4M OUTCROP MITIGATION SUMMARY REPORT

SOUTH FORK TEXAS CREEK AND PINE RIVER
LA PLATA COUNTY, COLORADO

JANUARY 2015

Prepared for:

COLORADO OIL AND GAS CONSERVATION COMMISSION
Denver, Colorado

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Prepared for:

COLORADO OIL AND GAS CONSERVATION COMMISSION
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FIGURES

TABLES

1.0 INTRODUCTION

The Fruitland Formation of the San Juan Basin extends from southwestern Colorado into New Mexico and is the most productive coal bed methane (CBM) reservoir in the United States. In La Plata County, Colorado, at the northern edge of the San Juan Basin, the Fruitland Formation rises steeply to the ground surface or near ground surface (Figure 1). This approximately 50-mile long strip of land across La Plata County is referred to as the Fruitland Formation outcrop (Outcrop). The Outcrop in some areas is breached and eroded by rivers and streams. Naturally occurring methane gas seepage has occurred historically in many of these topographically low-lying areas.

Where seepage is substantial, such as in the valleys of the Los Pinos (Pine) River, South Fork of Texas Creek, Florida River, Animas River, and Basin Creek, methane gas could accumulate in confined areas and create a risk of explosion. In addition, the methane in these areas has the potential to migrate into groundwater and affect water wells. In these areas, vegetation can be stressed by the methane seepage. Where methane seepage persists, trees, bushes, grass, and other plants often die, which leaves the soil bare and decreases wildlife habitat. Additionally, methane is a greenhouse gas. During the late 1990s and early to mid-2000s, CBM exploration and production in the Fruitland Formation was economically viable and robust in La Plata County. The increased drilling activity drew attention to free gas behavior in the reservoir, particularly near the Outcrop.

In 2000, the Colorado Oil and Gas Conservation Commission (COGCC) established the 3M (Mapping, Monitoring, and Modeling) Project to develop a more comprehensive understanding of gas and water production from the Fruitland Formation and potential impacts at the Outcrop. In 2007, at the urging of La Plata County, the COGCC expanded the 3M Project to include mitigation of methane seepage. The addition of mitigation prompted a change in name to the 4M Project. The primary objective of the mitigation portion of the 4M Project was to conduct testing of possible methane mitigation techniques to demonstrate the economical and technical viability to recover and use the uncontrolled methane along the Outcrop. The desired result was overall protection of the environment, including reduction of greenhouse gas emissions, plant growth improvement, structure safety, and beneficial use of the methane resource. In May 2008, LT Environmental, Inc. (LTE) was selected through competitive bid to design, install, and operate mitigation systems at South Fork Texas Creek (SFTC) and Pine River (PR) (Figure 1).

LTE installed the mitigation systems in 2008 and 2009 to capture naturally venting methane gas at SFTC and PR. At SFTC, the captured gas is routed to a compressor and combustion chamber to generate electricity. The electricity produced has been used to power the SFTC system and supply surplus to the local grid. From 2009 through 2012, LTE conducted operations and maintenance (O&M) at both sites for COGCC. In 2012, BP America (BP) volunteered to pay O&M costs in order to keep the systems operational.

The following report provides a summary of the system designs and presents operational results from both systems since installation to evaluate progress toward meeting the initial 4M Project goals. Finally, LTE provides recommendations for increased efficiency and improved data application as well as ideas for potential future use.

2.0 DESIGN SUMMARY

To optimize methane collection, LTE completed a soil vapor survey over the planned methane collection areas at SFTC and PR in 2008. The survey included use of a flux meter to measure the rate of methane seepage. Based on the results of the survey, LTE designed and installed vapor collection and barrier systems for methane collection at both the SFTC and PR sites, as displayed on Figure 2 and Figure 3, respectively.

2.1 SOUTH FORK TEXAS CREEK DESIGN

The focus for SFTC design was to capture methane efficiently, then compress and use the captured gas to produce electricity. The design for SFTC included installation of a reverse French drain and vapor barrier methane collection system over approximately 0.8 acres. The collection focused on areas where methane seepage was more prevalent as identified by the original soil gas survey. Four collection areas were utilized.

In each SFTC collection area, soil was removed to a depth of approximately 18 inches. Corrugated slotted drain piping was installed on 20 foot to 25 foot centers throughout the collection area. The entire collection areas were filled with approximately 9 inches of 3/8-1/2 inch gravel, and a 15-mil vapor barrier was installed over the rock. On top of the vapor barrier, soil was replaced and the area was seeded with a native mix.

Horizontal collection piping was connected to header piping, which was connected to a valve manifold. Sampling ports allow for collection and analytical testing of the gas for each of the four collection areas. The valves allow for flow adjustment, making it possible to focus on the more productive areas for gas collection.

The gas mixture is treated to remove moisture and filtered for particulates before being compressed. The process equipment is located in a small building on a concrete pad. The system includes a continuous methane and oxygen concentration detector. The sensors are connected to controls and are utilized to shut down the process equipment if the gas mixture is not able to be safely used to power the turbine or if the gas quality falls near the upper explosive range.

The turbine is located in a separate building to isolate the gas collection and use components for safety. A 30 kilowatt (kW) turbine fueled by the collected gas is utilized to create enough electricity to operate the collection equipment. The turbine returns any excess power to the local electrical grid for credit into a La Plata County Electric (LPEA) account in COGCC's name as a renewable energy resource. The credit has been used to pay monthly electrical billing fees for electrical service for both the SFTC and PR locations.

During June 2010, the SFTC system was expanded in order to increase methane collection. A collection liner designed to direct vapors into the existing collection system was installed beneath Texas Creek where bubbling methane had been observed for years and diagonal well points were installed along the creek and piped into the existing methane collection manifold.

To accomplish liner installation beneath Texas Creek, plant growth and top soil were removed to a depth of approximately 24 inches. Water was temporarily diverted around the excavation area, and a trash pump was used for additional dewatering during installation. The entire collection area was filled with approximately 9 inches of 3/8-inch to 1/2-inch gravel, and a 20-mil impervious membrane vapor barrier was installed over the gravel. The north and south edges of the vapor barrier were laid beneath the existing collection vapor barriers with 3 feet of overlap. The east and west edges were rolled down to direct the vapors toward the collection zones. The top soil and native vegetation were replaced on top of the barrier and additional native wetland flora was planted.

To evaluate an alternative methane collection method and to access methane beneath the portion of the creek surrounded by willow bushes while minimizing vegetation damage, diagonal well points were installed. A total of 32 well points were installed using a direct-push drilling rig. The wells consist of 2-inch diameter schedule 40 polyvinyl chloride (PVC) installed at a 45-degree angle with slots cut into the underside of the casing. Individual wells were connected to collection pipes which were connected to the existing system manifold. Sampling ports allow for collection and analytical testing of the gas for each of the three diagonal well collection areas and valves allow for flow adjustment.

In addition, gas from a COGCC monitoring well was piped to the collection system. The volume of methane recovered from the monitoring well source was not sustainable and the line was shut-in. The well was returned to monitoring status in late 2010 as the well is more valuable for monitoring than it is for gas recovery.

2.2 PINE RIVER DESIGN

At PR, LTE designed a system to collect methane efficiently and observe effects on vegetation. To address the seep and optimize recovery of methane, the design for PR included installation of a reverse French drain methane collection system over 0.7 acres utilizing four collection areas. In an effort to focus on areas where methane seepage was more prevalent and minimize oxygen recovery, some lengths of piping were solid while others were slotted, depending on the data collected during previous field studies.

Soil was removed to a depth of approximately 18 inches, where piping (both slotted and solid) was installed on 15 foot centers. Only the trenches where the piping was laid were filled with approximately 9 inches of 3/8-1/2 inch gravel under a 15-mil vapor barrier. On top of the vapor barrier, soil was replaced and the area was seeded with a native mix.

Horizontal collection piping was connected to header piping, which was connected to a valve manifold. Sampling ports allow for collection and analytical testing of the gas for each of the four collection areas.

The process equipment is located in a small building on a concrete pad. A vacuum blower on the manifold was installed to recover the captured gas from the collection areas and the gas is vented to the atmosphere. The system includes a continuous methane and oxygen concentration detector. The sensors are connected to controls designed to shut down the process equipment if methane concentrations drop too low.

3.0 OPERATIONS

The SFTC and PR mitigation systems were installed as described in the previous section in 2008 and 2009. Weekly O&M began in May 2009 and includes maintaining the equipment per manufacturer instructions, collecting data used to evaluate system performance, and adjusting the operating parameters to optimize system effectiveness.

Routine activities include:

- Recording and documenting operational parameters such as methane and oxygen concentration, operational hours for the turbine and compressor, applied vacuum to subsurface piping, turbine electrical generation, and methane flow rates and volume;
- Field screening the inlet gas quality;
- Reviewing gas quality measurements stored in the data loggers and obtaining weather station data;
- Changing oil, oil filters, an oil separator, and a coalescing filter in the gas compressor system;
- Changing the air filter on the turbine;
- Conducting larger repairs to equipment and troubleshooting as necessary; and
- Observing changes to vegetation.

3.1 SOUTH FORK TEXAS CREEK OPERATIONS

As part of the weekly O&M site visits at SFTC, data are collected and tabulated. Table 1 shows data collected from 2009 to present. The data are used to track system performance as measured by the amount of gas collected by the system (Figure 4), the percentage of methane in the recovered gas (Figure 5), and the quantity of electricity that is generated (Figure 6).

The amount of gas captured by the collection systems is determined by measuring the gas flow rate into the system manifold and calculating cumulative gas flow. The average weekly measured gas flow rate is 330 standard cubic feet per hour (scfh). The fluctuations observed in gas flow rate sometimes occurred coincident with system shutdown/startup periods, but not all fluctuations are completely understood. However, the flow of gas into the SFTC system has been generally steady over time as documented by the uniform slope of the cumulative flow measurements (red line) on Figure 5. As of December 31, 2014, the cumulative calculated gas recovered was 12,761,000 cubic feet (mcf).

