



2180 South Ivanhoe Street, Suite 5  
Denver, Colorado 80222-5710  
303-759-8373  
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December 7, 2018

Grand Mesa Operating Company  
1700 North Waterfront Parkway  
Building 600  
Wichita, Kansas 67206

Attention: Ms. Phyllis Brewer

Subject: Crater Lake #1-8 Drill Site (COGCC Location ID: 454043)  
Background and Pit Sampling  
Lincoln County, Colorado  
AGW Project Number: 178229

Dear Ms. Brewer:

As requested, A. G. Wassenaar, Inc. (AGW) collected mud samples from one unlined drill pit at the Crater Lake #1-8 drill site in Lincoln County, Colorado operated by Grand Mesa Operating Company (Grand Mesa). This letter summarizes the project activities and analytical results.

## **BACKGROUND**

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The subject site is located in an agricultural area in the northwest  $\frac{1}{4}$  of the northwest  $\frac{1}{4}$  of Section 8, Township 8 South, Range 54 West. It is approximately 0.98 miles northeast of the intersection of Lincoln County Road 3N and Lincoln County Road 32. Based on U.S. Geological Survey (USGS) Topographic Map data, the ground surface in the vicinity of the site generally slopes towards the southwest. Figure 1 in Attachment A illustrates the site location and topography.

In 2018, one (1) unlined drill pit and one lined water pit were constructed on the northern portion of the site to facilitate drilling of the Crater Lake #1-8 well. On September 26, 2018, AGW collected background soil samples from the area surrounding the well pad. To help restore the site after drilling and to comply with Colorado Oil and Gas Conservation Commission (COGCC) pit closure requirements, AGW was asked to collect mud samples from the base of the unlined pit. The samples were analyzed for total petroleum hydrocarbons (TPH); benzene, toluene, ethylbenzene, and xylenes (BTEX); sodium adsorption ratio (SAR); specific conductance (EC); arsenic; and pH. In accordance with COGCC rules, the TPH values were derived by adding the concentrations of gasoline range organics (GRO) and diesel range organics (DRO). The lined pit was used exclusively for clean water, so soil beneath the liner was not sampled.

## BACKGROUND SOIL SAMPLING METHODS

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On September 26, 2018, an AGW geologist visited the site to collect background soil samples for baseline characteristics. At that time, construction had been completed and the oil/gas well had been constructed. The site location consisted of grassland.

To evaluate the background soil conditions, AGW collected one composite sample from three discrete and random locations. The discrete samples were collected adjacent to the constructed well site location. To collect the discrete samples, AGW utilized a clean stainless-steel trowel. Prior to use, and between each discrete sample location, the trowel was cleaned in a solution of Alconox® detergent and municipal water followed by a municipal water rinse. To control potential cross contamination, the AGW geologist also wore new nitrile gloves for this sampling event. Each sample was collected from a depth ranging from two to six inches below ground surface (BGS).

Each discrete sample was immediately transferred into one Ziploc bag and sufficiently combined to create one representative composite sample. The final composited sample was transferred to clean, laboratory-supplied glass jars, labeled, and placed into a cooler with ice (a preservative) for laboratory submittal. During this project, AGW followed chain-of-custody procedures in general accordance with EPA guidelines. On the day of collection, AGW delivered the samples to Origins Laboratory, Inc. (Origins) in Denver, Colorado for testing.

## BACKGROUND ANALYTICAL RESULTS

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Origins analyzed the composite soil sample for arsenic by EPA Method 6020A, EC by EPA Method 2510B-2011 MOD, pH by EPA Method 9045D, and SAR by methods from the USDA Handbook 60. The arsenic, EC, pH, and SAR results are included below in Table 1. The laboratory report is included in Attachment B.

**Table 1: Background Soil Analytical Results  
Crater Lake #1-8 Drill Site  
September 26, 2018**

Sample Number	Arsenic (mg/kg) <sup>1</sup>	Specific Conductance (mmhos/cm) <sup>2</sup>	pH	Sodium Adsorption Ratio
8229-BG	5.03	0.108	7.87	0.20
COGCC Standard <sup>3</sup>	0.39*	< 4	6 - 9	< 12

**Legend:**

1: mg/kg - milligrams per kilogram (parts per million)

2: mmhos/cm - millimhos per centimeter

3: Standards from Colorado Oil and Gas Conservation Commission Table 910-1, effective January 30, 2015

\*: Naturally occurring elevated levels of arsenic are common in Colorado

## PIT SAMPLING METHODS

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After drilling was completed and the mud at the base of the pit was sufficiently dry, an AGW geologist visited the site on September 26, 2018 to collect samples from the base of the unlined drill pit. The unlined pit measured approximately 150 feet by 65 feet across and was 4 to 5 feet deep.

To evaluate the base of the pit, AGW collected three discrete mud samples. The first sample, 8229-P1-1, was collected from the northeast center of the pit; the second sample, 8229-P2-1, was obtained from the east center of the pit; and 8229-P3-1 was collected from the west center of the pit.

Prior to sampling, the AGW geologist wore new nitrile gloves at each sample location. Each sample was collected from a depth of approximately two inches beneath the base of the pit.

Each sample was immediately transferred into three laboratory-supplied glass jars, labeled, and placed into a cooler with ice (a preservative) for laboratory submittal. During this project, AGW followed chain-of-custody procedures in general accordance with EPA guidelines. On the day of collection, AGW delivered the samples to Origins for testing.

## ANALYTICAL RESULTS

Origins analyzed each pit sample for DRO and GRO by EPA Method 8015B, BTEX by EPA Method 8260B, and arsenic, EC, pH, and SAR by EPA Methods listed above for the background soil sample. In accordance with COGCC requirements as published in Table 910-1 of their Rules, each set of DRO and GRO values were added together to obtain the TPH concentration for comparison to the COGCC TPH standard. The DRO, GRO, TPH, BTEX, EC, pH, and SAR results are included below in Table 2. The results are also illustrated on Figure 2 in Attachment A. The laboratory report is included in Attachment B.

