

Wasa Septage Ponds 2021 Groundwater Monitoring Annual Report



PREPARED FOR: REGIONAL DISTRICT OF EAST KOOTENAY

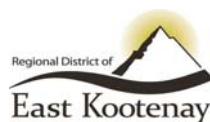
PREPARED BY: SPERLING HANSEN ASSOCIATES

January, 2022

PRJ21063



**SPERLING
HANSEN
ASSOCIATES**



- Landfill Engineering
- Solid Waste Planning
- Environmental Monitoring
- Landfill Fire Control

1. INTRODUCTION

Sperling Hansen Associates (SHA) was retained by the Regional District of East Kootenay (RDEK) in 2020 to develop an updated Groundwater Monitoring Program (GMP) for seven (7) Solid Waste Management facilities located within the RDEK. As part of this GMP update SHA, along with Subconsultant Bear Environmental Limited (BEAR), will conduct four (4) groundwater sampling events per year, and provide one interim report per event for each site. The goal of this program is to provide the RDEK with valuable information regarding the groundwater quality at disposal sites and to assist in developing appropriate monitoring and management until 2025.

In 2021, sampling events occurred in January, April, July, and November over a week period. Samples taken from each site are recorded below, and water quality analysis discussed in Section 3. This report details the sampling notes, lab analysis results, and trends observed at the wells throughout 2021. Section 5 presents recommendations for the next year of monitoring.

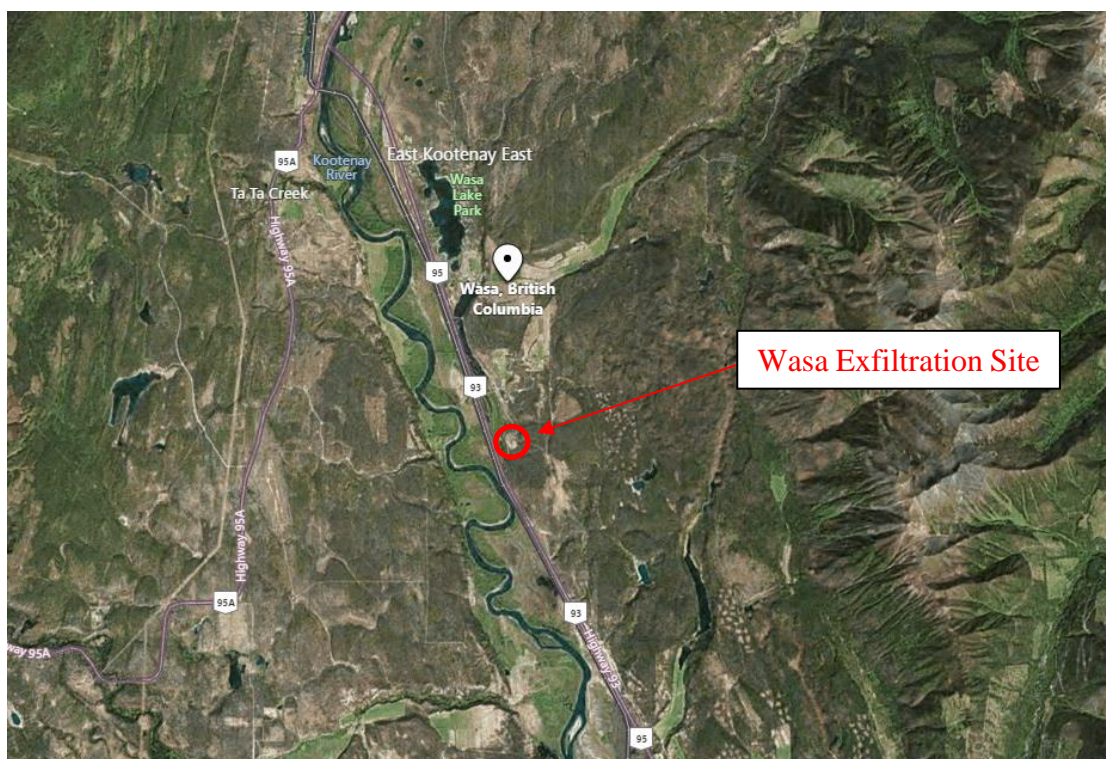


Photo 1-1. Wasa Site Location.

1.1 Location and Setting

The Wasa exfiltration site is located in the Central Valley sub-region within the Regional District of East Kootenay. The site is approximately 5 km south of Wasa. The latitude and longitude are 49.73717 N and 115.715356 W respectively.



Photo 1-2. Wasa Site Layout.

1.2 Site Operations

The site consists of two unlined septic waste disposal ponds, inside a fenced area which occupies approximately 0.44 hectares, the rest of the 16.5 hectares of the site are undeveloped. To the south of the two exfiltration ponds is a solid waste collection area at the Transfer Station.

Due to the potential for contamination when septic waste comes into contact with water, it is required to monitor the groundwater on and surrounding the site to observe any impacts from the exfiltration ponds. There are 4 groundwater wells at the Wasa site, which are monitored quarterly in January, April, July, and November. The well locations are identified in Figure 1.

The Operational Certificate for the Wasa Exfiltration site is attached to this report as Appendix A.

2. MONITORING PROGRAM

The monitoring program for the Site is documented in the Site's Operational Certificate 107105 (OC). Four wells are indicated, including one background and three downgradient wells.

The following wells were sampled in 2020:

Table 2-1: Groundwater Monitoring Plan Wells

Monitoring Well	Notes
E297150	Upgradient – Damaged
E297130	Downgradient of Septic Ponds - Sampled
E296151	Downgradient of Septic Ponds - Sampled
E297152	New Upgradient - Sampled

Due to E297150 being damaged, SHA reviewed historic monitoring data and site characteristics and determined that E297152 is adequately suited to be the new background well for the site.

2.1 Methodology

BEAR conducts the field sampling at the seven RDEK sites. Each well sampled is tested for a set of parameters that are intended to determine any site impact on the groundwater. Some parameters are tested quarterly while others are only tested annually, in accordance with Section 8.1.1. and 8.1.2. of the OC. Sampling was conducted in accordance with the BC Field Sampling Manual. Table 2-2 shows which parameters are tested Quarterly and Yearly.

Table 2-2 Groundwater Monitoring Parameters

Sampling Parameters	Quarterly	Annually
WASA Exfiltration Ponds	Temperature (field and lab)	Temperature (field and lab)
	Conductivity (field and lab)	Conductivity (field and lab)
	pH (field and lab)	pH (field and lab)
	Nitrite (N)	Nitrite (N)
	Nitrate (N)	Nitrate (N)
	Ammonia Nitrogen (NH3)	Ammonia Nitrogen (NH3)
	Fluoride (F)	Fluoride (F)
	Sulphate (SO4)	Sulphate (SO4)
	Chloride (Cl)	Chloride (Cl)
	Phosphate (PO3)	Phosphate (PO3)
	Hardness	Hardness
	Total Alkalinity	Total Alkalinity
	Total Suspended Solids	Total Suspended Solids
	Fecal and Total Coliform	Fecal and Total Coliform

Additionally, it was noted that E297150 was damaged and sampling could not be completed in 2021 (similar to previous years). As E297150 is the background/upgradient well, obtaining samples from this location is an important part of the monitoring process. As such, SHA has reviewed the location of

E297150 in relation to the septage ponds and have found that E297152 is similarly located upgradient, and based on its water quality, can be used as a background representation well in place of E297150.