The flow rate measured represents the gas used by the system but does not necessarily reflect the quantity of methane available for recovery. Once water and particulates are removed from the collected gas, it is compressed and methane concentrations are measured to determine how much of the gas composition consists of methane before combustion. Figure 4 shows methane concentrations over time. From May 2009 to August 2011, methane percentages fluctuated between 51 percent (%) and 99.5% representing variation in system performance during startup as well as degradation of the methane sensor that was originally installed in the system. The remaining gas composition consists primarily of oxygen and hydrogen sulfide (H_2S). A new methane sensor was installed in August 2011 that was better equipped for handling constant influx of near 100% methane. From August 2011 to March 2013, methane concentrations ranged from 99.3% and 99.5% methane. The methane concentrations began to fluctuate again beginning in March 2013 through December 2014, ranging from 77.8% to 99.8% methane. Large changes observed in methane concentrations are primarily attributed to system maintenance and system outages, but the small fluctuations are not yet understood. For example, the fluctuations could be related to equipment operation, changes in atmospheric conditions, or even the amount of water in the collection pipelines.

Electrical generation has been stable since the original startup period from April 2009 through January 2011. Beginning in February 2011, LTE has maintained regular electricity production except for two major system shut downs in November 2012 and May 2014 due to compressor equipment malfunctions that required replacement of compressor parts and extended down time. The weekly average for electricity generated is 876 kilowatt hour (kW-h), with a total electricity surplus of 201,529 kW-h as of December 31, 2014 (Figure 6). This production results from an average of 11 kW-h of electricity production, with approximately 6 kW-h of that electricity used by the system to operate the compressor and ancillary equipment.

LTE monitors vegetation growth at the Site regularly. Vegetation was affected by drought conditions from the summer of 2011 through summer 2012, but considerable plant growth has occurred in areas previously prohibitive of vegetative growth in the past two years especially where the vapor barriers were installed (Figure 7).

3.2 PINE RIVER OPERATIONS

Flow rate and cumulative flow are not measured at PR. A flow meter was removed shortly after system start up due to gas flow being so minimal that the meter would not turn. Gas collected at the PR system contained initial methane concentrations between 20% and 45% from May 2009 to May 2010 (Figure 8). However, a steady decline in methane concentrations was observed and LTE converted the system to passive venting on July 6, 2012. The blower was shut down and valves adjusted to allow recovered gas within the subsurface piping to vent. A wind driven turbine ventilator was added to the system stack to assist with gas venting. Field instrumentation is used to monitor methane concentrations in the ventilation piping monthly and it remains mostly low following a spike in concentrations after the system conversion.

The vegetation is observed monthly for negative effects from methane seepage and continued recovery. Since installation of the system in 2009, the health and coverage of vegetation in the area of the seep has steadily improved. In 2014 no stressed vegetation was observed at the site (Figure 9).

3.3 WEATHER STATION

Weather likely plays a role in the overall changes in methane seepage. LTE installed a weather station at SFTC in June 2010 to monitor conditions that may affect methane recovery and system operation. The weather station records the daily maximum and minimum temperatures, monthly precipitation, and the daily barometric pressures. Currently, these data are not compared to system performance metrics as the controlling factor on methane recovery is the ability to use the quantity of methane recovered, not the availability of methane for recovery. Weather station information comparisons might be useful for explaining overall fluctuations in gas flow rates and methane concentrations.

4.0 EVALUATION

The installation and operations of the SFTC and PR mitigation systems have shown that mitigation of methane seepage is possible. At SFTC and PR, LTE has demonstrated a technically viable method for capturing methane. At SFTC, the captured gas is being converted to a beneficial use.

The SFTC system has been recovering methane since 2009, and LTE has stabilized recovery rates and gas composition has improved since August 2011 by refining system performance over time. Vegetation has improved and greenhouse gases have been reduced as a result. SFTC generates approximately 900 kW-h of electricity each week which is enough to power the system and generate a surplus. La Plata Electric Association (LPEA) compensates COGCC for the surplus, which totals approximately $4,500 annually since startup. Additionally, LPEA has stated that electrical supply in the area has improved as a result of the SFTC contribution.

The system is not running at full capacity apparently due to limitations in the power transfer equipment. The maximum electrical output achievable is approximately 19 kW considering altitude and temperature de-rating of the turbine. The turbine is set at 11 kW to limit system shut downs, which also restricts the amount of electricity that is produced. Although the turbine is rated to operate at higher outputs, the higher settings cause the system to fault and restart causing excessive wear on the turbine and reducing overall operational time. The higher turbine output results in faster turbine rotation that creates a higher pitched and louder noise. When the turbine was intermittently operated at the higher rate, BP expressed concern over possible neighbor complaints. The system currently operates at just over one-half of its electrical generating capability.

The system requires a significant amount of expertise to operate, and compensation for the electrical generation does not cover expenses. The system components are reaching the maximum life expectancy and individual components may need to be replaced periodically. Repair and replacement of the gas compressor has occurred over the past several years. The micro-turbine generator requires minimal maintenance, but eventually the turbine may reach a point where replacement would be required.

Mitigation was achieved at PR by successfully gathering and venting methane, which resulted in rehabilitation of vegetation in the collection area. A significant rebound of vegetation has been observed in areas that were previously affected by methane seepage. Ultimately, methane concentrations decreased to such a low concentration that paying for electricity to operate a blower was deemed not valuable and the system was converted to a passive venting system. The passive venting system appears to be effectively venting excess methane that periodically accumulates in the system piping.

4.1 LESSONS LEARNED

The original design of the SFTC and PR systems proved to be successful and LTE has learned how to maintain consistent operation of the systems. Some lessons learned include:

- Controlling the amount of water entering the system, which has occasionally resulted in accumulation of water deposits within piping and water saturation of filters. This involved installing multiple fail safes to remove water and keep it from entering the turbine or compressor;

- Limiting H_2S entering the system is necessary. Deposits and corrosion within piping associated with the air compressor have been observed. Although the H_2S concentrations observed are within the specified tolerance of the turbine equipment, limiting H_2S recovery has resulted in less disruption to system operation. LTE monitors the lines that recover H_2S and shuts down recovery from these lines to limit problems associated with H_2S recovery;

- Using stainless steel components when valves have been replaced to avoid breakdown of materials;

- Ensuring flow from the collection areas can be adjusted to shut down lines with little to no flow or with excess water or H_2S;

- Winterizing the equipment and system housing;

- Fine tuning system power output to maximize run time and minimize system restarts;

- Adjusting time tables for preventative maintenance including filter element and desiccant replacement based on system operational requirements observed over time;

- Installing an automated call system that alerts O&M personnel of system shutdowns to optimize O&M visit and improve system run time;

- Installing a methane sensor that is better equipped to measure high concentrations of methane;

- Implementing more frequent maintenance for system components than the manufacturer suggests due to site-specific water recovery issues; and

- Upgrading the turbine system controls/program periodically to optimize system performance.

5.0 RECOMMENDATIONS AND FUTURE CONSIDERATIONS

The future of the 4M mitigation project should consider methods of increasing system capacity, evaluation of variables that impact methane seepage, and incorporation of methane seep data collected as part of the overall 4M Project since installation of the systems. Additionally, COGCC can consider broader uses for the technology.

5.1 IMPROVE OPERATION AND INCREASE SYSTEM CAPACITY

At SFTC, LTE believes the following steps may improve the current system to produce higher electrical generation and increase cost effectiveness:

- Although not budgeted as a routine maintenance item or listed as a requirement by the manufacturer, periodic turbine program updates have improved system operation. LTE recommends annual program updates be considered.

- Maximizing electrical generation may involve replacement of the phase converter and/or the transformer, which convert the electricity being generated by the turbine from 460 volts of alternating current (VAC) three phase to 230 VAC single phase while the turbine is operational and also convert the grid power to 460 VAC three phase during system startup periods. The 230 VAC single phase power is compatible with the rural electrical grid in the area. Using a converter in this situation had never been accomplished prior to installation of the SFTC system and the converter manufacturer has made improvements to the product and the solid state programming over the past few years. A newer model of the converter is now reportedly in use at another location in conjunction with a Capstone micro-turbine and improved success has been observed;

- Repair gathering lines at creek where ground settling has separated or cracked lines;

- Rework plastic sheeting connections adjacent to creek to better capture methane between the zones;

- Replace piping and other steel components that have been damaged from H_2S exposure and install an H_2S removal system to prevent corrosion in system piping;

- Some aspects of O&M that currently require frequent visits from field staff could be automated to reduce O&M costs, the most obvious being water removal from drier tank and knockout filters;

- Upgrade the methane data logger to better track fluctuations observed;

- Update the weather station software to improve the ability to correlate weather to changes in methane flow and concentration;

- Use a forward-looking infrared (FLIR) imaging camera to identify the location of the most prominent lost seepage and measure the rate of seepage being lost through more focused flux surveys. The frequency of these surveys could be increased to better gauge the total quantity of methane seepage at the SFTC location; and

- Use the data from the methane seepage monitoring to evaluate the potential to expand the recovery system.

At PR, passive venting should continue unless methane concentrations increase for a significant time period. More frequent methane seepage surveys could be completed at this location; however, declining methane concentrations and flow indicate that an insufficient volume of methane exists to operate a system similar to SFTC.

5.2 EVALUATE ADDITIONAL VARIABLES AND INCORPORATE ADDITIONAL DATA

As compared to the other 4M project components, a significant amount of data regarding methane seepage has been collected by the mitigation systems, which can be useful for addressing other 4M Project goals. In particular, methane flow rate over two large seeps has been monitored weekly since 2009. During that time, changes are evident in flow rate and methane concentration. The next step is to investigate why the changes are observed. Changes can be compared to weather data, which also exist over most of this time period, or other potential variables.

