



March 19, 2018

Mr. Scott Yount  
Tallgrass Energy, LLC c/o BNN Western, LLC  
4992 SW Buffalo Road  
Towanda, Kansas 67144

Via Email

**RE: COGCC Spill/Release Point #453835 BNN Western Horsetail #19-N SWD Facility  
Oil and Produced Water Spill Soil Sampling Report, Olsson Project #018-0595**

Dear Mr. Yount,

The Horsetail 19-N Saltwater Disposal (SWD) facility, a Class II underground injection control (UIC) disposal well, is located in the Southwest Quarter of the Southeast Quarter of Section 19, Township 10 North, Range 57 West, of the Sixth Principal Meridian. Coordinates for the BNN Horsetail 19-N disposal well are 40.818862 N latitude; -103.794092 W longitude. The facility is located approximately one mile southeast of the intersection of Weld County Road 116 and County Road 133. BNN Western, LLC (BNN) operates a water handling facility on the pad south of the tank batteries. A site location map is shown as **Figure 1** and a site map showing the location of the produced water spill is presented as **Figure 2** respectively.

### **Background**

On January 25, 2018, an aboveground fiberglass pipe failed at a joint outside of secondary containment prior to going into the inlet 750-bbl capacity gunbarrel separation tank. Approximately 100 barrels of produced water containing less than one barrel of crude oil was released to the ground. The pipe was isolated following discovery and the spill was contained on location. The pooled liquid was collected using a vacuum truck and the impacted soils were excavated and stockpiled in a lined containment on location.

### **Site Characterization**

BNN Western personnel escorted Olsson personnel to the Horsetail 19N site on February 8, 2018. M&E Oilfield Services was onsite excavating the impacted soil using a skidsteer and hand shovels beneath the aboveground piping on the north side of the produced water tank containment batteries. Site photographs are presented in **Attachment A**.

The produced water release extended along the north side of the site and around to the east of the processed produced water tank battery and into the detention pond on the east side of the Horsetail 19N location. Olsson collected a total of ten soil samples from the spill area following excavation.

A flush-mounted groundwater monitoring well was observed on the northeast corner of the east treated produced water tank battery. The concrete apron surrounding the well was damaged during soil excavation. A review of records from the previous owner indicate that the monitoring

well was reported dry at the time of installation, was required by Weld County under a use by special review (USR) permit, and not associated with a spill or remediation.

The samples were collected for the following analytes: pH, electrical conductivity, and sodium adsorption ratio (SAR) as required by the Colorado Oil and Gas Conservation Commission (COGCC) Table 910-1 soil parameters for produced water releases. The samples were also analyzed for total petroleum hydrocarbons (TPH) as gasoline range organics (GRO) and diesel range organics (DRO). These soil samples were collected from the surface to between three and five inches below ground surface (bgs). **Table 1** presents a summary of the site characterization soil sample results and a comparison with the Table 910-1 soil parameters. Soil sample locations are shown on **Figure 3**, and a copy of the laboratory report is presented as **Attachment B**.

### Laboratory Analytical Results

Characterization soil samples were collected in laboratory provided 4-ounce glass jars, labeled as HT19N-1 through HT19N-10, placed into a plastic cooler, stored on ice, following chain-of-custody protocols. The samples were hand delivered to Origins Laboratory, Inc. in Denver, Colorado for laboratory analysis of pH by Method SW846/EPA Method 9045D, specific conductivity by EPA modified Method 9050A, for sodium, calcium, and magnesium metals by SW846 6010C, and SAR by 20B Saturated Paste. The TPH-GRO was analyzed by EPA Method 8260C and the TPH-DRO was analyzed by EPA modified Method 8015C.

The laboratory analytical results reported pH ranged from 7.67 to 8.51 standard units (s.u.) which were within the Table 910-1 range of 6. To 9 s.u.. The electrical conductance values for the ten soil samples were reported below the Table 910-1 criteria listed less than 4 millimohs per centimeter (mmohs/cm). The SAR was calculated based on the results for calcium, magnesium, and sodium. The SAR was reported below the Table 910-1 criteria of 12 in all ten soil samples.

The laboratory reported concentrations of TPH-GRO were detected in nine of the ten soil samples. All of the reported concentrations were below the Table 910-1 TPH concentration of 500 mg/kg. Concentrations of TPH-GRO were not detected in soil sample HT19N-8 collected on the west end of the piping at a depth of approximately 6-inches bgs. Since the TPH-GRO concentrations were below 500 mg/kg, the samples were not analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 8260C.

