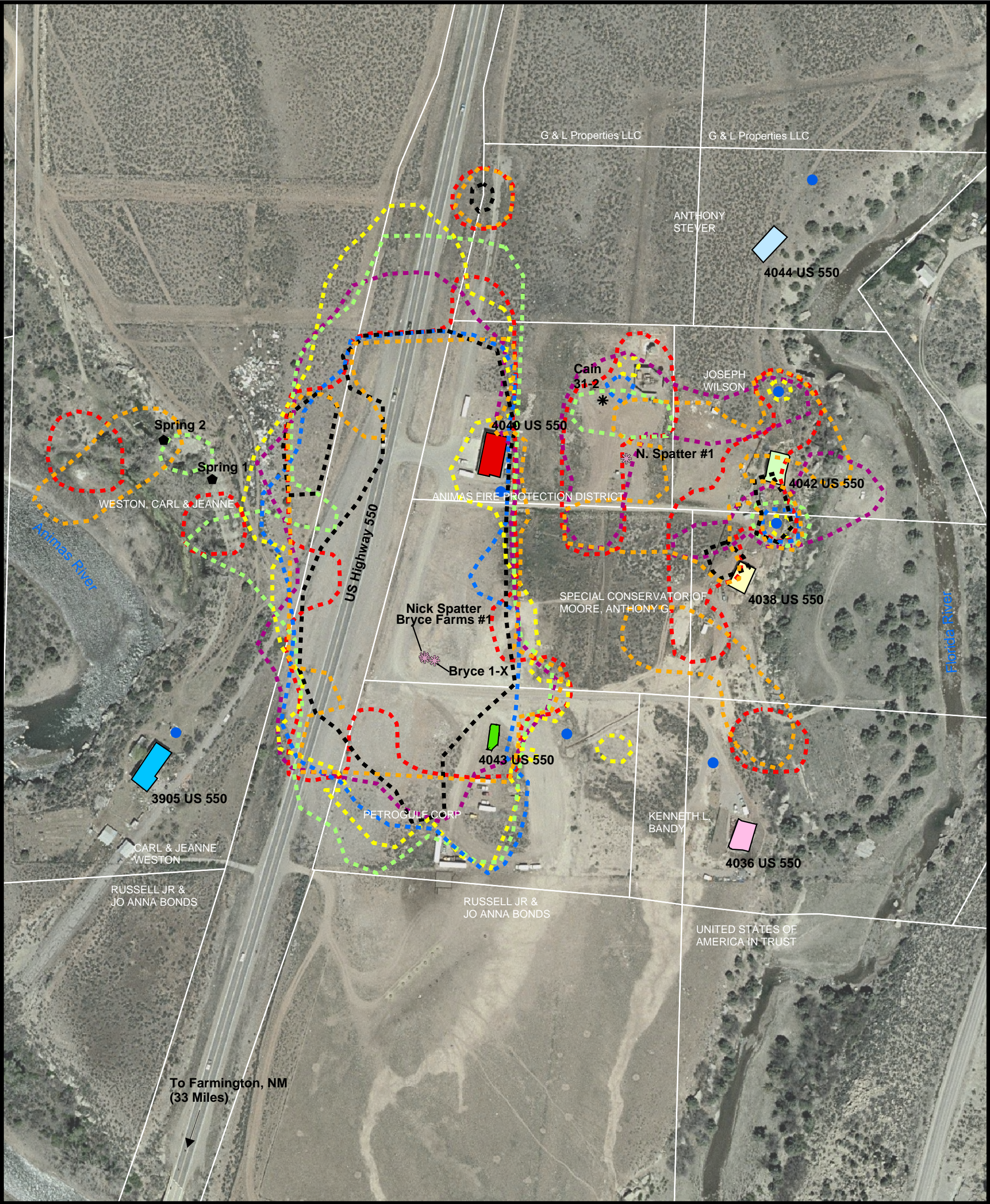


Landowner and Property Boundaries Labeled in White

FIGURE 1  
SUBSURFACE METHANE MEASUREMENTS  
APRIL 2006  
BONDAD GAS SEEP  
BONDAD, CO







Legend

- Water Supply Wells
  - ◆ Springs
  - \* Gas Well
  - ✱ Former Oil and Gas Well

**Methane Seepage**

  - February 2005
  - April 2005
  - June 2005
  - November 2005
  - December 2005
  - January 2006
  - April 2006

**Structures**

  - Williams Residence
  - Fire Station
  - Wilson Residence
  - Buddhue Residence
  - Bandy (former Grant) Residence
  - Former Yoakum Residence
  - Weston Residence

Landowner and Property Boundaries Labeled in White

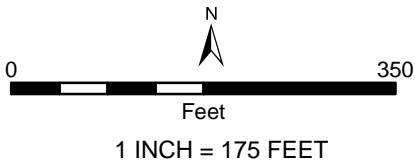


FIGURE 2  
HISTORICAL SUBSURFACE  
METHANE MEASUREMENTS  
FEBRUARY 2005 - APRIL 2006  
BONDAD GAS SEEP  
BONDAD, CO  
COLORADO OIL AND GAS CONSERVATION COMMISSION

