

PDC Energy, Inc.
Fourth Quarter 2016 Groundwater Monitoring Summary

January 23, 2017

Cottonwood #1 Tank Battery
NESE Section 13 T6N R66W
Weld County, API # 05-123-11801
Facility ID # 322644
Remediation # 9319

This groundwater summary has been prepared by Tasman Geosciences, Inc. for the Cottonwood #1 tank battery. On December 19, 2016, groundwater monitoring was conducted at all seven monitoring well locations at the site (BH01-BH03, BH04-R, and BH05-BH07). Seven groundwater samples were submitted to Summit Scientific Laboratories for analysis of benzene, toluene, ethylbenzene, and total xylenes (BTEX) by USEPA Method 8260B. Analytical results are summarized in Table 1 and the laboratory report is included as Attachment A. Sample locations and corresponding analytical results are illustrated on Figure 1. Fourth quarter 2016 analytical results indicate that BTEX concentrations are below the applicable COGCC Table 910-1 groundwater standards in all seven well locations.

Enhanced fluid recovery (EFR) and air sparge (AS) events were initiated on site during the fourth quarter 2012. During the second quarter 2016, a schedule of bi-weekly EFR/AS events staggered with bi-weekly AS events were initiated. A summary of the EFR/AS operational data is provided in Table 2. Mobile EFR/AS will remain the selected remediation strategy for this site through the first quarter 2017.

Historical sampling results for naphthalene and gasoline range organics (GRO) are presented in Table 3. Analysis of these constituents was discontinued following the third quarter 2012.

First quarter 2017 groundwater sampling will be conducted during March 2017.

TABLE 1
COTTONWOOD #1 TANK BATTERY
SURFACE WATER AND GROUNDWATER ANALYTICAL RESULTS SUMMARY TABLE

Sample ID	Date Sampled	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Depth to Water ⁽²⁾ (feet)
COGCC Table 910-1 Groundwater Standard (µg/L) ⁽¹⁾		5	560	700	1,400	
SW01	8/20/2012	<1.0	<1.0	<1.0	<1.0	NM
GW01	8/21/2012	3,000	1.7	320	1,900	~ 14
BH01	9/24/2012	160	<1.0	40	<1.0	16.31
BH01	12/20/2012	5.0	<1.0	<1.0	6.8	16.13
BH01	3/18/2013	<1.0	<1.0	<1.0	<1.0	16.58
BH01	6/20/2013	<1.0	<1.0	<1.0	<1.0	11.16
BH01	9/25/2013	<1.0	<1.0	<1.0	<1.0	13.61
BH01	12/30/2013	1.8	<1.0	<1.0	<1.0	14.38
BH01	3/28/2014	<1.0	<1.0	<1.0	<1.0	14.03
BH01	6/24/2014	<1.0	<1.0	<1.0	<1.0	11.79
BH01	9/24/2014	<1.0	<1.0	<1.0	<1.0	12.48
BH01	12/17/2014	<1.0	<1.0	<1.0	<1.0	13.16
BH01	3/26/2015	<1.0	<1.0	<1.0	<1.0	12.60
BH01	6/16/2015	<1.0	<1.0	<1.0	<1.0	11.33
BH01	9/28/2015	<1.0	<1.0	<1.0	<1.0	11.31
BH01	12/17/2015	3.8	<1.0	<1.0	<1.0	11.99
BH01	3/14/2016	3.5	<1.0	<1.0	<1.0	11.81
BH01	6/22/2016	37	<1.0	<1.0	<1.0	8.93
BH01	9/29/2016	5.4	3.1	<1.0	3.4	11.08
BH01	12/19/2016	2.3	<1.0	<1.0	<1.0	12.22
BH02	9/24/2012	1,300	<1.0	190	1,100	18.42
BH02	12/20/2012	24	<1.0	3.9	8.1	17.35
BH02	3/18/2013	18	<1.0	<1.0	<1.0	17.80
BH02	6/20/2013	15	<1.0	<1.0	<1.0	12.58
BH02	9/25/2013	8.6	<1.0	<1.0	<1.0	14.68
BH02	12/30/2013	16	<1.0	<1.0	<1.0	15.44
BH02	3/28/2014	<1.0	<1.0	<1.0	<1.0	15.15
BH02	6/24/2014	14	<1.0	1.6	<1.0	12.94
BH02	9/24/2014	59	<1.0	2.5	2.7	13.28
BH02	12/17/2014	29	<1.0	<1.0	<1.0	14.19
BH02	3/26/2015	47	<1.0	2.5	<1.0	13.65
BH02	6/16/2015	35	<1.0	<1.0	<1.0	12.55