Concentrations of TPH-DRO were reportedly not detected at or above the laboratory reporting limit of 50 milligrams per kilogram (mg/kg) in three of the ten soil samples. Four of the results were reported at concentrations below the COGCC Table 910-1. Concentrations of TPH-DRO were reported above the Table 910-1 TPH concentration of 500 mg/kg in three soil samples that were collected within the area excavated by hand beneath the aboveground piping run. Soil sample HT19N-5 collected north of the two tank batteries contained TPH-DRO reported at 1,630 mg/kg, HT19N-6 collected beneath the point of release had TPH-DRO reported at 1,370 mg/kg, and HT19N-7 collected on the northwest corner of the west tank battery near the piping run had a TPH-DRO reported at 1,880 mg/kg. There was visible soil staining in the soils beneath the pipe support pedestals in these areas.

## Confirmation Soil Sampling and Analytical Results

Additional excavation was conducted beneath the aboveground piping runs on the north side of the tank battery where the release occurred. Olsson personnel collected three additional soil samples on March 6, 2018 from areas that had TPH-DRO concentrations above the Table 910-1 TPH-DRO level of 500 mg/kg. The samples were submitted to Origins for analysis of TPH-DRO. Olsson requested that if the concentrations of TPH-DRO in the confirmation soil samples were greater than 500 mg/kg, that the laboratory run naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene. The other Table 910-1 parameters were not analyzed since the results of the February 8, 2018 sampling showed that they were not above their respective concentrations or levels.

The results for the three confirmation soil samples collected on March 6, 2018 show that TPH-DRO concentrations were below the Table 910-1 concentration of 500 mg/kg. The results for HT19N-11 collected near the point of release and HT19N-6 were reported at 66.2 mg/kg. The laboratory reported that TPH-DRO was not detected at or above the laboratory reporting limit in either HT19-12 collected in the over excavated area near the north lightning rod or in HT19-13 collected near the northwest corner of the secondary containment structure for the gunbarrel separators and produced water tank battery.

## Discussion of Results

The COGCC regulates exploration and production wastes, including spills and releases, under the 900 series Rules; Table 910-1 indicates that TPH (GRO/DRO) must be below 500 mg/kg. Initial analytical sample collected on 2/1/2018 indicated the need for further excavation with three of the ten samples above the 910-1 parameters for TPH. Following the recommended additional excavation, three samples were collected on 3/6/2018. All of these samples were within Table 910-1 standards. Analytical results indicate that the Horsetail 19N produced water spill has been cleaned up in compliance with the COGCC 900 series Rules.

The soil parameters for pH, EC, and SAR are agricultural parameters and are a measure of salt impact to soils with the potential to impact crops. None of these parameters were above their respective Table 910-1 concentrations or levels.

Olsson appreciates the opportunity to be of service in providing soil sampling and environmental oversight services to BNN for the Horsetail 19N produced water spill response. If you have any questions, please contact us at 303.461.7733 Extension 3727.

