



**PDC Energy, Inc.**  
**Second Quarter 2016 Groundwater Monitoring Summary**

July 8, 2016

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 June 22, 2016 groundwater sampling was conducted at the six monitoring well locations at the site (BH01-BH03, BH05-BH07). BH04 was destroyed and subsequently not sampled. Groundwater samples were submitted for laboratory 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. Second quarter 2016 analytical results indicate that the benzene concentration is above the applicable COGCC Table 910-1 groundwater standard in well BH01. BTEX concentrations are below COGCC regulatory standards in six sample locations.

Tasman initiated enhanced fluid recovery (EFR) and air sparge (AS) events on site during the fourth quarter 2012. A summary of the EFR/AS operational data is provided in Table 2. Mobile EFR/AS will remain the selected remediation strategy through the third quarter 2016.

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.

Third quarter 2016 groundwater sampling will be conducted during September 2016.

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

Sample ID	Date Sampled	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Depth to Water <sup>(2)</sup> (feet)
<b>COGCC Table 910-1 Groundwater Standard (µg/L) <sup>(1)</sup></b>		<b>5</b>	<b>560</b>	<b>700</b>	<b>1,400</b>	
SW01	8/20/2012	<1.0	<1.0	<1.0	<1.0	NM
GW01	8/21/2012	<b>3,000</b>	1.7	320	<b>1,900</b>	~ 14
BH01	9/24/2012	<b>160</b>	<1.0	40	<1.0	16.31
BH01	12/20/2012	<b>5.0</b>	<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	<b>37</b>	<1.0	<1.0	<1.0	8.93
BH02	9/24/2012	<b>1,300</b>	<1.0	190	1,100	18.42
BH02	12/20/2012	<b>24</b>	<1.0	3.9	8.1	17.35
BH02	3/18/2013	<b>18</b>	<1.0	<1.0	<1.0	17.80
BH02	6/20/2013	<b>15</b>	<1.0	<1.0	<1.0	12.58
BH02	9/25/2013	<b>8.6</b>	<1.0	<1.0	<1.0	14.68
BH02	12/30/2013	<b>16</b>	<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	<b>14</b>	<1.0	1.6	<1.0	12.94
BH02	9/24/2014	<b>59</b>	<1.0	2.5	2.7	13.28
BH02	12/17/2014	<b>29</b>	<1.0	<1.0	<1.0	14.19
BH02	3/26/2015	<b>47</b>	<1.0	2.5	<1.0	13.65
BH02	6/16/2015	<b>35</b>	<1.0	<1.0	<1.0	12.55
BH02	9/28/2015	<b>80</b>	<1.0	2.2	<1.0	12.27
BH02	12/17/2015	<b>9.5</b>	<1.0	<1.0	<1.0	13.01

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

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<b>COGCC Table 910-1 Groundwater Standard (µg/L) <sup>(1)</sup></b>		<b>5</b>	<b>560</b>	<b>700</b>	<b>1,400</b>	
BH04	3/14/2016	<1.0	<1.0	<1.0	<1.0	9.64
BH04	6/22/2016	Destroyed				
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
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
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

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<b>COGCC Table 910-1 Groundwater Standard (µg/L) <sup>(1)</sup></b>		<b>5</b>	<b>560</b>	<b>700</b>	<b>1,400</b>	
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
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