TABLE 1
COTTONWOOD #1 TANK BATTERY
SURFACE WATER AND GROUNDWATER ANALYTICAL RESULTS SUMMARY TABLE

Sample ID	Date Sampled	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Depth to Water ⁽²⁾ (feet)
COGCC Table 910-1 Groundwater Standard (µg/L) ⁽¹⁾		5	560	700	1,400	
BH02	9/28/2015	80	<1.0	2.2	<1.0	12.27
BH02	12/17/2015	9.5	<1.0	<1.0	<1.0	13.01
BH02	3/14/2016	8.0	<1.0	<1.0	<1.0	12.75
BH02	6/22/2016	1.8	<1.0	<1.0	<1.0	10.13
BH02	9/29/2016	1.1	2.4	<1.0	2.4	12.00
BH02	12/19/2016	3.5	<1.0	<1.0	<1.0	13.14
BH03	9/24/2012	350	<1.0	120	300	18.28
BH03	12/20/2012	15	<1.0	6.7	7.9	17.04
BH03	3/18/2013	14	<1.0	1.5	<1.0	17.46
BH03	6/20/2013	11	<1.0	2.1	<1.0	12.01
BH03	9/25/2013	39	<1.0	16	<1.0	14.26
BH03	12/30/2013	48	<1.0	3.6	<1.0	15.02
BH03	3/28/2014	<1.0	<1.0	<1.0	<1.0	14.79
BH03	6/24/2014	13	<1.0	1.2	<1.0	12.43
BH03	9/24/2014	45	<1.0	1.8	3.0	12.91
BH03	12/17/2014	<1.0	<1.0	<1.0	<1.0	13.72
BH03	3/26/2015	8.0	<1.0	<1.0	<1.0	13.24
BH03	6/16/2015	19	<1.0	<1.0	<1.0	12.03
BH03	9/28/2015	7.7	<1.0	<1.0	<1.0	11.82
BH03	12/17/2015	2.0	<1.0	<1.0	<1.0	12.61
BH03	3/14/2016	1.0	<1.0	<1.0	<1.0	12.43
BH03	6/22/2016	<1.0	<1.0	<1.0	<1.0	9.61
BH03	9/29/2016	<1.0	2.1	<1.0	<1.0	11.62
BH03	12/19/2016	<1.0	<1.0	<1.0	<1.0	12.82
BH04	9/24/2012	150	<1.0	96	400	16.58
BH04	12/20/2012	38	<1.0	40	170	13.95
BH04	3/18/2013	2.6	<1.0	<1.0	<1.0	14.38
BH04	6/20/2013	1.3	<1.0	5.4	19	8.70
BH04	9/25/2013	1.5	<1.0	2.5	<1.0	11.32
BH04	12/30/2013	<1.0	<1.0	<1.0	<1.0	12.12
BH04	3/28/2014	<1.0	<1.0	<1.0	<1.0	11.80
BH04	6/24/2014	<1.0	<1.0	2.2	<1.0	9.43
BH04	9/24/2014	<1.0	<1.0	1.2	3.1	10.22

TABLE 1
COTTONWOOD #1 TANK BATTERY
SURFACE WATER AND GROUNDWATER ANALYTICAL RESULTS SUMMARY TABLE

Sample ID	Date Sampled	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Depth to Water ⁽²⁾ (feet)
COGCC Table 910-1 Groundwater Standard (µg/L) ⁽¹⁾		5	560	700	1,400	
BH04	12/17/2014	<1.0	<1.0	<1.0	<1.0	10.96
BH04	3/26/2015	<1.0	<1.0	<1.0	<1.0	10.40
BH04	6/16/2015	1.8	<1.0	3.8	<1.0	9.09
BH04	9/28/2015	<1.0	<1.0	<1.0	<1.0	9.07
BH04	12/17/2015	<1.0	<1.0	<1.0	<1.0	9.81
BH04	3/14/2016	<1.0	<1.0	<1.0	<1.0	9.64
BH04	6/22/2016	Destroyed				
BH04-R	9/29/2016	<1.0	1.8	8.2	16	8.39
BH04-R	12/19/2016	<1.0	<1.0	1.1	<1.0	9.61
BH05	9/24/2012	<1.0	<1.0	<1.0	<1.0	15.42
BH05	12/20/2012	<1.0	<1.0	<1.0	<1.0	16.86
BH05	3/18/2013	<1.0	<1.0	<1.0	<1.0	17.31
BH05	6/20/2013	<1.0	<1.0	<1.0	<1.0	11.42
BH05	9/25/2013	<1.0	<1.0	<1.0	<1.0	14.02
BH05	12/30/2013	<1.0	<1.0	<1.0	<1.0	14.80
BH05	3/28/2014	<1.0	<1.0	<1.0	<1.0	14.45
BH05	6/24/2014	<1.0	<1.0	<1.0	<1.0	12.00
BH05	9/24/2014	<1.0	<1.0	<1.0	<1.0	12.93
BH05	12/17/2014	<1.0	<1.0	<1.0	<1.0	13.69
BH05	3/26/2015	<1.0	<1.0	<1.0	<1.0	13.30
BH05	6/16/2015	<1.0	<1.0	<1.0	<1.0	11.96
BH05	9/28/2015	<1.0	<1.0	<1.0	<1.0	11.98
BH05	12/17/2015	<1.0	<1.0	<1.0	<1.0	12.73
BH05	3/14/2016	<1.0	<1.0	<1.0	<1.0	12.58
BH05	6/22/2016	<1.0	<1.0	<1.0	<1.0	11.22
BH05	9/29/2016	<1.0	1.4	<1.0	<1.0	11.75
BH05	12/19/2016	<1.0	<1.0	<1.0	<1.0	13.01
BH06	9/24/2012	6.7	18	7.5	50	15.35
BH06	12/20/2012	<1.0	<1.0	<1.0	<1.0	16.79
BH06	3/18/2013	3.6	1.2	<1.0	<1.0	14.74
BH06	6/20/2013	<1.0	<1.0	<1.0	<1.0	11.72
BH06	9/25/2013	1.9	<1.0	<1.0	<1.0	14.05

