



HEMMERA ENVIROCHEM INC.  
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Date Received: 26-OCT-16  
Report Date: 23-NOV-16 15:05 (MT)  
Version: FINAL REV. 2

Client Phone: 867-456-4865

## Certificate of Analysis

Lab Work Order #: L1849203  
Project P.O. #: NOT SUBMITTED  
Job Reference: 1343-005.21  
C of C Numbers:  
Legal Site Desc:

### Comments:

23-NOV-2016 This report replaces the previous version and contains additional analyses, as requested.

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Brent Mack, B.Sc.  
Account Manager

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# ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID	L1849203-1 WATER 23-OCT-16 15:45 GWCC-2	L1849203-2 WATER  TRAVEL BLANK	L1849203-3 WATER 23-OCT-16 13:40 E1(H)	L1849203-4 WATER 23-OCT-16 16:15 GWCC-4	L1849203-5 WATER 23-OCT-16 16:00 GWCC-1	
Grouping	Analyte					
<b>WATER</b>						
<b>Physical Tests</b>	Conductivity (uS/cm)	2160	<2.0	662	929	2630
	Hardness (as CaCO3) (mg/L)	1540	<0.50 <sup>HTC</sup>	366	514	1850
	pH (pH)	7.98	5.11	8.00	7.95	7.81
	Total Suspended Solids (mg/L)	3.8	<3.0	<3.0	<3.0	10.4
<b>Anions and Nutrients</b>	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050	0.0283	<0.0050	<0.0050
	Nitrate (as N) (mg/L)	0.59	<0.0050	0.134	0.164	0.62
	Nitrite (as N) (mg/L)	<0.020 <sup>DLDS</sup>	<0.0010	0.0112	<0.0050 <sup>DLDS</sup>	<0.020 <sup>DLDS</sup>
	Phosphorus (P)-Total (mg/L)	0.0062	<0.0020	0.0048	0.0060	0.0110
	Sulfate (SO4) (mg/L)	1260	<0.30	222	389	1600
<b>Organic / Inorganic Carbon</b>	Dissolved Organic Carbon (mg/L)	6.76		16.3	9.34	5.10
	Total Organic Carbon (mg/L)		<0.50			
<b>Total Metals</b>	Aluminum (Al)-Total (mg/L)	0.0050	<0.0030	0.0279	0.0094	0.455
	Antimony (Sb)-Total (mg/L)	0.00113	<0.00010	0.00031	0.00083	0.00136
	Arsenic (As)-Total (mg/L)	0.00168	<0.00010	0.00077	0.00123	0.00296
	Barium (Ba)-Total (mg/L)	0.0209	<0.000050	0.0731	0.0330	0.0414
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000040 <sup>DLA</sup>
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010 <sup>DLA</sup>
	Boron (B)-Total (mg/L)	0.131	<0.010	0.011	0.039	0.360
	Cadmium (Cd)-Total (mg/L)	0.000186	<0.0000050	0.0000636	0.0000546	0.000253
	Calcium (Ca)-Total (mg/L)	218	<0.050	91.2	110	243
	Chromium (Cr)-Total (mg/L)	0.00325	<0.00010	0.00050	0.00061	0.00711
	Cobalt (Co)-Total (mg/L)	0.00013	<0.00010	0.00060	<0.00010	0.00057
	Copper (Cu)-Total (mg/L)	0.00126	<0.00050	0.00240	0.00109	0.0019
	Iron (Fe)-Total (mg/L)	0.029	<0.010	0.247	0.019	0.843
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000051	<0.000050	0.00041
	Lithium (Li)-Total (mg/L)	0.0257	<0.0010	0.0045	0.0069	0.125
	Magnesium (Mg)-Total (mg/L)	249	<0.10	39.3	72.2	311
	Manganese (Mn)-Total (mg/L)	0.00109	<0.00010	0.386	0.00177	0.0160
	Mercury (Hg)-Total (mg/L)	0.0000056	<0.0000050	0.0000055	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	0.00332	<0.000050	0.00150	0.00271	0.00292
	Nickel (Ni)-Total (mg/L)	0.0527	<0.00050	0.00486	0.0327	0.0905 <sup>DLA</sup>
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.10 <sup>DLA</sup>
	Potassium (K)-Total (mg/L)	2.25	<0.10	0.67	0.98	3.80
	Selenium (Se)-Total (mg/L)	0.00456	<0.000050	0.00194	0.00142	0.00448
	Silicon (Si)-Total (mg/L)	5.44	<0.050	5.44	5.36	7.81 <sup>DLA</sup>
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 <sup>DLA</sup>	

\* Please refer to the Reference Information section for an explanation of any qualifiers detected.

## ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID	L1849203-6 WATER 23-OCT-16 11:15 R2	L1849203-7 WATER 23-OCT-16 11:15 FB-1	L1849203-8 WATER 22-OCT-16 14:40 R1	L1849203-9 WATER 22-OCT-16 17:30 DUP1	L1849203-10 WATER 22-OCT-16 17:30 E1	
Grouping	Analyte					
<b>WATER</b>						
<b>Physical Tests</b>	Conductivity (uS/cm)	950	<2.0	996	677	672
	Hardness (as CaCO3) (mg/L)	557	<0.50	589	402	386
	pH (pH)	8.03	6.36	7.87	8.20	8.21
	Total Suspended Solids (mg/L)	3.5	<3.0	<3.0	<3.0	<3.0
<b>Anions and Nutrients</b>	Ammonia, Total (as N) (mg/L)	0.0192	<0.0050	0.0577	0.0161	0.0159
	Nitrate (as N) (mg/L)	0.098	<0.0050	0.097	0.152	0.157
	Nitrite (as N) (mg/L)	<0.0050 <sup>DLDS</sup>	<0.0010	<0.0050 <sup>DLDS</sup>	0.0059	0.0061
	Phosphorus (P)-Total (mg/L)	0.0057	0.0047 <sup>RRV</sup>	<0.0020	0.0063	0.0039
	Sulfate (SO4) (mg/L)	343	<0.30	388	219	221
<b>Organic / Inorganic Carbon</b>	Dissolved Organic Carbon (mg/L)	5.35	<0.50	10.6	14.7	15.0
	Total Organic Carbon (mg/L)					
<b>Total Metals</b>	Aluminum (Al)-Total (mg/L)	0.0672	<0.0030	0.0208	0.0230	0.0224
	Antimony (Sb)-Total (mg/L)	0.00051	<0.00010	0.00019	0.00032	0.00033
	Arsenic (As)-Total (mg/L)	0.00092	<0.00010	0.00060	0.00077	0.00079
	Barium (Ba)-Total (mg/L)	0.0726	<0.000050	0.0816	0.0676	0.0668
	Beryllium (Be)-Total (mg/L)	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	0.019	<0.010	<0.010	0.011	0.011
	Cadmium (Cd)-Total (mg/L)	0.0000398	<0.0000050	0.0000971	0.0000505	0.0000413
	Calcium (Ca)-Total (mg/L)	106	<0.050	148	96.6	96.9
	Chromium (Cr)-Total (mg/L)	0.00038	<0.00010	0.00021	0.00052	0.00047
	Cobalt (Co)-Total (mg/L)	0.00035	<0.00010	0.00204	0.00034	0.00032
	Copper (Cu)-Total (mg/L)	0.00088	<0.00050	0.00121	0.00228	0.00226
	Iron (Fe)-Total (mg/L)	0.361	<0.010	0.500	0.189	0.185
	Lead (Pb)-Total (mg/L)	0.000053	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.0098	<0.0010	0.0051	0.0048	0.0048
	Magnesium (Mg)-Total (mg/L)	76.8	<0.10	63.1	39.5	39.4
	Manganese (Mn)-Total (mg/L)	0.189	<0.00010	0.998	0.171	0.168
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000062
	Molybdenum (Mo)-Total (mg/L)	0.000802	<0.000050	0.00188	0.00154	0.00153
	Nickel (Ni)-Total (mg/L)	0.00356	<0.00050	0.00970	0.00554	0.00553
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	1.03	<0.10	0.78	0.71	0.70
	Selenium (Se)-Total (mg/L)	0.000791	<0.000050	0.00115	0.00196	0.00190
	Silicon (Si)-Total (mg/L)	6.12	<0.050	5.03	5.19	5.32
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

\* Please refer to the Reference Information section for an explanation of any qualifiers detected.

## ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	Description	Sampled Date	Sampled Time	Client ID	L1849203-1	L1849203-2	L1849203-3	L1849203-4	L1849203-5
					L1849203-1 WATER 23-OCT-16 15:45 GWCC-2	L1849203-2 WATER TRAVEL BLANK	L1849203-3 WATER 23-OCT-16 13:40 E1(H)	L1849203-4 WATER 23-OCT-16 16:15 GWCC-4	L1849203-5 WATER 23-OCT-16 16:00 GWCC-1
Grouping	Analyte								
<b>WATER</b>									
<b>Total Metals</b>	Sodium (Na)-Total (mg/L)	9.38	<0.050	3.67	3.81	24.0			
	Strontium (Sr)-Total (mg/L)	1.29	<0.00020	0.441	0.549	2.73			
	Sulfur (S)-Total (mg/L)	441	<0.50	73.2	126	529			
	Thallium (Tl)-Total (mg/L)	0.000067	<0.000010	<0.000010	0.000057	0.000111			
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020			DLA
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	0.00063	<0.00030	0.0276			
	Uranium (U)-Total (mg/L)	0.00462	<0.000010	0.00281	0.00177	0.00898			
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	0.0018			
	Zinc (Zn)-Total (mg/L)	0.0063	<0.0030	<0.0030	<0.0030	0.0118			DLA
	Zirconium (Zr)-Total (mg/L)	<0.00030	<0.00030	0.00095	<0.00030	<0.00060			DLA
<b>Dissolved Metals</b>	Dissolved Mercury Filtration Location	FIELD		FIELD	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD		FIELD	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0011		0.0238	0.0021	0.0021			
	Antimony (Sb)-Dissolved (mg/L)	0.00106		0.00029	0.00074	0.00136			
	Arsenic (As)-Dissolved (mg/L)	0.00155		0.00071	0.00122	0.00220			
	Barium (Ba)-Dissolved (mg/L)	0.0212		0.0728	0.0317	0.0225			DLA
	Beryllium (Be)-Dissolved (mg/L)	<0.000020		<0.000020	<0.000020	<0.000040			DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050		<0.000050	<0.000050	<0.00010			DLA
	Boron (B)-Dissolved (mg/L)	0.128		<0.010	0.038	0.357			
	Cadmium (Cd)-Dissolved (mg/L)	0.000198		0.0000603	0.0000522	0.000213			
	Calcium (Ca)-Dissolved (mg/L)	205		83.5	96.5	242			
	Chromium (Cr)-Dissolved (mg/L)	0.00278		0.00041	0.00045	0.00418			DLA
	Cobalt (Co)-Dissolved (mg/L)	<0.00010		0.00058	<0.00010	<0.00020			DLA
	Copper (Cu)-Dissolved (mg/L)	0.00103		0.00225	0.00097	0.00100			DLA
	Iron (Fe)-Dissolved (mg/L)	<0.010		0.196	<0.010	<0.020			DLA
	Lead (Pb)-Dissolved (mg/L)	<0.000050		<0.000050	<0.000050	<0.00010			DLA
	Lithium (Li)-Dissolved (mg/L)	0.0263		0.0041	0.0065	0.126			
	Magnesium (Mg)-Dissolved (mg/L)	249		38.2	66.3	303			
	Manganese (Mn)-Dissolved (mg/L)	<0.00010		0.373	0.00024	0.00021			
	Mercury (Hg)-Dissolved (mg/L)	0.0000054		<0.0000050	<0.0000050	<0.0000050			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00277		0.00132	0.00230	0.00287			
	Nickel (Ni)-Dissolved (mg/L)	0.0506		0.00477	0.0310	0.0824			DLA
	Phosphorus (P)-Dissolved (mg/L)	<0.050		<0.050	<0.050	<0.10			DLA
	Potassium (K)-Dissolved (mg/L)	2.18		0.68	0.95	3.74			
	Selenium (Se)-Dissolved (mg/L)	0.00490		0.00200	0.00156	0.00322			
	Silicon (Si)-Dissolved (mg/L)	5.38		5.28	5.43	5.20			DLA
	Silver (Ag)-Dissolved (mg/L)	<0.000010		<0.000010	<0.000010	<0.000020			DLA

\* Please refer to the Reference Information section for an explanation of any qualifiers detected.



# ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1849203-1	L1849203-2	L1849203-3	L1849203-4	L1849203-5
		Description	WATER	WATER	WATER	WATER	WATER
		Sampled Date	23-OCT-16		23-OCT-16	23-OCT-16	23-OCT-16
		Sampled Time	15:45		13:40	16:15	16:00
		Client ID	GWCC-2	TRAVEL BLANK	E1(H)	GWCC-4	GWCC-1
Grouping	Analyte						
<b>WATER</b>							
<b>Dissolved Metals</b>	Sodium (Na)-Dissolved (mg/L)	9.13			3.59	3.85	23.4
	Strontium (Sr)-Dissolved (mg/L)	1.19			0.405	0.482	2.70
	Sulfur (S)-Dissolved (mg/L)	424			70.7	131	395
	Thallium (Tl)-Dissolved (mg/L)	0.000062			<0.000010	0.000051	0.000097
	Tin (Sn)-Dissolved (mg/L)	<0.00010			<0.00010	<0.00010	<0.00020 <sup>DLA</sup>
	Titanium (Ti)-Dissolved (mg/L)	<0.00030			0.00049	<0.00030	<0.00060 <sup>DLA</sup>
	Uranium (U)-Dissolved (mg/L)	0.00426			0.00259	0.00161	0.00884
	Vanadium (V)-Dissolved (mg/L)	<0.00050			<0.00050	<0.00050	<0.0010 <sup>DLA</sup>
	Zinc (Zn)-Dissolved (mg/L)	0.0058			0.0018	0.0017	0.0089
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030			0.00088	<0.00030	<0.00060 <sup>DLA</sup>
<b>Speciated Metals</b>	Chromium (III)-Dissolved (mg/L)	<0.00076					<0.00091
	Chromium (III)-Total (mg/L)	<0.00090					0.0027
	Hexavalent Chromium (mg/L)	0.0028 <sup>RRV</sup>					0.0044 <sup>RRV</sup>
	Hexavalent Chromium-Dissolved (mg/L)	0.0029 <sup>RRV</sup>					0.0039 <sup>RRV</sup>

\* Please refer to the Reference Information section for an explanation of any qualifiers detected.



## Reference Information

## QC Samples with Qualifiers &amp; Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Dissolved Organic Carbon	MS-B	L1849203-3
Matrix Spike	Total Organic Carbon	MS-B	L1849203-2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Boron (B)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Iron (Fe)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1849203-1, -10, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Total	MS-B	L1849203-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L1849203-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1849203-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L1849203-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Total	MS-B	L1849203-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L1849203-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfur (S)-Total	MS-B	L1849203-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfate (SO4)	MS-B	L1849203-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

## Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).



## Reference Information

MS-B Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.  
 RRV Reported Result Verified By Repeat Analysis

### Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
<b>BE-D-L-CCMS-VA</b>	Water	Diss. Be (low) in Water by CRC ICPMS Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.	APHA 3030B/6020A (mod)
<b>BE-T-L-CCMS-VA</b>	Water	Total Be (Low) in Water by CRC ICPMS Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.	EPA 200.2/6020A (mod)
<b>CARBONS-DOC-VA</b>	Water	Dissolved organic carbon by combustion This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.	APHA 5310B TOTAL ORGANIC CARBON (TOC)
<b>CARBONS-TOC-VA</b>	Water	Total organic carbon by combustion This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".	APHA 5310B TOTAL ORGANIC CARBON (TOC)
<b>CR-CR3-DIS-CALC-ED</b>	Water	Dissolved Trivalent Chromium in Water Chromium (III)-Dissolved is calculated as the difference between the dissolved chromium and the dissolved hexavalent chromium (Cr(VI)) results.	CALCULATION
<b>CR-CR3-TOT-CALC-ED</b>	Water	Total Trivalent Chromium in Water Chromium (III)-Total is calculated as the difference between the total chromium and the hexavalent chromium (Cr(VI)) results.	CALCULATION
<b>CR-CR6-ED</b>	Water	Chromium, Hexavalent (Cr +6) This analysis is carried out using procedures adapted from method 3500-Cr C in "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from Method 1636 published by the United States Environmental Protection Agency (EPA). The procedure involves analysis for chromium (VI) by ion chromatography using diphenylcarbazide in a sulphuric acid solution. Results are based on an un-filtered, field-preserved sample.	APHA 3500-Cr C (Ion Chromatography)
<b>CR6-D-IC-ED</b>	Water	Chromium, Dissolved Hexavalent (Cr +6) This analysis is carried out using procedures adapted from method 3500-Cr C in "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from Method 1636 published by the United States Environmental Protection Agency (EPA). The procedure involves analysis for chromium (VI) by ion chromatography using diphenylcarbazide in a sulphuric acid solution. Results are based on a field-filtered, field-preserved sample.	APHA 3500-Cr C (Ion Chromatography)
<b>EC-PCT-VA</b>	Water	Conductivity (Automated) This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.	APHA 2510 Auto. Conduc.
<b>HARDNESS-CALC-VA</b>	Water	Hardness Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.	APHA 2340B
<b>HG-D-CVAA-VA</b>	Water	Diss. Mercury in Water by CVAAS or CVAFS Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.	APHA 3030B/EPA 1631E (mod)
<b>HG-T-CVAA-VA</b>	Water	Total Mercury in Water by CVAAS or CVAFS Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.	EPA 1631E (mod)
<b>MET-D-CCMS-VA</b>	Water	Dissolved Metals in Water by CRC ICPMS Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.	APHA 3030B/6020A (mod)
<b>MET-T-CCMS-VA</b>	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

## Reference Information

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

<b>NH3-F-VA</b>	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
<b>NH3-F-VA</b>	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.			
<b>NO2-L-IC-N-VA</b>	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
<b>NO3-L-IC-N-VA</b>	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
<b>P-T-PRES-COL-VA</b>	Water	Total P in Water by Colour	APHA 4500-P Phosphorus
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.			
<b>PH-PCT-VA</b>	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
<b>PH-PCT-VA</b>	Water	pH by Meter (Automated)	APHA 4500-H pH Value
This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode			
It is recommended that this analysis be conducted in the field.			
<b>SO4-IC-N-VA</b>	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
<b>TSS-VA</b>	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.			

\*\* ALS test methods may incorporate modifications from specified reference methods to improve performance.

*The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:*

Laboratory Definition Code	Laboratory Location
ED	ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

**Chain of Custody Numbers:**

## Reference Information

### GLOSSARY OF REPORT TERMS

*Surrogate* - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

*mg/kg* - milligrams per kilogram based on dry weight of sample.

*mg/kg wwt* - milligrams per kilogram based on wet weight of sample.

*mg/kg lwt* - milligrams per kilogram based on lipid-adjusted weight of sample.

*mg/L* - milligrams per litre.

*<* - Less than.

*D.L.* - The reported Detection Limit, also known as the Limit of Reporting (LOR).

*N/A* - Result not available. Refer to qualifier code and definition for explanation.

*Test results reported relate only to the samples as received by the laboratory.*

**UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.**

*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*



Contact: Brent Mack  
Company: ALS Environmental  
Address: 8081 Lougheed HWY, Suite 100  
Burnaby, BC V5A1W9

## REFERENCE DATA

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Project / Location: L1849203

PO Number: L1849203

ALS Work Order: 16101076

TEM Water Narrative: Analysis performed on FEI Tecnai TEM with integrated EDXA capabilities. Morphology, EDXA, and SAED measurements used to determine fiber species. Representative EDXA spectra of each asbestos type detected included. Compliance samples must be received and filtered within 48 hours of collection. Collection is performed outside ALS and is the responsibility of the client. Samples disposed after 60 days. TEM grids archived 3 years. Results apply only to portions analyzed.

TEM Water Methods: "EPA 100.2" refers to drinking water samples filtered on 47mm, 0.22µm pore MCE filters. "EPA 100.1" refers to drinking water samples filtered on 47mm, 0.1µm pore Polycarbonate filters. No standard method for asbestos in nonpotable water exists. All TEM waters (potable and nonpotable) analyzed at >10,000x magnification for asbestos fibers >10µm long. Whenever possible, sufficient volume is analyzed to yield an AS of <0.20 MFL based on the detection of 1 confirmed asbestos fiber in the total area analyzed. However, the volume analyzed is dependent upon a filter loading of <25% particulate. Samples containing excessive suspended solids may not reach the recommended AS of <0.20 MFL. In any case, a minimum of 4 and a maximum of 10 openings are analyzed regardless of the AS reached or asbestos concentration detected. ALS will report results directly to state of origin only when;

- a) the Chain of Custody clearly states "drinking water for state compliance",
- b) the appropriate state drinking water form is submitted with the samples,
- c) the state form is completely filled out by the client prior to submittal, and
- d) the address to which the form is to be sent is provided.

NOTES: NA=Not Applicable, ND=None Detected, AS=Analytical Sensitivity, MFL=Millions of Fibers per Liter. † Act-Tremolite concentrations include Actinolite as well as the Libby Amphiboles; Tremolite, Winchite, & Richterite.

OH Lab ID: #4077, Ohio Analysts; P. Johnson #2268, A. Sohn #3431

PA Lab ID: #68-01320, Cert. #003

## TEM ANALYSIS DATA

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EDXA Resolution (eV): <175

Accelerating Voltage (keV): 100

Prep Start Date: 10/31/2016

Calibration Constant (µm/cm): 0.74

Camera Constant (mm-Å): 129.25

Analysis Start Date: 11/1/2016

*Pamela Johnson*

---

Pamela Johnson  
ALS TEM Analyst

*Shawn Smythe*

---

Shawn Smythe  
ALS Project Manager

*This report shall not be reproduced except in full without written approval of ALS.*

## IDENTIFICATION

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Client Sample ID: L1849203-8 R1  
ALS Sample ID: 16101076-01  
Method: EPA 100.2  
Date of Collection: 10/22/2016  
Time of Collection: Not Provided

## FILTRATION & ANALYSIS

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Date of Filtration: 10/31/2016  
Time of Filtration: 11:00  
Volume Filtered (L): 0.01  
Openings Analyzed: 10  
Avg. Opening Area (mm<sup>2</sup>): 0.0108  
AS (MFL): 1.00

## ASBESTOS COUNT

---

Chrysotile: 0  
Amosite: 0  
Crocidolite: 0  
Act-Tremolite<sup>†</sup>: 0  
Anthophyllite: 0  
Total Asbestos: 0

## ASBESTOS CONCENTRATION (MFL)

---

Chrysotile: <AS  
Amosite: <AS  
Crocidolite: <AS  
Act-Tremolite<sup>†</sup>: <AS  
Anthophyllite: <AS  
**Total Asbestos: <AS**

## NOTES

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Sample received past the method 48 hour hold time. Excessive suspended solids including organic material, sediment, and iron deposits, prevented filtration of sufficient volume required to attain the recommended method AS of <0.20 MFL.

## EDXA SPECTRA

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*NOTE: Spurious peaks may originate from low background sample holder, column pole pieces, TEM grids, prep solutions or matrix materials.*

NONE.