The data collected from the 4M Project monitoring wells and outcrop seep mapping have not been evaluated as a whole since 2008. Additional modeling of new data collected since that time and understanding how that model may relate to methane captured at SFTC and PR would be useful for potential design changes at existing systems or new systems in different regions. For example, correlating spikes in methane concentrations with water levels in nearby COGCC monitoring wells may provide some information regarding control of groundwater levels on seepage behavior. Additionally, the COGCC could consider methods of calculating total emissions to estimate greenhouse gas reduction achieved and more formal assessments of vegetation growth at SFTC and PR. This seems pertinent in a time when the media and public are focusing on a recent study identifying a methane plume over the San Juan Basin through National Aeronautics and Space Administration (NASA) satellites. Natural methane seepage from the Outcrop was not considered as a possible source.

A potential method for analyzing these data may be to involve researchers and students at Fort Lewis College. Any of these suggestions would seem to be a meaningful student research project that could decrease cost to COGCC and BP while benefiting the local community.

Because methane seepage appears to be highly variable, future mitigation systems will require more flexibility and/or mobility to be effective in the long term or at different locations. The SFTC and PR systems can be used to apply results of these findings and possibly improve mitigation and electrical generation.

5.3 LONG-TERM VISION

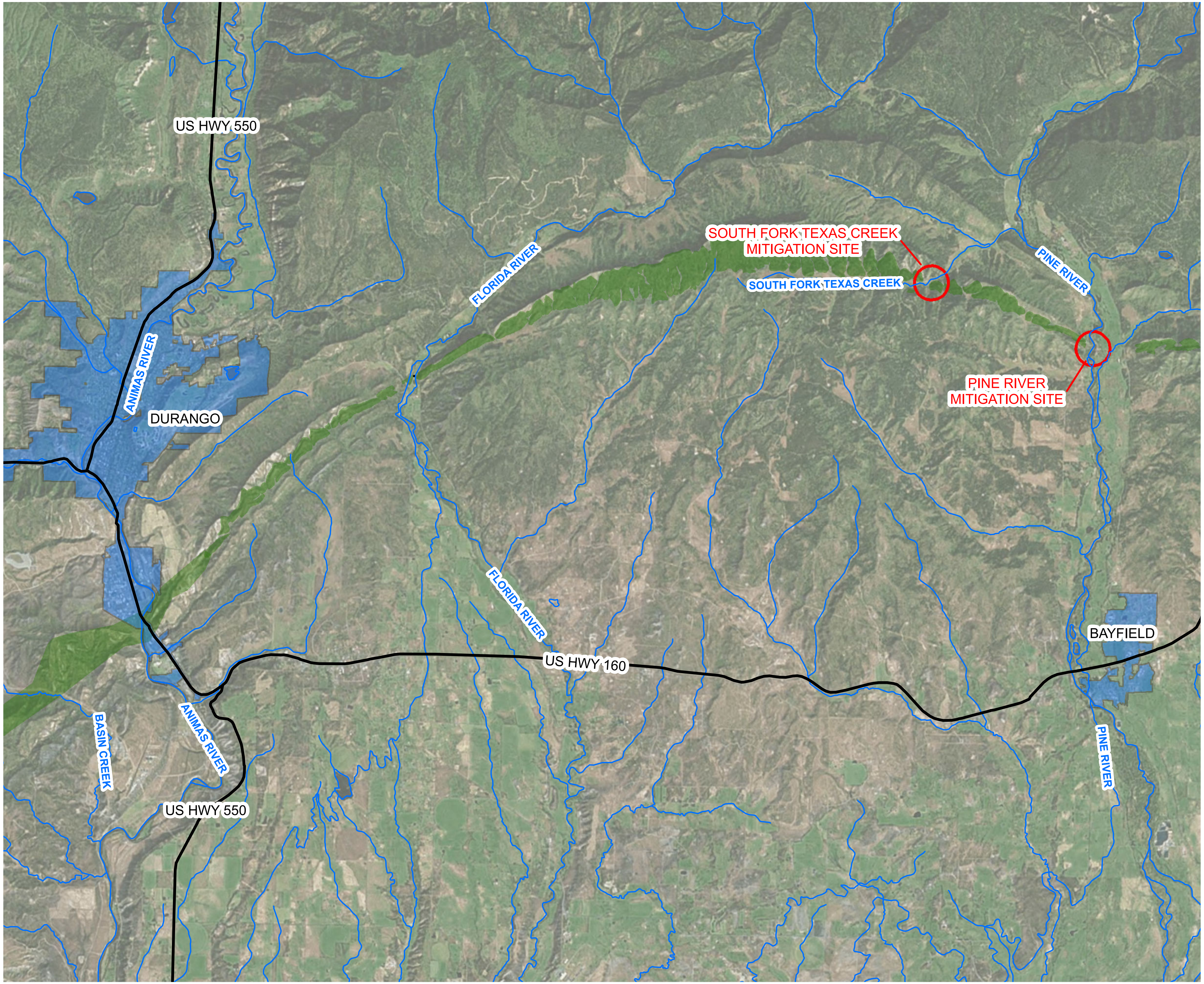
Possible longer term uses of the mitigation systems and expanding the technology used to operate them should be considered. COGCC would need to determine the recipient of the profits from electricity returned to the grid. It is currently unknown if the surface owner, mineral owner, or operator should receive the profits. The profits could be donated to struggling households in the area. This decision should be made by state legal personnel.

COGCC could investigate a more efficient system using lessons learned from installation and operation of the existing systems as well as methane seep behavior. The goal would be to construct a more cost-effective and long-term system that can mitigate methane according to site-specific conditions and generate enough electricity to pay for itself over the long term. One option might include wells designed to intercept the methane exiting the formation rather than capturing the methane distributed over a larger area after transport through the alluvium. This might result in a more concentrated methane source that could viably operate a larger scale generator. Close coordination with the rural electric provider will be required if system expansion exceeding 25 kW is considered.

COGCC could consider multiple collection systems that are mitigated by rotating mobile units. The collection systems can be monitored for flow and methane concentration and once parameters are optimal, mobile units are moved in to mitigate until conditions change.

Finally, it is possible to convert the SFTC system to a compressed natural gas (CNG) fueling station. A pilot test to determine the viability of such an option would be required. Because CNG fueling stations are limited in southwest Colorado, mitigating natural seepage and using the source for an alternative beneficial use would be constructive and may attract grant financing.

FIGURES



LEGEND

- RIVER
- SITE LOCATION
- CITY LIMIT

GEOLOGY

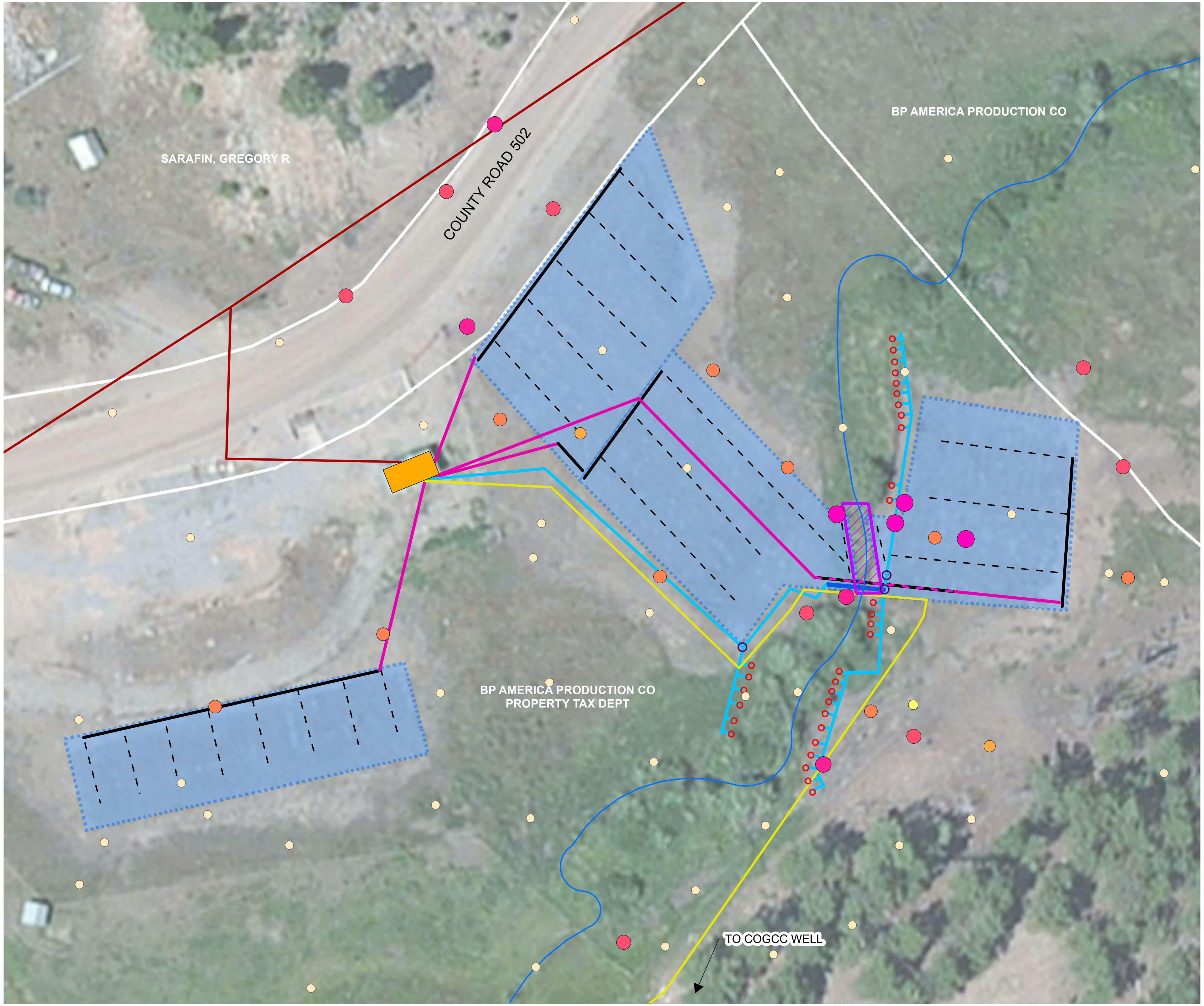
- FRUITLAND FORMATION (Kf)
  COLORADO GEOLOGICAL SURVEY