TABLE 1
COTTONWOOD #1 TANK BATTERY
SURFACE WATER AND GROUNDWATER ANALYTICAL RESULTS SUMMARY TABLE

Sample ID	Date Sampled	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Depth to Water ⁽²⁾ (feet)
COGCC Table 910-1 Groundwater Standard (µg/L) ⁽¹⁾		5	560	700	1,400	
BH06	12/30/2013	<1.0	<1.0	<1.0	<1.0	15.12
BH06	3/28/2014	<1.0	<1.0	<1.0	<1.0	14.78
BH06	6/24/2014	<1.0	<1.0	<1.0	<1.0	12.52
BH06	9/24/2014	<1.0	<1.0	<1.0	<1.0	13.26
BH06	12/17/2014	<1.0	<1.0	<1.0	<1.0	13.94
BH06	3/26/2015	<1.0	<1.0	<1.0	<1.0	13.45
BH06	6/16/2015	<1.0	<1.0	<1.0	<1.0	12.28
BH06	9/28/2015	<1.0	<1.0	<1.0	<1.0	12.09
BH06	12/17/2015	<1.0	<1.0	<1.0	<1.0	12.78
BH06	3/14/2016	<1.0	<1.0	<1.0	<1.0	12.80
BH06	6/22/2016	<1.0	<1.0	<1.0	<1.0	9.77
BH06	9/29/2016	<1.0	1.3	<1.0	<1.0	11.84
BH06	12/19/2016	<1.0	<1.0	<1.0	<1.0	13.01
BH07	9/24/2012	<1.0	<1.0	<1.0	<1.0	16.86
BH07	12/20/2012	<1.0	<1.0	<1.0	<1.0	18.32
BH07	3/18/2013	<1.0	<1.0	<1.0	<1.0	18.77
BH07	6/20/2013	1.6	<1.0	<1.0	<1.0	13.70
BH07	9/25/2013	<1.0	<1.0	<1.0	<1.0	15.95
BH07	12/30/2013	<1.0	<1.0	<1.0	<1.0	16.68
BH07	3/28/2014	<1.0	<1.0	<1.0	<1.0	16.39
BH07	6/24/2014	<1.0	<1.0	<1.0	<1.0	14.30
BH07	9/24/2014	<1.0	<1.0	<1.0	<1.0	14.84
BH07	12/17/2014	<1.0	<1.0	<1.0	<1.0	15.46
BH07	3/26/2015	<1.0	1.2	<1.0	<1.0	14.93
BH07	6/16/2015	<1.0	<1.0	<1.0	<1.0	13.71
BH07	9/28/2015	<1.0	<1.0	<1.0	<1.0	13.38
BH07	12/17/2015	<1.0	<1.0	<1.0	<1.0	14.03
BH07	3/14/2016	<1.0	<1.0	<1.0	<1.0	13.81
BH07	6/22/2016	<1.0	<1.0	<1.0	<1.0	11.22
BH07	9/29/2016	<1.0	1.2	<1.0	<1.0	13.12
BH07	12/19/2016	<1.0	<1.0	<1.0	<1.0	14.21

TABLE 1
COTTONWOOD #1 TANK BATTERY
SURFACE WATER AND GROUNDWATER ANALYTICAL RESULTS SUMMARY TABLE

Sample ID	Date Sampled	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Depth to Water ⁽²⁾ (feet)
COGCC Table 910-1 Groundwater Standard (µg/L) ⁽¹⁾		5	560	700	1,400	

Notes:

COGCC = Colorado Oil and Gas Conservation Commission

1. Groundwater standards referenced from 2 CCR 404-1, Table 910-1, effective January 30, 2015.

2. Depth to water measured from top of well casing or ground surface for monitoring well samples and excavation samples, respectively.

µg/L = Micrograms per liter

(<) = Analytical result is less than the indicated laboratory reporting limit.

NM = Not measured

BOLD = Analytical result is in exceedance of COGCC groundwater standards.