Sincerely,

**Olsson Associates**



James W. Hix  
Senior Geologist



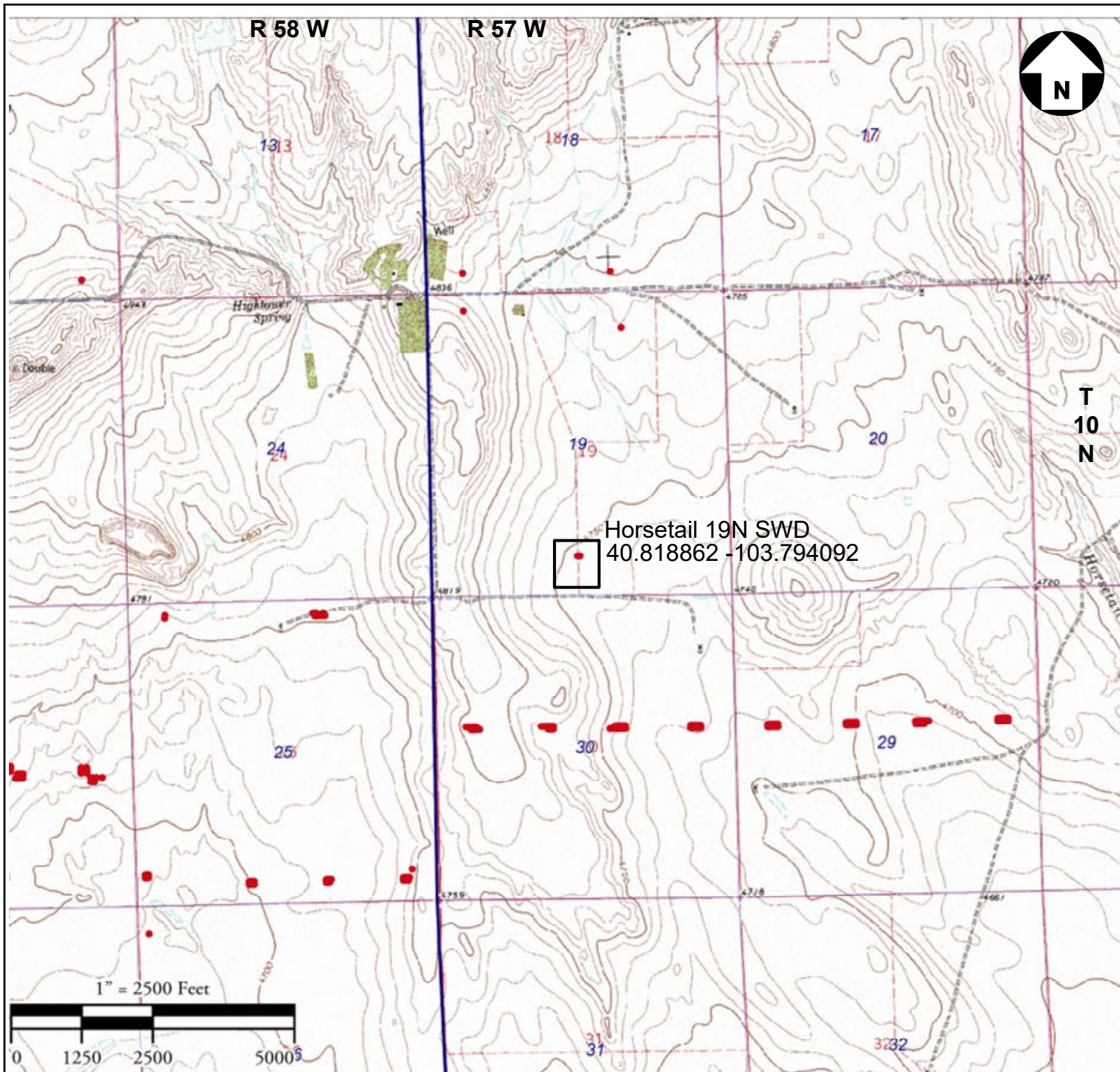
Nikki Graber  
Project Geologist

Attachments

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## FIGURES AND TABLE





**LEGEND:**



General Site Location  
 BNN Western LLC  
 UIC Disposal Facility  
 Horsetail 19N-1924M-R SWD

Adapted from the COGCC GIS Website  
 USGS Gatehook Spring 7.5-minute  
 Topographic Map Base 1977

PROJECT NO: 018-0595  
 DRAWN BY: JWH  
 DATE: 03/16/2018

General Site Location  
 Horsetail 19N SWD  
 SW ¼ SE ¼ Sec 19, T10N, R57W  
 Weld County, Colorado

**OLSSON**  
 ASSOCIATES

1880 Fall River Drive #200  
 Loveland, Colorado 80538  
 TEL 970.461.7733  
 FAX 970.635.3709

FIGURE  
 1



Approximate Scale in Feet

Aerial Photograph Base Adapted from the  
NRCS Web Soil Survey

#### LEGEND:

- 299510 Permitted Monitoring Well Location  
(Permit Number)
- Horsetail 19N-1924M Well Location  
(Whiting - Plugged and Abandoned)
- Horsetail 19N-1924M-R Well Location (BNN  
Western LLC – Injection Well Location)
- HT19N- Horsetail 19N Soil Sample Location

PROJECT NO: 018-0595

DRAWN BY: JWH

DATE: 03/14/2018

#### Site Map

Horsetail 19N SWD  
SW ¼ SE ¼ Sec 19, T10N, R57W  
Weld County, Colorado

**OLSSON**  
ASSOCIATES

1880 Fall River Drive #200  
Loveland, Colorado 80538  
TEL 970.461.7733  
FAX 970.635.3709

FIGURE

2

**TABLE 1**  
**Summary Table - Produced Water Site Characterization Soil Sample Results**  
**BNN Western - Horsetail 19N SWD**  
**Produced Water and Crude Oil Release**