**Notes:**

1. Groundwater standards referenced from 2 CCR 404-1, Table 910-1, effective March 16, 2016.

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

COGCC = Colorado Oil and Gas Conservation Commission

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)
Fourth Quarter 2012					
11/2/2012	BH01, BH02, BH03, BH04	6.75	13.8	BH01, BH02, BH03, BH04	8
11/14/2012		6	110		8
12/12/2012		6	400		8
Quarterly Totals		18.75	523.8		-
First Quarter 2013					
1/4/2013	BH02, BH03	6.5	185	BH01, BH02	10
1/18/2013	BH01, BH02, BH03, BH04	6.25	272	BH01, BH02, BH03, BH04	10
2/2/2013		6	278		10
2/15/2013		7	180		9.5
3/5/2013		6.75	364		10
3/22/2013		4.25	180		10
Quarterly Totals		36.75	1459		-
Second Quarter 2013					
4/3/2013	BH01, BH02, BH03, BH04	5	275	BH01, BH02, BH03, BH04	10
4/19/2013		6.5	373		10
5/13/2013		6	385		10
5/23/2013		6	151		10
6/6/2013		6	387		10
6/17/2013		4.75	300		10
Quarterly Totals		34.25	1871		-
Third Quarter 2013					
7/16/2013	BH01, BH02, BH03, BH04	6	340	BH01, BH02, BH03, BH04	10
7/30/2013	BH01, BH02, BH04, BH07	6	320	BH01, BH02, BH04, BH07	10
8/13/2013	BH02, BH03, BH04, BH07	6	294	BH02, BH03, BH04, BH07	10
8/30/2013		5.5	182		10
9/12/2013	BH01, BH02, BH03, BH04	5.75	180	BH01, BH02, BH03, BH04	10
9/27/2013	BH01, BH02, BH04, BH07	6	80	BH01, BH02, BH04, BH07	10
Quarterly Totals		35.25	1396		-
Fourth Quarter 2013					
10/10/2013	BH01, BH02, BH03, BH04, BH07	6	132	BH01, BH02, BH03, BH04, BH07	10
10/22/2013	BH02, BH03, BH04, BH06	6	159	BH02, BH03, BH04, BH06	11.5
11/12/2013		6	115		10
11/25/2013		6	65		10
12/13/2013		6	60		10
Quarterly Totals		30	531		-

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Date	EFR Wells	Total EFR/AS Duration (hours)	Approximate Gallons Extracted	AS Wells	Air Injection Pressure (psi)
First Quarter 2014					
1/3/2014	BH02, BH03, BH04, BH06	6	10	BH02, BH03, BH04, BH06	10
1/17/2014		6	240		10
2/17/2014	BH01, BH02, BH03, BH04	6	180	BH01, BH02, BH03, BH04	10
3/5/2014		5.25	270		10
3/14/2014		6	300		10
Quarterly Totals		29.25	1000		
Second Quarter 2014					
4/3/2014	BH01, BH02, BH03, BH04	6	120	BH01, BH02, BH04, BH05	10
4/18/2014		6	360	BH01, BH02, BH03, BH04	20
5/7/2014		6	225		10
5/22/2014		6	400		20
6/7/2014		6	200		10
6/20/2014		6	300		20
Quarterly Totals		36	1605		
Third Quarter 2014					
7/10/2014	BH02, BH03	6	250	BH02, BH03	10
7/25/2014		6	220		10
8/16/2014		6	120		10
9/8/2014		6	450		20
9/19/2014		6	150		20
Quarterly Totals		30	1190		
Fourth Quarter 2014					
10/8/2014	BH02, BH03	6	100	BH02, BH03	20
10/25/2014	BH01, BH02	6	260	BH01, BH02	20
11/7/2014	BH02, BH03	6	112	BH02, BH03	20
12/2/2014		6	250		20
12/15/2014		6	270		20
Quarterly Totals		30	992		
First Quarter 2015					
1/5/2015	BH02, BH03	6	0	BH02, BH03	20
1/16/2015		6	315		20
2/7/2015		6	410		20
3/2/2015		6	0		20
3/19/2015		6	0		20
Quarterly Totals		30	725		