TABLE 2
COTTONWOOD #1 TANK BATTERY
EFR / AS OPERATIONAL SUMMARY TABLE

Date	EFR Wells	Total EFR/AS Duration (hours)	Approximate Gallons Extracted	AS Wells	Air Injection Pressure (psi)	Average Air Flow Rate (cfm)
Fourth Quarter 2012						
11/2/2012	BH01, BH02, BH03, BH04	6.75	13.8	BH01, BH02, BH03, BH04	8	NR
11/14/2012		6	110		8	NR
12/12/2012		6	400		8	NR
Quarterly Totals		18.75	523.8		-	-
First Quarter 2013						
1/4/2013	BH02, BH03	6.5	185	BH01, BH02	10	NR
1/18/2013	BH01, BH02, BH03, BH04	6.25	272	BH01, BH02, BH03, BH04	10	NR
2/2/2013		6	278		10	NR
2/15/2013		7	180		9.5	NR
3/5/2013		6.75	364		10	NR
3/22/2013		4.25	180		10	NR
Quarterly Totals		36.75	1459		-	-
Second Quarter 2013						
4/3/2013	BH01, BH02, BH03, BH04	5	275	BH01, BH02, BH03, BH04	10	NR
4/19/2013		6.5	373		10	NR
5/13/2013		6	385		10	NR
5/23/2013		6	151		10	NR
6/6/2013		6	387		10	NR
6/17/2013		4.75	300		10	NR
Quarterly Totals		34.25	1871		-	-
Third Quarter 2013						
7/16/2013	BH01, BH02, BH03, BH04	6	340	BH01, BH02, BH03, BH04	10	NR
7/30/2013	BH01, BH02, BH04, BH07	6	320	BH01, BH02, BH04, BH07	10	NR
8/13/2013	BH02, BH03, BH04, BH07	6	294	BH02, BH03, BH04, BH07	10	NR
8/30/2013		5.5	182		10	NR
9/12/2013	BH01, BH02, BH03, BH04	5.75	180	BH01, BH02, BH03, BH04	10	NR
9/27/2013	BH01, BH02, BH04, BH07	6	80	BH01, BH02, BH04, BH07	10	NR
Quarterly Totals		35.25	1396		-	-

TABLE 2
COTTONWOOD #1 TANK BATTERY
EFR / AS OPERATIONAL SUMMARY TABLE

Date	EFR Wells	Total EFR/AS Duration (hours)	Approximate Gallons Extracted	AS Wells	Air Injection Pressure (psi)	Average Air Flow Rate (cfm)
Fourth Quarter 2013						
10/10/2013	BH01, BH02, BH03, BH04, BH07	6	132	BH01, BH02, BH03, BH04, BH07	10	NR
10/22/2013	BH02, BH03, BH04, BH06	6	159	BH02, BH03, BH04, BH06	11.5	NR
11/12/2013		6	115		10	NR
11/25/2013		6	65		10	NR
12/13/2013		6	60		10	NR
Quarterly Totals		30	531		-	-
First Quarter 2014						
1/3/2014	BH02, BH03, BH04, BH06	6	10	BH02, BH03, BH04, BH06	10	NR
1/17/2014		6	240		10	NR
2/17/2014	BH01, BH02, BH03, BH04	6	180	BH01, BH02, BH03, BH04	10	42
3/5/2014		5.25	270		10	30.5
3/14/2014		6	300		10	34
Quarterly Totals		29.25	1000		-	-
Second Quarter 2014						
4/3/2014	BH01, BH02, BH03, BH04	6	120	BH01, BH02, BH04, BH05	10	20
4/18/2014		6	360	BH01, BH02, BH03, BH04	20	33
5/7/2014		6	225		10	10
5/22/2014		6	400		20	30
6/7/2014		6	200		10	21.5
6/20/2014		6	300		20	30
Quarterly Totals		36	1605		-	-
Third Quarter 2014						
7/10/2014	BH02, BH03	6	250	BH02, BH03	10	12.5
7/25/2014		6	220		10	27.5
8/16/2014		6	120		10	25
9/8/2014		6	450		20	41.7
9/19/2014		6	150		20	40
Quarterly Totals		30	1190		-	-
Fourth Quarter 2014						
10/8/2014	BH02, BH03	6	100	BH02, BH03	20	20
10/25/2014	BH01, BH02	6	260	BH01, BH02	20	33.5
11/7/2014	BH02, BH03	6	112	BH02, BH03	20	20
12/2/2014		6	250		20	37.5
12/15/2014		6	270		20	20
Quarterly Totals		30	992		-	-

TABLE 2
COTTONWOOD #1 TANK BATTERY
EFR / AS OPERATIONAL SUMMARY TABLE

Date	EFR Wells	Total EFR/AS Duration (hours)	Approximate Gallons Extracted	AS Wells	Air Injection Pressure (psi)	Average Air Flow Rate (cfm)
First Quarter 2015						
1/5/2015	BH02, BH03	6	0	BH02, BH03	20	35
1/16/2015		6	315		20	35
2/7/2015		6	410		20	32.5
3/2/2015		6	0		20	27.5
3/19/2015		6	0		20	30
Quarterly Totals		30	725		-	-
Second Quarter 2015						
4/8/2015	BH02, BH03	6	0	BH02, BH03	20	17.5
4/15/2015		5.45	0		20	30
4/29/2015		6	320		20	27.5
5/13/2015		6	360		20	25
5/27/2015		6	480		20	27.5
6/10/2015		6	600		20	27.5
6/24/2015		6	480		20	30
Quarterly Totals		41.45	2240		-	-
Third Quarter 2015						
7/8/2015	BH02, BH03	6	400	BH02, BH03	20	35
7/22/2015		6	280		20	30
8/5/2015		6	250		20	35
8/17/2015		4	375		20	35
9/2/2015		6	640		20	32.5
9/30/2015	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	800	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	20	20
Quarterly Totals		34	2745		-	-