0 1.5 3
Miles

N

FIGURE 1
GENERAL SITE LOCATIONS
PINE RIVER AND SOUTH FORK TEXAS CREEK
4M OUTCROP MITIGATION
DURANGO, COLORADO

Path: P:\COGCC\4M Outcrop Mitigation\GIS\MXD\SITELOCATIONMAP_PINERIVER_AND_SFTC_2014.mxd



LEGEND

- DIAGONAL COLLECTION WELL
- VAULT FOR CONTROL VALVE
- POWER LINE
- SOUTH FORK TEXAS CREEK
- 20 MIL IMPERVIOUS MEMBRANE
- EXTENDED METHANE COLLECTION (20 MIL BARRIER)
- PROCESS EQUIPMENT FOOTPRINT
- PARCEL BOUNDARY & OWNER (WHITE)

2014 METHANE FLUX MEASUREMENT (mol/m ^{2} • day)

- 0.0000 - 0.1999
- 0.2000 - 0.5000
- 0.5001 - 1.0000
- 1.0001 - 10.0000
- 10.0001 - 50.0000
- 50.0001 - 100.0000
- 100.0001 - 5,000.0000

PIPING

- 2" SCH 40 PVC
- 2" SCH 80 PVC
- 3" SCH 40 PVC
- 3" SCH 80 PVC
- 4" ADS CORRUGATED PIPING (SLOTTED)
- 4" ADS CORRUGATED PIPING (SOLID)
- 1" HDPE

0 50 100
Feet

N

FIGURE 2
MITIGATION SYSTEM LAYOUT
SOUTH FORK TEXAS CREEK
4M OUTCROP MITIGATION PROJECT
DURANGO, COLORADO

COLORADO OIL AND GAS CONSERVATION COMMISSION

P:\COGCC\GIS\MXD\005211003_4M OUTCROP MITIGATION\005211003_FIG02_SFTC_2014.mxd

LEGEND

- VISIBLE METHANE SEEPS IN SURFACE WATER (2008)
- GAS MONITORING PROBES
- POWER POLE
- PROCESS EQUIPMENT FOOTPRINT
- PARCEL BOUNDARY & OWNER (WHITE)
- POWER LINE

2014 METHANE FLUX MEASUREMENT (mol/m^2 • day)

- 0.0000 - 0.1999
- 0.2000 - 0.5000
- 0.5001 - 1.0000
- 1.0001 - 10.0000
- 10.0001 - 50.0000
- 50.0001 - 100.0000
- 100.0001 - 5,000.0000

PIPING

- 3" SCH 40 PVC
- 4" ADS CORRUGATED PIPING (SLOTTED) WITH 15 MIL IMPERVIOUS LINER
- 4" ADS CORRUGATED PIPING (SOLID)

0 60 120
Feet

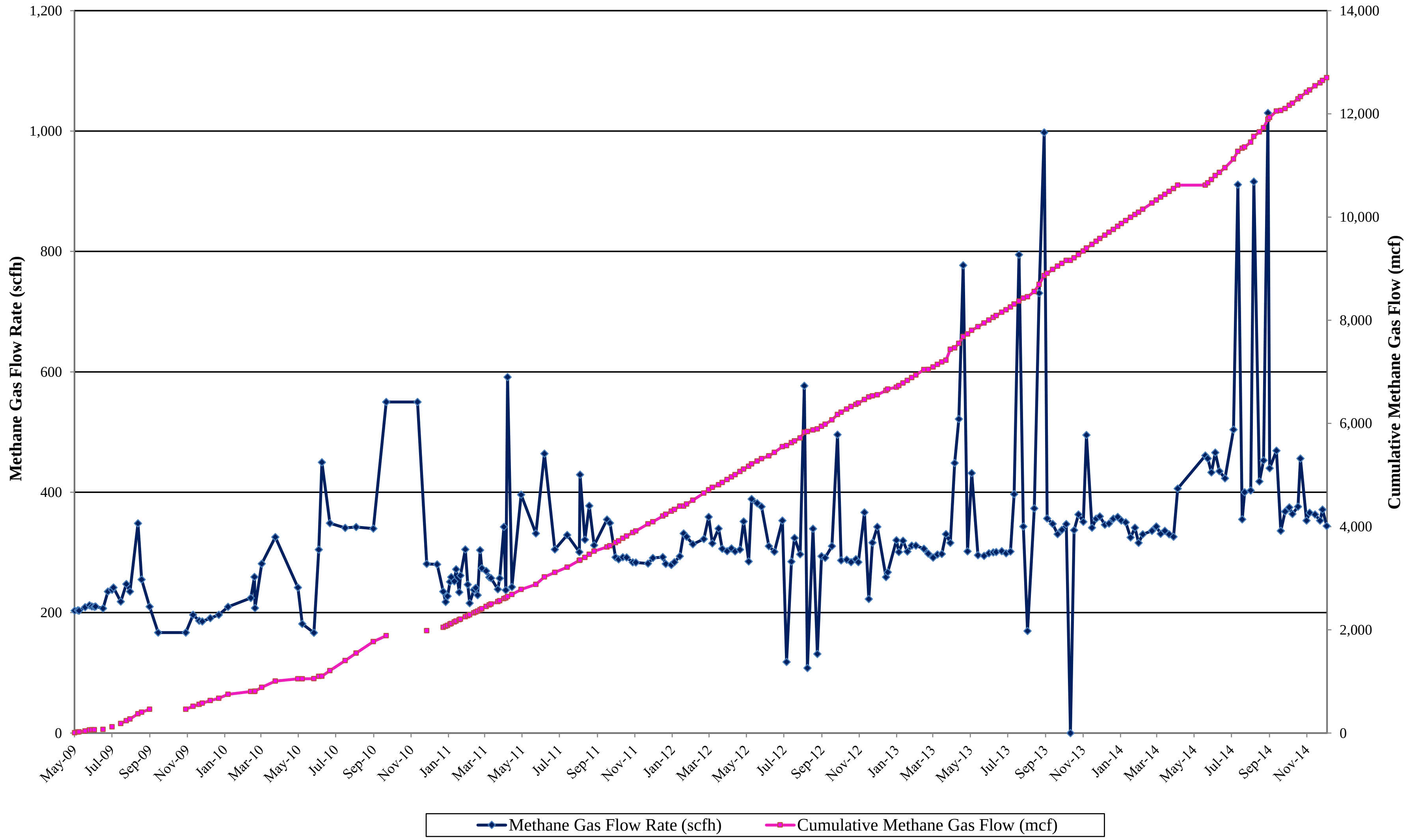
N

FIGURE 3
MITIGATION SYSTEM LAYOUT
PINE RIVER
4M OUTCROP MITIGATION PROJECT
DURANGO, COLORADO

COLORADO OIL AND GAS CONSERVATION COMMISSION

P:\COGCC\GIS\MXD\005211003_4M OUTCROP MITIGATION\005211003_FIG03_PINE_RIVER_2014.mxd

FIGURE 4
SOUTH FORK TEXAS CREEK METHANE GAS FLOW
4M OUTCROP MITIGATION PROJECT
COLORADO OIL AND GAS CONSERVATION COMMISSION