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Date	EFR Wells	Total EFR/AS Duration (hours)	Approximate Gallons Extracted	AS Wells	Air Injection Pressure (psi)
Second Quarter 2015					
4/8/2015	BH02, BH03	6	0	BH02, BH03	20
4/15/2015		5.45	0		20
4/29/2015		6	320		20
5/13/2015		6	360		20
5/27/2015		6	480		20
6/10/2015		6	600		20
6/24/2015		6	480		20
Quarterly Totals		41.45	2240		
Third Quarter 2015					
7/8/2015	BH02, BH03	6	400	BH02, BH03	20
7/22/2015		6	280		20
8/5/2015		6	250		20
8/17/2015		4	375		20
9/2/2015		6	640		20
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
Quarterly Totals		34	2745		
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
10/23/2015		5	552		20
11/5/2015		6	644	BH02, BH03, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	20
11/18/2015		6	480		20
12/3/2015		6	786	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	20
12/19/2015		6	320		20
12/31/2015		6	746	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR06, EFR07, EFR08, EFR09	20
Quarterly Totals		41	3758		



**TABLE 2**  
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Date	EFR Wells	Total EFR/AS Duration (hours)	Approximate Gallons Extracted	AS Wells	Air Injection Pressure (psi)
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
2/9/2016		6	924		20
2/23/2016		6	1600		20
3/8/2016		6	840		20
3/22/2016		6	900		30
Quarterly Totals		30	4744		
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
4/13/2016	None	6	0		20
4/19/2016	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1764		20
4/25/2016	None	6	0	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	15
5/5/2016	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	600	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	27
5/10/2016	None	6	0		15
5/17/2016	BH02, BH03, EFR01, EFR02, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	800		15
5/23/2016	None	6	0		0
6/9/2016	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1260	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	30
6/14/2016	None	6	0		10
6/23/2016	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	6	1596	BH02, BH03, EFR03, EFR04, EFR05, EFR06, EFR07, EFR08, EFR09, EFR10	10
6/28/2016	None	6	0		10
Quarterly Totals		72	6980		

**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 <sup>(1)</sup>		140	NS
SW01	8/20/2012	<1.0	<500
GW01	8/21/2012	<b>200</b>	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.



Irrigation  
Canal Flow

Surface  
Drainage

BH06		
Compound (µg/L)	3/14/2016	6/22/2016
Benzene	<1.0	<1.0
Toluene	<1.0	<1.0
Ethylbenzene	<1.0	<1.0
Total Xylenes	<1.0	<1.0

BH01		
Compound (µg/L)	3/14/2016	6/22/2016
Benzene	3.5	37
Toluene	<1.0	<1.0
Ethylbenzene	<1.0	<1.0
Total Xylenes	<1.0	<1.0

BH07		
Compound (µg/L)	3/14/2016	6/22/2016
Benzene	<1.0	<1.0
Toluene	<1.0	<1.0
Ethylbenzene	<1.0	<1.0
Total Xylenes	<1.0	<1.0

BH02		
Compound (µg/L)	3/14/2016	6/22/2016
Benzene	8.0	1.8
Toluene	<1.0	<1.0
Ethylbenzene	<1.0	<1.0
Total Xylenes	<1.0	<1.0

BH04		
Compound (µg/L)	3/14/2016	6/22/2016
Benzene	<1.0	NS
Toluene	<1.0	NS
Ethylbenzene	<1.0	NS
Total Xylenes	<1.0	NS

BH05		
Compound (µg/L)	3/14/2016	6/22/2016
Benzene	<1.0	<1.0
Toluene	<1.0	<1.0
Ethylbenzene	<1.0	<1.0
Total Xylenes	<1.0	<1.0

BH03		
Compound (µg/L)	3/14/2016	6/22/2016
Benzene	1.0	<1.0
Toluene	<1.0	<1.0
Ethylbenzene	<1.0	<1.0
Total Xylenes	<1.0	<1.0

SW01

0 25 ft 50 ft

**Note:** Surface drainage direction is estimated based on site topography and is not related to regional topography.

DRAWN BY: KBW

DATE: 6/29/2016

**Facility Diagram**  
PDC Energy, Inc. – DJ Basin  
Cottonwood #1 Tank Battery  
NESE S13 T6N R66W  
Weld County, CO



6899 Pecos Street, Unit C  
Denver, CO 80221

LEGEND

- Excavation Extent
- Monitoring Well Location
- Remediation EFR Well Location
- Excavation Groundwater Sample
- Excavation Surface Water Sample



