



November 29, 2017

Karen Shanahan Olson
Senior EHS Manager
PDC Energy, Inc.
1775 Sherman Street, Suite 3000
Denver, CO 80203

**RE: Produced Water Vessel Closure Report
Hardman 1, 2, 3, 4 Tank Battery
Facility ID #: 319492
NWSW S16 T5N R67W
Blanket Remediation #: 9440**

Dear Mrs. Olson,

On behalf of PDC Energy, Inc. (PDC), Tasman Geosciences, Inc. (Tasman) has prepared this Produced Water Vessel Closure Report (Report) to document environmental sampling activities performed at the above-referenced site. This Report is being submitted under the Form 27 Management Plan for Closure of Produced Water Vessels, which has been assigned Blanket Remediation #9440 by the Colorado Oil and Gas Conservation Commission (COGCC).

A summary of excavation and environmental sampling activities is provided below.

Site Assessment Activities

On November 16, 2017, confirmation sampling activities were conducted following the removal of the partially buried produced water vessel. Soil encountered in the excavation was field screened for volatile organic compound (VOC) concentrations in soil using a photoionization detector (PID). One soil sample (SS01) was collected below the former vessel location at approximately 6 feet below ground surface (bgs). The sample was submitted to Summit Scientific Laboratories in Golden, Colorado for analysis of benzene, toluene, ethylbenzene, and total xylenes (BTEX), naphthalene, and total petroleum hydrocarbons (TPH) – gasoline range organics (GRO) by United States Environmental Protection Agency (USEPA) Method 8260B, TPH – diesel range organics (DRO) by USEPA Method 8015, pH, and electrical conductivity (EC).

Analytical results indicated that organic compound concentrations and physical parameters were in compliance with COGCC Table 910-1 soil standards.

The excavation extent and soil sample location are illustrated on Figure 1. Soil analytical data is summarized in Table 1 and the laboratory analytical report is included as Attachment A.

Conclusions

Based on the soil analytical data described herein, petroleum hydrocarbon impacts in exceedance of regulatory standards were not encountered during the removal of the produced water vessel.

Consequently, no further site investigation is recommended at this time. The facility was decommissioned following site assessment activities.

Please contact me at (720) 409-8791 if you have questions regarding this report.

Sincerely,

Tasman Geosciences, Inc.

A handwritten signature in black ink that reads 'Christine Hamlin' in a cursive script.

Christine Hamlin
Program Manager

Enclosures:

Figure 1 – Excavation Site Map

Table 1 – Soil Analytical Results Summary Table

Attachment A – Laboratory Analytical Report



Legend

- Excavation Extent
- ⊕ Excavation Soil Sample Location

Notes

All locations are approximate unless otherwise noted.

Surface drainage direction is estimated based on topography and is not related to regional topography.

GPS – Global Positioning System

0 ft. 15 ft. 30 ft.

Image Source: Google Earth; 2016 Google
Projection: WGS 84 UTM Zone 13 North

DATE:	November 29, 2017
DESIGNED BY:	C. Hamlin
DRAWN BY:	C. Armbruster

TASMAN
GEOSCIENCES

Tasman Geosciences, Inc.
6899 Pecos Street – Unit C
Denver, CO 80221

PDC Energy, Inc. – DJ Basin
Hardman 1, 2, 3, 4 Tank Battery
NWSW, Section 16, Township 5 North, Range 67 West
Weld County, Colorado

EXCAVATION SITE MAP

FIGURE
1

TABLE 1
HARDMAN 1, 2, 3, 4 TANK BATTERY
SOIL ANALYTICAL RESULTS SUMMARY TABLE

Sample ID	Date Sampled	Depth (feet bgs)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)	Naphthalene (mg/kg)	TPH ⁽²⁾ (mg/kg)	pH (units)	EC (mmhos/cm)
COGCC standards for soil (mg/kg) ⁽¹⁾			0.17	85	100	175	23	500	6-9	<4
SS01 @ 6'	11/16/2017	6'	<0.0020	<0.0050	<0.0050	<0.010	<0.010	<50	8.45	0.714

Notes:

1. Standards for soil are taken from 2 CCR 404-1, Table 910-1, effective January 30, 2015.
2. TPH - Total volatile and extractable petroleum hydrocarbons. Value calculated by adding GRO and DRO concentrations.