**Table 2: Pit Sampling Results  
Crater Lake #1-8 Drill Site  
September 26, 2018**

Sample Number	8229-BG <sup>1</sup>	8229-P1-1	8229-P2-1	8229-P3-1	COGCC Standard <sup>2</sup>
DRO (mg/kg) <sup>3</sup>	NA <sup>4</sup>	ND <sup>5</sup>	ND	ND	500
GRO (mg/kg)	NA <sup>4</sup>	ND	ND	ND	
TPH <sup>5</sup> (mg/kg)	NA <sup>4</sup>	ND	ND	ND	
Benzene (mg/kg)	NA <sup>4</sup>	ND	ND	ND	0.17
Toluene (mg/kg)	NA <sup>4</sup>	ND	ND	ND	85
Ethylbenzene (mg/kg)	NA <sup>4</sup>	ND	ND	ND	100
Xylenes (mg/kg)	NA <sup>4</sup>	ND	ND	ND	175
Arsenic (mg/kg)	<b>5.03</b>	<b>6.63</b>	<b>5.16</b>	<b>5.93</b>	0.39 <sup>7</sup>
Specific Conductance (mmhos/cm) <sup>8</sup>	0.108	0.538	1.24	0.454	< 4

Sample Number	8229-BG <sup>1</sup>	8229-P1-1	8229-P2-1	8229-P3-1	COGCC Standard <sup>2</sup>
pH	7.87	8.47	8.25	8.33	6 – 9
Sodium Adsorption Ratio	0.20	8.10	<b>32.46</b>	8.36	< 12

**Legend:**

- 1: Background sample collected from surficial soil on September 26, 2018
- 2: Standards from Colorado Oil and Gas Conservation Commission Table 910-1, effective January 30, 2015
- 3: mg/kg - Milligrams per kilogram
- 4: NA - Not analyzed
- 5: TPH - Total petroleum hydrocarbons. Value determined by adding DRO and GRO per COGCC Table 910-1 Rules
- 6: ND - Not detected at or above laboratory reporting limit
- 7: Naturally occurring elevated levels of arsenic are common in Colorado
- 8: mmhos/cm - millimhos per centimeter

To evaluate the analytical results, AGW compared detected concentrations to the regulatory standards published in Table 910-1 of the COGCC Series 900 Rules. Elevated levels of SAR were detected in sample 8229-P2-1. The analytical laboratory reports for the background and pit sampling are included in Attachment B.

Arsenic was detected at levels greater than the COGCC Table 910-1 standard; however, elevated levels of arsenic are common in Colorado, as indicated by the background sample collected in March 2018 from surficial soil. The CDPHE has issued a risk management guidance document for evaluating arsenic concentrations in soil, reviewed/revised July 2014, which relies on an EPA study of background levels in Colorado. The data indicate arsenic concentrations commonly range from 3 to 14 mg/kg on native grassland, rangeland, and other agricultural uses. The arsenic concentrations in the samples collected from the pit are within this range and therefore do not require further action in this regard.

**CONCLUSIONS AND RECOMMENDATIONS**

To help evaluate the condition of soils/bentonitic drilling mud at the base of pits at the Crater Lake #1-8 drill site, AGW visited the site on September 26, 2018 and collected a total of three discrete samples from the base of the pit for analytical testing. The pit was generally dry. The samples were analyzed for TPH, BTEX, arsenic, EC, pH, and SAR.

Based on the analytical results, SAR was detected at levels greater than background and regulatory guidance in sample 8229-P2-1.

Arsenic was detected at levels greater than the COGCC Table 910-1 standard in all samples, including the background sample; however, elevated levels of arsenic are common in Colorado. The Colorado Department of Public Health and Environment (CDPHE) has issued a risk management guidance document for evaluating arsenic concentrations in soil, reviewed/revised July 2014, which relies on an EPA study of background levels in Colorado. The data indicate arsenic concentrations commonly range from 3 mg/kg to 14 mg/kg on native grassland, rangeland, and other agricultural uses. The arsenic concentrations in the samples collected from the pit are within this range and are consistent with background levels and therefore do not require further action.

Based on the project results, the minor analytical exceedance of SAR in one (1) sample of soil/bentonitic mud at the base of the unlined reserve pit and the depth at which burial of this material will occur, which averages approximately five (5) feet BGS, should enable the pit to be backfilled with native soils that are currently stockpiled onsite. Site reclamation activities can subsequently take place.

Thank you for the opportunity to assist you with this project. If you have any questions or require further information, please call us at (303) 759-8373.

Sincerely,  
A.G. Wassenaar, Inc.

A handwritten signature in cursive script that reads "Rachel A. Peterson". The signature is written in black ink and is positioned above a horizontal line.