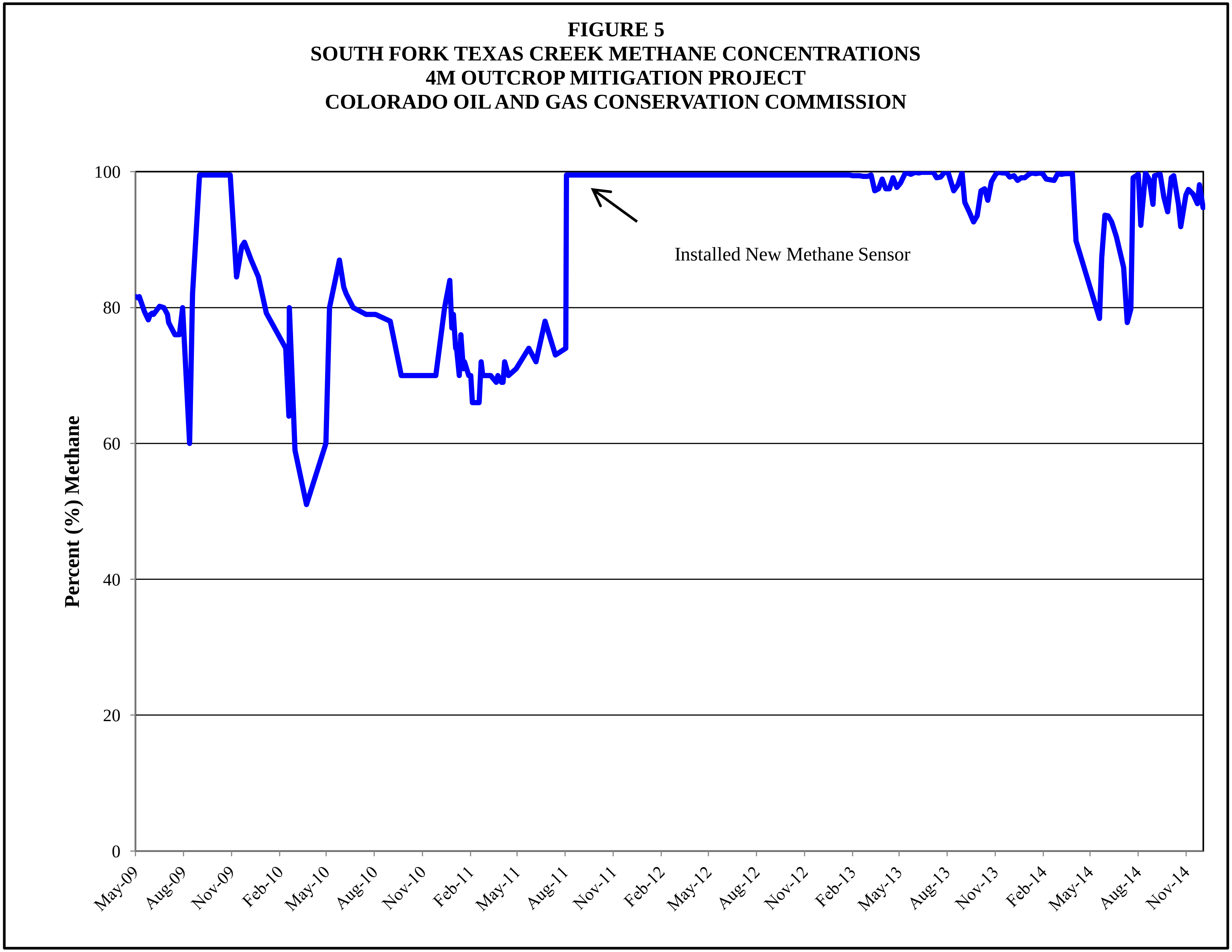


FIGURE 5
SOUTH FORK TEXAS CREEK METHANE CONCENTRATIONS
4M OUTCROP MITIGATION PROJECT
COLORADO OIL AND GAS CONSERVATION COMMISSION
Percent (%) Methane
100
80
60
40
20
0
Installed New Methane Sensor
May-09
Aug-09
Nov-09
Feb-10
May-10
Aug-10
Nov-10
Feb-11
May-11
Aug-11
Nov-11
Feb-12
May-12
Aug-12
Nov-12
Feb-13
May-13
Aug-13
Nov-13
Feb-14
May-14
Aug-14
Nov-14

FIGURE 6
SOUTH FORK TEXAS CREEK
SURPLUS ELECTRICITY GENERATED
4M OUTCROP MITIGATION PROJECT
COLORADO OIL AND GAS CONSERVATION COMMISSION

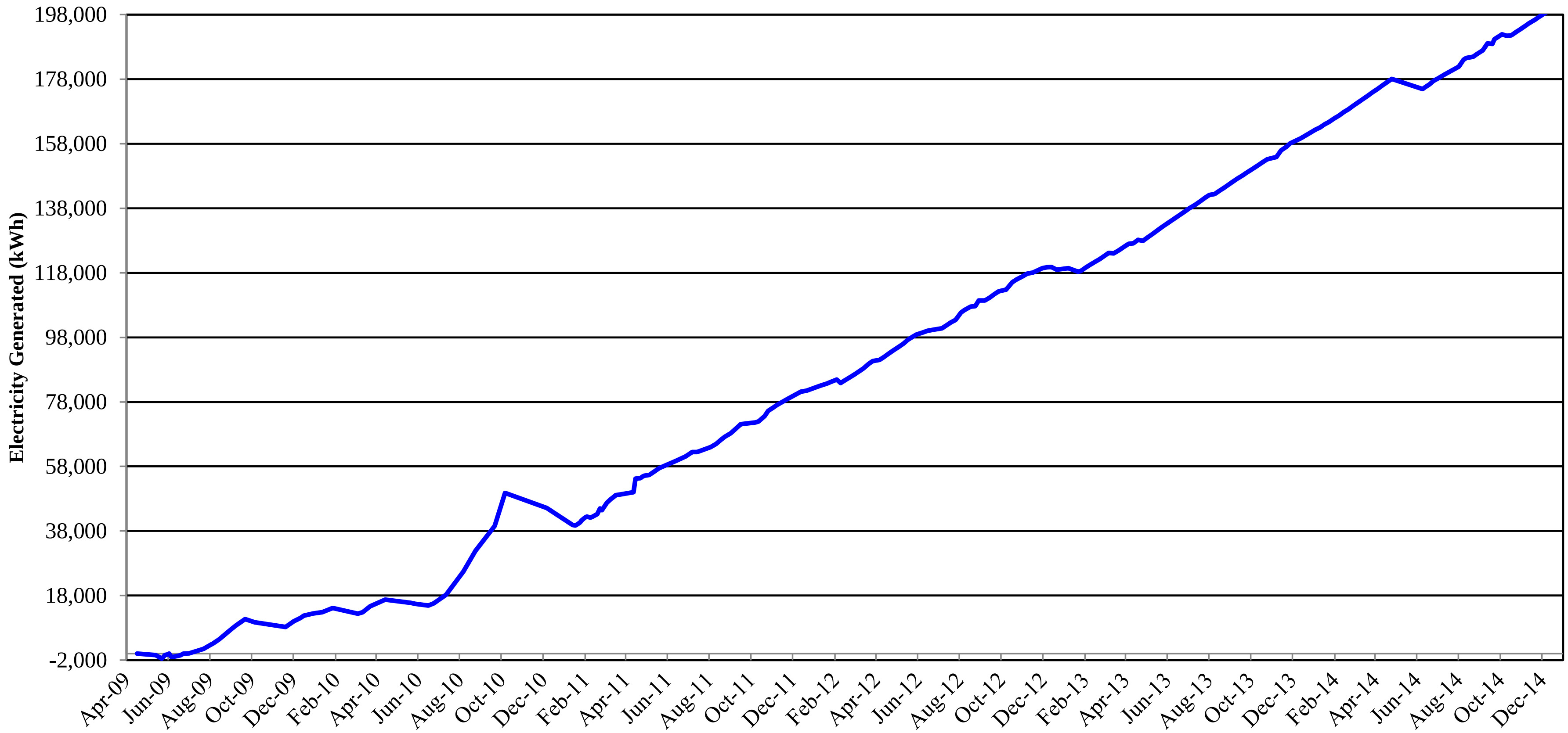
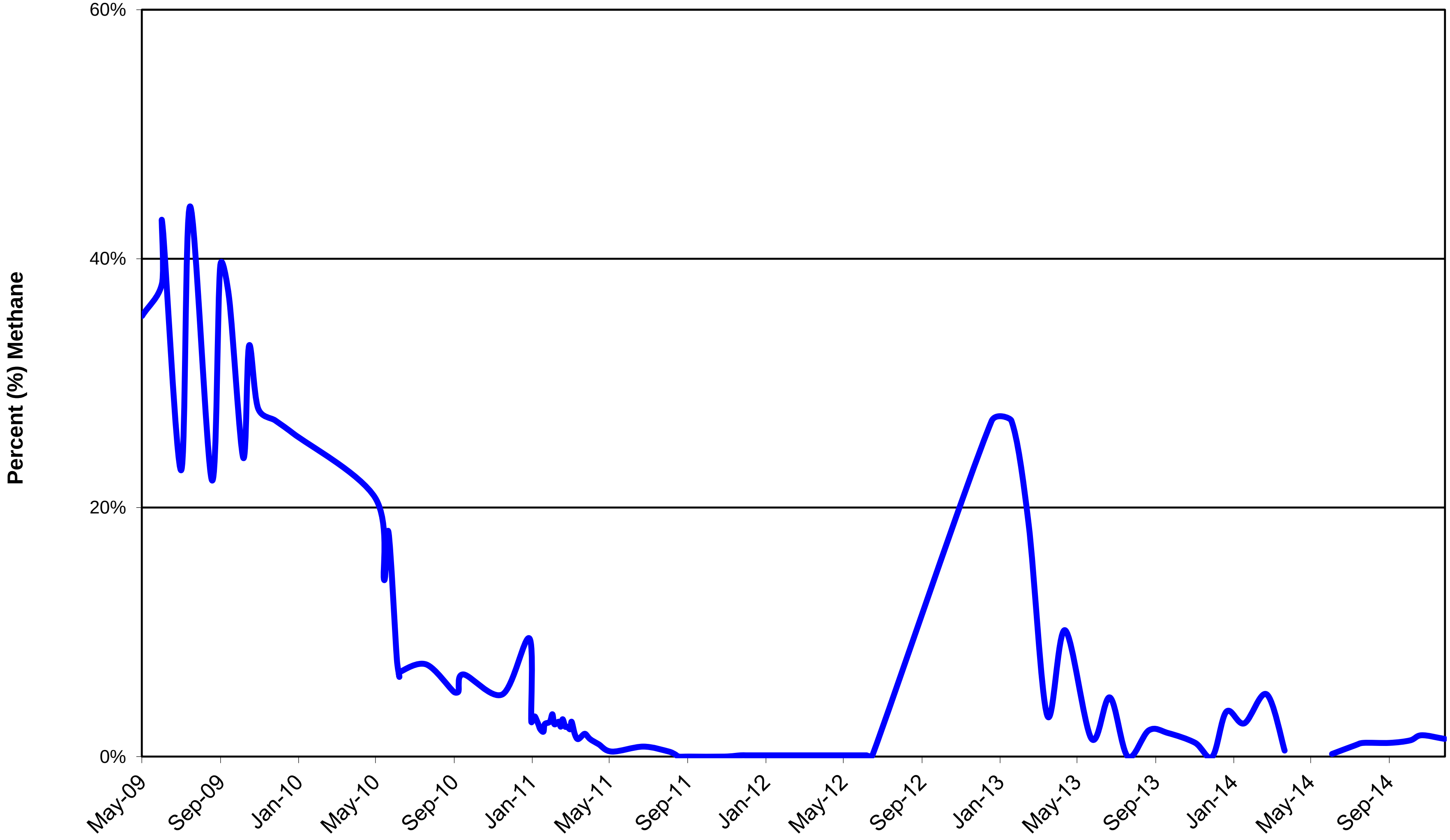


FIGURE 7
PINE RIVER METHANE CONCENTRATIONS
4M OUTCROP MITIGATION PROJECT
COLORADO OIL AND GAS CONSERVATION COMMISSION



LEGEND

- SOUTH FORK TEXAS CREEK
- 20 MIL IMPERVIOUS MEMBRANE
- EXTENDED METHANE COLLECTION (20 MIL BARRIER)
- PROCESS EQUIPMENT FOOTPRINT
- STRESSED VEGETATION (2014)
- STRESSED VEGETATION (PRIOR TO SYSTEM STARTUP)
- PARCEL BOUNDARY & OWNER (WHITE)