Point of Release

All locations are approximate unless otherwise noted

**FIGURE 1**  
GROUNDWATER ANALYTICAL RESULTS MAP

## **ATTACHMENT A**

# Summit Scientific

---

741 Corporate Circle – Suite I ♦ Golden, Colorado 80401

303.277.9310 - laboratory ♦ 303.277.9531 - fax

June 28, 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 06/22/16 17:30. 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:**  
06/28/16 11:58

### ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
BH01	1606258-01	Water	06/22/16 12:45	06/22/16 17:30
BH02	1606258-02	Water	06/22/16 13:00	06/22/16 17:30
BH03	1606258-03	Water	06/22/16 13:15	06/22/16 17:30
BH05	1606258-04	Water	06/22/16 13:30	06/22/16 17:30
BH06	1606258-05	Water	06/22/16 12:15	06/22/16 17:30
BH07	1606258-06	Water	06/22/16 12:30	06/22/16 17:30

Summit Scientific

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

Project: Cottonwood #1

Project Number: [none]  
Project Manager: Mark Longhurst

Reported:  
06/28/16 11:58

1606258

741 Corporate Circle Suite 1 Golden, Colorado 80401  
303-277-9310 303-277-9531 Fax

Client: PDC Page 1 of 1  
Address: \_\_\_\_\_  
City/State/Zip: \_\_\_\_\_  
Phone: 970 470 9042 Fax: \_\_\_\_\_  
Sampler Name: R. Fria

Project Manager: Mark Longhurst  
E-Mail: mark.longhurst@pdcenergy.com  
Project Name: Cottonwood #1  
Project Number: \_\_\_\_\_

Sample Description	Date Sampled	Time Sampled	Number of Containers	Preservative				Matrix			Analyze For:	Special Instructions
				HCl	HNO <sub>3</sub>	None	Other (Specify)	Groundwater	Soil	Air - Canister Serial #		
BH01	6/22/16	1245	3	X								
BH02	6/22/16	1300	3	X								
BH03	6/22/16	1315	3	X								
BH05	6/22/16	1330	3	X								
BH06	6/22/16	1215	3	X								
BH07	6/22/16	1230	3	X								

Relinquished by: [Signature] Date/Time: 6/22/16 1730 Received by: [Signature] Date/Time: 6/22/16 1730  
Relinquished by: [Signature] Date/Time: 6/23/16 11:20 Received by: [Signature] Date/Time: 6/23/16 11:20  
Relinquished by: \_\_\_\_\_ Date/Time: \_\_\_\_\_ Received in Lab by: \_\_\_\_\_ Date/Time: \_\_\_\_\_

Turn Around Time (Check)  
Same Day ☐ 24 Hours ☐ 48 Hours ☐ 72 Hours ☒ Standard

Sample Integrity:  
Temperature Upon Receipt: 9.3°C  
Intact: Yes ☐ No ☐

Notes: on 1A

www.scientific.com

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:  
06/28/16 11:58

### Sample Receipt Checklist

S2 Work Order: 1606258

Client: PDC

Client Project ID: Cottonwood 1

Shipped Via: P/U

(UPS, FedEx, Hand Delivered, Pick-up, etc.)

Airbill #: \_\_\_\_\_

Matrix (check all that apply): ☐ Air ☐ Soil/Solid ☒ Water ☐ Other: \_\_\_\_\_  
(Describe)