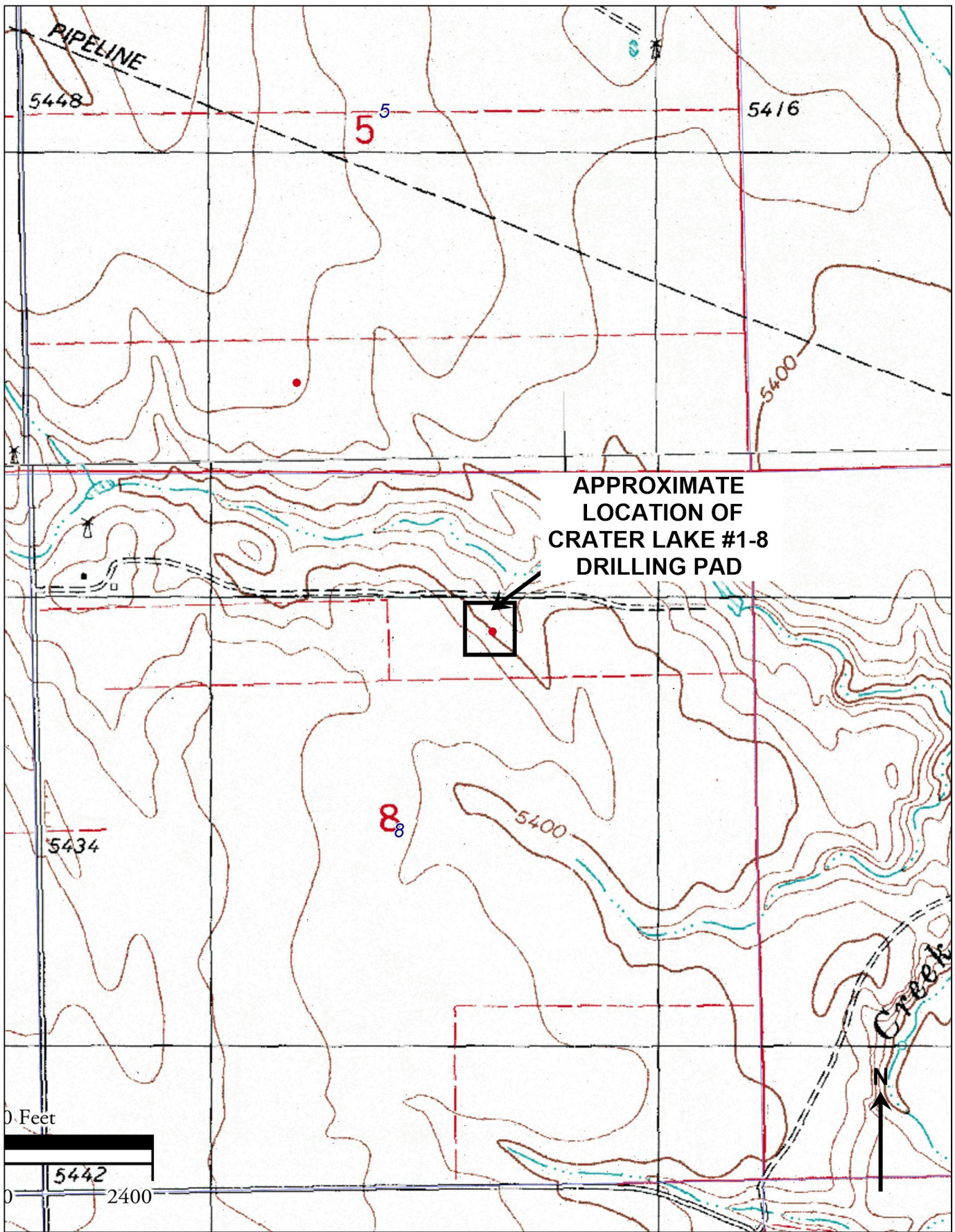
Rachel A. Peterson, P.G.  
Senior Project Manager

