

February 15, 2018

Mr. Brett Middleton  
Caerus Oil and Gas  
143 Diamond Avenue  
Parachute, CO 81635

**RE: 2017 Annual Report of Work Completed**  
EF C27 595 – Pit Closure and Remediation System  
COGCC Location ID: 335828  
NENW, Section 27, T5S-R95W (Lat = 39.589377, Long = -108.044445)  
Garfield County, Colorado

Dear Mr. Middleton:

Rule Engineering, LLC (Rule) has prepared this report to summarize monitoring and remediation activities completed in 2017 for Caerus Oil and Gas (Caerus) at the above-referenced location. This report will outline quarterly soil-vapor extraction (SVE) events conducted and in-situ soil samples collected from soil borings and bio-vent well installation activities completed in 2017.

### **Background**

Based on records acquired from the Colorado Oil & Gas Conservation Commission (COGCC) and provided by Caerus, the produced water storage pit at this location was closed in 2014. Per COGCC rules, the closure was documented in a Form 27, and a remediation number was assigned. After removal of the pit liner, soil samples were collected below-liner identifying organic, inorganic, and metal constituents of concern above COGCC allowable concentrations, indicating a possible liner failure. A subsequent site investigation with a hollow-stem auger drilling rig was completed in 2014. The investigation was conducted to determine the vertical and horizontal extent of soil impacts. Vertical bio-vent wells were also installed to augment natural attenuation, monitor subsurface conditions, and support future remediation efforts. More detailed descriptions and details of these project phases, may be found in the following COGCC documents associated with this project.

- Form 27 (Doc: 2147922) (Rem: 8255)
- Form 4 (Doc: 400818110)
- Form 19 (Doc 400772403) Spill ID 159744
- Form 19 Supplemental Spill Closure (Doc 400815164)

## 2017 Remediation and Monitoring Activities

### *SVE Remediation Events*

Rule completed one quarterly SVE event on September 13<sup>th</sup> and 14<sup>th</sup>, 2017 using Caerus' SVE pilot trailer. Outlined below please find the table outlining results from the SVE event:

<i>Well</i>	<i>Time</i>	<i>Duration (min)</i>	<i>SCFM</i>	<i>Vacuum (inch Hg)</i>	<i>PID (ppm)</i>
SBMID02A	11:50	35	125	4	18.4
SEWALLA					
EWALLA	12:35	40	135	4	24.6
SBN01					
SBNEWALLA	1:20	50	140	4	85.5
SBN02A					
SBW02	2:15	30	140	4	5.8
SBN02A					
SBS02A	2:45	30	140	3	12.6
SBW01					
SBS01A	12:35	30	140	3	6.8
SBOTB					
EWALLB	1:05	30	140	4	67.3
WWALLB					
NBOTB	1:35	30	140	4	26.7
SBN01					
SBW05	2:05	30	140	5	8.9
SBN02					

### *Remediation Progress Soil Monitoring*

Between April 20<sup>th</sup> and April 27<sup>th</sup> Rule provided oversight and sampling for drilling using a hollow-stem auger rig to advance twelve soil borings to depths between five and thirty-five feet below ground surface (bgs). Of the twelve soil borings, three were advanced to assess existing bio-vent wells with the other nine soil borings being constructed into new bio-vent wells.

### *Assessment Boring*

Bio-vent well assessment borings were located within two feet of the original bio-vent well to assess remediation of impacted soils within the pit. Based on previous sample analytical results, soil samples were collected using a 2-foot split-spoon sampler within the hydrocarbon impacted zone.

### *Bio-vent Well Construction*

Soil borings constructed into new bio-vent wells were sampled every five feet bgs to determine impacted soil depths and concentrations. Each new bio-vent well was drilled to 35 feet bgs and constructed with 25 feet of slotted poly-vinyl chloride (PVC) and completed with ten feet of solid PVC pipe to the surface.

Soil samples were selected from the borings for chemical analysis based on field screening and were placed into clean, laboratory provided containers and shipped under chain-of-custody procedures via FedEx to Environmental Science Corporation located in Mt. Juliet, Tennessee. Each soil sample was analyzed for gasoline range (GRO) and

diesel range (DRO) total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and xylene (BTEX) (see attached laboratory analytical spreadsheet and laboratory reports for soil sampling results).