TABLE 2
COTTONWOOD #1 TANK BATTERY
EFR / AS OPERATIONAL SUMMARY TABLE

Date	EFR Wells	Total EFR/AS Duration (hours)	Approximate Gallons Extracted	AS Wells	Air Injection Pressure (psi)	Average Air Flow Rate (cfm)
Fourth Quarter 2015						
10/15/2015	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	230	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	20	20
10/23/2015		5	552	EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	20	22.5
11/5/2015		6	644	BH02, BH03, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	20	22.3
11/18/2015		6	480	EFR08, EFR09, EFR10	20	12.5
12/3/2015		6	786	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	20	20
12/19/2015		6	320	EFR07, EFR08, EFR09, EFR10	20	25
12/31/2015		6	746	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR06, EFR07, EFR08, EFR09	20	25
Quarterly Totals		41	3758		-	-
First Quarter 2016						
1/28/2016	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	480	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	20	17.5
2/9/2016		6	924		20	27.5
2/23/2016		6	1600		20	10
3/8/2016		6	840		20	22.5
3/22/2016		6	900		30	15.5
Quarterly Totals		30	4744		-	-

TABLE 2
COTTONWOOD #1 TANK BATTERY
EFR / AS OPERATIONAL SUMMARY TABLE

Date	EFR Wells	Total EFR/AS Duration (hours)	Approximate Gallons Extracted	AS Wells	Air Injection Pressure (psi)	Average Air Flow Rate (cfm)
Second Quarter 2016						
4/5/2016	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	960	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	22	14.2
4/13/2016	None	6	0		20	10
4/19/2016	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1764		20	17
4/25/2016	None	6	0	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	15	8
5/5/2016	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	600		27	16.4
5/10/2016	None	6	0		15	12
5/17/2016	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	800		15	10.4
5/23/2016	None	6	0		0	7
6/9/2016	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1260		30	8.8
6/14/2016	None	6	0		10	3.4
6/23/2016	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1596		10	8.4
6/28/2016	None	6	0		10	7
Quarterly Totals		72	6980		-	-

TABLE 2
COTTONWOOD #1 TANK BATTERY
EFR / AS OPERATIONAL SUMMARY TABLE

Date	EFR Wells	Total EFR/AS Duration (hours)	Approximate Gallons Extracted	AS Wells	Air Injection Pressure (psi)	Average Air Flow Rate (cfm)
Third Quarter 2016						
7/7/2016	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1386	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	20	10
7/12/2016	None	6	0	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	10	5
7/21/2016	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1554		20	8.4
8/4/2016		6	1470	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	10	10
8/13/2016	None	6	0	BH01, BH02, BH03, EFR03, EFR04, EFR06, EFR07, EFR08, EFR09, EFR10	5	5
8/18/2016	BH01, BH02, BH03, EFR03, EFR04, EFR06, EFR07, EFR08, EFR09, EFR10	6	1260		15	10
8/27/2016	None	6	0		20	5
9/2/2016	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1680		7.5	5
9/15/2016		6	2100		20	15
9/20/2016	None	6	0	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	10	5.4
9/26/2016	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1680	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	20	10
Quarterly Totals		66	11130		-	-

TABLE 2
COTTONWOOD #1 TANK BATTERY
EFR / AS OPERATIONAL SUMMARY TABLE

Date	EFR Wells	Total EFR/AS Duration (hours)	Approximate Gallons Extracted	AS Wells	Air Injection Pressure (psi)	Average Air Flow Rate (cfm)
Fourth Quarter 2016						
10/8/2016	None	6	0	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	10	6
10/10/2016	BH01, BH02, BH03, EFR03, EFR04, EFR06, EFR07, EFR08, EFR09, EFR10	6	1470		20	10
10/18/2016	None	6	0		5	5
10/24/2016	BH01, BH02, BH03, EFR03, EFR04, EFR06, EFR07, EFR08, EFR09, EFR10	6	2100		5	5
11/5/2016	None	6	0		NR	8
11/7/2016	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1680		20	10
11/19/2016	None	6	0		NR	12
11/25/2016	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1680		20	10
11/29/2016	None	6	0		10	7.5
12/5/2016	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1680		10	5
12/15/2016	None	6	0		22	10
12/20/2016	BH01, BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	630		15	5
12/27/2016	None	6	0		10	7
Quarterly Totals		78	9240		-	-

TABLE 2
COTTONWOOD #1 TANK BATTERY
EFR / AS OPERATIONAL SUMMARY TABLE

Date	EFR Wells	Total EFR/AS Duration (hours)	Approximate Gallons Extracted	AS Wells	Air Injection Pressure (psi)	Average Air Flow Rate (cfm)
------	-----------	-------------------------------------	-------------------------------------	----------	---------------------------------	-----------------------------------

Notes:

EFR = Enhanced fluid recovery

AS = Air sparge

psi = Pounds per square inch

cfm = Cubic feet per minute

NR = Not recorded

TABLE 3
COTTONWOOD #1 TANK BATTERY
SURFACE WATER AND GROUNDWATER ANALYTICAL RESULTS SUMMARY TABLE
GRO & NAPHTHALENE

Sample ID	Date Sampled	Naphthalene (µg/L)	TPH-GRO (µg/L)
CDPHE WQCC Groundwater Standard ⁽¹⁾		140	NS
SW01	8/20/2012	<1.0	<500
GW01	8/21/2012	200	32,000
BH01	9/24/2012	5.5	830
BH02	9/24/2012	25	6,800
BH03	9/24/2012	13	2,900
BH04	9/24/2012	14	3,100
BH05	9/24/2012	<1.0	<500
BH06	9/24/2012	<1.0	<500
BH07	9/24/2012	1.6	<500

Notes:

1. Groundwater standards referenced from Colorado Department of Public Health Water Quality Control Commission 5CCR 1002-41 Basic Standards for Groundwater.