RAP/STS

Attachments

**ATTACHMENT A**  
**FIGURES**



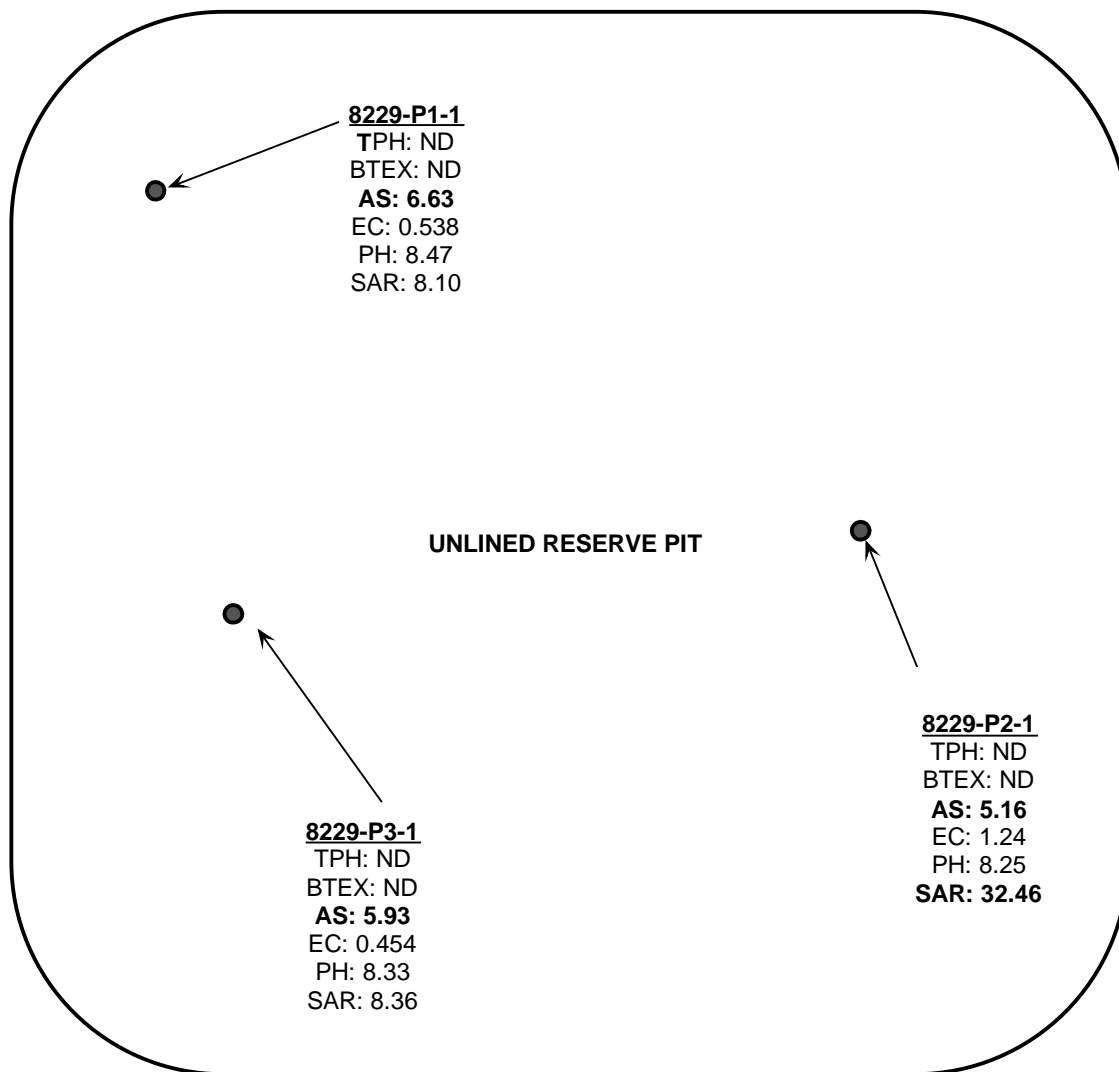


**A.G. WASSENAAR** | **INC.**

GEOTECHNICAL • ENVIRONMENTAL  
CONSULTANTS

**CRATER LAKE #1-8 WELL SITE**  
**LINCOLN COUNTY, COLORADO**  
**GRAND MESA OPERATING COMPANY**

**FIGURE 1**  
**SITE TOPOGRAPHY AND**  
**LOCATION**  
**PROJECT: 178229**



LEGEND

- - SAMPLE LOCATION
- TPH- TOTAL PETROLEUM HYDROCARBONS
- B - BENZENE
- T - TOLUENE
- E - ETHYLBENZENE
- X - TOTAL XYLENE
- AS - ARSENIC
- EC - SPECIFIC CONDUCTIVITY
- SAR - SODIUM ADSORPTION RATIO
- ND - NOT DETECTED

NOTE: TPH, BTEX, AND ARSENIC CONCENTRATIONS ARE IN MILLIGRAMS PER KILOGRAM (mg/kg)  
 EC CONCENTRATIONS ARE IN MILLIMHOS PER CENTIMETER  
 VALUES IN BOLD ARE GREATER THAN THE RESPECTIVE COGCC TABLE 910-1 STANDARD  
 ALL LOCATIONS ARE APPROXIMATE

**A. G. WASSENAAR** | **INC.**  
GEOTECHNICAL • ENVIRONMENTAL CONSULTANTS

Crater Lake #1-8 WELL SITE  
 LINCOLN COUNTY, COLORADO  
 GRAND MESA OPERATING COMPANY

**FIGURE 2**  
**ANALYTICAL RESULTS**  
 Spetember 26, 2018  
 PROJECT: 178229

**ATTACHMENT B**

**LABORATORY REPORT**





October 03, 2018

**A.G. Wassenaar**

**Rachel Peterson**

**2180 South Ivanhoe Street - Suite 5**

**Denver**

**CO 80222**

**Project Name - Crater Lake #1-8**

**Project Number - 178229**

Attached are your analytical results for Crater Lake #1-8 received by Origins Laboratory, Inc. September 26, 2018. This project is associated with Origins project number Y809368-01.

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

A.G. Wassenaar  
2180 South Ivanhoe Street - Suite 5  
Denver CO 80222

Rachel Peterson  
Project Number: 178229  
Project: Crater Lake #1-8

CROSS REFERENCE REPORT

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
8229-P1-1	Y809368-01	Soil	September 26, 2018 14:01	09/26/2018 17:15
8229-P2-1	Y809368-02	Soil	September 26, 2018 14:11	09/26/2018 17:15
8229-P3-1	Y809368-03	Soil	September 26, 2018 14:20	09/26/2018 17:15
8229-BG	Y809368-04	Soil	September 26, 2018 15:01	09/26/2018 17:15

Origins Laboratory, Inc.



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A.G. Wassenaar  
 2180 South Ivanhoe Street - Suite 5  
 Denver CO 80222

Rachel Peterson  
 Project Number: 178229  
 Project: Crater Lake #1-8

Origins Laboratory

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

**Sample Receipt Checklist**

Origins Work Order: Y804368 Client: A.G. Wassenaar  
 Client Project ID: Crater Lake 1-8  
 Checklist Completed by: SG Shipped Via: HD  
 Date/time completed: 9/27/12 (UPS, FedEx, Hand Delivered, Pick-up, etc.)  
 Airbill #: N/A  
 Matrix(s) Received: (Check all that apply):  Soil/Solid  Water  Other: \_\_\_\_\_  
 Cooler Number/Temperature: 1 / 3.4 °C \_\_\_\_\_ °C \_\_\_\_\_ °C \_\_\_\_\_ °C (Describe)  
 Thermometer ID: T003

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? <b>If yes, contact client and note in narrative.</b>		<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) RP

Date/Time Reviewed 9/28/12

Origins Laboratory, Inc.



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A.G. Wassenaar  
 2180 South Ivanhoe Street - Suite 5  
 Denver CO 80222

Rachel Peterson  
 Project Number: 178229  
 Project: Crater Lake #1-8

8229-P1-1

9/26/2018 2:01:00PM

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Analyst	Prepared	Analyzed	Notes
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**Origins Laboratory, Inc.**  
 Y809368-01 (Soil)

**BTEX by EPA 8260C**

Benzene	ND	0.002	mg/kg	1	B812710	JTD	09/27/2018	09/27/2018	Ua
Toluene	ND	0.002	"	"	"	JTD	"	"	Ua
Ethylbenzene	ND	0.002	"	"	"	JTD	"	"	Ua
Xylenes, total	ND	0.002	"	"	"	JTD	"	"	Ua

Surrogate: 1,2-Dichloroethane-d4	109 %	70-130			"	"	"	"	
Surrogate: Toluene-d8	96.5 %	70-130			"	"	"	"	
Surrogate: 4-Bromofluorobenzene	106 %	70-130			"	"	"	"	

**Metals (Saturated Paste Prep)**

Calcium	22.02		me/L	1	'[none]'		09/28/2019	10/02/2018	
Magnesium	4.77		"	"	"		"	"	
Sodium	29.63		"	"	"		"	"	

**pH in Soil by EPA 9045D**

pH	8.47		pH Units	1	B812705	OLAB	09/27/2018	09/27/2018	
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**SAR by 20B Saturated Paste**

SAR	8.10			1	'[none]'		09/28/2019	10/02/2018	
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**Specific Conductance by Modified 9050A**

Specific Conductance (EC)	0.538	0.00506	mmhos/cm	1	B812706	OLAB	09/27/2018	09/27/2018	
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Origins Laboratory, Inc.