## Findings

### *Assessment Boring*

A total of three assessment borings were conducted to determine progress of the current bio-vent wells. Six soil samples were collected for laboratory analysis, with three samples demonstrating exceedances for TPH and one for benzene:

Sample Location	TPH concentration mg/Kg	
	2014	2017
SBWWALL (10-12')	<b>1,300</b>	<b>585.4</b>
SBWWALL (25')	Not analyzed	296.1
SBN02 (10-12')	<b>3,600</b> 0.088 benzene	<b>628.7</b> <b>0.245 benzene</b>
SBN02 (25')	Not analyzed	244.0
SBS01 (5-7')	<b>1,200</b>	<b>1,686</b>
SBS01 (25')	Not analyzed	172.1

**Bold** indicates an exceedance to COGCC Table 910-1 soil standards.

### *Bio-vent well Construction*

A total of nine bio-vent wells were installed with 63 soil samples collected from the borings for laboratory analysis. A summary table outlining each bio-vent well location and depth of the highest TPH concentration is outlined below:

Bio-Vent Well	Impacted soil depth (ft)	TPH concentration (mg/Kg)
SBOTB	20-22	104
SBS02A	15-17	227
SBMID02A	20-22	125
SBN02A	20-22	<b>2,542</b>
EWALLB	30-32	393
EWALLA	15-17	<b>664</b>
NBOTB	10-12	<b>889</b>
SEWALLA	25-27	<b>1,741</b>
NEWALLA	25-27	151

**Bold** indicates an exceedance to COGCC soil standards for TPH.

## Conclusions

Available laboratory analytical data between 2014 and present demonstrates the current bio-vent wells in place are successfully degrading the hydrocarbon impacts in 2 of the 3 wells sampled. Caerus plans to continue to utilize the bio-vent wells for passive venting with quarterly SVE events using an SVE trailer to introduce additional airflow to the treatment area.

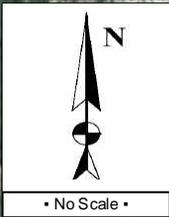
If you have any questions with the provided report, please contact me at (970) 244-8500 or at [brollins@ruleengineering.com](mailto:brollins@ruleengineering.com).

Sincerely,  
**Rule Engineering, LLC**

*Blair K. Rollins*

Blair K. Rollins  
Project Manager

cc: M. Brown  
R. Knight



SBW05  
[45-47']  
10 TPH

SBN02  
[10-12']  
628 TPH  
0.245 benzene

NBOTB  
[10-12']  
889 TPH

SBN01  
[15-17']  
230 TPH

EWALLB  
[30-32']  
393 TPH

SBW03  
[45-47']  
130 TPH

SBOTB  
[20-22']  
104 TPH

WWALLB  
[10-12']  
585 TPH

SBMID  
[10-12']  
1300 TPH

SBS01A  
[5-7']  
1686 TPH

SBN01  
[30-32']  
8,800 TPH

SBNEWALLA  
[25-27']  
151 TPH

SBN01  
(2016)  
[30-32']  
3053 TPH

SBN02A  
[20-22']  
2542 TPH

SBW02  
[45-47']  
160 TPH

SBMID01  
[25-27']  
120 TPH

EWALLA  
[15-17']  
664 TPH

SBMID02A  
[20-22']  
125 TPH

SBW01  
[45-47']  
120 TPH

SBS01  
[5-7']  
1200 TPH

SEWALLA  
[25-27']  
1741 TPH

SBS02A  
[15-17']  
227 TPH

SBMID02  
[15-17']  
196 TPH

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Imagery Date: 6/17/2016

lat: 39.539603° lon: -109.043987° elev: 0 ft

Eye alt: 599 ft

● - Sample	BLACK - 2014 Event
■ - Biovent/Sample	GREEN - 2016 Event
■ - North Pit	PURPLE - 2017 Event
■ - South Pit	



Pad: C27 Pit (Facility ID: 278619)  
 Area: North Parachute Ranch  
 Legal: NENW, Sec. 27, T5S, R95W, 6th PM