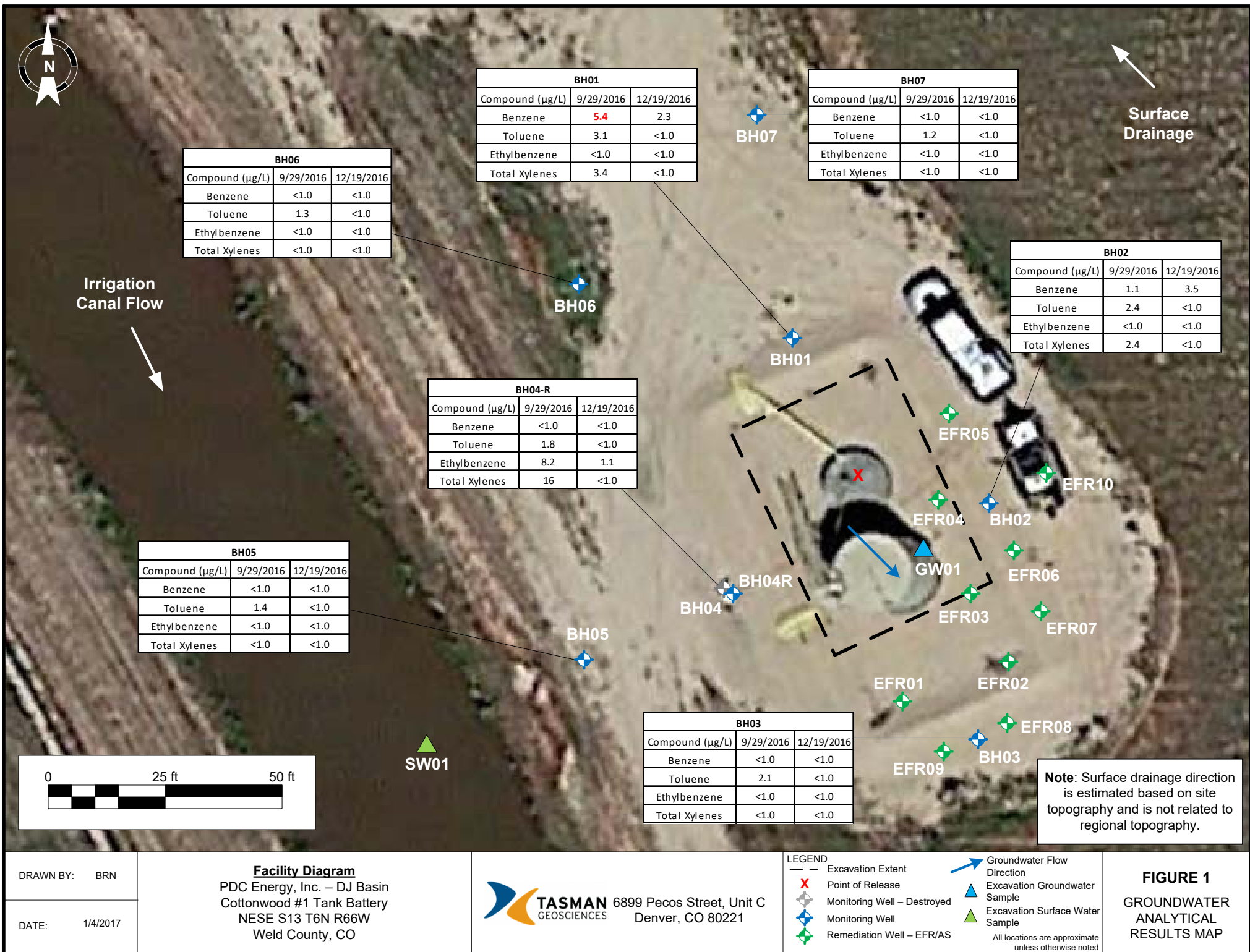
TPH-GRO = Total Petroleum Hydrocarbons - Gasoline Range Organics

µg/L = Micrograms per liter

(<) = Analytical result is less than the indicated laboratory reporting limit.

NS = No Standard

BOLD = Analytical result is in exceedance of applicable groundwater standards.



ATTACHMENT A

Summit Scientific

741 Corporate Circle – Suite I ♦ Golden, Colorado 80401

303.277.9310 - laboratory ♦ 303.277.9531 - fax

December 27, 2016

Mark Longhurst
PDC Energy
1775 Sherman St. STE. 3000
Denver, CO 80203
RE: Cottonwood #1

Enclosed are the results of analyses for samples received by Summit Scientific on 12/19/16 17:05. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read 'P. Shrewsbury', with a stylized, cursive script.

