

January 2, 2019
Karen Shanahan Olson
Senior EHS Manager
PDC Energy, Inc.
1775 Sherman Street, Suite 3000
Denver, CO 80203

**RE: Produced Water Vessel Closure Report
Former National Hog Farm 21-9 Tank Battery
Facility ID #: 331576
NENW S9 T5N R63W**

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 in accordance with Colorado Oil and Gas Conservation Commission (COGCC) Rule 905 – Closure of Buried or Partially Buried Produced Water Vessels.

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

Site Assessment Activities

On December 17, 2018, 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) [Table 2]. One soil sample (SS01) was collected below the former vessel location at approximately 5.5 feet below ground surface (bgs). The sample was submitted to Summit Scientific Laboratories in Golden, Colorado (Summit) 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).

In addition, the soil sample (SS05) collected from the east sidewall of the excavation which exhibited the highest PID reading was submitted to Summit for analysis of BTEX, naphthalene, TPH – GRO, and TPH – DRO.

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 locations 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 (912) 230-2807 if you have questions regarding this report.

Sincerely,

Tasman Geosciences, Inc.

A handwritten signature in blue ink, appearing to read "Brock Nelson".

Brock Nelson
Project Manager

Enclosures:

Figure 1 – Excavation Site Map

Table 1 – Soil Analytical Results Summary Table

Table 2 – VOC Concentrations Summary Table

Attachment A – Laboratory Analytical Report



Legend

- Excavation Extent
- ⊕ Soil Sample Location (Collected via Trimble GPS)

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:	December 17, 2018
DESIGNED BY:	B. Nelson
DRAWN BY:	J. McCarver



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

PDC Energy, Inc. – DJ Basin
Former National Hog Farm 21-9 Tank Battery
NENW, Section 9, Township 5 North, Range 63 West
Weld County, Colorado

EXCAVATION SITE MAP

FIGURE
1

TABLE 1
FORMER NATIONAL HOG FARM 21-9 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 @ 5.5'	12/17/2018	5.5	<0.0020	<0.0050	<0.0050	<0.010	<0.010	53	6.93	1.46
SS05 @ 3'	12/17/2018	3	<0.0020	<0.0050	<0.0050	<0.010	<0.010	<50	NA	NA

Notes:

1. Standards for soil are taken from 2 CCR 404-1, Table 910-1, effective May 1, 2018.

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

NA = Constituent Not Analyzed

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

TABLE 2
FORMER NATIONAL HOG FARM 21-9 TANK BATTERY
VOC CONCENTRATIONS SUMMARY TABLE

Sample ID	Date Sampled	Depth (feet bgs)	Sample Location ⁽¹⁾	Field Measured VOC Concentration ⁽²⁾ (ppm)
SS01 @ 5'	12/17/2018	5.5	Base	38.3
SS02 @ 3'	12/17/2018	3	North Sidewall	4.8
SS03 @ 3'	12/17/2018	3	West Sidewall	4.9
SS04 @ 3'	12/17/2018	3	South Sidewall	0.7
SS05 @ 3'	12/17/2018	3	East Sidewall	15.0

Notes:

1. Refers to the sample location within the excavation area below the former produced water vessel.

2. Volatile organic compound (VOC) concentrations are measured in the field using a photoionization detector (PID).

bgs = Below ground surface

ppm = Parts per million

= Sample submitted for laboratory analysis.

ATTACHMENT A

Summit Scientific

4653 Table Mountain Drive, Golden, Colorado 80403

303.277.9310

December 18, 2018

Mark Longhurst

PDC Energy

1775 Sherman St. STE. 3000

Denver, CO 80203

RE: National Hog Farm 21-9

Enclosed are the results of analyses for samples received by Summit Scientific on 12/17/18 18:00. 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: National Hog Farm 21-9

Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/18/18 05:39

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SS01@5.5'	1812205-01	Soil	12/17/18 11:11	12/17/18 18:00
SS05@3'	1812205-05	Soil	12/17/18 11:19	12/17/18 18:00

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.

Summit Scientific

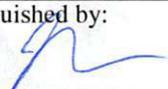
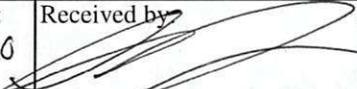
18V2205

741 Corporate Circle Suite I ♦ Golden, Colorado 80401
303-277-9310 ♦ 303-374-5933 Fax

Page 1 of 1

Client: PDC
Address: _____
City/State/Zip: _____
Phone: _____ Fax: _____
Sampler Name: Jake McCarver

Project Manager: Mark Longhurst
E-Mail: Mark.Longhurst@pdce.com
Project Name: National Hog Farm 21-9
Project Number: _____

Sample Description	Date Sampled	Time Sampled	Number of Containers	Preservative				Matrix				Analyze For:						Special Instructions				
				HCl	HNO ₃	None	Other (Specify)	Groundwater	Soil	Air - Canister Serial #	Other (Specify)	GBTEXN (8260)	TPH - DRO	EC / pH	HOLD							
SS01 @ 5.5'	12/17/2018	11:11	1			X		X					X	X	X							
SS02 @ 3'	12/17/2018	11:13	1			X		X									X					
SS03 @ 3'	12/17/2018	11:15	1			X		X									X					
SS04 @ 3'	12/17/2018	11:17	1			X		X									X					
SS05 @ 3'	12/17/2018	11:19	1			X		X					X	X								
Relinquished by: 				Date/Time: <u>12/17/18</u> <u>1840</u>				Received by: 				Date/Time: <u>12-17-18</u> <u>1840</u>				Turn Around Time (Check)						Hold SS02-SS04
												Same Day <input checked="" type="checkbox"/>				72 Hours <input type="checkbox"/>		Standard <input type="checkbox"/>				
												24 Hours <input type="checkbox"/>										
Relinquished by:				Date/Time:				Received by:				Date/Time:				48 Hours <input type="checkbox"/>						
Relinquished by:				Date/Time:				Received in Lab by:				Date/Time:				Sample Integrity:						
																Temperature Upon Receipt: <u>5.6</u>						
																Intact: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>						

Sample Receipt Checklist

S2 Work Order 1812205

Client: PDC Client Project ID: National Hog Farm

Shipped Via: H.D./P.U./FedEx/UPS/USPS/Other P.U. Airbill #: _____

Matrix (check all that apply): Air Soil/Solid Water Other: _____
(Describe)

Temp (°C)	5.6
-----------	-----

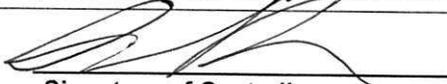
Thermometer ID: 61857155-K

	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.	✓			
Were all samples received intact ⁽¹⁾ ?	✓			
Was adequate sample volume provided ⁽¹⁾ ?	✓			
If custody seals are present, are they intact ⁽¹⁾ ?			✓	
Are samples with holding times due within 48 hours sample due within 48 hours present?			✓	
Is a chain-of-custody (COC) form present and filled out completely ⁽¹⁾ ?	✓			
Does the COC agree with the number and type of sample bottles received ⁽¹⁾ ?	✓			
Do the sample IDs on the bottle labels match the COC ⁽¹⁾ ?	✓			
Is the COC properly relinquished by the client w/ date and time recorded ⁽¹⁾ ?	✓			
For volatiles in water – is there headspace present? If yes, contact client and note in narrative.			✓	
Are samples preserved that require preservation (excluding cooling) ⁽¹⁾ ? 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⁾ ? Record the pH in Comments.			✓	
If dissolved metals are requested, were samples field filtered?			✓	

Additional Comments (if any):

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

MP
Custodian Printed Name or Initials


Signature of Custodian

12.17.18 1840
Date/Time



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

Project: National Hog Farm 21-9

Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/18/18 05:39

SS01@5.5'
1812205-01 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/17/18 11:11**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020	mg/kg	1	1812233	12/17/18	12/17/18	EPA 8260B	
Toluene	ND	0.0050	"	"	"	"	"	"	
Ethylbenzene	ND	0.0050	"	"	"	"	"	"	
Xylenes (total)	ND	0.010	"	"	"	"	"	"	
Naphthalene	ND	0.010	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50	"	"	"	"	"	"	

Date Sampled: **12/17/18 11:11**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		106 %	23-173		"	"	"	"	
Surrogate: Toluene-d8		101 %	20-170		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		106 %	21-167		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **12/17/18 11:11**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	53	50	mg/kg	1	1812234	12/17/18	12/17/18	EPA 8015M	

Date Sampled: **12/17/18 11:11**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		99.7 %	30-150		"	"	"	"	

Physical Parameters by APHA/ASTM/EPA Methods

Date Sampled: **12/17/18 11:11**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
pH	6.93		pH Units	1	1812236	12/17/18	12/17/18	EPA 9045D	

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

Project: National Hog Farm 21-9

Project Number: [none]
 Project Manager: Mark Longhurst

Reported:
 12/18/18 05:39

SS01@5.5'
1812205-01 (Soil)

Summit Scientific

Physical Parameters by APHA/ASTM/EPA Methods

Specific Conductance by EPA Method 120.1

Date Sampled: **12/17/18 11:11**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Specific Conductance (EC)	1.46	0.0100	mmhos/cm	1	1812235	12/17/18	12/17/18	EPA 120.1	

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

Project: National Hog Farm 21-9

Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/18/18 05:39

SS05@3'
1812205-05 (Soil)

Summit Scientific

Volatile Organic Compounds by EPA Method 8260B

Date Sampled: **12/17/18 11:19**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Benzene	ND	0.0020	mg/kg	1	1812233	12/17/18	12/18/18	EPA 8260B	
Toluene	ND	0.0050	"	"	"	"	"	"	
Ethylbenzene	ND	0.0050	"	"	"	"	"	"	
Xylenes (total)	ND	0.010	"	"	"	"	"	"	
Naphthalene	ND	0.010	"	"	"	"	"	"	
Gasoline Range Hydrocarbons	ND	0.50	"	"	"	"	"	"	

Date Sampled: **12/17/18 11:19**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: 1,2-Dichloroethane-d4		106 %	23-173		"	"	"	"	
Surrogate: Toluene-d8		98.3 %	20-170		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		107 %	21-167		"	"	"	"	

Extractable Petroleum Hydrocarbons by 8015

Date Sampled: **12/17/18 11:19**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
C10-C28 (DRO)	ND	50	mg/kg	1	1812234	12/17/18	12/18/18	EPA 8015M	

Date Sampled: **12/17/18 11:19**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
Surrogate: o-Terphenyl		104 %	30-150		"	"	"	"	

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

Project: National Hog Farm 21-9

Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/18/18 05:39

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 1812233 - EPA 5030 Soil MS

Blank (1812233-BLK1)

Prepared & Analyzed: 12/17/18

Benzene	ND	0.0020	mg/kg							
Toluene	ND	0.0050	"							
Ethylbenzene	ND	0.0050	"							
Xylenes (total)	ND	0.010	"							
Naphthalene	ND	0.010	"							
Gasoline Range Hydrocarbons	ND	0.50	"							
Surrogate: 1,2-Dichloroethane-d4	0.0454		"	0.0396		115	23-173			
Surrogate: Toluene-d8	0.0376		"	0.0400		94.0	20-170			
Surrogate: 4-Bromofluorobenzene	0.0415		"	0.0400		104	21-167			

LCS (1812233-BS1)

Prepared & Analyzed: 12/17/18

Benzene	0.112	0.0020	mg/kg	0.100		112	70-130			
Toluene	0.113	0.0050	"	0.100		113	70-130			
Ethylbenzene	0.121	0.0050	"	0.100		121	70-130			
m,p-Xylene	0.237	0.010	"	0.200		119	70-130			
o-Xylene	0.107	0.0050	"	0.100		107	70-130			
Surrogate: 1,2-Dichloroethane-d4	0.0453		"	0.0396		114	23-173			
Surrogate: Toluene-d8	0.0402		"	0.0400		101	20-170			
Surrogate: 4-Bromofluorobenzene	0.0426		"	0.0400		106	21-167			

Matrix Spike (1812233-MS1)

Source: 1812201-01

Prepared & Analyzed: 12/17/18

Benzene	0.111	0.0020	mg/kg	0.100	ND	111	70-130			
Toluene	0.113	0.0050	"	0.100	ND	113	70-130			
Ethylbenzene	0.124	0.0050	"	0.100	ND	124	70-130			
m,p-Xylene	0.246	0.010	"	0.200	0.00366	121	70-130			
o-Xylene	0.112	0.0050	"	0.100	ND	112	70-130			
Surrogate: 1,2-Dichloroethane-d4	0.0433		"	0.0396		109	23-173			
Surrogate: Toluene-d8	0.0401		"	0.0400		100	20-170			
Surrogate: 4-Bromofluorobenzene	0.0449		"	0.0400		112	21-167			

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

Project: National Hog Farm 21-9

Project Number: [none]
 Project Manager: Mark Longhurst

Reported:
 12/18/18 05:39

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

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

Batch 1812233 - EPA 5030 Soil MS

Matrix Spike Dup (1812233-MSD1)	Source: 1812201-01			Prepared & Analyzed: 12/17/18						
Benzene	0.111	0.0020	mg/kg	0.100	ND	111	70-130	0.622	30	
Toluene	0.111	0.0050	"	0.100	ND	111	70-130	1.34	30	
Ethylbenzene	0.118	0.0050	"	0.100	ND	118	70-130	5.33	30	
m,p-Xylene	0.238	0.010	"	0.200	0.00366	117	70-130	3.22	30	
o-Xylene	0.104	0.0050	"	0.100	ND	104	70-130	7.20	30	
<i>Surrogate: 1,2-Dichloroethane-d4</i>	<i>0.0449</i>		<i>"</i>	<i>0.0396</i>		<i>113</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>0.0425</i>		<i>"</i>	<i>0.0400</i>		<i>106</i>	<i>21-167</i>			

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

Project: National Hog Farm 21-9

Project Number: [none]
 Project Manager: Mark Longhurst

Reported:
 12/18/18 05:39

Extractable Petroleum Hydrocarbons by 8015 - Quality Control
Summit Scientific

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

Batch 1812234 - EPA 3550A

Blank (1812234-BLK1)

Prepared: 12/17/18 Analyzed: 12/18/18

C10-C28 (DRO) ND 50 mg/kg

LCS (1812234-BS1)

Prepared: 12/17/18 Analyzed: 12/18/18

C10-C28 (DRO) 539 50 mg/kg 500 108 70-130

Matrix Spike (1812234-MS1)

Source: 1812201-01

Prepared: 12/17/18 Analyzed: 12/18/18

C10-C28 (DRO) 590 50 mg/kg 500 22.2 113 70-130

Matrix Spike Dup (1812234-MSD1)

Source: 1812201-01

Prepared: 12/17/18 Analyzed: 12/18/18

C10-C28 (DRO) 601 50 mg/kg 500 22.2 116 70-130 1.85 20

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: National Hog Farm 21-9 Project Number: [none] Project Manager: Mark Longhurst	Reported: 12/18/18 05:39
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Physical Parameters by APHA/ASTM/EPA Methods - Quality Control
Summit Scientific

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

Batch 1812236 - General Preparation

LCS (1812236-BS1)				Prepared & Analyzed: 12/17/18						
pH	9.2		pH Units	9.23		99.9	95-105			
Duplicate (1812236-DUP1)				Source: 1812205-01		Prepared & Analyzed: 12/17/18				
pH	6.9		pH Units		6.9			0.0144	20	

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: National Hog Farm 21-9 Project Number: [none] Project Manager: Mark Longhurst	Reported: 12/18/18 05:39
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Specific Conductance by EPA Method 120.1 - Quality Control
Summit Scientific

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

Batch 1812235 - General Preparation

Blank (1812235-BLK1)		Prepared & Analyzed: 12/17/18									
Specific Conductance (EC)	ND	0.0100	mmhos/cm								
LCS (1812235-BS1)		Prepared & Analyzed: 12/17/18									
Specific Conductance (EC)	0.766	0.0100	mmhos/cm	0.750	102	90-110					
Duplicate (1812235-DUP1)		Source: 1812205-01		Prepared & Analyzed: 12/17/18							
Specific Conductance (EC)	1.46	0.0100	mmhos/cm		1.46				0.171	20	

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: National Hog Farm 21-9

Project Number: [none]
Project Manager: Mark Longhurst

Reported:
12/18/18 05:39

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