Cooler ID					
Temp (°C)	<u>9.3</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 <sup>(1)</sup> ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<u>PS</u>
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 <sup>(1)</sup> ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was adequate sample volume provided <sup>(1)</sup> ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If custody seals are present, are they intact <sup>(1)</sup> ?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Are short holding time analytes or samples with HTs due within 48 hours present?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Is a chain-of-custody (COC) form present and filled out completely <sup>(1)</sup> ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Does the COC agree with the number and type of sample bottles received <sup>(1)</sup> ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Do the sample IDs on the bottle labels match the COC <sup>(1)</sup> ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Is the COC properly relinquished by the client w/ date and time recorded <sup>(1)</sup> ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
For volatiles in water – is there headspace present? If yes, contact client and note in narrative.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Are samples preserved that require preservation (excluding cooling) <sup>(1)</sup> ?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>HCC</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 <sup>(1)</sup> ?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Record the pH in Comments.				
If dissolved metals are requested, were samples field filtered?	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Additional Comments (if any):				

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

Nakita  
Custodian Printed Name

ML  
Signature or Initials of Custodian

6/23/16 11:20  
Date/Time





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

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

**Reported:**  
06/28/16 11:58

**BH01**  
**1606258-01 (Water)**

**Summit Scientific**

**Volatile Organic Compounds by EPA Method 8260B**

Date Sampled: **06/22/16 12:45**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
<b>Benzene</b>	<b>37</b>	1.0	ug/l	1	1606253	06/26/16	06/26/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	"	"	
Ethylbenzene	ND	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **06/22/16 12:45**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
<i>Surrogate: 1,2-Dichloroethane-d4</i>		<i>115 %</i>	<i>37-154</i>		"	"	"	"	
<i>Surrogate: Toluene-d8</i>		<i>97.4 %</i>	<i>45-149</i>		"	"	"	"	
<i>Surrogate: 4-Bromofluorobenzene</i>		<i>97.5 %</i>	<i>45-146</i>		"	"	"	"	

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:**  
06/28/16 11:58

**BH02**  
**1606258-02 (Water)**

**Summit Scientific**

**Volatile Organic Compounds by EPA Method 8260B**

Date Sampled: **06/22/16 13:00**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
<b>Benzene</b>	<b>1.8</b>	1.0	ug/l	1	1606253	06/26/16	06/26/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	"	"	
Ethylbenzene	ND	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **06/22/16 13:00**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
<i>Surrogate: 1,2-Dichloroethane-d4</i>		113 %	37-154		"	"	"	"	
<i>Surrogate: Toluene-d8</i>		97.7 %	45-149		"	"	"	"	
<i>Surrogate: 4-Bromofluorobenzene</i>		98.6 %	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:**  
06/28/16 11:58

**BH03**  
**1606258-03 (Water)**

**Summit Scientific**

**Volatile Organic Compounds by EPA Method 8260B**

Date Sampled: **06/22/16 13:15**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	1.0	ug/l	1	1606253	06/26/16	06/26/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	"	"	
Ethylbenzene	ND	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **06/22/16 13:15**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		111 %	37-154		"	"	"	"	
Surrogate: Toluene-d8		95.8 %	45-149		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		98.0 %	45-146		"	"	"	"	

Summit Scientific

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

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

**Reported:**  
06/28/16 11:58

**BH05**  
**1606258-04 (Water)**

**Summit Scientific**

**Volatile Organic Compounds by EPA Method 8260B**

Date Sampled: **06/22/16 13:30**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	1.0	ug/l	1	1606253	06/26/16	06/26/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	"	"	
Ethylbenzene	ND	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **06/22/16 13:30**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		108 %	37-154		"	"	"	"	
Surrogate: Toluene-d8		98.1 %	45-149		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		98.5 %	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:**  
06/28/16 11:58

**BH06**  
**1606258-05 (Water)**

**Summit Scientific**

**Volatile Organic Compounds by EPA Method 8260B**

Date Sampled: **06/22/16 12:15**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	1.0	ug/l	1	1606253	06/26/16	06/26/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	"	"	
Ethylbenzene	ND	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **06/22/16 12:15**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		112 %	37-154		"	"	"	"	
Surrogate: Toluene-d8		97.7 %	45-149		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		97.3 %	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:**  
06/28/16 11:58