0 50 100
Feet

N

FIGURE 8
STRESSED VEGETATION
SOUTH FORK TEXAS CREEK
4M OUTCROP MITIGATION PROJECT
DURANGO, COLORADO

COLORADO OIL AND GAS CONSERVATION COMMISSION

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FIGURE 9
STRESSED VEGETATION
PINE RIVER
4M OUTCROP MITIGATION PROJECT
DURANGO, COLORADO

COLORADO OIL AND GAS CONSERVATION COMMISSION

P:\COGCC\GIS\MXD\005211003_4M OUTCROP MITIGATION\005211003_FIG09_PINE_RIVER_2014.mxd

TABLES

TABLE 1

OPERATIONS AND MAINTENANCE DATA
SOUTH FORK TEXAS CREEK
4M OUTCROP MITIGATION PROJECT
BP AMERICA PRODUCTION COMPANY & COLORADO OIL AND GAS CONSERVATION COMMISSION

Date	System Status Upon Arrival	Electric Meter (kW)	Turbine (hours)	Turbine Demand (kW)	From Chart, Btu/hr needed	Compressor (hours)	Methane (%)	Oxygen (% or ppm)	Calculated Methane Flow (scfh)	Cumulative Calculated Methane Recovered (mcf)
5/22/2009	OFF	51,540	34	10	166,000	--	81.6	130	203	7
5/27/2009	OFF	50,355	90	10	166,000	--	81.4	33	204	18
5/29/2009	OFF	50,368	113	10	166,000	--	81.6	15.2	203	23
6/8/2009	OFF	50,967	192	10	166,000	--	79.4	14.9	209	40
6/15/2009	OFF	50,683	286	10	166,000	289	78.2	83	212	59
6/19/2009	OFF	50,510	305	10	166,000	308	79.0	19.8	210	63
6/23/2009	OFF	50,004	310	10	166,000	402	79.2	0.16	210	65
6/25/2009	OFF	--	318	10	166,000	411	79.0	--	--	--
7/7/2009	OFF	50,983	338	10	166,000	431	80.2	51.2	207	69
7/15/2009	ON	--	523	10 to 12	188,000	620	--	--	--	--
7/22/2009	OFF	50,519	558	12	188,000	659	79.0	48	238	121
7/24/2009	OFF	50,365	600	12	188,000	700	--	--	--	--
8/5/2009	ON	46,840	891	10	166,000	993	76.0	5.25	218	185
8/14/2009	ON	45,536	1,106	12	188,000	1,208	76.0	3.25	247	238
8/20/2009	ON	44,501	1,251	12	188,000	1,353	80.0	4.25	235	272
9/2/2009	OFF	42,246	1,538	14	209,000	1,602	60.0	0.39	348	372
9/8/2009	ON	41,236	1,666	14	209,000	1,779	82.0	0.1	255	404
9/21/2009	ON	39,298	1,934	14 to 16	209,000	2,101	99.5	0.1	210	461
10/5/2009	OFF FOR REPAIRS	40,322	2,009	OFF	166,000	2,332	--	2.75	--	--
11/19/2009	ON	41,776	1	12	166,000	--	99.5	93 ppm	167	461
12/1/2009	ON	39,960	286	12	166,000	2,623	84.5	1.9 ppm	196	517
12/11/2009	OFF	38,941	495	12	166,000	2,866	89.0	2.0 ppm	187	556
12/16/2009	ON	38,235	615	12	166,000	2,986	89.6	1.8 ppm	185	578
12/29/2009	OFF	37,548	876	12	166,000	3,321	87.0	3.0 ppm	191	628
1/12/2010	OFF	37,127	1,109	12	166,000	3,632	84.5	3.25 ppm	196	674
1/27/2010	ON	35,875	1,469	12	166,000	3,993	79.2	0.1	210	749
3/5/2010	OFF	37,586	1,722	12	166,000	4,246	74.0	0.16	224	806
3/11/2010	OFF	37,217	1,723	12	166,000	4,247	64.0	130 ppm	259	806
3/12/2010	ON	37,172	1,747	12	166,000	4,271	80.0	23.2 ppm	208	811
3/23/2010	ON	35,364	2,009	12	166,000	4,533	59.0	0.1	281	885
4/14/2010	--	33,275	2,379	12	166,000	4,900	51.0	52 ppm	325	1,005
5/21/2010	OFF	34,290	2,573	8	145,000	5,099	60.0	--	242	1,052
5/28/2010	OFF	34,589	2,573	8	145,000	5,099	80.0	--	181	1,052
6/16/2010	ON	35,119	2,574	8	145,000	5,101	87.0	0.1	167	1,052
6/24/2010	OFF *	34,436	2,720	18	253,000	5,249	83.0	0.1	305	1,097
6/29/2010	ON	34,412	2,733	20	274,000	5,262	82.0	0.1	450	1,102
7/12/2010	ON	31,780	3,035	20	274,000	5,576	80.0	0.1	349	1,208
8/6/2010	ON	24,587	3,613	19.2	265,000	6,171	79.0	0.1	341	1,405

TABLE 1

OPERATIONS AND MAINTENANCE DATA
SOUTH FORK TEXAS CREEK
4M OUTCROP MITIGATION PROJECT
BP AMERICA PRODUCTION COMPANY & COLORADO OIL AND GAS CONSERVATION COMMISSION

Date	System Status Upon Arrival	Electric Meter (kW)	Turbine (hours)	Turbine Demand (kW)	From Chart, Btu/hr needed	Compressor (hours)	Methane (%)	Oxygen (% or ppm)	Calculated Methane Flow (scfh)	Cumulative Calculated Methane Recovered (mcf)
8/24/2010	ON	18,172	4,035	19	265,000	6,605	79.0	0.1	342	1,549
9/21/2010	ON	10,437	4,690	18.1	253,000	7,279	78.0	0.1	340	1,771
10/1/2010	ON	8,260	4,900	18.0	253,000	8,154	70.0	0.1	1251	2,034
12/2/2010	--	3,290	--	--	--	--	--	--	--	--
12/17/2010	OFF	4,901	5,246	12.0	166,000	8,364	70.0	0.1	281	2,131
1/3/2011	--	7,820	--	--	--	--	--	--	--	--
1/13/2011	OFF	10,209	5,592	8.0	145,000	8,574	84.0	0.1	235	2,197
1/17/2011	ON	10,102	5,684	8.0	145,000	8,668	77.0	0.1	218	2,217
1/20/2011	ON	9,869	5,758	9.9	166,000	8,741	79.0	0.1	227	2,234
1/24/2011	ON	9,269	5,854	13.0	199,000	8,838	74.0	0.1	251	2,258
1/26/2011	ON	8,856	5,898	14.9	220,000	8,884	74.0	0.1	259	2,269
1/31/2011	ON	7,872	6,013	14.5	209,000	9,000	70.0	0.1	252	2,298
2/3/2011	OFF	7,549	6,075	12.9	199,000	9,079	76.0	0.1	272	2,315
2/8/2011	ON	6,846	6,191	12.9	199,000	9,194	71.0	0.1	234	2,342
2/10/2011	OFF	6,694	6,240	13.9	209,000	9,247	72.0	0.1	262	2,355
2/18/2011	OFF	5,712	6,386	13.9	209,000	9,412	70.0	0.1	305	2,400
2/22/2011	ON	5,157	6,476	14.0	209,000	9,506	70.0	0.1	247	2,422
2/25/2011	ON	4,581	6,550	13.0	199,000	9,580	66.0	0.1	216	2,438
3/4/2011	ON	3,243	6,707	13.0	199,000	9,747	66.0	0.1	238	2,475
3/7/2011	ON	--	6,776	13.0	199,000	9,817	66.0	0.1	241	2,492
3/10/2011	ON	2,138	6,846	12.3	188,000	9,888	66.0	0.1	229	2,508
3/14/2011	ON	1,397	6,941	13.0	199,000	9,984	72.0	0.1	304	2,537
3/17/2011	ON	873	7,008	12.9	199,000	10,051	70.0	0.1	274	2,555
3/24/2011	ON	99,288	7,170	12.9	199,000	10,218	70.0	0.1	269	2,599
3/29/2011	ON	98,294	7,288	12.9	199,000	10,338	70.0	0.1	259	2,629
4/1/2011	ON	97,517	7,362	9.9	166,000	10,414	70.0	0.1	257	2,648
4/12/2011	ON	96,305	7,553	10.9	177,000	10,674	69.0	0.1	239	2,694
4/15/2011	ON	95,767	7,626	10.9	177,000	10,747	70.0	0.1	257	2,713
4/22/2011	ON	95,629	7,740	8.0	145,000	10,915	69.0	0.1	343	2,752
4/25/2011	ON	95,164	7,797	8.0	145,000	11,012	69.0	0.1	237	2,765
4/28/2011	ON	94,834	7,844	10.9	177,000	11,058	72.0	0.1	591	2,793
5/5/2011	ON	94,642	8,009	11.0	177,000	11,224	70.0	0.1	243	2,833
5/20/2011	ON	92,515	8,251	10.9	177,000	11,577	71.0	0.1	396	2,929
6/13/2011	ON	90,313	8,551	20.0	209,000	11,889	74.0	0.1	332	3,028
6/27/2011	ON	88,943	8,864	11.9	188,000	12,459	72.0	0.1	464	3,174
7/14/2011	ON	87502	9,148	13.0	199,000	12,866	78.0	0.1	305	3,260
8/3/2011	ON	86014	9,459	12.9	199,000	13,347	73.0	0.1	329	3,362
8/23/2011	ON	82,879	9,892	13.0	199,000	13,824	74.0	0.1	301	3,493
8/24/2011	ON	82753	9,908	12.9	199,000	13,831	99.5	0.1	429	3,500