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2180 South Ivanhoe Street - Suite 5  
Denver CO 80222

Rachel Peterson  
Project Number: 178229  
Project: Crater Lake #1-8

8229-P1-1

9/26/2018 2:01:00PM

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Analyst	Prepared	Analyzed	Notes
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**Origins Laboratory, Inc.**  
Y809368-01 (Soil)

**Total Metals by 6010C**

Arsenic	6.63	3.26	mg/kg dry	1	1807106	TXT1	10/01/2018	10/01/2018	
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**TPH-Carbon Chain by EPA Method 8015C**

Gasoline (C6-C10)	ND	50.0	mg/kg	1	B8I2711	JTD	09/27/2018	09/27/2018	Ua
Diesel (C10-C28)	ND	50.0	"	"	"	JTD	"	"	Ua
Residual Range Organics (C28-C40)	ND	200	"	"	"	JTD	"	"	Ua
Surrogate: o-Terphenyl	72.6 %	65-146				"	"	"	

Origins Laboratory, Inc.



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 Denver CO 80222

Rachel Peterson  
 Project Number: 178229  
 Project: Crater Lake #1-8

**8229-P2-1**

**9/26/2018 2:11:00PM**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Analyst	Prepared	Analyzed	Notes
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**Origins Laboratory, Inc.**  
**Y809368-02 (Soil)**

**BTEX by EPA 8260C**

Benzene	ND	0.002	mg/kg	1	B812710	JTD	09/27/2018	09/28/2018	Ua
Toluene	ND	0.002	"	"	"	JTD	"	"	Ua
Ethylbenzene	ND	0.002	"	"	"	JTD	"	"	Ua
Xylenes, total	ND	0.002	"	"	"	JTD	"	"	Ua

Surrogate: 1,2-Dichloroethane-d4	128 %	70-130			"	"	"	"	
Surrogate: Toluene-d8	96.5 %	70-130			"	"	"	"	
Surrogate: 4-Bromofluorobenzene	96.8 %	70-130			"	"	"	"	

**Metals (Saturated Paste Prep)**

Calcium	16.60		me/L	1	'[none]'		09/28/2019	10/02/2018	
Magnesium	8.59		"	"	"		"	"	
Sodium	115.21		"	"	"		"	"	

**pH in Soil by EPA 9045D**

pH	8.25		pH Units	1	B812705	OLAB	09/27/2018	09/27/2018	
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**SAR by 20B Saturated Paste**

SAR	32.46			1	'[none]'		09/28/2019	10/02/2018	
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**Specific Conductance by Modified 9050A**

Specific Conductance (EC)	1.24	0.00502	mmhos/cm	1	B812706	OLAB	09/27/2018	09/27/2018	
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 2180 South Ivanhoe Street - Suite 5  
 Denver CO 80222

Rachel Peterson  
 Project Number: 178229  
 Project: Crater Lake #1-8

8229-P2-1

9/26/2018 2:11:00PM

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Analyst	Prepared	Analyzed	Notes
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**Origins Laboratory, Inc.**  
 Y809368-02 (Soil)

**Total Metals by 6010C**

Arsenic	5.16	4.04	mg/kg dry	1	1807106	TXT1	10/01/2018	10/01/2018	
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**TPH-Carbon Chain by EPA Method 8015C**

Gasoline (C6-C10)	ND	50.0	mg/kg	1	B8I2711	JTD	09/27/2018	09/27/2018	Ua
Diesel (C10-C28)	ND	50.0	"	"	"	JTD	"	"	Ua
Residual Range Organics (C28-C40)	ND	200	"	"	"	JTD	"	"	Ua
Surrogate: o-Terphenyl	71.2 %	65-146				"	"	"	

Origins Laboratory, Inc.



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 2180 South Ivanhoe Street - Suite 5  
 Denver CO 80222

Rachel Peterson  
 Project Number: 178229  
 Project: Crater Lake #1-8

8229-P3-1

9/26/2018 2:20:00PM

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Analyst	Prepared	Analyzed	Notes
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**Origins Laboratory, Inc.**  
 Y809368-03 (Soil)

**BTEX by EPA 8260C**

Benzene	ND	0.002	mg/kg	1	B812710	JTD	09/27/2018	09/28/2018	Ua
Toluene	ND	0.002	"	"	"	JTD	"	"	Ua
Ethylbenzene	ND	0.002	"	"	"	JTD	"	"	Ua
Xylenes, total	ND	0.002	"	"	"	JTD	"	"	Ua

Surrogate: 1,2-Dichloroethane-d4	142 %	70-130			"	"		"	S-07
Surrogate: Toluene-d8	98.4 %	70-130			"	"		"	
Surrogate: 4-Bromofluorobenzene	94.7 %	70-130			"	"		"	

**Metals (Saturated Paste Prep)**

Calcium	22.24		me/L	1	'[none]'		09/28/2019	10/02/2018	
Magnesium	9.72		"	"	"		"	"	
Sodium	33.42		"	"	"		"	"	

**pH in Soil by EPA 9045D**

pH	8.33		pH Units	1	B812705	OLAB	09/27/2018	09/27/2018	
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**SAR by 20B Saturated Paste**

SAR	8.36			1	'[none]'		09/28/2019	10/02/2018	
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**Specific Conductance by Modified 9050A**

Specific Conductance (EC)	0.454	0.00503	mmhos/cm	1	B812706	OLAB	09/27/2018	09/27/2018	
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Origins Laboratory, Inc.