Sample ID	Date	Depth (inches)	TPH-GRO (mg/kg)	TPH-DRO (mg/kg)	pH (s.u.)	Specific Conductivity (mmohs/cm) ( < 4 mmohs/cm or 2x background < 2 to < 4 mmohs/cm)	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	SAR	Comments
COGCC T910-1			500	500	6 to 9		N/A	N/A	N/A	< 12	
HT19N-1	2/8/2018	0 to 3	1.47	432	7.67	0.184	8.99	4.07	5.64	2.21	Post excavation soil sample collected on the southeast side of the spill near the treated produced water containment SE Corner.
HT19N-2	2/8/2018	0 to 3	0.135	< 50.0	7.80	0.293	15.09	5.51	8.47	2.64	Post excavation soil sample collected on the east side of the spill near the treated produced water containment/lightning rod.
HT19N-3	2/8/2018	0 to 3	0.115	< 50.0	7.71	0.420	30.11	10.19	16.33	3.64	Post excavation soil sample collected on the northeast corner of the spill area near the treated produced water containment NE / lightning rod.
HT19N-4	2/8/2018	0 to 3	1.33	70.0	7.86	0.335	16.42	6.07	8.26	2.46	Post excavation soil sample collected on the north side of the treated produced water containment tank ladder
HT19N-5	2/8/2018	0 to 3	8.06	<b>1630</b>	8.06	0.206	10.47	3.6	4.89	1.84	Post excavation soil sample collected in spill area north lightning rod, between containments.
HT19N-6	2/8/2018	~12	132	<b>1370</b>	7.71	0.571	47.36	17.27	18.51	3.26	Hand shovel excavation soil sample collected beneath the point of release piping on the north side of the gun barrel separator and produced water AST containment.
HT19N-7	2/8/2018	6	7.70	<b>1880</b>	7.71	0.704	44.28	14.81	23.61	4.34	Hand shovel excavation soil sample collected beneath piping near the NW corner of the gunbarrel separator/produced water AST containment.
HT19N-8	2/8/2018	6	< 2.50	130	7.96	0.243	15.48	5.51	4.32	1.33	Hand shovel excavation soil sample collected on the south side on the west end of the piping and near the barricades.
HT19N-9	2/8/2018	0 to 3	11.8	< 50.0	7.92	0.241	14.97	5.04	5.86	1.85	Post excavation soil sample collected west of the piping and north of the pump building.
HT19N-10	2/8/2018	60	0.540	109	8.51	0.0762	2.16	0.91	2.16	1.74	Posts excavation soil sample collected from the bottom of the stormwater pond on the east side of the pad, southeast of the treated produced water AST secondary containment.
HT19N-11	3/6/2018	12	NA	66.2	NA	NA	NA	NA	NA	NA	Additional excavation confirmation soil sample near the location of HT19N-6 near point of release.
HT19N-12	3/6/2018	6	NA	< 50.0	NA	NA	NA	NA	NA	NA	Additional excavation confirmation soil sample near the location of HT19N-5 and near north lightning rod
HT19N-13	3/6/2018	6	NA	< 50.0	NA	NA	NA	NA	NA	NA	Additional excavation confirmation soil sample near HT19N-7 and the NW corner of secondary containment

Notes:

Values shown in bold font are above the Colorado Oil and Gas Conservation Commission (COGCC) Table 910-1 concentrations or levels.

pH (s.u.) measure of soil acidity (< 7) or alkalinity (> 7) with pH reported in standard units. The COGCC Table 910-1 range for soil pH is from 6 to 9 s.u.

According to the NRCS - Weld County Soil Survey, Northern Part, the site soils are characterized by the Kim-Mitchell complex

The surficial horizon of these soils typically have a salinity of < 2 millimohs per centimeter (mmohs/cm).

mg/l - milligrams per liter

The produced water spill remained on the Wildhorse 16-13L SWD facility pad with some flow into the onsite stormwater detention pond. Agricultural land was not impacted.