Paul Shrewsbury
President



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BH01	1612135-01	Water	12/19/16 12:32	12/19/16 17:05
BH02	1612135-02	Water	12/19/16 12:47	12/19/16 17:05
BH03	1612135-03	Water	12/19/16 12:54	12/19/16 17:05
BH04-R	1612135-04	Water	12/19/16 13:03	12/19/16 17:05
BH05	1612135-05	Water	12/19/16 12:59	12/19/16 17:05
BH06	1612135-06	Water	12/19/16 12:33	12/19/16 17:05
BH07	1612135-07	Water	12/19/16 12:45	12/19/16 17:05

Summit Scientific

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

Sample Receipt Checklist

S2 Work Order: 1612135
Client: PDC Energy Client Project ID: Cottonwood #1
Shipped Via: PLU Airbill #: _____
(UPS, FedEx, Hand Delivered, Pick-up, etc.)
Matrix (check all that apply): ☐ Air ☐ Soil/Solid ☒ Water ☐ Other: _____ (Describe)

Cooler ID					
Temp (°C)	<u>26</u>				

Thermometer ID: 61857155-K

	Yes	No	N/A	Comments (if any)
If samples require cooling, was the temperature just above 0°C to ≤ 6°C ⁽¹⁾ ?	<input checked="" type="checkbox"/>			
NOTE: If samples are delivered the same day of sampling, this requirement is waived provided that there is evidence that cooling has begun.				
Were all samples received intact ⁽¹⁾ ?	<input checked="" type="checkbox"/>			
Was adequate sample volume provided ⁽¹⁾ ?	<input checked="" type="checkbox"/>			
If custody seals are present, are they intact ⁽¹⁾ ?			<input checked="" type="checkbox"/>	
Are short holding time analytes or samples with HTs due within 48 hours present?			<input checked="" type="checkbox"/>	
Is a chain-of-custody (COC) form present and filled out completely ⁽¹⁾ ?	<input checked="" type="checkbox"/>			
Does the COC agree with the number and type of sample bottles received ⁽¹⁾ ?	<input checked="" type="checkbox"/>			
Do the sample IDs on the bottle labels match the COC ⁽¹⁾ ?	<input checked="" type="checkbox"/>			
Is the COC properly relinquished by the client w/ date and time recorded ⁽¹⁾ ?	<input checked="" type="checkbox"/>			
For volatiles in water – is there headspace present? If yes, contact client and note in narrative.		<input checked="" type="checkbox"/>		
Are samples preserved that require preservation (excluding cooling) ⁽¹⁾ ?	<input checked="" type="checkbox"/>			<u>HCL</u>
Note the type of preservative in the Comments column – HCl, H2SO4, NaOH, HNO3, ect				
If samples are acid preserved for metals, is the pH ≤ 2 ⁽¹⁾ ?			<input checked="" type="checkbox"/>	
Record the pH in Comments.				
If dissolved metals are requested, were samples field filtered?			<input checked="" type="checkbox"/>	
Additional Comments (if any):				

⁽¹⁾ If NO, then contact the client before proceeding with analysis and note in case narrative.

WAKHA
Custodian Printed Name

[Signature]
Signature or Initials of Custodian

12/19/16 1705
Date/Time



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

BH01
1612135-01 (Water)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/19/16 12:32**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	2.3	1.0	ug/l	1	1612205	12/20/16	12/20/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	"	"	
Ethylbenzene	ND	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **12/19/16 12:32**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
<i>Surrogate: 1,2-Dichloroethane-d4</i>		90.7 %	37-154		"	"	"	"	
<i>Surrogate: Toluene-d8</i>		104 %	45-149		"	"	"	"	
<i>Surrogate: 4-Bromofluorobenzene</i>		104 %	45-146		"	"	"	"	

Summit Scientific

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

BH02
1612135-02 (Water)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/19/16 12:47**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	3.5	1.0	ug/l	1	1612205	12/20/16	12/21/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	12/21/16	"	
Ethylbenzene	ND	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **12/19/16 12:47**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		92.6 %	37-154		"	"	"	"	
Surrogate: Toluene-d8		104 %	45-149		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		102 %	45-146		"	"	"	"	

Summit Scientific

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

BH03
1612135-03 (Water)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/19/16 12:54**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	1.0	ug/l	1	1612205	12/20/16	12/21/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	"	"	
Ethylbenzene	ND	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **12/19/16 12:54**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		93.5 %	37-154		"	"	"	"	
Surrogate: Toluene-d8		104 %	45-149		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		102 %	45-146		"	"	"	"	

Summit Scientific

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

BH04-R
1612135-04 (Water)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/19/16 13:03**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	1.0	ug/l	1	1612205	12/20/16	12/21/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	"	"	
Ethylbenzene	1.1	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **12/19/16 13:03**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
<i>Surrogate: 1,2-Dichloroethane-d4</i>		93.9 %	37-154		"	"	"	"	
<i>Surrogate: Toluene-d8</i>		101 %	45-149		"	"	"	"	
<i>Surrogate: 4-Bromofluorobenzene</i>		133 %	45-146		"	"	"	"	