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A.G. Wassenaar  
 2180 South Ivanhoe Street - Suite 5  
 Denver CO 80222

Rachel Peterson  
 Project Number: 178229  
 Project: Crater Lake #1-8

8229-P3-1

9/26/2018 2:20:00PM

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Analyst	Prepared	Analyzed	Notes
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**Origins Laboratory, Inc.**  
 Y809368-03 (Soil)

**Total Metals by 6010C**

Arsenic	5.93	3.62	mg/kg dry	1	1807106	TXT1	10/01/2018	10/01/2018	
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**TPH-Carbon Chain by EPA Method 8015C**

Gasoline (C6-C10)	ND	50.0	mg/kg	1	B8I2711	JTD	09/27/2018	09/27/2018	Ua
Diesel (C10-C28)	ND	50.0	"	"	"	JTD	"	"	Ua
Residual Range Organics (C28-C40)	ND	200	"	"	"	JTD	"	"	Ua
Surrogate: o-Terphenyl	75.5 %	65-146				"	"	"	

Origins Laboratory, Inc.



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 Denver CO 80222

Rachel Peterson  
 Project Number: 178229  
 Project: Crater Lake #1-8

**8229-BG**

**9/26/2018 3:01:00PM**

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Analyst	Prepared	Analyzed	Notes
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**AAL, Inc.**  
**Y809368-04 (Soil)**

**Metals (Saturated Paste Prep)**

Calcium	4.91		me/L	1	'[none]'		09/28/2019	10/02/2018	
Magnesium	0.93		"	"	"		"	"	
Sodium	0.35		"	"	"		"	"	

**pH in Soil by EPA 9045D**

pH	7.87		pH Units	1	B812705	OLAB	09/27/2018	09/27/2018	
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**SAR by 20B Saturated Paste**

SAR	0.20			1	'[none]'		09/28/2019	10/02/2018	
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**Specific Conductance by Modified 9050A**

Specific Conductance (EC)	0.108	0.00500	mmhos/cm	1	B812706	OLAB	09/27/2018	09/27/2018	
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**Total Metals by 6010C**

Arsenic	5.03	2.94	mg/kg dry	1	1807106	TXT1	10/01/2018	10/01/2018	
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 Project: Crater Lake #1-8

**Volatile Organic Compounds by GC/MS SW846 8260C - 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 B812710 - EPA 5030 (soil)**

**Blank (B812710-BLK1)**

Prepared: 09/27/2018 Analyzed: 09/27/2018

Benzene	ND	0.002	mg/kg							Ua
Toluene	ND	0.002	"							Ua
Ethylbenzene	ND	0.002	"							Ua
Xylenes, total	ND	0.002	"							Ua
<i>Surrogate: 1,2-Dichloroethane-d4</i>	65		ug/kg	62.5	104		70-130			
<i>Surrogate: Toluene-d8</i>	63		"	62.5	101		70-130			
<i>Surrogate: 4-Bromofluorobenzene</i>	58		"	62.5	93.1		70-130			

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**Volatile Organic Compounds by GC/MS SW846 8260C - 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 B812710 - EPA 5030 (soil)**

**Blank (B812710-BLK2)**

Prepared: 09/27/2018 Analyzed: 09/27/2018

Benzene	ND	0.002	mg/kg							Ua
Toluene	ND	0.002	"							Ua
Ethylbenzene	ND	0.002	"							Ua
Xylenes, total	ND	0.002	"							Ua
Surrogate: 1,2-Dichloroethane-d4	66		ug/kg	62.5		106	70-130			
Surrogate: Toluene-d8	60		"	62.5		96.1	70-130			
Surrogate: 4-Bromofluorobenzene	63		"	62.5		101	70-130			

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**Volatile Organic Compounds by GC/MS SW846 8260C - 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 B812710 - EPA 5030 (soil)**

**LCS (B812710-BS1)**

Prepared: 09/27/2018 Analyzed: 09/27/2018

Benzene	0.107	0.002	mg/kg	0.100		107	77.1-124			
Toluene	0.107	0.002	"	0.100		107	74.5-128			
Ethylbenzene	0.115	0.002	"	0.100		115	66.4-127			
m,p-Xylene	0.229	0.004	"	0.200		114	76.6-124			
o-Xylene	0.116	0.002	"	0.100		116	76.6-124			
Surrogate: 1,2-Dichloroethane-d4	62		ug/kg	62.5		98.5	70-130			
Surrogate: Toluene-d8	62		"	62.5		99.8	70-130			
Surrogate: 4-Bromofluorobenzene	65		"	62.5		103	70-130			

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Rachel Peterson  
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Project: Crater Lake #1-8

**Volatile Organic Compounds by GC/MS SW846 8260C - 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 B812710 - EPA 5030 (soil)

**LCS (B812710-BS2)**

Prepared: 09/27/2018 Analyzed: 09/27/2018

Benzene	0.108	0.002	mg/kg	0.100		108	77.1-124			
Toluene	0.105	0.002	"	0.100		105	74.5-128			
Ethylbenzene	0.109	0.002	"	0.100		109	66.4-127			
m,p-Xylene	0.217	0.004	"	0.200		109	76.6-124			
o-Xylene	0.105	0.002	"	0.100		105	76.6-124			
Surrogate: 1,2-Dichloroethane-d4	59		ug/kg	62.5		94.4	70-130			
Surrogate: Toluene-d8	61		"	62.5		97.3	70-130			
Surrogate: 4-Bromofluorobenzene	62		"	62.5		99.9	70-130			

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**Volatile Organic Compounds by GC/MS SW846 8260C - 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 B8I2710 - EPA 5030 (soil)