**BH07**  
**1606258-06 (Water)**

**Summit Scientific**

**Volatile Organic Compounds by EPA Method 8260B**

Date Sampled: **06/22/16 12:30**

Analyte	Result	Reporting	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
		Limit							
Benzene	ND	1.0	ug/l	1	1606253	06/26/16	06/26/16	EPA 8260B	
Toluene	ND	1.0	"	"	"	"	"	"	
Ethylbenzene	ND	1.0	"	"	"	"	"	"	
Xylenes (total)	ND	1.0	"	"	"	"	"	"	

Date Sampled: **06/22/16 12:30**

Analyte	Result	Reporting	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
		Limit							
Surrogate: 1,2-Dichloroethane-d4		115 %	37-154		"	"	"	"	
Surrogate: Toluene-d8		96.6 %	45-149		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		97.2 %	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:  
06/28/16 11:58

## 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 1606253 - EPA 5030 Water MS

##### Blank (1606253-BLK1)

Prepared & Analyzed: 06/24/16

Benzene	ND	1.0	ug/l							
Toluene	ND	1.0	"							
Ethylbenzene	ND	1.0	"							
Xylenes (total)	ND	1.0	"							
Surrogate: 1,2-Dichloroethane-d4	14.1		"	13.3		106	37-154			
Surrogate: Toluene-d8	12.8		"	13.3		96.0	45-149			
Surrogate: 4-Bromofluorobenzene	13.1		"	13.3		98.6	45-146			

##### LCS (1606253-BS1)

Prepared & Analyzed: 06/24/16

Benzene	38.6	1.0	ug/l	33.3		116	51-132			
Toluene	41.1	1.0	"	33.3		123	51-138			
Ethylbenzene	44.7	1.0	"	33.1		135	58-146			
m,p-Xylene	87.8	2.0	"	66.5		132	57-144			
o-Xylene	43.8	1.0	"	32.7		134	53-146			
Surrogate: 1,2-Dichloroethane-d4	14.1		"	13.3		105	37-154			
Surrogate: Toluene-d8	13.8		"	13.3		103	45-149			
Surrogate: 4-Bromofluorobenzene	13.3		"	13.3		99.5	45-146			

##### Matrix Spike (1606253-MS1)

Source: 1606256-01

Prepared & Analyzed: 06/24/16

Benzene	39.9	1.0	ug/l	33.3	ND	120	34-141			
Toluene	42.8	1.0	"	33.3	ND	128	27-151			
Ethylbenzene	47.7	1.0	"	33.1	ND	144	29-160			
m,p-Xylene	94.2	2.0	"	66.5	ND	142	20-166			
o-Xylene	46.4	1.0	"	32.7	ND	142	33-159			
Surrogate: 1,2-Dichloroethane-d4	14.8		"	13.3		111	37-154			
Surrogate: Toluene-d8	13.4		"	13.3		100	45-149			
Surrogate: 4-Bromofluorobenzene	13.2		"	13.3		98.8	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:  
06/28/16 11:58

**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 1606253 - EPA 5030 Water MS**

Matrix Spike Dup (1606253-MSD1)		Source: 1606256-01			Prepared & Analyzed: 06/24/16					
Benzene	40.4	1.0	ug/l	33.3	ND	121	34-141	1.29	32	
Toluene	43.3	1.0	"	33.3	ND	130	27-151	1.21	25	
Ethylbenzene	49.4	1.0	"	33.1	ND	149	29-160	3.50	50	
m,p-Xylene	97.0	2.0	"	66.5	ND	146	20-166	2.89	36	
o-Xylene	47.7	1.0	"	32.7	ND	146	33-159	2.79	26	
Surrogate: 1,2-Dichloroethane-d4	14.8		"	13.3		111	37-154			
Surrogate: Toluene-d8	13.1		"	13.3		98.2	45-149			
Surrogate: 4-Bromofluorobenzene	13.1		"	13.3		98.1	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:**  
06/28/16 11:58

### 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

---

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.*

A handwritten signature in black ink, appearing to be 'MSM'.