Summit Scientific

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

BH05
1612135-05 (Water)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/19/16 12:59**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	1.0	ug/l	1	1612205	12/20/16	12/21/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	12/21/16	"	
Ethylbenzene	ND	1.0	"	"	"	"	12/21/16	"	
Xylenes (total)	ND	1.0	"	"	"	"	12/21/16	"	

Date Sampled: **12/19/16 12:59**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		93.3 %	37-154		"	"	"	"	
Surrogate: Toluene-d8		105 %	45-149		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		104 %	45-146		"	"	"	"	

Summit Scientific

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

BH06
1612135-06 (Water)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/19/16 12:33**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	1.0	ug/l	1	1612205	12/20/16	12/21/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	"	"	
Ethylbenzene	ND	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **12/19/16 12:33**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		93.1 %	37-154		"	"	"	"	
Surrogate: Toluene-d8		103 %	45-149		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		103 %	45-146		"	"	"	"	

Summit Scientific

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

BH07
1612135-07 (Water)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/19/16 12:45**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	1.0	ug/l	1	1612205	12/20/16	12/21/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	"	"	
Ethylbenzene	ND	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **12/19/16 12:45**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		98.7 %	37-154		"	"	"	"	
Surrogate: Toluene-d8		105 %	45-149		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		100 %	45-146		"	"	"	"	

Summit Scientific

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

Volatile Organic Compounds by EPA Method 8260B - Quality Control

Summit Scientific

Analyte	Reporting			Spike	Source		%REC		RPD	
	Result	Limit	Units	Level	Result	%REC	Limits	RPD	Limit	Notes

Batch 1612205 - EPA 5030 Water MS

Blank (1612205-BLK1)

Prepared & Analyzed: 12/20/16

Benzene	ND	1.0	ug/l							
Toluene	ND	1.0	"							
Ethylbenzene	ND	1.0	"							
Xylenes (total)	ND	1.0	"							
Surrogate: 1,2-Dichloroethane-d4	15.2		"	13.3	114	37-154				
Surrogate: Toluene-d8	13.8		"	13.3	103	45-149				
Surrogate: 4-Bromofluorobenzene	13.7		"	13.3	103	45-146				

LCS (1612205-BS1)

Prepared & Analyzed: 12/20/16

Benzene	39.3	1.0	ug/l	33.3	118	51-132				
Toluene	38.0	1.0	"	33.3	114	51-138				
Ethylbenzene	38.2	1.0	"	33.1	116	58-146				
m,p-Xylene	75.1	2.0	"	66.5	113	57-144				
o-Xylene	37.8	1.0	"	32.7	116	53-146				
Surrogate: 1,2-Dichloroethane-d4	13.0		"	13.3	97.7	37-154				
Surrogate: Toluene-d8	14.4		"	13.3	108	45-149				
Surrogate: 4-Bromofluorobenzene	14.0		"	13.3	105	45-146				

Matrix Spike (1612205-MS1)

Source: 1612121-01

Prepared & Analyzed: 12/20/16

Benzene	44.0	1.0	ug/l	33.3	ND	132	34-141			
Toluene	42.8	1.0	"	33.3	ND	128	27-151			
Ethylbenzene	43.3	1.0	"	33.1	ND	131	29-160			
m,p-Xylene	83.8	2.0	"	66.5	ND	126	20-166			
o-Xylene	41.8	1.0	"	32.7	ND	128	33-159			
Surrogate: 1,2-Dichloroethane-d4	11.6		"	13.3		87.2	37-154			
Surrogate: Toluene-d8	14.4		"	13.3		108	45-149			
Surrogate: 4-Bromofluorobenzene	13.6		"	13.3		102	45-146			

Summit Scientific

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

Volatile Organic Compounds by EPA Method 8260B - Quality Control
Summit Scientific

Analyte	Reporting			Spike	Source		%REC		RPD	
	Result	Limit	Units	Level	Result	%REC	Limits	RPD	Limit	Notes

Batch 1612205 - EPA 5030 Water MS

Matrix Spike Dup (1612205-MSD1)	Source: 1612121-01			Prepared & Analyzed: 12/20/16						
Benzene	41.3	1.0	ug/l	33.3	ND	124	34-141	6.33	32	
Toluene	39.9	1.0	"	33.3	ND	120	27-151	6.92	25	
Ethylbenzene	41.7	1.0	"	33.1	ND	126	29-160	3.74	50	
m,p-Xylene	81.1	2.0	"	66.5	ND	122	20-166	3.28	36	
o-Xylene	40.1	1.0	"	32.7	ND	123	33-159	4.06	26	
Surrogate: 1,2-Dichloroethane-d4	11.7		"	13.3		87.7	37-154			
Surrogate: Toluene-d8	14.2		"	13.3		107	45-149			
Surrogate: 4-Bromofluorobenzene	13.6		"	13.3		102	45-146			

Summit Scientific

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



PDC Energy
1775 Sherman St. STE. 3000
Denver CO, 80203

Project: Cottonwood #1
Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/27/16 15:30

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference