

1625 Broadway
Suite 2200
Denver, CO 80202



Tel: 303.228.4000
Fax: 303.228.4286
www.nobleenergyinc.com

February 19, 2016

Hungenberg McKee Farms LLLP
976 N Balsam Ave
Greeley, CO 80631

RE: Water Well Sampling Results – Domestic Water Well (Receipt # 0090684)

Dear Mr. Hungenberg:

The Colorado Oil and Gas Conservation Commission (COGCC) observed methane in a monitoring well and requested that operators sample nearby water wells. You granted permission for Noble Energy, Inc. (Noble) to sample your well on January 18, 2016. On January 19, 2016, Noble collected groundwater samples from your domestic water well and submitted them to ALS Environmental (ALS) in Fort Collins, Colorado for laboratory analysis.

The laboratory analytical results for your water are provided in Attachment 1. The results indicate that methane was detected at less than 1 milligram per liter (mg/L). A sample was then sent to the Dolan Integration Group (DIG) in Boulder, Colorado on January 26, 2016 to determine if the methane is from microbial sources or if it is thermogenic. The lab results indicate that the methane is microbial. The ALS and DIG reports containing all laboratory analyses for your water well are provided in Attachment 2.

Basic information concerning the groundwater that is supplied to you from your private water well is provided as a reference guide (How Well Do You Know Your Water Well booklet). This booklet also includes information on drinking water standards and methane as related to private water wells. Additional resources concerning water well matters, water quality considerations or oil and gas activities in your vicinity can be found by contacting the appropriate regulatory agency:

Colorado Division of Water Resources, Groundwater Information Desk
(303) 866-3587
<http://www.water.state.co.us>

Colorado Department of Public Health and Environment, Water Quality Control Division
(303) 692-3500
<http://www.cdphe.state.co.us>

Colorado Oil and Gas Conservation Commission
(303) 894-2100
<http://cogcc.state.co.us>

If you have any questions or concerns regarding the sampling results for the water well on your property, please feel free to contact me at (303) 228-4000.

Sincerely,

A handwritten signature in black ink, appearing to read 'Curtis Rueter', written over a horizontal line.

Curtis Rueter
Project Manager

CC: Rick Allison, COGCC
Attachments

ATTACHMENT 1

LABORATORY ANALYTICAL SUMMARY

Well Permit: 0097143-A Receipt: 0090684 Location: SWSW Section 23 Township 6N Range 65W
 Sample Date: 1/19/16

Field Water Quality Parameter Summary

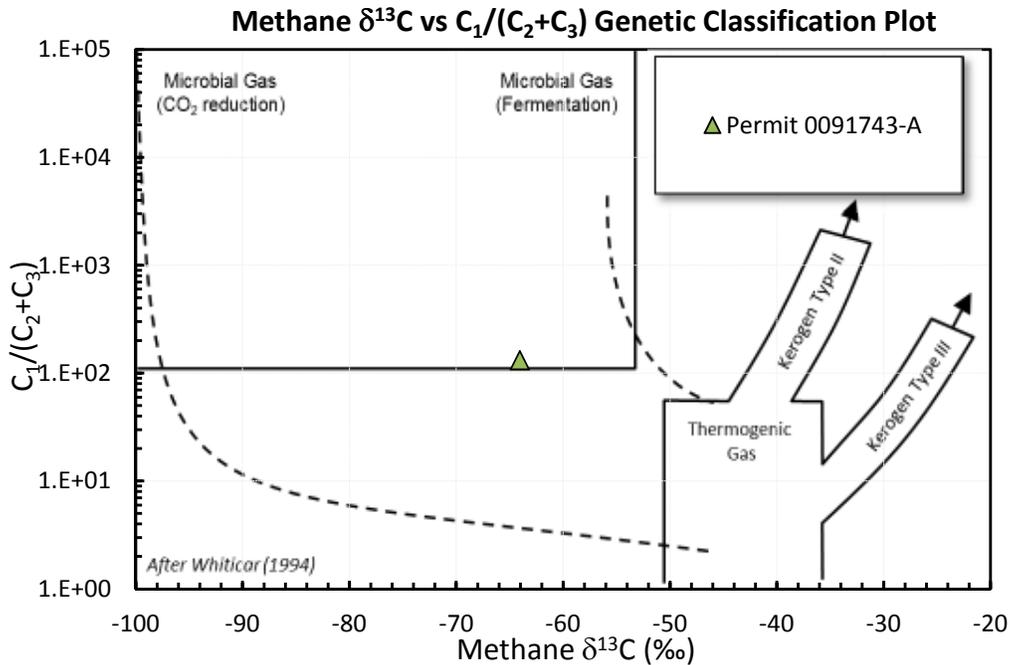
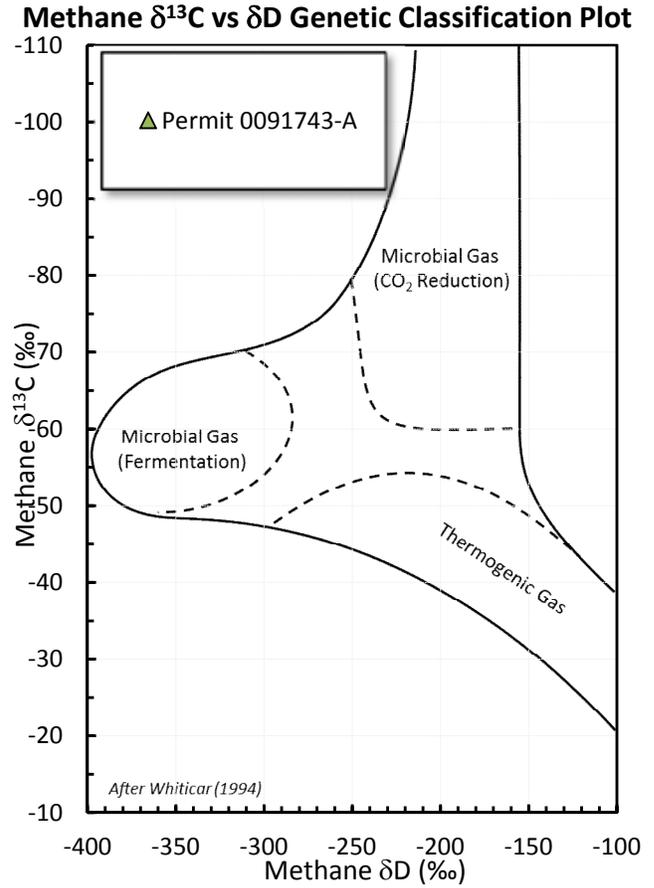
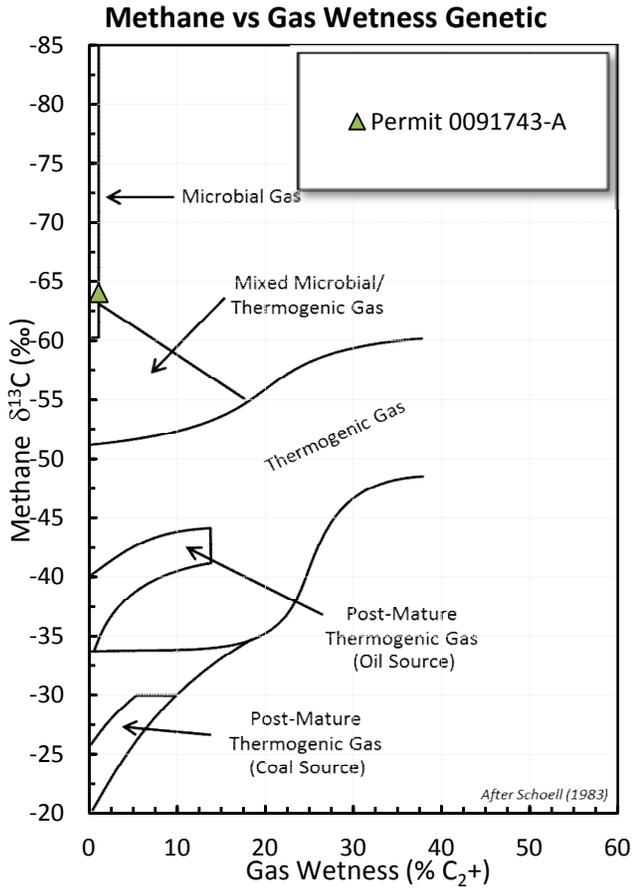
Sample ID	pH	Temp (°C)	Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Latitude (North)	Longitude (West)
Permit 91743A	8.27	9.01	1.314	3.36	NM	40.467063	-104.639492

Laboratory Analytical Summary

	Concentration	DWS
Dissolved Gases		
Methane (mg/L)	0.370	NA
Ethane (mg/L)	U	NA
Propane (mg/L)	U	NA
Volatile Organic Compounds (VOCs)		
Benzene (mg/L)	U	0.005
Toluene (mg/L)	U	1
Ethylbenzene (mg/L)	U	0.68
Total Xylenes (mg/L)	U	10
Gasoline Range Organics (mg/L)	U	NA
Diesel Range Organics (mg/L)	U	NA
Biological Activity and Reaction Test (BART)		
Iron Reducing Bacteria (CFU/ml)	2300	NA
Slime Forming Bacteria (CFU/ml)	U	NA
Sulfate Reducing Bacteria (CFU/ml)	1200	NA
General Chemistry		
Alkalinity, Bicarbonate as CaCO ₃ (mg/L)	270	NA
Alkalinity, Carbonate (mg/L)	U	NA
Alkalinity, Total as CaCO ₃ (mg/L)	270	NA
Bromide (mg/L)	U	NA
Chloride (mg/L)	35	250
Fluoride (mg/L)	0.98	4
Nitrogen, Nitrate (mg/L)	U	10
Nitrogen, Nitrite (mg/L)	U	1
Total Phosphorus (mg/L)	U	NA
Total Dissolved Solids (mg/L)	850	500
Specific Conductivity (umhos/cm)	1274	NA
Sulfate (mg/L)	350	250
pH Adjusted to 25 deg. Celsius	8.09	6.5 - 8.5
Dissolved Metals		
Barium (mg/L)	0.024	2
Boron (mg/L)	0.12	NA
Calcium (mg/L)	50	NA
Iron (mg/L)	U	0.3
Magnesium (mg/L)	18	NA
Manganese (mg/L)	0.11	NA
Potassium (mg/L)	2.6	NA
Selenium (mg/L)	U	0.05
Sodium (mg/L)	210	NA
Strontium (mg/L)	1.2	NA

Notes: U = analysis performed but not detected
 CFU/ml= colony forming units per milliliter
 mg/L = milligrams per liter
 umhos/cm = micromhos per centimeter
 mS/cm = milli Siemens per centimeter
 DWS = Drinking Water Standard
 NM = Not Measured
 NA = Not Applicable
BOLD - Reported concentration above Colorado drinking water standard

Stable Isotope Interpretive Plots



ATTACHMENT 2
LABORATORY ANALYTICAL REPORTS

Friday, January 29, 2016

Nikki Graber
Olsson Associates
5285 McWhinney Blvd, Suite 160
Loveland, CO 80538

Re: ALS Workorder: 1601210
Project Name: Sand Creek
Project Number: 016-0111

Dear Ms. Graber:

Three water samples were received from Olsson Associates, on 1/20/2016. The samples were scheduled for the following analyses:

BART

Dissolved Gasses

GC/MS Volatiles

Inorganics

Metals

Total Extractable Petroleum Hydrocarbons (Diesel)

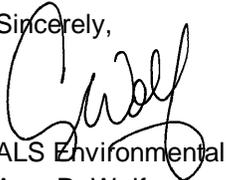
Total Volatile Petroleum Hydrocarbons (Gasoline)

The results for these analyses are contained in the enclosed reports.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,



ALS Environmental
Amy R. Wolf
Project Manager

ALS Environmental – Fort Collins is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

ALS Environmental – Fort Collins	
Accreditation Body	License or Certification Number
Alaska (AK)	UST-086
Alaska (AK)	CO01099
Arizona (AZ)	AZ0742
California (CA)	06251CA
Colorado (CO)	CO01099
Connecticut (CT)	PH-0232
Florida (FL)	E87914
Idaho (ID)	CO01099
Kansas (KS)	E-10381
Kentucky (KY)	90137
L-A-B (DoD ELAP/ISO 170250)	L2257
Louisiana (LA)	05057
Maryland (MD)	285
Missouri (MO)	175
Nebraska(NE)	NE-OS-24-13
Nevada (NV)	CO000782008A
New York (NY)	12036
North Dakota (ND)	R-057
Oklahoma (OK)	1301
Pennsylvania (PA)	68-03116
Tennessee (TN)	2976
Texas (TX)	T104704241
Utah (UT)	CO01099
Washington (WA)	C1280



1601210

GC/MS Volatiles:

The samples were analyzed using GC/MS following the current revision of SOP 525 based on SW-846 Method 8260C.

All acceptance criteria were met.

Dissolved Gasses:

The sample was prepared and analyzed according to method RSK-175 procedures and the current revision of SOP 449.

The sample had a pH > 2 at the time of analysis.

All acceptance criteria were met.

GRO:

The sample was analyzed following the current revision of SOP 425 generally based on SW-846 Methods 8000C and 8015D. TVPH is a multicomponent mixture and is quantitated by summing the entire carbon range, rather than individual peaks. The carbon range integrated in this test extends from C6 to C10.

All acceptance criteria were met.

DRO:

The sample was analyzed following the current revision of SOP 406 generally based on SW-846 Methods 8000C and 8015D. TEPH is a multicomponent mixture and is quantitated by summing the entire carbon range, rather than individual peaks. The carbon range integrated in this test extends from C10 to C28.

All acceptance criteria were met.

BART:

The Biological Activity Reaction Test was completed with the Iron-Related Bacteria, Sulfate-Reducing Bacteria, and Slime-Forming Bacteria kit manufactured by Hach Company. The analysis was performed following the manufacturer provided instructions. If the target analyte is not detected (absent), then the sample will be reported with "ND" in the result field. If the target analyte is detected (present), then the sample will be reported with the estimated colony forming units/mL (cfu/mL) as provided by the manufacturer based on the day reaction was observed.

**Metals:**

The sample was analyzed following Methods for the Determination of Metals in Environmental Samples – Supplement 1 procedures. Analysis by ICPMS followed method 200.8 and the current revision of SOP 827.

The sample was to be analyzed for dissolved metals. The sample was filtered through a 0.45 micron filter and preserved with nitric acid to a pH less than 2 prior to analysis.

All acceptance criteria were met.

Inorganics:

The sample was analyzed following MCAWW, EMSL, and Standard Method procedures for the current revisions of the following SOPs and methods:

<u>Analyte</u>	<u>Method</u>	<u>SOP #</u>
Alkalinity	SM2320B	1106
Bicarbonate	SM2320B	1106
Carbonate	SM2320B	1106
pH	SM4500-H ⁺ B	1126
Total phosphorus	365.2	1119
Specific conductance	SM2510B	1128
TDS	SM2540C	1101
Bromide	300.0 Revision 2.1	1113
Chloride	300.0 Revision 2.1	1113
Fluoride	300.0 Revision 2.1	1113
Nitrate as N	300.0 Revision 2.1	1113
Nitrite as N	300.0 Revision 2.1	1113
Total Nitrates	300.0 Revision 2.1	1113
Sulfate	300.0 Revision 2.1	1113

All acceptance criteria were met.

ALS Environmental -- FC

Sample Number(s) Cross-Reference Table

OrderNum: 1601210

Client Name: Olsson Associates

Client Project Name: Sand Creek

Client Project Number: 016-0111

Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
Permit 91743A	1601210-1		WATER	19-Jan-16	14:32
Permit 91743A-D	1601210-2		WATER	19-Jan-16	14:32
Trip Blank	1601210-3		WATER	19-Jan-16	



ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: Olsson
Project Manager: ARW

Workorder No: 1601210
Initials: SDM Date: 1-20-16

1. Does this project require any special handling in addition to standard ALS procedures?		YES	<input checked="" type="radio"/> NO
2. Are custody seals on shipping containers intact?	<input checked="" type="radio"/> NONE	YES	NO
3. Are Custody seals on sample containers intact?	<input checked="" type="radio"/> NONE	YES	NO
4. Is there a COC (Chain-of-Custody) present or other representative documents?		<input checked="" type="radio"/> YES	NO
5. Are the COC and bottle labels complete and legible?		<input checked="" type="radio"/> YES	NO
6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		YES	<input checked="" type="radio"/> NO
7. Were airbills / shipping documents present and/or removable?	<input checked="" type="radio"/> DROP OFF	<input checked="" type="radio"/> YES	NO
8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	N/A	<input checked="" type="radio"/> YES	NO
9. Are all aqueous non-preserved samples pH 4-9?	N/A	<input checked="" type="radio"/> YES	NO
10. Is there sufficient sample for the requested analyses?		<input checked="" type="radio"/> YES	NO
11. Were all samples placed in the proper containers for the requested analyses?		<input checked="" type="radio"/> YES	NO
12. Are all samples within holding times for the requested analyses?		<input checked="" type="radio"/> YES	NO
13. Were all sample containers received intact? (not broken or leaking, etc.)		<input checked="" type="radio"/> YES	NO
14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ___ < green pea ___ > green pea	N/A	YES	<input checked="" type="radio"/> NO
15. Do any water samples contain sediment? Amount of sediment: ___ dusting ___ moderate ___ heavy	Amount N/A	YES	<input checked="" type="radio"/> NO
16. Were the samples shipped on ice?		<input checked="" type="radio"/> YES	NO
17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: <input checked="" type="radio"/> #2 #4		<input checked="" type="radio"/> YES	NO
Cooler #: <u>1</u>			
Temperature (°C): <u>1.6</u>			
No. of custody seals on cooler: <u>0</u>			
External µR/hr reading: <u>N/A</u>			
Background µR/hr reading: <u>11</u>			
Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? YES / NO / <input checked="" type="radio"/> NA (If no, see Form 008.)			

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

6.) For sample one → a 120ml sterile bottle was sent with the samples. No BART test is indicated on the COC for required analysis. → Sample 1 says 14 bottles shipped on COC actually received 17 for sample 1.

14.) Sample 1 bottle 11 & 12 have a headspace < green pea.

If applicable, was the client contacted? YES / NO / NA Contact: _____ Date/Time: _____

Project Manager Signature / Date: [Signature] 1-20-16

Form 201r24.xls (06/04/2012) *IR Gun #2: Oakton, SN 29922500201-0066 *IR Gun #4: Oakton, SN 2372220101-0002

Client: Olsson Associates
Project: 016-0111 Sand Creek
Sample ID: Permit 91743A
Legal Location:
Collection Date: 1/19/2016 14:32

Date: 29-Jan-16
Work Order: 1601210
Lab ID: 1601210-1
Matrix: WATER
Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Alkalinity as Calcium Carbonate						
			SM2320B		Prep Date: 1/25/2016	PrepBy: TLB
BICARBONATE AS CaCO3	270		20	MG/L	1	1/25/2016
CARBONATE AS CaCO3	ND		20	MG/L	1	1/25/2016
TOTAL ALKALINITY AS CaCO3	270		20	MG/L	1	1/25/2016
Biological Activity Reaction Test						
			BART		Prep Date: 1/21/2016	PrepBy: CDR
IRON RELATED BACTERIA	2300		1	cfu/ml	1	1/29/2016
SLIME FORMING BACTERIA	ND		1	cfu/ml	1	1/29/2016
SULFATE REDUCING BACTERIA	1200		1	cfu/ml	1	1/29/2016
Diesel Range Organics						
			SW8015M		Prep Date: 1/25/2016	PrepBy: ACK
Diesel Range Organics	ND		0.61	MG/L	1	1/27/2016 15:08
Surr: O-TERPHENYL	117		63-126	%REC	1	1/27/2016 15:08
Dissolved Gasses						
			RSK175		Prep Date: 1/21/2016	PrepBy: DMS
METHANE	370		1	UG/L	1	1/21/2016 17:31
ETHANE	ND		2	UG/L	1	1/21/2016 17:31
PROPANE	ND		1	UG/L	1	1/21/2016 17:31
Gasoline Range Organics						
			SW8015		Prep Date: 1/27/2016	PrepBy: TWK
GASOLINE RANGE ORGANICS	ND		0.05	MG/L	1	1/27/2016 13:01
Surr: 2,3,4-TRIFLUOROTOLUENE	97		74-129	%REC	1	1/27/2016 13:01
GC/MS Volatiles						
			SW8260_25		Prep Date: 1/20/2016	PrepBy: JXK
BENZENE	ND		1	UG/L	1	1/20/2016 19:26
TOLUENE	ND		1	UG/L	1	1/20/2016 19:26
ETHYLBENZENE	ND		1	UG/L	1	1/20/2016 19:26
M+P-XYLENE	ND		1	UG/L	1	1/20/2016 19:26
O-XYLENE	ND		1	UG/L	1	1/20/2016 19:26
TOTAL XYLENES	ND		1	UG/L	1	1/20/2016 19:26
Surr: 4-BROMOFLUOROBENZENE	98		85-115	%REC	1	1/20/2016 19:26
Surr: DIBROMOFLUOROMETHANE	102		84-118	%REC	1	1/20/2016 19:26
Surr: TOLUENE-D8	98		85-115	%REC	1	1/20/2016 19:26
Ion Chromatography						
			EPA300.0		Prep Date: 1/20/2016	PrepBy: JFN
BROMIDE	ND		0.4	MG/L	2	1/20/2016 19:43
CHLORIDE	35		0.4	MG/L	2	1/20/2016 19:43
FLUORIDE	0.98		0.2	MG/L	2	1/20/2016 19:43
NITRATE/NITRITE AS N	ND		0.1	MG/L	1	1/20/2016 19:43
NITRATE AS N	ND		0.4	MG/L	2	1/20/2016 19:43
NITRITE AS N	ND		0.2	MG/L	2	1/20/2016 19:43
SULFATE	350		12	MG/L	12.5	1/20/2016 16:27
Dissolved Metals by 200.8						
			EPA200.8		Prep Date: 1/22/2016	PrepBy: CDR
BARIUM	0.024		0.001	MG/L	10	1/26/2016 18:45
BORON	0.12		0.05	MG/L	10	1/26/2016 18:45
CALCIUM	50		1	MG/L	10	1/26/2016 18:45
IRON	ND		0.1	MG/L	10	1/26/2016 18:45
MAGNESIUM	18		0.1	MG/L	10	1/26/2016 18:45
MANGANESE	0.11		0.002	MG/L	10	1/26/2016 18:45
POTASSIUM	2.6		1	MG/L	10	1/26/2016 18:45

Client: Olsson Associates
Project: 016-0111 Sand Creek
Sample ID: Permit 91743A
Legal Location:
Collection Date: 1/19/2016 14:32

Date: 29-Jan-16
Work Order: 1601210
Lab ID: 1601210-1
Matrix: WATER
Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
SELENIUM	ND		0.001	MG/L	10	1/26/2016 18:45
SODIUM	210		1	MG/L	10	1/26/2016 18:45
STRONTIUM	1.2		0.001	MG/L	10	1/26/2016 18:45
pH		SM4500-H			Prep Date: 1/21/2016	PrepBy: SDW
PH	8.09		0.1	pH	1	1/21/2016
Specific Conductance in Water		SM2510B			Prep Date: 1/21/2016	PrepBy: SDW
SPECIFIC CONDUCTIVITY	1274		1	umhos/cm	1	1/21/2016
Total Dissolved Solids		SM2540C			Prep Date: 1/25/2016	PrepBy: TLB
TOTAL DISSOLVED SOLIDS	850		20	MG/L	1	1/26/2016
Total Phosphorus as P		EPA365.2			Prep Date: 1/21/2016	PrepBy: TLB
TOTAL PHOSPHORUS	ND		0.05	MG/L	1	1/21/2016

Client: Olsson Associates
Project: 016-0111 Sand Creek
Sample ID: Permit 91743A-D
Legal Location:
Collection Date: 1/19/2016 14:32

Date: 29-Jan-16
Work Order: 1601210
Lab ID: 1601210-2
Matrix: WATER
Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
----------	--------	------	-----------------	-------	--------------------	---------------

Client: Olsson Associates
Project: 016-0111 Sand Creek
Sample ID: Trip Blank
Legal Location:
Collection Date: 1/19/2016

Date: 29-Jan-16
Work Order: 1601210
Lab ID: 1601210-3
Matrix: WATER
Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
GC/MS Volatiles			SW8260_25		Prep Date: 1/20/2016	PrepBy: JXK
BENZENE	ND		1	UG/L	1	1/20/2016 19:05
TOLUENE	ND		1	UG/L	1	1/20/2016 19:05
ETHYLBENZENE	ND		1	UG/L	1	1/20/2016 19:05
M+P-XYLENE	ND		1	UG/L	1	1/20/2016 19:05
O-XYLENE	ND		1	UG/L	1	1/20/2016 19:05
TOTAL XYLENES	ND		1	UG/L	1	1/20/2016 19:05
Surr: 4-BROMOFLUOROBENZENE	100		85-115	%REC	1	1/20/2016 19:05
Surr: DIBROMOFLUOROMETHANE	101		84-118	%REC	1	1/20/2016 19:05
Surr: TOLUENE-D8	101		85-115	%REC	1	1/20/2016 19:05

Client: Olsson Associates
Project: 016-0111 Sand Creek
Sample ID: Trip Blank
Legal Location:
Collection Date: 1/19/2016

Date: 29-Jan-16
Work Order: 1601210
Lab ID: 1601210-3
Matrix: WATER
Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
----------	--------	------	--------------	-------	-----------------	---------------

Explanation of Qualifiers

Radiochemistry:

- U or ND - Result is less than the sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- Y2 - Chemical Yield outside default limits.
- W - DER is greater than Warning Limit of 1.42
- * - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
- # - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.
- G - Sample density differs by more than 15% of LCS density.
- D - DER is greater than Control Limit
- M - Requested MDC not met.
- LT - Result is less than requested MDC but greater than achieved MDC.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
- L - LCS Recovery below lower control limit.
- H - LCS Recovery above upper control limit.
- P - LCS, Matrix Spike Recovery within control limits.
- N - Matrix Spike Recovery outside control limits
- NC - Not Calculated for duplicate results less than 5 times MDC
- B - Analyte concentration greater than MDC.
- B3 - Analyte concentration greater than MDC but less than Requested MDC.

Inorganics:

- B - Result is less than the requested reporting limit but greater than the instrument method detection limit (MDL).
- U or ND - Indicates that the compound was analyzed for but not detected.
- E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.
- M - Duplicate injection precision was not met.
- N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.
- Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.
- * - Duplicate analysis (relative percent difference) not within control limits.
- S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

Organics:

- U or ND - Indicates that the compound was analyzed for but not detected.
- B - Analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user.
- E - Analyte concentration exceeds the upper level of the calibration range.
- J - Estimated value. The result is less than the reporting limit but greater than the instrument method detection limit (MDL).
- A - A tentatively identified compound is a suspected aldol-condensation product.
- X - The analyte was diluted below an accurate quantitation level.
- * - The spike recovery is equal to or outside the control criteria used.
- + - The relative percent difference (RPD) equals or exceeds the control criteria.
- G - A pattern resembling gasoline was detected in this sample.
- D - A pattern resembling diesel was detected in this sample.
- M - A pattern resembling motor oil was detected in this sample.
- C - A pattern resembling crude oil was detected in this sample.
- 4 - A pattern resembling JP-4 was detected in this sample.
- 5 - A pattern resembling JP-5 was detected in this sample.
- H - Indicates that the fuel pattern was in the heavier end of the retention time window for the analyte of interest.
- L - Indicates that the fuel pattern was in the lighter end of the retention time window for the analyte of interest.
- Z - This flag indicates that a significant fraction of the reported result did not resemble the patterns of any of the following petroleum hydrocarbon products:
 - gasoline
 - JP-8
 - diesel
 - mineral spirits
 - motor oil
 - Stoddard solvent
 - bunker C

ALS Environmental -- FC

Date: 1/29/2016 1:46:

Client: Olsson Associates

QC BATCH REPORT

Work Order: 1601210

Project: 016-0111 Sand Creek

Batch ID: **HC160121-99-1**

Instrument ID **MEE-1**

Method: **RSK175**

LCS Sample ID: **HC160121-99** Units: **UG/L** Analysis Date: **1/21/2016 17:22**

Client ID: Run ID: **HC160121-99A** Prep Date: **1/21/2016** DF: **1**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
METHANE	150	1	142		105	80-120				25	
ETHANE	285	2	267		107	80-120				25	
PROPANE	409	1	391		105	80-120				25	

LCSD Sample ID: **HC160121-99** Units: **UG/L** Analysis Date: **1/21/2016 18:11**

Client ID: Run ID: **HC160121-99A** Prep Date: **1/21/2016** DF: **1**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
METHANE	148	1	142		104	80-120		150	2	25	
ETHANE	282	2	267		106	80-120		285	1	25	
PROPANE	404	1	391		103	80-120		409	1	25	

MB Sample ID: **HC160121-99** Units: **UG/L** Analysis Date: **1/21/2016 17:25**

Client ID: Run ID: **HC160121-99A** Prep Date: **1/21/2016** DF: **1**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
METHANE	ND	1									
ETHANE	ND	2									
PROPANE	ND	1									

The following samples were analyzed in this batch:

1601210-1

Client: Olsson Associates
 Work Order: 1601210
 Project: 016-0111 Sand Creek

QC BATCH REPORT

Batch ID: **HC160127-6-2** Instrument ID **FUELS-1** Method: **SW8015**

LCS Sample ID: **HC160127-6** Units: **MG/L** Analysis Date: **1/27/2016 09:41**
 Client ID: Run ID: **HC160127-6A** Prep Date: **1/27/2016** DF: **1**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
GASOLINE RANGE ORGANICS	0.524	0.05	0.5		105	79-118				20	
Surr: 2,3,4-TRIFLUOROTOLUENE	0.104		0.1		104	74-129					

LCSD Sample ID: **HC160127-6** Units: **MG/L** Analysis Date: **1/27/2016 12:38**
 Client ID: Run ID: **HC160127-6A** Prep Date: **1/27/2016** DF: **1**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
GASOLINE RANGE ORGANICS	0.505	0.05	0.5		101	79-118		0.524	4	20	
Surr: 2,3,4-TRIFLUOROTOLUENE	0.101		0.1		101	74-129			3		

MB Sample ID: **HC160127-6** Units: **MG/L** Analysis Date: **1/27/2016 10:03**
 Client ID: Run ID: **HC160127-6A** Prep Date: **1/27/2016** DF: **1**

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
GASOLINE RANGE ORGANICS	ND	0.05									
Surr: 2,3,4-TRIFLUOROTOLUENE	0.1		0.1		100	74-129					

The following samples were analyzed in this batch:

Client: Olsson Associates
 Work Order: 1601210
 Project: 016-0111 Sand Creek

QC BATCH REPORT

Batch ID: EX160125-2-1 Instrument ID FUELS-1 Method: SW8015M

DUP Sample ID: 1601210-1 Units: **MG/L** Analysis Date: 1/27/2016 15:38
 Client ID: Permit 91743A Run ID: HC160127-7 Prep Date: 1/25/2016 DF: 1

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
Diesel Range Organics	ND	0.625						0.61		30	
Surr: O-TERPHENYL	1.02		0.868		118	63-126					

LCS Sample ID: EX160125-2 Units: **MG/L** Analysis Date: 1/27/2016 10:17
 Client ID: Run ID: HC160127-7 Prep Date: 1/25/2016 DF: 1

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
Diesel Range Organics	18.3	0.646	17.9		102	36-150				20	
Surr: O-TERPHENYL	0.972		0.897		108	63-126					

LCSD Sample ID: EX160125-2 Units: **MG/L** Analysis Date: 1/27/2016 10:47
 Client ID: Run ID: HC160127-7 Prep Date: 1/25/2016 DF: 1

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
Diesel Range Organics	18.1	0.636	17.7		102	36-150		18.3	1	20	
Surr: O-TERPHENYL	0.97		0.884		110	63-126				0	

MB Sample ID: EX160125-2 Units: **MG/L** Analysis Date: 1/27/2016 09:42
 Client ID: Run ID: HC160127-7 Prep Date: 1/25/2016 DF: 1

Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
Diesel Range Organics	ND	0.67									
Surr: O-TERPHENYL	1.09		0.935		117	63-126					

The following samples were analyzed in this batch:

Client: Olsson Associates
 Work Order: 1601210
 Project: 016-0111 Sand Creek

QC BATCH REPORT

Batch ID: **IP160122-2-2** Instrument ID **ICPMS2** Method: **EPA200.8**

LCS		Sample ID: FM160122-2			Units: MG/L		Analysis Date: 1/26/2016 18:42				
Client ID:		Run ID: IM160126-12A4			Prep Date: 1/22/2016		DF: 10				
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
BARIUM	0.106	0.001	0.1		106	85-115				20	
BORON	0.996	0.05	1		100	85-115				20	
CALCIUM	9.27	1	10		93	85-115				20	
IRON	4.97	0.1	5		99	85-115				20	
MAGNESIUM	9.83	0.1	10		98	85-115				20	
MANGANESE	0.102	0.002	0.1		102	85-115				20	
POTASSIUM	4.93	1	5		99	85-115				20	
SELENIUM	0.0966	0.001	0.1		97	85-115				20	
SODIUM	9.42	1	10		94	85-115				20	
STRONTIUM	0.0987	0.001	0.1		99	85-115				20	

MB		Sample ID: FP160122-2			Units: MG/L		Analysis Date: 1/26/2016 18:38				
Client ID:		Run ID: IM160126-12A4			Prep Date: 1/22/2016		DF: 10				
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
BARIUM	ND	0.001									
BORON	ND	0.05									
CALCIUM	ND	1									
IRON	ND	0.1									
MAGNESIUM	ND	0.1									
MANGANESE	ND	0.002									
POTASSIUM	ND	1									
SELENIUM	ND	0.001									
SODIUM	ND	1									
STRONTIUM	ND	0.001									

The following samples were analyzed in this batch:

1601210-1

Client: Olsson Associates
 Work Order: 1601210
 Project: 016-0111 Sand Creek

QC BATCH REPORT

Batch ID: VL160120-3-1 Instrument ID: HPV1 Method: SW8260_25

LCS		Sample ID: VL160120-3			Units: %REC		Analysis Date: 1/20/2016 11:19				
Client ID:		Run ID: VL160120-3A			Prep Date: 1/20/2016		DF: 1				
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
Surr: 4-BROMOFLUOROBENZENE	24.1		25		96	85-115					
Surr: DIBROMOFLUOROMETHANE	25.7		25		103	84-118					
Surr: TOLUENE-D8	24.6		25		98	85-115					
BENZENE	10.2	1	10		102	83-117				20	
TOLUENE	10	1	10		100	82-113				20	
ETHYLBENZENE	10.1	1	10		101	81-113				20	
M+P-XYLENE	20.6	1	20		103	82-115				20	
O-XYLENE	10.2	1	10		102	81-115				20	

LCSD		Sample ID: VL160120-3			Units: %REC		Analysis Date: 1/20/2016 11:41				
Client ID:		Run ID: VL160120-3A			Prep Date: 1/20/2016		DF: 1				
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
Surr: 4-BROMOFLUOROBENZENE	24.1		25		97	85-115			0		
Surr: DIBROMOFLUOROMETHANE	25.7		25		103	84-118			0		
Surr: TOLUENE-D8	24.8		25		99	85-115			1		
BENZENE	10.2	1	10		102	83-117		10.2	1	20	
TOLUENE	10.3	1	10		103	82-113		10	3	20	
ETHYLBENZENE	10.2	1	10		102	81-113		10.1	1	20	
M+P-XYLENE	20.9	1	20		105	82-115		20.6	2	20	
O-XYLENE	10.4	1	10		104	81-115		10.2	2	20	

MB		Sample ID: VL160120-3			Units: %REC		Analysis Date: 1/20/2016 13:16				
Client ID:		Run ID: VL160120-3A			Prep Date: 1/20/2016		DF: 1				
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
Surr: 4-BROMOFLUOROBENZENE	25.6		25		102	85-115					
Surr: DIBROMOFLUOROMETHANE	25.1		25		100	84-118					
Surr: TOLUENE-D8	24.7		25		99	85-115					
BENZENE	ND	1									
TOLUENE	ND	1									
ETHYLBENZENE	ND	1									
M+P-XYLENE	ND	1									
O-XYLENE	ND	1									
TOTAL XYLENES	ND	1									

The following samples were analyzed in this batch:

1601210-1 1601210-3

Client: Olsson Associates
 Work Order: 1601210
 Project: 016-0111 Sand Creek

QC BATCH REPORT

Batch ID: **AK160125-1-2** Instrument ID **Balance** Method: **SM2320B**

LCS		Sample ID: AK160125-1			Units: MG/L		Analysis Date: 1/25/2016				
Client ID:		Run ID: AK160125-1A1			Prep Date: 1/25/2016		DF: 1				
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
TOTAL ALKALINITY AS CaCO3	98.8	5	100		99	85-115				15	

MB		Sample ID: AK160125-1			Units: MG/L		Analysis Date: 1/25/2016				
Client ID:		Run ID: AK160125-1A1			Prep Date: 1/25/2016		DF: 1				
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
BICARBONATE AS CaCO3	ND	5									
CARBONATE AS CaCO3	ND	5									
TOTAL ALKALINITY AS CaCO3	ND	5									

The following samples were analyzed in this batch:

1601210-1

Client: Olsson Associates
 Work Order: 1601210
 Project: 016-0111 Sand Creek

QC BATCH REPORT

Batch ID: **ic160120-2-2** Instrument ID **IC-2** Method: **EPA300.0**

LCS		Sample ID: ic160120-2			Units: MG/L		Analysis Date: 1/20/2016 13:25				
Client ID:		Run ID: IC160120-1A2			Prep Date: 1/20/2016		DF: 1				
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
BROMIDE	4.81	0.2	5		96	90-110				15	
CHLORIDE	4.82	0.2	5		96	90-110				15	
FLUORIDE	1.98	0.1	2		99	90-110				15	
NITRATE AS N	4.9	0.2	5		98	90-110				15	
NITRITE AS N	2.1	0.1	2		105	90-110				15	
SULFATE	18.9	1	20		94	90-110				15	

MB		Sample ID: ic160120-2			Units: MG/L		Analysis Date: 1/20/2016 13:10				
Client ID:		Run ID: IC160120-1A2			Prep Date: 1/20/2016		DF: 1				
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
BROMIDE	ND	0.2									
CHLORIDE	ND	0.2									
FLUORIDE	ND	0.1									
NITRATE AS N	ND	0.2									
NITRITE AS N	ND	0.1									
SULFATE	ND	1									

The following samples were analyzed in this batch:

1601210-1

Client: Olsson Associates
Work Order: 1601210
Project: 016-0111 Sand Creek

QC BATCH REPORT

Batch ID: **TD160125-1-1** Instrument ID **Balance** Method: **SM2540C**

LCS	Sample ID: TD160125-1					Units: MG/L	Analysis Date: 1/26/2016				
Client ID:		Run ID: TD160126-1A1					Prep Date: 1/25/2016		DF: 1		
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
TOTAL DISSOLVED SOLIDS	401	20	400		100	85-115				5	

MB	Sample ID: TD160125-1					Units: MG/L	Analysis Date: 1/26/2016				
Client ID:		Run ID: TD160126-1A1					Prep Date: 1/25/2016		DF: 1		
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
TOTAL DISSOLVED SOLIDS	ND	20									

The following samples were analyzed in this batch:

1601210-1

Client: Olsson Associates
Work Order: 1601210
Project: 016-0111 Sand Creek

QC BATCH REPORT

Batch ID: **TP160121-1-1** Instrument ID: **Spec** Method: **EPA365.2**

LCS	Sample ID: TP160121-1					Units: MG/L	Analysis Date: 1/21/2016				
Client ID:		Run ID: TP160121-1A1					Prep Date: 1/21/2016		DF: 1		
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
TOTAL PHOSPHORUS	0.524	0.05	0.5		105	80-120				20	

MB	Sample ID: TP160121-1					Units: MG/L	Analysis Date: 1/21/2016				
Client ID:		Run ID: TP160121-1A1					Prep Date: 1/21/2016		DF: 1		
Analyte	Result	ReportLimit	SPK Val	SPK Ref Value	%REC	Control Limit	Decision Level	RPD Ref	RPD	RPD Limit	Qual
TOTAL PHOSPHORUS	ND	0.05									

The following samples were analyzed in this batch:

1601210-1



dig
Dolan Integration Group

Geochemistry for Energy

2520 55th St, Suite 101
Boulder, CO 80301
p: 303.531.2030

Hydrocarbon Gas Composition and Stable Isotopes Data and Interpretation

Job #: 16010557
Lab #: DIG-008794
Client: ALS
Sample Name(s): Permit 0091743-A

Analytical Report



Job #: 16010557
 Lab #: DIG-008794
 Client: ALS
 Sample Name: Permit 0091743-A
 Date Sampled: 01/19/16
 Time Sampled: 14:32
 Sample Description: Water with Preservative
 Sampling Notes:
 Date Received: 01/26/16
 Date Analyzed: Gas Composition: 2/3/16 $\delta^{13}\text{C}$: 2/2/16
 Date Reported: 02/03/16
 Comments: Created Headspace with UHP Helium

Measured Values:	Measured ppm	Analyte mol % ^a	HC mol %	$\delta^{13}\text{C}$ ‰ VPDB	δD ‰ VSMOW	Comments
Nitrogen (N ₂)	730015	91.37	-	-	-	
Oxygen + Argon (O ₂ +Ar)	52210	6.53	-	-	-	
Carbon Dioxide (CO ₂)	4201	0.53	-	-	-	
Helium (He) ^b	na	na	-	-	-	Added Headspace
Hydrogen (H ₂)	nd	nd	-	-	-	
Methane (CH ₄)	12377	1.55	98.92	-64.0	na	
Ethane (C ₂ H ₆)	25	0	0.20	nd	-	
Propane (C ₃ H ₈)	69	0.01	0.55	nd	-	
iso-Butane (C ₄ H ₁₀)	13	0	0.10	nd	-	
n-Butane (C ₄ H ₁₀)	21	0	0.17	nd	-	
iso-Pentane (C ₅ H ₁₂)	7	0	0.06	nd	-	
n-Pentane (C ₅ H ₁₂)	nd	nd	nd	nd	-	
Hexanes + (C ₆ H ₁₄)	nd	nd	nd	nd	-	

Calculated Values:	
Total HCs (ppm)	12512
Gas Wetness (mol % C ₂ +C ₁ +))	1.08
C ₁ /(C ₂ +C ₃) (mol/mol)	132

^a Analyte concentrations normalized to 100% (Mol. % is approximately equal to Vol. %)

^b Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

HC= Hydrocarbons

nd = not detected

na = not analyzed

Stable isotope results based on multi-point laboratory calibration

Error $\delta^{13}\text{C}$ < 0.5 ‰

Error δD < 5.0 ‰

Stable Isotope Interpretive Plots