N/A - Not Applicable. The COGCC Table 910-1 does not list cleanup levels or concentrations for calcium, magnesium, or sodium, but does have a

NA - Not Analyzed. Parameters that previously met Table 910-1 concentrations or levels were not analyzed in the confirmation sampling conducted on 03/06/2018.

cleanup level for sodium adsorption ratio (SAR) which is calculated based on a ratio of calcium and magnesium to sodium.

These parameters are based on agricultural values that could affect plant growth.

$$SAR = \frac{Na^{+}}{\sqrt{1/2(Ca^{2+} + Mg^{2+})}}$$

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# ATTACHMENT A SITE PHOTOGRAPHS





**Subject:** A 100 barrel produced water were released outside containment on January 25, 2018 as a result of a broken fiberglass pipe joint on the north side of the Horsetail 19N tank battery. The spill remained on location.

**Date:** 02/08/2018

**View:** Northwest



**Subject:** M&E Oilfield Services excavated impacted soil in the area of the spill using a skid steer and hand tools. Excavation activities were ongoing as of February 8, 2018. Confirmation soil sample, HT19N-6 was collected beneath the piping at the point of release to assess progress.

**Date:** 02/08/2018

**View:** West



**Subject:** M&E used a vacuum truck to recover produced water at the time of the January 25, 2018 release following its discovery. Olsson collected confirmation soil sample HT19N-7 near the piping and the northwest corner of the containment.

**Date:** 02/08/2018

**View:** Northeast





**Subject:** The produced water release extended along the north part of the Horsetail 19N pad and flowed east beyond the filtered produced water tank battery. Confirmation soil sample, HT19N-3 was collected near the northeast lightning rod shown on the left hand side of the photo. Confirmation soil sample HT19N-4 was collected near the base of the tank stairs.

**Date:** 02/08/2018

**View:** West



**Subject:** The produced water flowed to the south along the northeastern part of the Horsetail 19N pad and east of the filtered produced water tank battery. Olsson collected confirmation soil sample HT19N-2 between the monitoring well and lightning rod east of the tank battery.

**Date:** 02/08/2018

**View:** South



**Subject:** A flush mount groundwater monitoring well installed by Talon/LPE was located on the northwest side of the site. According to Division of Water Resource records the monitoring well was reportedly dry when installed.

**Date:** 02/08/2018

**View:** North





**Subject:** The produced water release extended along the east side of the Horsetail 19N pad past the filtered produced water tank battery and toward a detention pond. Olsson collected confirmation soil sample HT19N-1 near the southeast corner of the filtered water tank battery secondary containment.

**Date:** 02/08/2018

**View:** North



**Subject:** Photograph shows the detention pond on the east side of the Horsetail 19N pad following excavation. Confirmation soil sample HT19N-10 was collected from the base of the excavated detention pond.

**Date:** 02/08/2018

**View:** East



**Subject:** M & E Oilfield Services was retained to remove impacted soil at the site using a skid steer and hand tools. Excavation work was ongoing.

**Date:** 02/08/2018

**View:** West





**Subject:** M&E Oilfield Services removed the impacted soils north and east of the filtered water tank battery using the skid steer. Olsson personnel collected confirmation soil sample HT19N-4 near the filtered produced water tank battery stairs.

**Date:** 02/08/2018

**View:** East



**Subject:** M&E removed the impacted soil along the north side of the Horsetail 19N pad to the west of the piping and base of the north berm. Shallow claystone or siltstone bedrock was present near the surface.

**Date:** 02/08/2018

**View:** Northeast



**Subject:** M&E had removed the impacted soils west of the aboveground piping run along the northwest side of the site using a skid steer.

**Date:** 02/08/2018

**View:** East





**Subject:** Following additional excavation at the site Olsson personnel collected soil sample HT19N-11 (near HT19-6) for confirmation.

**Date:** 03/06/2018

**View:** Northwest



**Subject:** M&E performed additional excavation since the 02/08/2018 sampling event. Olsson collected confirmation soil samples near locations where previous soil samples had total petroleum hydrocarbons (TPH) as diesel range organics (DRO) above the COGCC Table 910-1 standard of 500 mg/kg.

**Date:** 03/06/2018

**View:** East



**Subject:** Photograph shows the location of confirmation soil sample HT19N-13 following additional excavation. Soil sample was located west of the point of release and previous soil sample HT19N-7 and the northwest corner of the raw produced water battery secondary containment.

**Date:** 03/06/2018

**View:** Northwest





**Subject:** Olsson personnel collected confirmation soil sample, HT19N-12 near the lightning rod on the north side of both tank batteries.

**Date:** 03/06/2018

**View:** East



**Subject:** Confirmation soil sample, HT19N-12 was collected near the HT19N-5 sample location and the north lightning rod. Additional soil excavation had been performed.

**Date:** 03/06/2018

**View:** East



**Subject:** Photograph shows the location of confirmation soil sample HT19N-12 looking back toward the point of release, and the locations of soil samples HT19N-11, and HT19N-13.

**Date:** 03/06/2018

**View:** West

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# ATTACHMENT B ANALYTICAL RESULTS



March 13, 2018

**Olsson Associates**

**James Hix**

**4690 Table Mountain Drive**

**Golden**

**CO 80403**

**Project Name - BNN-Western-Horsetail 19N**

**Project Number - 018-0595**

Attached are your analytical results for BNN-Western-Horsetail 19N received by Origins Laboratory, Inc. March 06, 2018. This project is associated with Origins project number Y803111-01.

The analytical results in the following report were analyzed under the guidelines of EPA Methods. These methods are identified as follows; "SW" are defined in SW-846, "EPA" are defined in 40CFR part 136 and "SM" are defined in the most current revision of Standard Methods For the Examination of Water and Wastewater.

The analytical results apply specifically to the samples and analyses specified per the attached Chain of Custody. As such, this report shall not be reproduced except in full, without the written approval of Origin's laboratory.

Unless otherwise noted, the analytical results for all soil samples are reported on a wet weight basis. All analytical analyses were performed under NELAP guidelines unless noted by a data qualifier.

Any holding time exceedances, deviations from the method specifications or deviations from Origins Laboratory's Standard Operating Procedures are outlined in the case narrative.

Thank you for selecting Origins for your analytical needs. Please contact us with any questions concerning this report, or if we can help with anything at all.

Origins Laboratory, Inc.  
303.433.1322  
o-squad@oelabinc.com



1725 Elk Place, Denver, CO 80211 | Phone: 303.433.1322 | Fax: 303.265.9645

Olsson Associates

4690 Table Mountain Drive

Golden CO 80403

James Hix

Project Number: 018-0595

Project: BNN-Western-Horsetail 19N

## CROSS REFERENCE REPORT

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
HT19N-11	Y803111-01	Soil	March 6, 2018 10:05	03/06/2018 15:55
HT19N-12	Y803111-02	Soil	March 6, 2018 10:15	03/06/2018 15:55
HT19N-13	Y803111-03	Soil	March 6, 2018 10:20	03/06/2018 15:55

Origins Laboratory, Inc.



*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.*



Olsson Associates  
4690 Table Mountain Drive  
Golden CO 80403

James Hix  
Project Number: 018-0595  
Project: BNN-Western-Horsetail 19N

**ORIGINS**  
LABORATORY, INC

www.originslaboratory.com

1003111

page 1 of 1

Client: Olsson Associates Project Manager: James Hix  
Address: 1880 Fall River Drive #200 Project Name: BNN Horsetail 19N  
Love land, CO 80538 Project Number: 018-0595  
Telephone Number: 303.589.1572 Samples Collected By: James Hix  
Email Address: j.hix@olssonassociates.com

Fax: 303.265.9645

Sample ID Description	Date Sampled	Time Sampled	# of Containers	Preservative				Matrix		Analysis	Sample Instructions	
				Unpreserved	HCl	HNO <sub>3</sub>	Other	Groundwater	Soil			Air Summa #
HT19N-11	03/06/18	10:05	2						✓		TFH-D10 (M-8015) 1-HAD, 2-HAD	1
HT19N-12	03/06/18	10:15	2						✓		1-HAD	2
HT19N-13	03/06/18	10:20	2						✓		1-HAD	3
												4
												5
												6
												7
												8
												9
												10

Relinquished By:	Date:	Time:	Received By:	Date:	Time:	Turnaround Time:
James Hix	03/06/18	1555	[Signature]	3-6-18	1555	Same Day <input type="checkbox"/> 24 Hr <input type="checkbox"/> 48 Hr <input type="checkbox"/> Standard <input checked="" type="checkbox"/>

Date Results Needed

Temp Received- 6.0

Origins Laboratory, Inc.

*Jefe Pellegrini*

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.



Olsson Associates  
4690 Table Mountain Drive  
Golden CO 80403

James Hix  
Project Number: 018-0595  
Project: BNN-Western-Horsetail 19N

Origins Laboratory

F-012207-01-R1  
Effective Date: 01/09/12

## Sample Receipt Checklist

Origins Work Order: 460311 Client: Olsson Assoc.  
Client Project ID: BNN Horsetail 19N  
Checklist Completed by: Don Lu Shipped Via: 14D  
Date/time completed: 3-7-12 (UPS, FedEx, Hand Delivered, Pick-up, etc.)  
Airbill #: NP  
Matrix(s) Received: (Check all that apply): ☒ Soil/Solid ☐ Water ☐ Other: \_\_\_\_\_  
(Describe)  
Cooler Number/Temperature: 16.0 °C 1 °C 1 °C 1 °C  
Thermometer ID: 1603

Requirement Description	Yes	No	N/A	Comments (if any)
If samples require cooling, was the temperature between 0°C to ≤ 6°C <sup>(1)</sup> ?	<input checked="" type="checkbox"/>			
Is there ice present (document if blue ice is used)	<input checked="" type="checkbox"/>			
Are custody seals present on cooler? (if so, document in comments if they are signed and dated, broken or intact)		<input checked="" type="checkbox"/>		
Are custody seals present on each sample container? (if so, document in comments if they are signed and dated, broken or intact)		<input checked="" type="checkbox"/>		
Were all samples received intact <sup>(1)</sup> ?	<input checked="" type="checkbox"/>			
Was adequate sample volume provided <sup>(1)</sup> ?	<input checked="" type="checkbox"/>			
Are short holding time analytes or samples with HTs due within 48 hours present <sup>(1)</sup> ?		<input checked="" type="checkbox"/>		
Is a chain-of-custody (COC) present and filled out completely <sup>(1)</sup> ?	<input checked="" type="checkbox"/>			
Does the COC agree with the number and type of sample bottles received <sup>(1)</sup> ?	<input checked="" type="checkbox"/>			
Do the sample IDs on the bottle labels match the COC <sup>(1)</sup> ?	<input checked="" type="checkbox"/>			
Is the COC properly relinquished by the client with date and time recorded <sup>(1)</sup> ?	<input checked="" type="checkbox"/>			
For volatiles in water – is there headspace (> ¼ inch bubble) present? If yes, contact client and note in narrative.			<input checked="" type="checkbox"/>	
Are samples preserved that require preservation and was it checked <sup>(1)</sup> ? (note ID of confirmation instrument used in comments) / (preservation is not confirmed for subcontracted analyses in order to insure sample integrity)/(pH <2 for samples preserved with HNO <sub>3</sub> , HCL, H <sub>2</sub> SO <sub>4</sub> ) / (pH >10 for samples preserved with NaAsO <sub>2</sub> +NaOH, ZnAc+NaOH)			<input checked="" type="checkbox"/>	
Additional Comments (if any):				

<sup>(1)</sup>If NO, then contact the client before proceeding with analysis and note date/time and person contacted as well as the corrective action to in the additional comments (above) and the case narrative.

Reviewed by (Project Manager) [Signature] Date/Time Reviewed 3/8/12

Origins Laboratory, Inc.

[Signature]

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.

Olsson Associates  
4690 Table Mountain Drive  
Golden CO 80403

James Hix  
Project Number: 018-0595  
Project: BNN-Western-Horsetail 19N

HT19N-11  
3/6/2018 10:05:00AM

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Notes
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Origins Laboratory, Inc.  
Y803111-01 (Soil)

## Diesel Range Organics (DRO/TEPH) by EPA 8015C

Diesel (C10-C28)	66.2	50.0	mg/kg	1	B8C1206	03/12/2018	03/13/2018	
Surrogate: o-Terphenyl	87.8 %	59-131			"	"	"	

Origins Laboratory, Inc.



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.

Olsson Associates  
4690 Table Mountain Drive  
Golden CO 80403

James Hix  
Project Number: 018-0595  
Project: BNN-Western-Horsetail 19N

HT19N-12  
3/6/2018 10:15:00AM

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Notes
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Origins Laboratory, Inc.  
Y803111-02 (Soil)

## Diesel Range Organics (DRO/TEPH) by EPA 8015C

Diesel (C10-C28)	ND	50.0	mg/kg	1	B8C1206	03/12/2018	03/13/2018	U
------------------	----	------	-------	---	---------	------------	------------	---

Surrogate: o-Terphenyl	76.2 %	59-131			"	"	"	
------------------------	--------	--------	--	--	---	---	---	--

Origins Laboratory, Inc.



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.

Olsson Associates  
4690 Table Mountain Drive  
Golden CO 80403

James Hix  
Project Number: 018-0595  
Project: BNN-Western-Horsetail 19N

HT19N-13  
3/6/2018 10:20:00AM

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Notes
---------	--------	--------------------	-------	----------	-------	----------	----------	-------

Origins Laboratory, Inc.  
Y803111-03 (Soil)

## Diesel Range Organics (DRO/TEPH) by EPA 8015C

Diesel (C10-C28)	ND	50.0	mg/kg	1	B8C1206	03/12/2018	03/13/2018	U
Surrogate: o-Terphenyl	83.6 %	59-131			"	"	"	

Origins Laboratory, Inc.



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Golden CO 80403

James Hix  
Project Number: 018-0595  
Project: BNN-Western-Horsetail 19N

## Extractable Petroleum Hydrocarbons by 8015C - Quality Control Origins Laboratory, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
<b>Batch B8C1206 - EPA 3550B</b>										
<b>Blank (B8C1206-BLK1)</b>					Prepared: 03/12/2018 Analyzed: 03/12/2018					
Diesel (C10-C28)	ND	50.0	mg/kg							U
Surrogate: o-Terphenyl	43		"	50.0		86.9	59-131			
<b>Blank (B8C1206-BLK2)</b>					Prepared: 03/12/2018 Analyzed: 03/12/2018					
Diesel (C10-C28)	ND	50.0	mg/kg							U
Surrogate: o-Terphenyl	39		"	50.0		78.8	59-131			
<b>LCS (B8C1206-BS1)</b>					Prepared: 03/12/2018 Analyzed: 03/12/2018					
Diesel (C10-C28)	840	50.0	mg/kg	1000		84.0	64-121			
Surrogate: o-Terphenyl	45		"	50.0		90.8	59-131			
<b>LCS (B8C1206-BS2)</b>					Prepared: 03/12/2018 Analyzed: 03/12/2018					
Diesel (C10-C28)	881	50.0	mg/kg	1000		88.1	64-121			
Surrogate: o-Terphenyl	49		"	50.0		97.4	59-131			
<b>Matrix Spike (B8C1206-MS1)</b>					<b>Source: Y803145-01</b>		Prepared: 03/12/2018 Analyzed: 03/12/2018			
Diesel (C10-C28)	891	50.0	mg/kg	1000	24.1	86.7	53-125			
Surrogate: o-Terphenyl	50		"	50.0		101	59-131			
<b>Matrix Spike (B8C1206-MS2)</b>					<b>Source: Y803145-02</b>		Prepared: 03/12/2018 Analyzed: 03/12/2018			
Diesel (C10-C28)	834	50.0	mg/kg	1000	24.7	80.9	53-125			
Surrogate: o-Terphenyl	47		"	50.0		94.0	59-131			
<b>Matrix Spike Dup (B8C1206-MSD1)</b>					<b>Source: Y803145-01</b>		Prepared: 03/12/2018 Analyzed: 03/12/2018			
Diesel (C10-C28)	887	50.0	mg/kg	1000	24.1	86.3	53-125	0.450	20	
Surrogate: o-Terphenyl	48		"	50.0		95.4	59-131			
<b>Matrix Spike Dup (B8C1206-MSD2)</b>					<b>Source: Y803145-02</b>		Prepared: 03/12/2018 Analyzed: 03/12/2018			

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Extractable Petroleum Hydrocarbons by 8015C - Quality Control  
Origins Laboratory, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
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Batch B8C1206 - EPA 3550B

Matrix Spike Dup (B8C1206-MSD2)		Source: Y803145-02			Prepared: 03/12/2018 Analyzed: 03/12/2018					
Diesel (C10-C28)	867	50.0	mg/kg	1000	24.7	84.3	53-125	3.94	20	
Surrogate: o-Terphenyl	47		"	50.0		95.0	59-131			

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### Notes and Definitions

U Sample is Non-Detect.

ND Analyte NOT DETECTED at or above the reporting limit

RPD Relative Percent Difference

All soil results are reported at a wet weight basis.

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