## PHOTOMICROGRAPHS

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*Collected using Gatan Digital Micrograph.*

NONE.



ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878



L1849203-COFC

COC Number: 1

Page 1 of 1

<b>Report To</b>		<b>Report Format / Distribution</b>			<b>Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)</b>																	
Company: Hemmera Environchem Inc.		Select Report Format:			R																	
Contact: Natasha Sandys		Quality Control (QC) Report with Report <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			P																	
Address: 230 - 2237 2nd Avenue Whitehorse, YT		Select Distribution:			E																	
Phone: 867-456-4865		Email 1 or Fax nsandys@hemmera.com			E2																	
		Email 2 chris@elr.ca			Specify Date Required for E2,E or P:																	
<b>Invoice To</b>		<b>Invoice Distribution</b>			<b>Analysis Request</b>																	
Same as Report To <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		Select Invoice Distribution:			Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																	
Copy of Invoice with Report <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		Email 1 or Fax nsandys@hemmera.com			F/P P P F/P P F/P																	
Company: Hemmera Environchem Inc.		Email 2 chris@elr.ca			Low Level Diss. Met (incl. Hg) and Hardness																	
Contact: Natasha Sandys		Oil and Gas Required Fields (client use)			Low Level Tot. Met (incl. Hg) and Hardness																	
<b>Project Information</b>		Approver ID: [redacted] Cost Center: [redacted]			Chromium Speciation (II/VI) - Total																	
ALS Quote #: Q56044		GL Account: [redacted] Routing Code: [redacted]			Chromium Speciation (II/VI) - Dissolved																	
Job #: 1343-005.21		Activity Code: [redacted]			Ammonia - N																	
PO / AFE:		Location: [redacted]			Dissolved Organic Carbon (DOC)																	
LSD:		ALS Contact:			Nitrate-N																	
ALS Lab Work Order # (lab use only)		Sampler: AN/NB			Nitrite - N																	
ALS Sample # (lab use only)		Sample Identification and/or Coordinates (This description will appear on the report)			Date (dd-mm-yy)			Time (hh:mm)		Sample Type		Total Phosphorus										Number of Containers
GWCC-2					23-Oct-16			15:45		Water		Sulfate										
TRAVEL BLANK										Water		pH, Conductivity										
E1(H)					23-Oct-16			13:40		Water		Asbestos-TEM-AD										
GWCC-4					23-Oct-16			16:15		Water		Total Suspended Solids										
GWCC-1					23-Oct-16			16:00		Water												
R2					23-Oct-16			11:15		Water												
FB-1					23-Oct-16			11:15		Water												
R1					22-Oct-16			14:40		Water												
DUP1					22-Oct-16			17:30		Water												
E1					22-Oct-16			17:30		Water												
<b>Drinking Water (DW) Samples<sup>1</sup> (client use)</b>				<b>Special Instructions / Specify Criteria to add on report (client Use)</b>				<b>SAMPLE CONDITION AS RECEIVED (lab use only)</b>														
Are samples taken from a Regulated DW System? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No				Please hold samples for total and dissolved Chromium II/VI pending/regular metals analysis results. Please supply ELR EQWIN EDD file with results.				Frozen <input type="checkbox"/> SIF Observations Yes <input type="checkbox"/> No <input type="checkbox"/>														
Are samples for human drinking water use? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No								Ice packs Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Custody seal intact Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>														
								Cooling Initiated <input type="checkbox"/>														
								INITIAL COOLER TEMPERATURES °C: [redacted] FINAL COOLER TEMPERATURES °C: [redacted]														
<b>SHIPMENT RELEASE (client use)</b>				<b>INITIAL SHIPMENT RECEPTION (lab use only)</b>				<b>FINAL SHIPMENT RECEPTION (lab use only)</b>														
Released by: [Signature]		Date: 06/25/2016		Time: 09:45		Received by: [Signature]		Date: 06/26/16		Time: 13:20												

Short Holding Time  
Rush Processing

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION... Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.