TABLE 1

OPERATIONS AND MAINTENANCE DATA
SOUTH FORK TEXAS CREEK
4M OUTCROP MITIGATION PROJECT
BP AMERICA PRODUCTION COMPANY & COLORADO OIL AND GAS CONSERVATION COMMISSION

Date	System Status Upon Arrival	Electric Meter (kW)	Turbine (hours)	Turbine Demand (kW)	From Chart, Btu/hr needed	Compressor (hours)	Methane (%)	Oxygen (% or ppm)	Calculated Methane Flow (scfh)	Cumulative Calculated Methane Recovered (mcf)
9/1/2011	OFF	81745	10,062	13.0	199,000	14,036	99.5	0.1	321	3,549
9/8/2011	ON	80440	10,228	13.0	199,000	14,204	99.5	0.1	378	3,612
9/16/2011	ON	78926	10,419	13.0	199,000	14,396	99.5	0.1	312	3,671
10/7/2011	OFF	78343	10,646	13.0	199,000	14,893	99.5	0.1	355	3,752
10/12/2011	OFF	78065	10,713	10.0	166,000	15,012	99.5	0.1	349	3,775
10/21/2011	ON	77901	10,927	10.0	166,000	15,227	99.5	0.1	292	3,838
10/26/2011	ON	76,338	11,045	20.0	274,000	15,346	99.5	0.1	288	3,872
11/2/2011	ON	75,330	11,215	11.0	177,000	15,517	99.5	0.1	292	3,921
11/8/2011	ON	74,515	11,359	11.0	177,000	15,660	99.5	0.1	292	3,963
11/18/2011	ON	73,275	11,598	11.0	177,000	15,899	99.5	0.1	284	4,031
11/23/2011	ON	72,623	11,715	11.0	177,000	16,016	99.5	0.1	283	4,064
12/13/2011	ON	70,334	12,198	11.0	177,000	16,499	99.5	0.1	282	4,200
12/21/2011	OFF	70,062	12,338	11.0	177,000	16,691	99.5	0.1	291	4,241
1/6/2012	ON	68,872	12,721	11.0	177,000	17,075	99.5	0.1	292	4,353
1/11/2012	ON	68,481	12,840	11.0	177,000	17,193	99.5	0.1	281	4,386
1/20/2012	ON	67,814	13,057	11.0	177,000	17,410	99.5	0.1	279	4,447
1/25/2012	ON	67,382	13,179	11.0	177,000	17,532	99.5	0.1	284	4,482
2/3/2012	ON	66,646	13,391	11.0	177,000	17,744	99.5	0.1	294	4,544
2/9/2012	OFF	67,672	13,394	11.0	177,000	17,749	99.5	0.1	332	4,545
2/14/2012	ON	66,993	13,513	11.0	177,000	17,868	99.5	0.1	326	4,584
2/24/2012	ON	65,738	13,751	11.0	177,000	18,106	99.5	0.1	314	4,658
3/13/2012	ON	63,190	14,178	12.0	166,000	18,537	99.5	0.1	322	4,796
3/21/2012	ON	61,775	14,364	20.0	274,000	18,729	99.5	0.1	359	4,863
3/27/2012	ON	60,912	14,509	12.0	166,000	18,874	99.5	0.1	315	4,908
4/6/2012	OFF	60,519	14,657	11.0	177,000	19,111	99.5	0.1	340	4,959
4/12/2012	ON	59,661	14,800	11.0	177,000	19,254	99.5	0.1	306	5,002
4/20/2012	ON	58,486	14,993	11.0	177,000	19,447	99.5	0.1	302	5,061
4/27/2012	ON	57,475	15,161	11.0	177,000	19,615	99.5	0.1	307	5,112
5/3/2012	ON	56,611	15,306	11.0	177,000	19,760	99.5	0.1	302	5,156
5/11/2012	ON	55,460	15,499	11.0	177,000	19,953	99.5	0.1	305	5,215
5/17/2012	ON	54,358	15,634	11.0	177,000	20,094	99.5	0.1	352	5,262
5/25/2012	ON	53,228	15,826	11.0	177,000	20,287	99.5	0.1	285	5,317
5/30/2012	ON	52,627	15,945	11.0	177,000	20,405	99.5	0.1	389	5,363
6/8/2012	OFF	52,020	16,087	11.0	177,000	20,620	99.5	0.1	382	5,417
6/15/2012	OFF	51,512	16,210	11.0	177,000	20,789	99.5	0.1	376	5,464
6/27/2012	ON	51,039	16,392	10.0	166,000	21,070	99.5	0.1	311	5,520
7/6/2012	ON	50,712	16,611	11.0	177,000	21,289	99.5	0.1	301	5,586
7/19/2012	ON	48,930	16,923	11.0	177,000	21,601	99.5	0.1	453	5,727
7/26/2012	ON	48,136	17,092	11.0	177,000	21,770	99.5	0.1	18	5,730

TABLE 1

OPERATIONS AND MAINTENANCE DATA
SOUTH FORK TEXAS CREEK
4M OUTCROP MITIGATION PROJECT
BP AMERICA PRODUCTION COMPANY & COLORADO OIL AND GAS CONSERVATION COMMISSION

Date	System Status Upon Arrival	Electric Meter (kW)	Turbine (hours)	Turbine Demand (kW)	From Chart, Btu/hr needed	Compressor (hours)	Methane (%)	Oxygen (% or ppm)	Calculated Methane Flow (scfh)	Cumulative Calculated Methane Recovered (mcf)
8/3/2012	ON	45,832	17,293	11.0	177,000	21,961	99.5	0.1	285	5,788
8/8/2012	ON	45,132	17,402	11.0	177,000	22,080	99.5	0.1	324	5,823
8/17/2012	ON	44,033	17,592	11.0	177,000	22,270	99.5	0.1	297	5,879
8/24/2012	ON	43,879	17,785	11.0	177,000	22,463	99.5	0.1	577	5,991
8/29/2012	ON	42,152	17,928	11.0	177,000	22,606	99.5	0.1	108	6,006
9/7/2012	OFF	42,124	18,011	11.0	177,000	22,800	99.5	0.1	339	6,034
9/14/2012	ON	41,166	18,174	11.0	177,000	22,963	99.5	0.1	131	6,056
9/21/2012	ON	40,158	18,343	11.0	177,000	23,133	99.5	0.1	294	6,105
9/27/2012	ON	39,307	18,489	11.0	177,000	23,279	99.5	0.1	291	6,148
10/8/2012	ON	38,739	18,753	11.0	177,000	23,543	99.5	0.1	311	6,230
10/17/2012	ON	36,454	18,968	11.0	177,000	23,758	99.5	0.1	496	6,336
10/23/2012	ON	35,608	19,112	11.0	177,000	23,902	99.5	0.1	287	6,378
11/1/2012	ON	34,651	19,328	11.0	177,000	24,118	99.5	0.1	288	6,440
11/8/2012	ON	33,827	19,499	11.0	177,000	24,289	99.5	0.1	284	6,488
11/16/2012	OFF	33,502	19,644	11.0	177,000	24,481	99.5	0.1	289	6,530
11/20/2012	ON	33,142	19,739	11.0	177,000	24,576	99.5	0.1	284	6,557
11/30/2012	OFF	32,139	19,925	11.0	177,000	24,814	99.5	0.1	366	6,625
12/7/2012	ON	31,826	20,143	11.0	177,000	24,982	99.5	0.1	223	6,674
12/13/2012	OFF	31,763	20,216	11.0	177,000	25,126	99.5	0.1	316	6,697
12/21/2012	OFF	32,550	20,268	9.0	155,500	25,318	99.5	0.1	343	6,715
1/4/2013	ON	32,154	20,600	9.0	155,500	25,651	99.5	0.1	259	6,801
1/7/2013	ON	32,084	20,695	10.0	166,000	25,746	99.5	0.1	267	6,826
1/21/2013	OFF	33,216	20,814	11.0	177,000	25,993	99.5	0.1	320	6,864
1/25/2013	ON	33,024	20,911	11.0	177,000	26,089	99.5	0.1	301	6,894
2/1/2013	ON	31,930	21,073	11.5	177,000	26,255	99.5	0.1	319	6,945
2/8/2013	ON	31,044	21,241	11.5	177,000	26,423	99.5	0.1	301	6,996
2/15/2013	ON	30,155	21,411	12.0	188,000	26,593	99.5	0.1	311	7,049
2/22/2013	ON	29,261	21,577	12.0	188,000	26,759	99.4	0.1	311	7,101
3/7/2013	ON	27,392	21,914	12.0	188,000	27,096	99.4	0.1	306	7,204
3/14/2013	ON	27,502	21,923	11.0	177,000	27,105	99.3	0.1	298	7,206
3/22/2013	OFF	26,548	22,089	11.0	177,000	27,271	99.3	0.1	291	7,255
3/29/2013	ON	25,567	22,257	11.0	177,000	27,439	99.5	0.3	297	7,305
4/5/2013	ON	24,541	22,423	11.0	177,000	27,605	97.2	0.23	297	7,354
4/12/2013	OFF	24,374	22,518	11.1	177,000	27,775	97.5	0.31	330	7,385
4/19/2013	ON	23,359	22,688	11.1	177,000	27,944	98.9	0.3	316	7,439
4/26/2013	OFF	23,629	22,743	11.1	177,000	28,112	97.5	0.32	449	7,464

TABLE 1

OPERATIONS AND MAINTENANCE DATA
SOUTH FORK TEXAS CREEK
4M OUTCROP MITIGATION PROJECT
BP AMERICA PRODUCTION COMPANY & COLORADO OIL AND GAS CONSERVATION COMMISSION