Matrix Spike (B8I2710-MS1)	Source: Y809362-02			Prepared: 09/27/2018 Analyzed: 09/27/2018						
Benzene	0.104	0.002	mg/kg	0.100	ND	104	71.8-126			
Toluene	0.100	0.002	"	0.100	ND	100	65.1-130			
Ethylbenzene	0.103	0.002	"	0.100	ND	103	62.2-130			
m,p-Xylene	0.206	0.004	"	0.200	ND	103	46.5-137			
o-Xylene	0.096	0.002	"	0.100	ND	95.7	54.2-134			
Surrogate: 1,2-Dichloroethane-d4	64		ug/kg	62.5		102	70-130			
Surrogate: Toluene-d8	60		"	62.5		96.5	70-130			
Surrogate: 4-Bromofluorobenzene	65		"	62.5		103	70-130			

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**Volatile Organic Compounds by GC/MS SW846 8260C - 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 B812710 - EPA 5030 (soil)**

<b>Matrix Spike (B812710-MS2)</b>	<b>Source: Y809368-01</b>			<b>Prepared: 09/27/2018 Analyzed: 09/27/2018</b>						
Benzene	0.095	0.002	mg/kg	0.100	ND	95.3	71.8-126			
Toluene	0.090	0.002	"	0.100	ND	90.5	65.1-130			
Ethylbenzene	0.090	0.002	"	0.100	ND	89.7	62.2-130			
m,p-Xylene	0.178	0.004	"	0.200	ND	89.2	46.5-137			
o-Xylene	0.087	0.002	"	0.100	ND	87.1	54.2-134			
Surrogate: 1,2-Dichloroethane-d4	67		ug/kg	62.5		108	70-130			
Surrogate: Toluene-d8	59		"	62.5		94.4	70-130			
Surrogate: 4-Bromofluorobenzene	62		"	62.5		98.5	70-130			

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**Volatile Organic Compounds by GC/MS SW846 8260C - 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 B812710 - EPA 5030 (soil)**

<b>Matrix Spike Dup (B812710-MSD1)</b>	<b>Source: Y809362-02</b>			<b>Prepared: 09/27/2018 Analyzed: 09/27/2018</b>						
Benzene	0.093	0.002	mg/kg	0.100	ND	93.1	71.8-126	10.7	11.3	
Toluene	0.094	0.002	"	0.100	ND	94.1	65.1-130	6.16	15.4	
Ethylbenzene	0.102	0.002	"	0.100	ND	102	62.2-130	0.955	19.6	
m,p-Xylene	0.206	0.004	"	0.200	ND	103	46.5-137	0.262	19.2	
o-Xylene	0.114	0.002	"	0.100	ND	114	54.2-134	17.4	17.9	
Surrogate: 1,2-Dichloroethane-d4	61		ug/kg	62.5		97.4	70-130			
Surrogate: Toluene-d8	61		"	62.5		96.9	70-130			
Surrogate: 4-Bromofluorobenzene	67		"	62.5		107	70-130			

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**Volatile Organic Compounds by GC/MS SW846 8260C - 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 B812710 - EPA 5030 (soil)**

<b>Matrix Spike Dup (B812710-MSD2)</b>	<b>Source: Y809368-01</b>			<b>Prepared: 09/27/2018 Analyzed: 09/27/2018</b>						
Benzene	0.093	0.002	mg/kg	0.100	ND	93.2	71.8-126	2.14	11.3	
Toluene	0.087	0.002	"	0.100	ND	87.4	65.1-130	3.44	15.4	
Ethylbenzene	0.086	0.002	"	0.100	ND	85.5	62.2-130	4.77	19.6	
m,p-Xylene	0.171	0.004	"	0.200	ND	85.6	46.5-137	4.06	19.2	
o-Xylene	0.084	0.002	"	0.100	ND	83.6	54.2-134	4.05	17.9	
Surrogate: 1,2-Dichloroethane-d4	69		ug/kg	62.5		110	70-130			
Surrogate: Toluene-d8	59		"	62.5		93.8	70-130			
Surrogate: 4-Bromofluorobenzene	62		"	62.5		99.9	70-130			

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**Volatile Organic Compounds by GC/MS SW846 8260C - 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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**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 B812711 - EPA 3580**

**Blank (B812711-BLK1)**

Prepared: 09/27/2018 Analyzed: 09/27/2018

Gasoline (C6-C10)	ND	50.0	mg/kg							Ua
Diesel (C10-C28)	ND	50.0	"							Ua
Residual Range Organics (C28-C40)	ND	200	"							Ua

Surrogate: o-Terphenyl

37.6

"

50.0

75.2

65-146

**Blank (B812711-BLK2)**

Prepared: 09/27/2018 Analyzed: 09/27/2018

Gasoline (C6-C10)	ND	50.0	mg/kg							Ua
Diesel (C10-C28)	ND	50.0	"							Ua
Residual Range Organics (C28-C40)	ND	200	"							Ua

Surrogate: o-Terphenyl

41.2

"

50.0

82.4

65-146

**LCS (B812711-BS1)**

Prepared: 09/27/2018 Analyzed: 09/27/2018

Gasoline (C6-C10)	986	50.0	mg/kg	1000		98.6	66.7-119			
Diesel (C10-C28)	945	50.0	"	1000		94.5	70.1-127			
Residual Range Organics (C28-C40)	961	200	"	1000		96.1	54.5-139			

Surrogate: o-Terphenyl

47.2

"

50.0

94.5

65-146

**LCS (B812711-BS2)**

Prepared: 09/27/2018 Analyzed: 09/27/2018

Gasoline (C6-C10)	919	50.0	mg/kg	1000		91.9	66.7-119			
Diesel (C10-C28)	1010	50.0	"	1000		101	70.1-127			
Residual Range Organics (C28-C40)	885	200	"	1000		88.5	54.5-139			