COGCC = Colorado Oil and Gas Conservation Commission

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

GRO = Total volatile petroleum hydrocarbons - gasoline range organics

DRO = Total extractable petroleum hydrocarbons - diesel range organics

mg/kg = Milligrams per kilogram

bgs = Below ground surface

EC = Electrical conductivity

mmhos/cm = millimhos per centimeter

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

ATTACHMENT A

Summit Scientific

741 Corporate Circle – Suite I ♦ Golden, Colorado 80401

303.277.9310 - laboratory ♦ 303.277.9531 - fax

November 22, 2017

Mark Longhurst
PDC Energy
1775 Sherman St. STE. 3000
Denver, CO 80203
RE: Hardman 1 2, 3, 4

Enclosed are the results of analyses for samples received by Summit Scientific on 11/16/17 14:22. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read 'Ben Shrewsbury', with a long, sweeping horizontal line extending to the right.

Ben Shrewsbury
Laboratory Manager



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

Project: Hardman 1 2, 3, 4

Project Number: [none]
Project Manager: Mark Longhurst

Reported:
11/22/17 12:07

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SS01@6'	1711229-01	Soil	11/16/17 13:21	11/16/17 14:22

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.

1711229

Sample Receipt Checklist

S2 Work Order: _____

Client: PDC Client Project ID: HARDMAN 1,2,3,4Shipped Via: P.U. Airbill #: _____
(UPS, FedEx, Hand Delivered, Pick-up, etc.)Matrix (check all that apply): Air Soil/Solid Water Other: _____
(Describe)

Cooler ID					
Temp (°C)	5.3				

Thermometer ID: 61857155-K

	Yes	No	N/A	Comments (if any)
If samples require cooling, was the temperature at 4°C +/- 2°C ⁽¹⁾ ? NOTE: If samples are delivered the same day of sampling, this requirement is met provided that there is evidence that cooling has begun.	<input checked="" type="checkbox"/>			
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⁾ ? Note the type of preservative in the Comments column – HCl, H2SO4, NaOH, HNO3, ect			<input checked="" type="checkbox"/>	
If samples are acid preserved for metals, is the pH ≤ 2 ⁽¹⁾ ? Record the pH in Comments.			<input checked="" type="checkbox"/>	
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.				

Murip.
Custodian Printed NameMA 11-16-17
Signature or Initials of Custodian17:30
Date/Time



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

Project: Hardman 1 2, 3, 4

Project Number: [none]
Project Manager: Mark Longhurst

Reported:
11/22/17 12:07

SS01@6'
1711229-01 (Soil)

Summit Scientific

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **11/16/17 13:21**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50	mg/kg	1	1711281	11/20/17	11/21/17	8015M	

Date Sampled: **11/16/17 13:21**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: <i>o</i> -Terphenyl		97.0 %	30-150		"	"	"	"	

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **11/16/17 13:21**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Naphthalene	ND	0.010	mg/kg	1	1711252	11/17/17	11/17/17	EPA 8260B	
Benzene	ND	0.0020	"	"	"	"	"	"	
Toluene	ND	0.0050	"	"	"	"	"	"	
Ethylbenzene	ND	0.0050	"	"	"	"	"	"	
Xylenes (total)	ND	0.010	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50	"	"	"	"	"	"	

Date Sampled: **11/16/17 13:21**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		153 %	23-173		"	"	"	"	
Surrogate: Toluene-d8		99.2 %	20-170		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		103 %	21-167		"	"	"	"	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **11/16/17 13:21**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	8.45	0.100	pH Units	1	1711255	11/17/17	11/17/17	EPA 9045	

Summit Scientific

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PDC Energy
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Project: Hardman 1 2, 3, 4

Project Number: [none]
 Project Manager: Mark Longhurst

Reported:
 11/22/17 12:07

SS01@6'
1711229-01 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Specific Conductance by EPA120.1

Date Sampled: **11/16/17 13:21**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	0.714	0.0100	mmhos/cm	1	1711256	11/17/17	11/17/17	EPA 120.1	