Date	System Status Upon Arrival	Electric Meter (kW)	Turbine (hours)	Turbine Demand (kW)	From Chart, Btu/hr needed	Compressor (hours)	Methane (%)	Oxygen (% or ppm)	Calculated Methane Flow (scfh)	Cumulative Calculated Methane Recovered (mcf)
5/3/2013	ON	22,574	22,911	11.1	177,000	28,280	97.5	0.3	522	7,551
5/10/2013	ON	21,491	23,080	11.1	177,000	28,448	99.1	0.28	777	7,683
5/17/2013	ON	20,426	23,247	11.1	177,000	28,616	97.7	0.26	302	7,733
5/24/2013	ON	19,384	23,413	11.1	177,000	28,782	98.3	0.3	432	7,805
6/3/2013	ON	17,944	23,653	11.1	177,000	29,023	99.9	0.29	296	7,876
6/13/2013	ON	16,453	23,895	11.1	177,000	29,264	99.6	0.28	294	7,947
6/21/2013	ON	15,331	24,081	11.1	177,000	29,450	99.9	0.3	299	8,002
6/28/2013	ON	14,308	24,250	11.1	177,000	29,620	99.8	0.17	300	8,053
7/3/2013	ON	13,570	24,372	11.1	177,000	29,742	99.9	0.29	301	8,090
7/12/2013	ON	12,398	24,586	11.1	177,000	29,956	99.9	0.29	302	8,154
7/19/2013	ON	11,318	24,752	11.1	177,000	30,121	99.9	0.2	298	8,204
7/26/2013	ON	10,305	24,923	11.1	177,000	30,293	99.9	0.17	301	8,256
8/1/2013	ON	9,447	25,067	11.0	177,000	30,437	99.1	0.18	397	8,313
8/9/2013	ON	9,126	25,139	11.1	177,000	30,509	99.2	0.2	795	8,370
8/16/2013	ON	8,139	25,307	11.0	177,000	30,677	99.9	0.1	343	8,428
8/23/2013	ON	7,130	25,476	11.0	177,000	30,846	99.9	0.1	169	8,456
9/3/2013	ON	5,560	25,743	11.1	177,000	31,112	97.2	0.1	373	8,556
9/11/2013	ON	4,425	25,932	11.0	177,000	31,302	98.1	0.1	731	8,694
9/19/2013	OFF	3,304	26,104	11.0	177,000	31,474	99.9	0.1	998	8,866
9/24/2013	ON	2,666	26,227	11.0	177,000	31,597	95.5	0.1	356	8,909
10/3/2013	ON	1,414	26,442	11.0	177,000	31,812	94.0	0.1	348	8,984
10/11/2013	ON	257	26,632	11.0	177,000	32,062	92.6	0.1	330	9,047
10/18/2013	ON	99,265	26,799	10.9	177,000	32,169	93.5	0.1	338	9,103
10/25/2013	ON	98,342	26,965	11.0	177,000	32,335	97.2	0.1	347	9,161
11/1/2013	ON	97,992	27,131	10.9	177,000	32,501	97.5	0.1	0	9,161
11/7/2013	ON	97,642	27,280	10.9	177,000	32,650	95.8	0.1	337	9,211
11/14/2013	ON	95,637	27,445	11.0	177,000	32,815	98.5	0.19	363	9,271
11/22/2013	ON	94,483	27,642	11.0	177,000	33,012	99.6	0.1	351	9,340
11/27/2013	ON	93,488	27,758	20.0	209,000	33,131	99.9	0.1	495	9,398
12/6/2013	ON	92,568	27,974	11.0	177,000	33,347	99.8	0.1	341	9,471
12/13/2013	ON	91,854	28,141	11.0	177,000	33,515	99.8	0.1	356	9,531
12/19/2013	ON	91,104	28,286	11.0	177,000	33,659	99.2	0.1	360	9,583
12/27/2013	ON	90,108	28,478	11.0	177,000	33,851	99.4	0.1	346	9,649
1/3/2014	ON	89,226	28,644	11.0	177,000	34,017	98.7	0.13	348	9,707
1/10/2014	OFF	88,536	28,796	11.0	177,000	33,081	99.1	0.1	356	9,761
1/17/2014	ON	87,509	28,965	11.0	177,000	33,249	99.1	0.1	359	9,822

TABLE 1

OPERATIONS AND MAINTENANCE DATA
SOUTH FORK TEXAS CREEK
4M OUTCROP MITIGATION PROJECT
BP AMERICA PRODUCTION COMPANY & COLORADO OIL AND GAS CONSERVATION COMMISSION

Date	System Status Upon Arrival	Electric Meter (kW)	Turbine (hours)	Turbine Demand (kW)	From Chart, Btu/hr needed	Compressor (hours)	Methane (%)	Oxygen (% or ppm)	Calculated Methane Flow (scfh)	Cumulative Calculated Methane Recovered (mcf)
1/23/2014	ON	86,822	29,109	11.0	177,000	33,393	99.5	0.1	353	9,873
1/30/2014	ON	85,846	29,275	11.0	177,000	33,560	99.8	0.1	350	9,931
2/7/2014	ON	84,811	29,472	11.0	177,000	33,756	99.7	0.1	325	9,995
2/14/2014	ON	83,702	29,635	11.0	177,000	33,920	99.8	0.1	341	10,050
2/20/2014	ON	82,933	29,775	11.0	177,000	34,060	99.7	0.1	316	10,095
2/27/2014	ON	81,888	29,947	11.0	177,000	34,231	98.9	0.1	330	10,151
3/14/2014	ON	79,643	30,307	11.0	177,000	34,592	98.7	0.3	336	10,272
3/21/2014	ON	78,636	30,474	11.0	177,000	34,759	99.7	0.1	343	10,330
3/28/2014	ON	77,608	30,643	11.0	177,000	34,928	99.6	0.15	331	10,386
4/4/2014	ON	76,575	30,810	11.0	177,000	35,095	99.7	0.1	336	10,442
4/11/2014	ON	75,529	30,979	11.0	177,000	35,264	99.7	0.1	330	10,498
4/18/2014	ON	74,478	31,147	11.0	177,000	35,432	99.7	0.1	326	10,552
4/25/2014	ON	73,446	31,313	11.0	177,000	35,598	89.8	0.1	406	10,620
6/9/2014	ON	76,589	31,314	11.0	177,000	35,600	78.4	0.1	461	10,620
6/13/2014	ON	76,022	31,407	11.0	177,000	35,693	87.4	0.1	456	10,663
6/19/2014	ON	75,121	31,554	11.0	177,000	35,839	93.6	0.1	433	10,726
6/25/2014	ON	74,118	31,719	11.0	177,000	36,005	93.5	0.1	466	10,803
7/2/2014	ON	73,266	31,863	11.0	177,000	36,149	92.6	0.1	435	10,866
7/11/2014	ON	72,077	32,079	11.0	177,000	36,365	90.4	0.1	423	10,957
7/25/2014	ON	70,502	32,412	20.0	177,000	36,703	85.9	0.1	504	11,125
8/1/2014	ON	69,634	32,575	11.0	177,000	36,866	77.8	0.1	911	11,273
8/8/2014	ON	67,507	32,747	11.0	177,000	37,038	79.8	0.1	355	11,334
8/12/2014	ON	67,002	32,691	11.0	177,000	37,135	99.1	0.1	400	11,357
8/22/2014	ON	66,593	32,456	11.0	177,000	37,369	99.6	0.1	403	11,452
8/27/2014	ON	65,842	32,335	11.0	177,000	37,492	92.1	0.1	916	11,562
9/5/2014	ON	64,607	32,121	11.0	177,000	37,706	99.8	0.1	418	11,652
9/12/2014	ON	62,501	31,949	11.0	177,000	37,877	98.8	0.1	453	11,730
9/19/2014	ON	62,634	31,786	11.0	177,000	38,041	95.2	0.1	1030	11,898
9/22/2014	ON	61,192	31,709	11.0	177,000	38,118	99.4	0.1	440	11,932
10/3/2014	ON	59,625	31,447	11.0	177,000	38,379	99.6	0.1	469	12,054
10/10/2014	OFF	60,103	31,411	11.0	177,000	38,546	96.3	0.1	336	12,067
10/17/2014	ON	59,999	31,313	11.0	177,000	38,714	94.1	0.1	368	12,103
10/24/2014	ON	58,875	31,141	11.0	177,000	38,886	99.1	0.1	375	12,167
10/29/2014	ON	58,208	31,028	11.0	177,000	38,999	99.4	0.1	364	12,208
11/7/2014	ON	56,918	30,806	11.0	177,000	39,221	95.2	0.1	376	12,292
11/11/2014	ON	56,333	30,710	11.0	177,000	39,317	91.9	0.1	456	12,335

TABLE 1

OPERATIONS AND MAINTENANCE DATA
SOUTH FORK TEXAS CREEK
4M OUTCROP MITIGATION PROJECT
BP AMERICA PRODUCTION COMPANY & COLORADO OIL AND GAS CONSERVATION COMMISSION

Date	System Status Upon Arrival	Electric Meter (kW)	Turbine (hours)	Turbine Demand (kW)	From Chart, Btu/hr needed	Compressor (hours)	Methane (%)	Oxygen (% or ppm)	Calculated Methane Flow (scfh)	Cumulative Calculated Methane Recovered (mcf)
11/21/2014	ON	55,087	30,474	11.0	177,000	39,553	96.6	0.1	353	12,419
11/26/2014	ON	54,312	30,350	11.0	177,000	39,677	97.4	0.1	366	12,464
12/5/2014	ON	53,056	30,132	11.0	177,000	39,895	96.7	0.1	363	12,543
12/13/2014	ON	52,129	29,966	11.0	177,000	40,062	95.3	0.1	353	12,602
12/17/2014	ON	51,450	29,846	11.0	177,000	40,181	98.1	0.1	371	12,646
12/24/2014	ON	50,586	29,681	11.0	177,000	40,347	94.7	0.1	344	12,703
12/31/2014	ON	50,011	29,513	11.0	177,000	40,514	96.2	0.1	348	12,762

Notes:
kW - kilowatts
Btu/hr - British thermal units per hour
% - percent
mcf - 1,000 cubic feet
ppm - parts per million
scfh - standard cubic feet per hour
-- reading not collected/not applicable
* - new flow meter was installed
some kwh readings 1st qtr 2011 adjusted to correct meter readings compared to LPEA readings