Surrogate: o-Terphenyl

46.0

"

50.0

92.0

65-146

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Rachel Peterson  
 Project Number: 178229  
 Project: Crater Lake #1-8

**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 B8I2711 - EPA 3580</b>										
<b>Matrix Spike (B8I2711-MS1)</b>			<b>Source: Y809362-02</b>			Prepared: 09/27/2018 Analyzed: 09/27/2018				
Gasoline (C6-C10)	961	50.0	mg/kg	1000	ND	96.1	56.4-132			
Diesel (C10-C28)	922	50.0	"	1000	ND	92.2	57.4-138			
Residual Range Organics (C28-C40)	940	200	"	1000	5.90	93.4	47.7-129			
Surrogate: o-Terphenyl	46.4		"	50.0		92.8	65-146			
<b>Matrix Spike (B8I2711-MS2)</b>			<b>Source: Y809386-01</b>			Prepared: 09/27/2018 Analyzed: 09/27/2018				
Gasoline (C6-C10)	1000	50.0	mg/kg	1000	ND	100	56.4-132			
Diesel (C10-C28)	1110	50.0	"	1000	ND	111	57.4-138			
Residual Range Organics (C28-C40)	1000	200	"	1000	15.3	98.5	47.7-129			
Surrogate: o-Terphenyl	49.4		"	50.0		98.9	65-146			
<b>Matrix Spike Dup (B8I2711-MSD1)</b>			<b>Source: Y809362-02</b>			Prepared: 09/27/2018 Analyzed: 09/27/2018				
Gasoline (C6-C10)	958	50.0	mg/kg	1000	ND	95.8	56.4-132	0.252	22	
Diesel (C10-C28)	927	50.0	"	1000	ND	92.7	57.4-138	0.464	18.3	
Residual Range Organics (C28-C40)	945	200	"	1000	5.90	94.0	47.7-129	0.576	30.1	
Surrogate: o-Terphenyl	46.5		"	50.0		93.0	65-146			
<b>Matrix Spike Dup (B8I2711-MSD2)</b>			<b>Source: Y809386-01</b>			Prepared: 09/27/2018 Analyzed: 09/27/2018				
Gasoline (C6-C10)	1000	50.0	mg/kg	1000	ND	100	56.4-132	0.266	22	
Diesel (C10-C28)	1070	50.0	"	1000	ND	107	57.4-138	4.10	18.3	
Residual Range Organics (C28-C40)	974	200	"	1000	15.3	95.9	47.7-129	2.66	30.1	
Surrogate: o-Terphenyl	50.1		"	50.0		100	65-146			

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 Denver CO 80222

Rachel Peterson  
 Project Number: 178229  
 Project: Crater Lake #1-8

**Classical Chemistry Parameters - Quality Control**  
**Origins Laboratory, Inc.**

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
<b>Batch B812705 - NO PREP</b>										
<b>Duplicate (B812705-DUP1)</b>		<b>Source: Y809365-01</b>			Prepared: 09/27/2018 Analyzed: 09/27/2018					
pH	8.21		pH Units		8.41			2.41	25	
<b>Duplicate (B812705-DUP2)</b>		<b>Source: Y809387-01</b>			Prepared: 09/27/2018 Analyzed: 09/27/2018					
pH	8.74		pH Units		8.69			0.574	25	
<b>Batch B812706 - NO PREP</b>										
<b>Blank (B812706-BLK1)</b>		Prepared: 09/27/2018 Analyzed: 09/27/2018								
Specific Conductance (EC)	0.00220	0.00500	mmhos/cm							
<b>Blank (B812706-BLK2)</b>		Prepared: 09/27/2018 Analyzed: 09/27/2018								
Specific Conductance (EC)	0.00230	0.00500	mmhos/cm							
<b>Duplicate (B812706-DUP1)</b>		<b>Source: Y809365-01</b>			Prepared: 09/27/2018 Analyzed: 09/27/2018					
Specific Conductance (EC)	1.28	0.00500	mmhos/cm		1.19			6.60	25	
<b>Duplicate (B812706-DUP2)</b>		<b>Source: Y809387-01</b>			Prepared: 09/27/2018 Analyzed: 09/27/2018					
Specific Conductance (EC)	0.0575	0.00500	mmhos/cm		0.0725			23.1	25	

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Rachel Peterson  
 Project Number: 178229  
 Project: Crater Lake #1-8

**Total Metals by 6010C - Quality Control**  
**GEL Laboratories, LLC**

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
<b>Batch 1807106 - SW846 3050B</b>										
<b>BLANK (1204123669-BLK)</b>					Prepared: 10/01/2018 Analyzed: 10/01/2018					
Arsenic	ND	2.76	mg/kg				-			U
<b>LCS (1204123670-BKS)</b>					Prepared: 10/01/2018 Analyzed: 10/01/2018					
Arsenic	45.2	2.96	mg/kg	49.3		91.7	80-120			
<b>DUP (1204123671 D)</b>					Source: 460450001 Prepared: 10/01/2018 Analyzed: 10/01/2018					
Arsenic	7.23	3.11	mg/kg dry		7.02		0-20	2.86	20	
<b>MS (1204123672 S)</b>					Source: 460450001 Prepared: 10/01/2018 Analyzed: 10/01/2018					
Arsenic	40.0	2.96	mg/kg dry	49.4	7.02	66.7	75-125			
<b>PS (1204126025 S)</b>					Source: 460450001 Prepared: 10/01/2018 Analyzed: 10/02/2018					
Arsenic	0.569	0.0321	mg/kg dry	0.500		93	75-125			

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Rachel Peterson  
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Project: Crater Lake #1-8

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**Notes and Definitions**

Ua Sample is Non-Detect.

U Result not detected above the detection limit

S-07 High surrogate in sample, however sample is non-detect. High surrogate indicates result values are biased high.

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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*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.*

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Jen Pellegrini For Noelle Doyle Mathis, President