Summit Scientific

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Project: Hardman 1 2, 3, 4

Project Number: [none]
 Project Manager: Mark Longhurst

Reported:
 11/22/17 12:07

Extractable Petroleum Hydrocarbons by 8015 - Quality Control
Summit Scientific

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

Batch 1711281 - EPA 3550A

Blank (1711281-BLK1)				Prepared & Analyzed: 11/20/17							
C10-C28 (DRO)	ND	50	mg/kg								
<i>Surrogate: o-Terphenyl</i>	12.2		"	12.5		97.9	30-150				
LCS (1711281-BS1)				Prepared & Analyzed: 11/20/17							
C10-C28 (DRO)	510	50	mg/kg	499		102	73-134				
<i>Surrogate: o-Terphenyl</i>	12.6		"	12.5		101	30-150				
Matrix Spike (1711281-MS1)				Source: 1711228-01		Prepared & Analyzed: 11/20/17					
C10-C28 (DRO)	531	50	mg/kg	499	31.7	100	50-148				
<i>Surrogate: o-Terphenyl</i>	15.6		"	12.5		125	30-150				
Matrix Spike Dup (1711281-MSD1)				Source: 1711228-01		Prepared & Analyzed: 11/20/17					
C10-C28 (DRO)	483	50	mg/kg	499	31.7	90.5	50-148	9.45		20	
<i>Surrogate: o-Terphenyl</i>	12.8		"	12.5		103	30-150				

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

Project: Hardman 1 2, 3, 4

Project Number: [none]
Project Manager: Mark Longhurst

Reported:
11/22/17 12:07

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

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

Batch 1711252 - EPA 5030 Soil MS

Blank (1711252-BLK1)

Prepared & Analyzed: 11/17/17

Naphthalene	ND	0.010	mg/kg							
Benzene	ND	0.0020	"							
Toluene	ND	0.0050	"							
Ethylbenzene	ND	0.0050	"							
Xylenes (total)	ND	0.010	"							
Gasoline Range Hydrocarbons	ND	0.50	"							
<i>Surrogate: 1,2-Dichloroethane-d4</i>	<i>0.0531</i>		<i>"</i>	<i>0.0400</i>		<i>133</i>	<i>23-173</i>			
<i>Surrogate: Toluene-d8</i>	<i>0.0401</i>		<i>"</i>	<i>0.0400</i>		<i>100</i>	<i>20-170</i>			
<i>Surrogate: 4-Bromofluorobenzene</i>	<i>0.0401</i>		<i>"</i>	<i>0.0400</i>		<i>100</i>	<i>21-167</i>			

LCS (1711252-BS1)

Prepared & Analyzed: 11/17/17

Naphthalene	ND	0.010	mg/kg				66-138			
Benzene	0.0939	0.0020	"	0.100		93.9	58-130			
Toluene	0.0978	0.0050	"	0.100		97.8	61-134			
Ethylbenzene	0.104	0.0050	"	0.0992		105	74-139			
m,p-Xylene	0.204	0.010	"	0.200		102	73-137			
o-Xylene	0.101	0.0050	"	0.0980		103	73-141			
Xylenes (total)	0.305	0.010	"				0-200			
Gasoline Range Hydrocarbons	2.33	0.50	"				30-150			
<i>Surrogate: 1,2-Dichloroethane-d4</i>	<i>0.0516</i>		<i>"</i>	<i>0.0400</i>		<i>129</i>	<i>23-173</i>			
<i>Surrogate: Toluene-d8</i>	<i>0.0409</i>		<i>"</i>	<i>0.0400</i>		<i>102</i>	<i>20-170</i>			
<i>Surrogate: 4-Bromofluorobenzene</i>	<i>0.0403</i>		<i>"</i>	<i>0.0400</i>		<i>101</i>	<i>21-167</i>			

Matrix Spike (1711252-MS1)

Source: 1711226-01

Prepared & Analyzed: 11/17/17

Naphthalene	ND	0.010	mg/kg		ND		10-158			
Benzene	0.0916	0.0020	"	0.100	ND	91.6	30-131			
Toluene	0.0899	0.0050	"	0.100	ND	89.9	30-134			
Ethylbenzene	0.100	0.0050	"	0.0992	ND	101	22-153			
m,p-Xylene	0.191	0.010	"	0.200	ND	95.9	10-159			
o-Xylene	0.0887	0.0050	"	0.0980	ND	90.6	31-151			
Xylenes (total)	0.280	0.010	"		ND		30-160			
Gasoline Range Hydrocarbons	1.94	0.50	"		ND		30-160			
<i>Surrogate: 1,2-Dichloroethane-d4</i>	<i>0.0541</i>		<i>"</i>	<i>0.0400</i>		<i>135</i>	<i>23-173</i>			
<i>Surrogate: Toluene-d8</i>	<i>0.0379</i>		<i>"</i>	<i>0.0400</i>		<i>94.6</i>	<i>20-170</i>			
<i>Surrogate: 4-Bromofluorobenzene</i>	<i>0.0369</i>		<i>"</i>	<i>0.0400</i>		<i>92.2</i>	<i>21-167</i>			

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

Project: Hardman 1 2, 3, 4

Project Number: [none]
 Project Manager: Mark Longhurst

Reported:
 11/22/17 12:07

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

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

Batch 1711252 - EPA 5030 Soil MS

Matrix Spike Dup (1711252-MSD1)	Source: 1711226-01			Prepared & Analyzed: 11/17/17						
Naphthalene	ND	0.010	mg/kg	ND	ND	10-158			42	
Benzene	0.0916	0.0020	"	0.100	ND	91.6	30-131	0.0983	34	
Toluene	0.0960	0.0050	"	0.100	ND	96.0	30-134	6.58	30	
Ethylbenzene	0.0989	0.0050	"	0.0992	ND	99.7	22-153	1.24	24	
m,p-Xylene	0.192	0.010	"	0.200	ND	96.3	10-159	0.438	68	
o-Xylene	0.0935	0.0050	"	0.0980	ND	95.4	31-151	5.20	38	
Xylenes (total)	0.286	0.010	"		ND		30-160	1.97	30	
Gasoline Range Hydrocarbons	3.35	0.50	"		ND		30-160	53.2	30	QM-07
<i>Surrogate: 1,2-Dichloroethane-d4</i>	<i>0.0521</i>		<i>"</i>	<i>0.0400</i>		<i>130</i>	<i>23-173</i>			
<i>Surrogate: Toluene-d8</i>	<i>0.0405</i>		<i>"</i>	<i>0.0400</i>		<i>101</i>	<i>20-170</i>			
<i>Surrogate: 4-Bromofluorobenzene</i>	<i>0.0326</i>		<i>"</i>	<i>0.0400</i>		<i>81.4</i>	<i>21-167</i>			

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

Project: Hardman 1 2, 3, 4

Project Number: [none]
 Project Manager: Mark Longhurst

Reported:
 11/22/17 12:07

**Physical Parameters by APHA/ASTM/EPA Methods - Quality Control
 Summit Scientific**

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

Batch 1711255 - General Preparation

LCS (1711255-BS1)

Prepared & Analyzed: 11/17/17

pH	9.18	0.100	pH Units	9.16	100	95-105
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Duplicate (1711255-DUP1)

Source: 1711223-01

Prepared & Analyzed: 11/17/17

pH	8.15	0.100	pH Units	8.15	0.00	20
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Summit Scientific

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

Project: Hardman 1 2, 3, 4

Project Number: [none]
 Project Manager: Mark Longhurst

Reported:
 11/22/17 12:07

Specific Conductance by EPA120.1 - Quality Control
Summit Scientific

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

Batch 1711256 - General Preparation

Blank (1711256-BLK1)

Prepared & Analyzed: 11/17/17

Specific Conductance (EC) ND 0.0100 mmhos/cm

LCS (1711256-BS1)

Prepared & Analyzed: 11/17/17

Specific Conductance (EC) 0.752 0.0100 mmhos/cm 0.750 100 90-110

Duplicate (1711256-DUP1)

Source: 1711223-01

Prepared & Analyzed: 11/17/17

Specific Conductance (EC) 1.20 0.0100 mmhos/cm 1.41 16.1 20

Summit Scientific

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

Project: Hardman 1 2, 3, 4

Project Number: [none]
Project Manager: Mark Longhurst

Reported:
11/22/17 12:07

Notes and Definitions

- QM-07 The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS/LCSD recovery.
- 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