Laboratory Certificates of Analysis are shown in Appendix C. Based on internal laboratory QA/QC, results from 2021 are considered reliable.

2.2 Groundwater Flow

The Wasa site is located approximately 700 m east of the Kootenay River. The ground elevation shows the local topography slopes from the east just over 200 m down to the valley where the river lies.

Per the BC Water Resource Atlas, there is no mapped aquifer underlying the site, however, the site is located adjacent to the south east of the boundary of Aquifer 540, which runs north to south and covers the greater area of Wasa Lake. Aquifer 540 is described as highly vulnerable to pollution and is unconfined over much of the aquifer with water use described as domestic/commercial. The regional groundwater flow is inferred to follow the Kootenay River, which is south, southeast.

Locally, groundwater flow can be affected by building foundations, recharge areas, drainage and subsurface utilities. Depending on their depth, underground structures may significantly influence shallow groundwater flow in the vicinity of the Site. Locally, based on groundwater elevation measurements, groundwater appears to flow northwest. Well details and water level (depth to water bgs) are shown in the Table 2-3 below.

Table 2-3. Well Details and Water Level

Well ID	Well Construction	Q1 Water Level (m)	Q2 Water Level (m)	Q3 Water Level (m)	Q4 Water Level (m)
E297130	2" PVC	13.165	13.185	11.485	12.920
E297151	2" PVC	16.100	16.135	14.365	15.850
E297152	2" PVC	14.430	14.210	14.160	13.255

2.3 Regulatory Criteria

Per the OC published in 2014, there are no specified criteria for water quality comparison at the Wasa site.

The BC Contaminated Sites Regulation (CSR) Protocol 21 indicates that Aquatic Life Standards (AW) generally apply to all groundwater located within 500 m of a surface water body containing aquatic life. The Site is located approximately 700m east of Kootenay River. For sites located at a distance greater than 500m from a surface water body, investigations must show that groundwater containing substances at concentrations greater than the applicable aquatic life water use standards do not have the potential to migrate to within 500 m of a surface water body used by aquatic life, considering preferential flow

corridors. Without further investigation of the Site, the Aquatic Life for Freshwater (AW) standards will apply.

The CSR Protocol 21 indicates that Drinking Water (DW) Standards generally apply to groundwater and surface water where drinking water sources are within 500m of a site, or if a property is situated on an aquifer that could be used in the future for Drinking Water. A search for water wells revealed that there are no domestic use water wells within 500m of the Site. Information from the BC Water Atlas indicates that there are no mapped aquifers underlying the Site. Although current DW use appears to not apply to the site, without further investigation, future DW standards are assumed to apply. Note that future drinking water use applies where information is unavailable or inadequate to demonstrate an absence of drinking water aquifers below a site.

Recent standards and guidelines have been applied by SHA to include:

- The Schedule 3.2 of the BC CSR with consideration to Aquatic Life (AW) and Drinking Water (DW);

These standards and guidelines are the most recent published by BC ENV used to assess groundwater at contaminated sites and the quality of drinking water.

3. RESULTS

Per the OC Section 8.1.2., parameters tested in 2021 included:

- Temperature, conductivity, pH, nitrite, nitrate, ammonia nitrogen, fluoride, chloride, sulphate, hardness, total alkalinity, total suspended solids, fecal and total coliform.

Table B- 1 of Appendix B outlines the water quality analysis alongside the applicable water standards. Laboratory Certificates are included in Appendix C.

Table 3-1 below summarizes observed exceedances by analyte. Details are provided in the section below.

Table 3-1. Summary of Observed Exceedances by Analyte.

	E297130	E297151	E297152
Lab Results			
Dissolved Metals			
Lithium (dissolved)	X	X	X
General and Inorganic Parameters			
Nitrate (as N)	X	X	X
Nitrate + Nitrite (as N)	X	X	X

3.1 Exceedances

All parameters tested were detected below applicable BC CSR AW standards.

Parameters above the BC CSR DW standards in 2021 included:

- Lithium (dissolved)
- Nitrate (as N)
- Nitrate + Nitrite (as N)

Note that Fecal Coliforms were present in some wells in numbers that exceed Canadian Drinking Water Standards.

Maximum concentrations are shown in the Table below:

Table 3-2. Maximum Concentrations Above BC CSR DW Standards

Parameter	BC CSR DW Standard	Maximum Concentration (mg/L)	Well Name
Lithium (Li)	8 µg/L	19.8	E297152
Nitrate (as N)	10 mg/L	22.6	E297151
Nitrate + Nitrite (as N)	10 g/L	22.6	E297151
Fecal Coliforms	*No detectable bacteria per 100 mL	100	E297152

“*” Denotes applicable Canadian Drinking Water Standard as there is no BC CSR standards for coliforms.

Green shading indicates a concentration above applicable standards.

Note: concentrations listed in the table are all above applicable DW standards. Maximum concentrations are shown in **bold**.

3.2 Annual Event

The annual event in 2021 was completed in the same quarter as previous years, in April, as per the precedent set by EcoLogic. The annual event is the sampling event when select parameters that are only tested for once a year are completed. For Wasa, the parameters sampled did not differ from other monitoring events, since as per the OC, the required sampling parameters are the same year-round. It was noted by SHA after the Q1 January event that dissolved metals are not required under section 8.1.2. of the OC, and therefore this analysis was not completed in Q2, Q3, or Q4.

3.3 Notes on Regional Background Concentrations

As per the British Columbia Contaminated Sites Regulation (CSR) Schedule 3.2, 2019, the drinking water limit for Lithium (Li) is 8 µg/L or 0.008 mg/L. Many regions in B.C. have background concentrations of lithium that exceed this limit, which poses a complication for monitored sites that are required under Operation Certificates or Permits to avoid exceedances of harmful parameters. In response, the B.C. Ministry of Environment and Climate Change (BC ENV) published a document in 2018 qualifying the

limit and providing background concentrations for three regions in the province for five metals, including lithium. The limits published in the *Technical Bulletin 3: Regional Background Concentrations for Select Inorganic Substances in Groundwater* account for naturally occurring levels of the five metals, and are therefore higher than the limit within the CSR currently.

However, these three regions only comprise the Lower Mainland, South Vancouver Island, and Thompson-Okanagan. SHA believes the exceedances in lithium observed at the RDEK sites are attributable to natural background concentrations that are not accounted for in the CSR Schedule 3.2 or *Technical Bulletin 3*. It should be noted that Eco/Logic did not have a limit for lithium, which explains the discrepancy in exceedances despite there being little difference between 2019 and 2020 results.

Thompson-Okanagan, the nearest region to the RDEK with a background concentration qualifier for lithium, has a qualified concentration in the Bulletin of 96 µg/L, or 0.096 mg/L. None of the wells monitored in July, 2020 would exceed a limit of 0.096 mg/L, so SHA recommends keeping a note of this and a close eye on this parameter in ongoing monitoring. SHA does not believe the RD needs to look into remediation measures at this point, but recommends the RD flag this exceedance history in the case that the Ministry publishes a background concentration for the Kootenay region.

4. DISCUSSION

All parameters tested were below applicable BC CSR Schedule 3.2 AW standards.

Parameters above applicable BC CSR Schedule 3.2 DW standards included the following.

- Lithium
- Nitrate
- Nitrate + Nitrite
- Fecal Coliform (above the Canadian Drinking Water Standard)

The maximum concentration of lithium was found at E297151 at 19.8 µg/L versus the BC CSR DW standard of 8 µg/L. The maximum concentration of nitrate was found at E297151 at 22.6 mg/L versus the BC CSR DW standard of 10 mg/L. The maximum nitrate + nitrite concentration was also found at E297151 at 22.6 mg/L versus the CSR DW limit of 10 mg/L.

These maximums are calculated as the following times respective standards:

- Lithium – 2.5
- Nitrate – 2.3
- Nitrate + Nitrite – 2.3
- Fecal Coliforms – 100

In line with SHA's understanding of groundwater flow direction, wells E297151 and E297130 are located downgradient of the septic ponds. E297150 was identified by the OC as the background well for the site, but with its condition, SHA has determined E297152 is a suitable background well to use in its place.

Note that bacterial coliforms and elevated nitrate were found in site groundwater indicating expected local impacts from the sewage exfiltration basins.

SHA reviewed Site and surrounding water use per CSR Protocol 21. Although current DW use appears to not apply to the site, without further investigation of the underlying unmapped aquifer, future DW standards are assumed to apply.

Based on this information regarding current water use, and results that show concentrations below applicable AW standards, SHA considers the impacts of the sewage infiltration basin to the surrounding environment to be low.

4.1 Trend Analysis

To illustrate the trends observed in key parameters at the wells sampled, SHA has prepared figures that combine the 2020 analytical results with the applicable criteria limits. These figures are attached to this report as Appendix D.

- Figure 2 – Lithium concentrations
- Figure 3 – Sulfate concentrations
- Figure 4 – Sodium concentrations
- Figure 5 – Chloride concentrations
- Figure 6 – Nitrate Concentrations
- Figure 7 – Specific Conductance (Conductivity)

Sulfate, sodium, chloride, nitrate, and conductivity are graphed because they are typical landfill indicators. As shown in the graphs, with the exception of nitrate, these parameters are below allowable limits and show the site is not impacting groundwater chemistry beyond regulatory standards.

Please note that the graphs provided are for observing trends, and data less than or equal to the detection limit for a parameter appears on graphs as trace concentrations. If a well shows to have no data on the graph, please refer to the master data table for the exact parameter concentration.

5. CONCLUSIONS AND RECOMMENDATIONS

In 2021, sampling at the Site occurred in accordance with the OC.

Well E297150, has been reportedly damaged since July, 2020. Prior to this, there is no record of its sampling since before 2019. Per the OC, this well is a background monitoring location, and as such is used to obtain a representation of natural ambient water quality. As this location has not been viable for sampling, SHA has determined that nearby well E297152 is similarly located upgradient of the septage ponds, and displays water quality indicative of unimpacted, background groundwater. As a result, SHA has used E297152 as a reference point for water quality impact comparison and has updated Figure 1 attached to show its status as the new identified background well location.

Some parameters generally associated with sewage effluent including nitrate and fecal coliforms were noted above applicable BC CSR DW Standards, but below BC CSR AW standards in Site groundwater.

Although there appears to be local impacts to groundwater from the Site's sewage exfiltration basins, SHA considers the overall impacts to human health and the surrounding environment to be low based on Site and surrounding water use.

Other parameters that appear slightly elevated included lithium, which may be related to Site impacts but may also be naturally occurring. In conducting analyses for seven different sites within the RDEK with similar exceedances of lithium under the CSR DW limit, SHA believes these elevated concentrations are a region-wide occurrence caused by existing background concentrations rather than impacts caused by activities at the solid waste sites.

SHA recommends the following:

Parameter concentrations of dissolved metals slightly above applicable standards were detected in the Site groundwater monitoring wells. Based on surrounding land use, and relatively low impact to the immediate environment, SHA does not envision a change to the sampling method is warranted at this time. However, if exceeding parameters begin to form a consistently increasing trend, the RDEK may consider groundwater sampling methods using a low flow technique, where possible, to minimize the re-suspension of colloidal materials that can be caused during sampling with bailers and/or Waterra inertia pumps. If this sampling method is effective in providing a more accurate interpretation of groundwater data and able to show the groundwater exceedances are a result of suspended materials from bailer sampling, then SHA could make a recommendation to the Regional District to implement this sampling method for the monitoring going forward.

The next sampling event is scheduled for Q2 in April 2022.

6. STATEMENT OF LIMITATIONS

This report has been prepared by Sperling Hansen Associates. (SHA) on behalf of the Regional District of East Kootenay (RDEK) in accordance with generally accepted engineering practices to a level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions in British Columbia.

The report is based on site visits, project experience, and analysis by SHA staff of data compiled during the preparation of this report from a number of sources. Except where specifically stated to the contrary, the information on which this study is based has been obtained from external sources. This external information has not been independently verified or otherwise examined by SHA to determine its accuracy and completeness. SHA has relied in good faith on this information and does not accept responsibility of any deficiency, misstatements or inaccuracies contained in the reports as a result of omissions, misinterpretation and/or fraudulent acts of the persons interviewed or contacted, or errors or omissions in the reviewed documentation.

The report is intended solely for the use of the RDEK. Any use which other parties makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such other parties. SHA does not accept any responsibility for other uses of the material contained herein nor for damages, if any, suffered by any third party because of decisions made or actions based on this report. Copying of this intellectual property for other purposes is not permitted.

The findings and conclusions of this report are valid only as of the date of this report. The interpretations presented in this report and the conclusions and recommendations that are drawn are based on information that was made available to SHA during the course of this project. Should additional new data become available in the future, SHA should be requested to re-evaluate the findings of this report and modify the conclusions and recommendations drawn, as required.

Should you have any questions on this report or require further assistance or information, please feel free to contact the undersigned at 778-471-7088 or 604-986-7723.

Report prepared by:



Chloe Hetherington
Environmental Analyst Assistant

Report reviewed by:



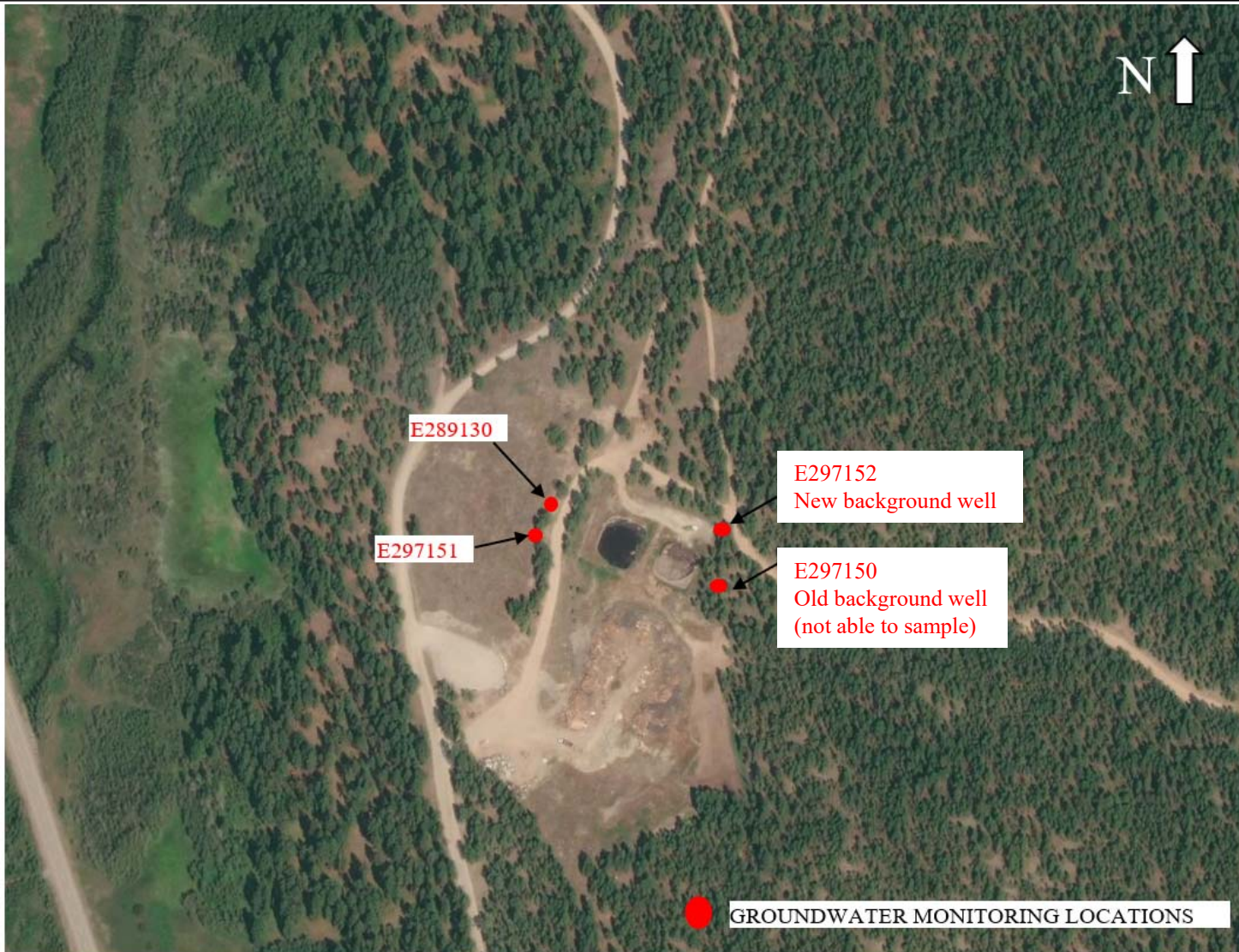
Scott Garthwaite
Sr. Civil Technologist

7. REFERENCES

Environmental Management Act, BC Contaminated Sites Regulation Schedule 3.2, 2019.

Ministry of Environment, BC Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture Summary Report, August 2019.

RDEK Public Web Map 2020, retrieved from <https://www.rdek.bc.ca/departments/mapping>



SPERLING
HANSEN
ASSOCIATES



PROJECT:

**SOLID WASTE FACILITY
MONITORING
PROGRAM 2020-2025**

TITLE:

**WASA SEPTAGE POND
MONITORING LOCATIONS**

SCALE:
N/A

DATE:
2022/01/10
yyyy/mm/dd

PROJECT NO:
21063

DESIGNED

DRAWN

CHECKED

DRAWING NO:

Figure 1

APPENDICES

APPENDIX A
Operational Certificate



April 8, 2014

Tracking Number: 320585
Authorization Number: 107105

REGISTERED MAIL

Regional District of East Kootenay
12 24th Ave. S.
Cranbrook, BC V1C 3H8

Dear Operational Certificate Holder:

Enclosed is Operational Certificate 107105 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the operational certificate. An annual fee will be determined according to the Permit Fees Regulation.

This operational certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the operational certificate holder. It is also the responsibility of the operational certificate holder to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

This decision may be appealed to the Environmental Appeal Board in accordance with Part 8 of the *Environmental Management Act*. An appeal must be delivered within 30 days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Administration of this operational certificate will be carried out by staff from the Southern Interior Region - Kootenay. Plans, data and reports pertinent to the operational certificate are to be submitted to the Director, Environmental Protection, at the Ministry of Environment, Regional Operations, Southern Interior Region, 205 Industrial Road G, Cranbrook, BC V1C 7G5.

Yours truly,

Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*

April 8, 2014

- 2 -

Tracking Number: 320585

Authorization Number: 107105

Southern Interior Region - Kootenay

Enclosure

cc: Environment Canada



Ministry of Environment
OPERATIONAL CERTIFICATE
107105

Under the Provisions of the *Environmental Management Act*

Regional District of East Kootenay
19 24th AVE S.
Cranbrook, BC V1C 3H8

is authorized to discharge effluent from septic tank pump-out operations to the ex-filtration ponds at the Transfer Station in Wasa, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

An annual permit fee will be charged as per the *Environmental Management Act* Permit Fee Regulation.

1. SPECIFIC AUTHORIZATION DISCHARGES AND RELATED REQUIREMENTS

1.1. Discharge of effluent to which this section is applicable is septic tank pumpage from the Central Subregion of the Regional District of East Kootenay as shown on the attached Site Plan.

1.1.1. The authorized rate of discharge is 175 m³/day.

1.1.2. The location of the discharge is District Lot 131, Kootenay District.

1.1.3. The characteristics of the effluent must be equivalent to or better than typical septic tank effluent and for the purpose of permit fee calculations, the following discharge factors must be used:

a) 5-day Biochemical Oxygen Demand, 130 mg/L

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for Director, *Environmental Management Act*
Southern Interior Region - Kootenay
Operational Certificate Number: 107105

b) Total Suspended Solids, 130 mg/L.

- 1.2. The area from which the effluent originates is the Central Subregion of the Regional District of East Kootenay.
- 1.3. The works authorized are two ex-filtration ponds and related appurtenances, approximately located as shown on the attached Site Plan.
- 1.4. The works authorized must be complete and in operation at the time of discharge.

2. **MAINTENANCE OF WORKS, EMERGENCY PROCEDURES AND NONCOMPLIANCE**

The Permittee must inspect the pollution control works regularly and maintain them in good working order. In the event of an emergency or any condition which prevents continuing operation of the approved method of pollution control or results in noncompliance with the terms and conditions of this permit, the Permittee must immediately notify the Director and take appropriate remedial action.

3. **SLUDGE WASTING AND DISPOSAL**

The aged and dewatered sludge from the authorized works must be disposed of at a site authorized by the Director.

4. **EX-FILTRATION PONDS**

- 4.1. Discharge is to the upper pond for solids removal. Decanted liquids flow through a culvert to the lower pond where it eventually evaporates or infiltrates into the ground. Mechanical removal of solids from the upper pond occurs biennially and is applied in layers to the east side of the property.
- 4.2. There must be no overflow from the ex-filtration pond to the receiving environment. The ponds must have a minimum of 0.5m of freeboard at all times.
- 4.3. Surface drainage must be diverted away from the ex-filtration pond.
- 4.4. The residue removed from the ex-filtration pond must be disposed of in a manner authorized by the Director.

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for Director, *Environmental Management Act*
Southern Interior Region - Kootenay

5. FENCING

The Permittee must erect a fence around the ex-filtration pond and such other areas as required by the Director. The height and type of fencing must meet the approval of the Director.

6. POSTING OF CAUTIONARY SIGNS

The Permittee must post signs to the satisfaction of the Director.

7. HAZARDOUS WASTES

No other waste including hazardous waste as defined by the Hazardous Waste Regulation is to be disposed of at the site without prior written authorization of the Director.

MONITORING**8. DISCHARGE MONITORING**

The Permittee must record the monthly volume of effluent discharged to the ponds.

8.1. Sample Location and Frequency/Type

The Permittee must monitor all monitoring wells quarterly for the following parameters:


8.1.1. Field Tests:

Static water levels, pH, Sample temperature, Conductivity, and Total dissolved solids.

8.1.2. Laboratory Tests:

Sample temperature, Conductivity, Total alkalinity, Dissolved Chloride, Fluoride, Sulphate, Nitrate, Nitrite, TSS, Phosphate, Total coliform and Fecal coliform.

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Southern Interior Region - Kootenay

8.1.3. Environmental Monitoring System (EMS) Numbers

The following are the EMS site numbers assigned to the monitoring sites. These numbers are to be used when entering data directly into the Ministry EMS database in accordance with Section 55 of the Municipal Wastewater Regulation. Monitoring data must be submitted to the Ministry data base quarterly within 30 days of receipt.

Monitoring Well	EMS Number	Coordinates	Descriptor
MW-01	E297150	49.7373 N 115.7146 W	Background (Upgradient)
MW-02	E297130	49.7377 N 115.7160 W	Downgradient, NW of septic ponds
MW-03	E297151	49.7375 N 115.7161 W	Downgradient, W of septic ponds
MW-04	E297152	49.7376 N 115.7144 W	Downgradient, E of septic ponds


9. **REPORTING**

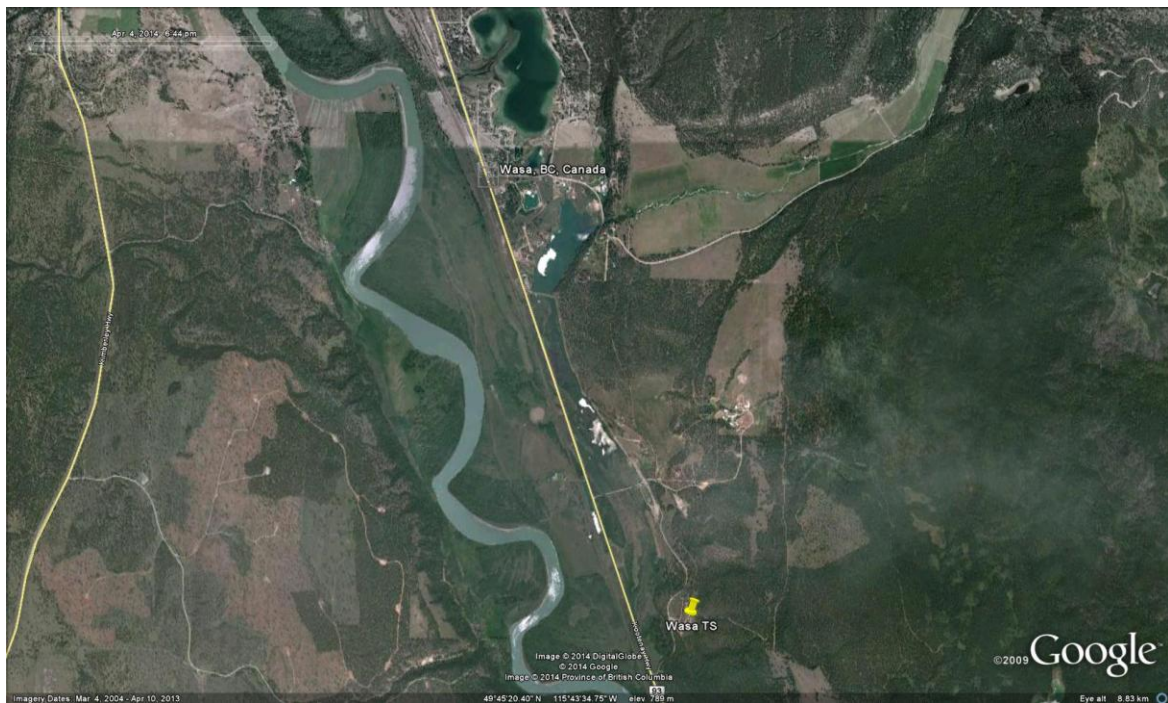
The Permittee must maintain data of analyses and volumes for inspection and submit the data to the Director for the previous year's monitoring.

All reports must be submitted within 60 days of the end of the calendar year.


Monitoring data must be submitted in an electronic format satisfactory to the Director.

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Southern Interior Region - Kootenay



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 Southern Interior Region - Kootenay

APPENDIX B
Water Quality Results

Table B-1 Water Quality Analysis

Sampling Location				E297130	E297130	E297130	E297130	E297130	E297130	E297151	E297151	E297151	E297151	E297151	E297151	E297152	E297152	E297152	E297152	E297152	E297152	
Date Sampled				20-Jul-20	19-Oct-20	11-Jan-21	26-Apr-21	26-Jul-21	08-Nov-21	20-Jul-20	19-Oct-20	11-Jan-21	26-Apr-21	26-Jul-21	08-Nov-21	20-Jul-20	19-Oct-20	11-Jan-21	26-Apr-21	26-Jul-21	08-Nov-21	
Lab Sample ID				L2477031-7	L2518933-1	L2547260-1	L2580623-1	L2619047-1	L2660626-1	L2477031-8	L2518933-2	L2547260-2	L2580623-2	L2619047-2	L2660626-2	L2477031-9	L2518933-3	L2547260-3	L2580623-3	L2619047-3	L2660626-3	
Sample Type																						
Analyte	Unit	Guideline																				
		CSR AW	CSR DW																			
Lab Results																						
Anions and Cations in meq/L unit																						
Aluminum (meq/L) (calculated)	meq/L	NG	NG	0.166	0.00013	0.00013				0.0002	<0.00011	0.00028				0.00062	0.00024	0.00040				
Barium (meq/L) (calculated)	meq/L	NG	NG	0.00609	0.000610	0.000569				0.000604	0.00169	0.00166				0.001	0.00338	0.00290				
Bicarbonate (HCO3) (meq/L) (calculated)	meq/L	NG	NG	13.4	8.69	7.95	8.59	8.42	6.7	8.92	11.3	11.6	11.2	10.8	9.93	10.3	7.06	7.21	6.62	6.82	5.93	
Boron (meq/L) (calculated)	meq/L	NG	NG	0.0033	0.0078	0.0061				0.0072	0.0069	0.0080				0.0042	0.0039	0.0044				
Calcium (meq/L) (calculated)	meq/L	NG	NG	4.6	2.87	2.39	2.55	2.82	2.54	2.7	3.11	2.88	3.18	2.74	3.14	2.29	1.61	1.44	1.5	1.62	1.68	
Carbonate (CO3) (meq/L) (calculated)	meq/L	NG	NG	<0.17	0.26	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	0.21	<0.17	<0.17	<0.17	<0.17	
Chloride (meq/L) (calculated)	meq/L	NG	NG	0.0663	0.590	0.519	0.559	0.344	0.463	0.381	1.61	1.67	1.58	1.35	1.54	1.19	0.0663	0.0635	0.0666	0.0863	0.0719	
Chromium (meq/L) (calculated)	meq/L	NG	NG	0.000104	0.000033	0.00003				0.000035	0.000047	0.000044				0.00004	<0.000058	<0.000058				
Copper (meq/L) (calculated)	meq/L	NG	NG	0.000935	0.000014	0.000024				0.0000570	0.000019	0.000028				0.000028	0.000017	0.000025				
Fluoride (meq/L) (calculated)	meq/L	NG	NG	0.0039	<0.0053	<0.0011	<0.0053	<0.0011	<0.0011	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	<0.0053	0.00563	0.0049	0.0038	0.0034	0.00653	
Hydroxide (OH) (meq/L) (calculated)	meq/L	NG	NG	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	<0.29	
Lead (meq/L) (calculated)	meq/L	NG	NG	0.000273	<0.00000048	<0.00000048				0.00000056	<0.00000048	<0.00000048				0.00000081	<0.00000048	<0.00000048				
Lithium (meq/L) (calculated)	meq/L	NG	NG	0.00156	0.00071	0.00062				0.00062	0.00290	0.00285				0.00215	0.00161	0.00147				
Magnesium (meq/L) (calculated)	meq/L	NG	NG	5.3	8.39	7.58	8.64	7.07	6.86	7.19	11.5	11.1	12.3	9.79	10.6	9.55	4.78	4.49	4.79	4.25	4.43	
Potassium (meq/L) (calculated)	meq/L	NG	NG	0.0468	0.0586	0.0550				0.0568	0.0663	0.064				0.0601	0.0366	0.0350				
Sodium (meq/L) (calculated)	meq/L	NG	NG	0.744	0.835	0.87				0.687	1.74	1.86				1.34	0.726	0.761				
Strontium (meq/L) (calculated)	meq/L	NG	NG	0.0170	0.00886	0.00842				0.00806	0.0156	0.02				0.0118	0.0163	0.0159				
Sulfate (meq/L) (calculated)	meq/L	NG	NG	0.136	1.85	1.28	1.45	1.68	1.24	1.78	1.27	1.46	1.37	1.35	1.35	0.899	0.153	0.141	0.139	0.144	0.154	
Zinc (meq/L) (calculated)	meq/L	NG	NG	0.000835	0.0002	0.00046				0.000046	0.00018	0.000655				0.00009	0.0002	0.000064				
Dissolved Metals																						
Aluminum (dissolved)	µg/L	NG	9500 ^{2,1}	1490	1.2	1.2				2	<1.0	2.5				5.6	2.2	3.6				
Antimony (dissolved)	µg/L	90	6	<0.10	<0.10	<0.10				<0.10	<0.10	<0.10				<0.10	<0.10	<0.10				
Arsenic (dissolved)	µg/L	50	10	3.55	0.14	0.17				0.14	0.16	0.17				0.13	1.05	0.96				
Barium (dissolved)	µg/L	10000	1000	418	41.9	39.1				41.5	116	114				100	232	199				
Beryllium (dissolved)	µg/L	1.5	8	0.186	<0.020	<0.020				<0.020	<0.020	<0.020				<0.020	<0.020	<0.020				
Bismuth (dissolved)	µg/L	NG	NG	<0.050	<0.050	<0.050				<0.050	<0.050	<0.050				<0.050	<0.050	<0.050				
Boron (dissolved)	µg/L	12000	5000	12	28	22				26	25	29				15	14	16				
Cadmium (dissolved)	mg/L	Calc ^{1,1}	0.005	0.000229	<0.0000050	0.0000101				0.0000053	<0.000050	0.0000102				0.0000072	0.0000059	0.0000149				
Calcium (dissolved)	µg/L	NG	NG	92100	57600	47800	51100	56500	51000	55000	62400	57800	63700	54900	62900	45800	32300	28900	30000	32400	33600	
Chromium (dissolved)	µg/L	10 ^{1,2}	50 ^{2,2}	1.81	0.57	0.6				0.61	0.81	0.77				0.7	<0.10	<0.10				
Cobalt (dissolved)	µg/L	40	20 ^{2,3}	3.84	<0.10	<0.10				<0.10	0.11	0.12				<0.10	0.24	0.16				
Copper (dissolved)	µg/L	Calc ^{1,3}	1500 ^{2,4}	29.7	0.43	0.75				1.81	0.61	0.89				0.89	0.54	0.81				
Hardness, Total (dissolved as CaCO3)	mg/L	NG	NG	494	563	499	560	495	471	497	732	699	772	628	690	592	320	297	315	293	306	
Iron (dissolved)	µg/L	NG	6500 ^{2,5}	2790	<10	<10				<10	<10	<10				<10	<10	<10				
Lead (dissolved)	µg/L	Calc ^{1,4}	10	28.3	<0.050	<0.050				0.058	<0.050	<0.050				0.084	<0.050	<0.050				
Lithium (dissolved)	µg/L	NG	8	10.8	4.9	4.3				4.3	20.1	19.8				14.9	11.2	10.2				
Magnesium (dissolved)	mg/L	NG	NG	64	102	92.1	105	85.9	83.4	87.4	140	135	149	119	129	116	58.1	54.6	58.2	51.6	53.8	
Manganese (dissolved)	µg/L	NG	1500 ^{2,6}	354	0.34	0.4				0.22	0.13	0.84				1.34	54.4	36.1				
Mercury (dissolved)	µg/L	0.25	1		<0.0050	<0.0050					<0.0050	<0.0050					<0.0050	<0.0050				
Molybdenum (dissolved)	µg/L	10000	250	0.347	0.246	0.362				0.172	0.271	0.241				0.178	4.96	5.33				
Nickel (dissolved)	µg/L	Calc ^{1,5}	80	4.21	<0.50	0.52				<0.50	0.96	1.12				0.78	<0.50	<0.50				
Phosphorus (dissolved, by IC/PMS/ICPOES)	µg/L	NG	NG	270	<50	<50				<50	<50	<50				<50	<50	<50				
Potassium (dissolved)	µg/L	NG	NG	1830	2290	2150				2220	2590	2500				2350	1430	1370				
Selenium (dissolved)	µg/L	20	10	<0.050	0.082	0.117				0.17	0.636	0.714				0.694	<0.050	0.177				
Silicon (dissolved, as Si)	µg/L	NG	NG	7830	8420	7500				8160	9100	8260				7960	6060	5700				
Silver (dissolved)	µg/L	Calc ^{1,6}	20	<0.010	<0.010	<0.010				<0.010	<0.010	<0.010				<0.010	<0.010	<0.010				
Sodium (dissolved)	mg/L	NG	200 ^{2,7}	17.1	19.2	20				15.8	39.9	42.7				30.8	16.7	17.5				
Strontium (dissolved)	µg/L	NG	2500	746	388	369				353	683	700				519	715	696				
Sulphur (dissolved)	µg/L	NG	NG	4850	28200	23100				35400	21500	22300				19400	2730	3040				
Thallium (dissolved)	µg/L	3	NG	0.037	<0.010	<0.010				<0.010	<0.010	<0.010				<0.010	<0.010	<0.010				
Tin (dissolved)	µg/L	NG	2500	0.52	<0.10	0.12				<0.10	0.11	0.23				<0.10	0.11	0.12				
Titanium (dissolved)	µg/L	1000	NG	25.4	<0.30	<0.30				<0.30	<0.30	<0.30				<0.30	<0.30	<0.30				
Uranium (dissolved)	µg/L	85	20	4.11	5.64	5.64				4.94	8.42	9.8				5.99	4.37	4.82				
Vanadium (dissolved)	µg/L	NG	20	3.19	<0.50	<0.50				<0.50	<0.50	<0.50				<0.5						

APPENDIX C
Certificates of Analysis



Sperling Hansen Associates Inc.
ATTN: Scott Garthwaite
#8 - 1225 East Keith Road
North Vancouver BC V7J 1J3

Date Received: 27-APR-21
Report Date: 05-MAY-21 13:55 (MT)
Version: FINAL

Client Phone: 604-986-7723

Certificate of Analysis

Lab Work Order #: L2580623
Project P.O. #: NOT SUBMITTED
Job Reference: 20050 WASA
C of C Numbers:
Legal Site Desc:

Patryk Wojciak, B.Sc., P.Chem.
Account Manager

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ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2580623-1	E297130							
Sampled By:	TM on 26-APR-21 @ 12:00							
Matrix:	GROUNDWATER							
Hardness								
Dissolved Metals by ICPOES								
Dissolved Metals Filtration Location	LAB						03-MAY-21	R5446161
Calcium (Ca)-Dissolved	51.1			0.10	mg/L		03-MAY-21	R5446358
Magnesium (Mg)-Dissolved	105			0.10	mg/L		03-MAY-21	R5446358
Hardness								
Hardness (as CaCO3)	560			0.50	mg/L		03-MAY-21	
Miscellaneous Parameters								
Ammonia as N	0.0107			0.0050	mg/L		04-MAY-21	R5448846
Chloride (Cl)	19.8	DLHC		0.50	mg/L		27-APR-21	R5442562
Coliform Bacteria - Fecal	<5	DLM		5	CFU/100mL		27-APR-21	R5442696
Fluoride (F)	<0.10			0.10	mg/L		27-APR-21	R5442562
Nitrate (as N)	11.2	DLHC		0.025	mg/L		27-APR-21	R5442562
Nitrate and Nitrite (as N)	11.2			0.025	mg/L		28-APR-21	
Nitrite (as N)	0.0085	DLHC		0.0050	mg/L		27-APR-21	R5442562
Sulfate (SO4)	69.5	DLHC		0.25	mg/L		27-APR-21	R5442562
Temperature	20.0			1.0	Degree C		03-MAY-21	R5446420
MPN - Total Coliforms	11			1	MPN/100mL		27-APR-21	R5442693
Total Suspended Solids	593			1.0	mg/L		03-MAY-21	R5447581
pH, Conductivity and Total Alkalinity								
pH	7.72			0.10	pH		03-MAY-21	R5446420
Conductivity (EC)	954			2.0	uS/cm		03-MAY-21	R5446420
Bicarbonate (HCO3)	524			5.0	mg/L		03-MAY-21	R5446420
Carbonate (CO3)	<5.0			5.0	mg/L		03-MAY-21	R5446420
Hydroxide (OH)	<5.0			5.0	mg/L		03-MAY-21	R5446420
Alkalinity, Total (as CaCO3)	430			2.0	mg/L		03-MAY-21	R5446420
L2580623-2	E297151							
Sampled By:	TM on 26-APR-21 @ 12:00							
Matrix:	GROUNDWATER							
Hardness								
Dissolved Metals by ICPOES								
Dissolved Metals Filtration Location	LAB						03-MAY-21	R5446161
Calcium (Ca)-Dissolved	63.7			0.10	mg/L		03-MAY-21	R5446358
Magnesium (Mg)-Dissolved	149			0.10	mg/L		03-MAY-21	R5446358
Hardness								
Hardness (as CaCO3)	772			0.50	mg/L		03-MAY-21	
Miscellaneous Parameters								
Ammonia as N	0.0192			0.0050	mg/L		04-MAY-21	R5448846
Chloride (Cl)	56.0	DLHC		0.50	mg/L		27-APR-21	R5442562
Coliform Bacteria - Fecal	<5	DLM		5	CFU/100mL		27-APR-21	R5442696
Fluoride (F)	<0.10			0.10	mg/L		27-APR-21	R5442562
Nitrate (as N)	21.9	DLHC		0.025	mg/L		27-APR-21	R5442562
Nitrate and Nitrite (as N)	21.9			0.025	mg/L		28-APR-21	
Nitrite (as N)	<0.0050	DLHC		0.0050	mg/L		27-APR-21	R5442562
Sulfate (SO4)	65.8	DLHC		0.25	mg/L		27-APR-21	R5442562
Temperature	19.3			1.0	Degree C		03-MAY-21	R5446420
MPN - Total Coliforms	2			1	MPN/100mL		27-APR-21	R5442693
Total Suspended Solids	1520			1.0	mg/L		03-MAY-21	R5447581
pH, Conductivity and Total Alkalinity								
pH	7.60			0.10	pH		03-MAY-21	R5446420

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2580623-2	E297151							
Sampled By:	TM on 26-APR-21 @ 12:00							
Matrix:	GROUNDWATER							
pH, Conductivity and Total Alkalinity								
Conductivity (EC)	1330			2.0	uS/cm		03-MAY-21	R5446420
Bicarbonate (HCO3)	682			5.0	mg/L		03-MAY-21	R5446420
Carbonate (CO3)	<5.0			5.0	mg/L		03-MAY-21	R5446420
Hydroxide (OH)	<5.0			5.0	mg/L		03-MAY-21	R5446420
Alkalinity, Total (as CaCO3)	559			2.0	mg/L		03-MAY-21	R5446420
L2580623-3	E297152							
Sampled By:	TM on 26-APR-21 @ 12:00							
Matrix:	GROUNDWATER							
Hardness								
Dissolved Metals by ICPOES								
Dissolved Metals Filtration Location	LAB						03-MAY-21	R5446161
Calcium (Ca)-Dissolved	30.0			0.10	mg/L		03-MAY-21	R5446358
Magnesium (Mg)-Dissolved	58.2			0.10	mg/L		03-MAY-21	R5446358
Hardness								
Hardness (as CaCO3)	315			0.50	mg/L		03-MAY-21	
Miscellaneous Parameters								
Ammonia as N	0.126			0.0050	mg/L		04-MAY-21	R5448846
Chloride (Cl)	2.36			0.10	mg/L		27-APR-21	R5442562
Coliform Bacteria - Fecal	100	DLM		100	CFU/100mL		27-APR-21	R5442696
Fluoride (F)	0.073			0.020	mg/L		27-APR-21	R5442562
Nitrate (as N)	0.0252			0.0050	mg/L		27-APR-21	R5442562
Nitrate and Nitrite (as N)	0.0296			0.0051	mg/L		28-APR-21	
Nitrite (as N)	0.0044			0.0010	mg/L		27-APR-21	R5442562
Sulfate (SO4)	6.68			0.050	mg/L		27-APR-21	R5442562
Temperature	19.9			1.0	Degree C		03-MAY-21	R5446420
MPN - Total Coliforms	<1			1	MPN/100mL		27-APR-21	R5442693
Total Suspended Solids	544			1.0	mg/L		03-MAY-21	R5447581
pH, Conductivity and Total Alkalinity								
pH	7.89			0.10	pH		03-MAY-21	R5446420
Conductivity (EC)	560			2.0	uS/cm		03-MAY-21	R5446420
Bicarbonate (HCO3)	404			5.0	mg/L		03-MAY-21	R5446420
Carbonate (CO3)	<5.0			5.0	mg/L		03-MAY-21	R5446420
Hydroxide (OH)	<5.0			5.0	mg/L		03-MAY-21	R5446420
Alkalinity, Total (as CaCO3)	331			2.0	mg/L		03-MAY-21	R5446420

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-L-IC-N-CL	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
F-L-IC-CL	Water	Fluoride	APHA 4110 B-Ion Chromatography
FCC-MF-CL	Water	Fecal Coliform Count-MF	APHA 9222D
This analysis is carried out using procedures adapted from APHA Method 9222 "Membrane Filter Technique for Members of the Coliform Group". Coliform bacteria is enumerated by culturing and colony counting. A known sample volume is filtered through a 0.45 micron membrane filter. The test involves an initial 24 hour incubation at 44.5 degrees C of the filter with the appropriate growth medium. This method is specific for thermotolerant bacteria (Fecal) and is used for non-turbid water with a low background bacteria level.			
HARDNESS-CALC-CL	Water	Hardness	APHA 2340 B
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.			
MET-DIS-ICP-CL	Water	Dissolved Metals by ICPOES	APHA 3030B/EPA 6010D
"This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (APHA Method 3030B) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).			
N2N3-CALC-CL	Water	Nitrate+Nitrite	CALCULATION
NH3-L-F-CL	Water	Ammonia, Total (as N)	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.			
NO2-L-IC-N-CL	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.			
NO3-L-IC-N-CL	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.			
PH/EC/ALK-CL	Water	pH, Conductivity and Total Alkalinity	APHA 4500H,2510,2320
All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current			
SO4-L-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TC-MPN-CL	Water	Total Coliform	APHA 9223B
This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table. Recommended Holding Time: Sample: 1 day Reference: APHA			
TEMP-CL	Water	Temperature	APHA 2550-Thermometer
TSS-L-CL	Water	Total Suspended Solids	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, and by drying the filter at 104 deg. C.			

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
---------------	--------	------------------	--------------------

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

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

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

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.

Quality Control Report

Workorder: L2580623

Report Date: 05-MAY-21

Page 1 of 4

Client: Sperling Hansen Associates Inc.
#8 - 1225 East Keith Road
North Vancouver BC V7J 1J3

Contact: Scott Garthwaite

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-L-IC-N-CL		Water						
Batch	R5442562							
WG3525743-3	DUP	L2580623-3						
Chloride (Cl)		2.36	2.35		mg/L	0.3	20	27-APR-21
WG3525743-2	LCS		97.7		%		85-115	27-APR-21
Chloride (Cl)								
WG3525743-1	MB		<0.10		mg/L		0.1	27-APR-21
Chloride (Cl)								
WG3525743-4	MS	L2580623-3	111.2		%		75-125	27-APR-21
Chloride (Cl)								
F-L-IC-CL		Water						
Batch	R5442562							
WG3525743-3	DUP	L2580623-3						
Fluoride (F)		0.073	0.073		mg/L	0.0	20	27-APR-21
WG3525743-2	LCS		93.4		%		85-115	27-APR-21
Fluoride (F)								
WG3525743-1	MB		<0.020		mg/L		0.02	27-APR-21
Fluoride (F)								
WG3525743-4	MS	L2580623-3	99.0		%		75-125	27-APR-21
Fluoride (F)								
FCC-MF-CL		Water						
Batch	R5442696							
WG3525864-1	MB		<1		CFU/100mL		1	27-APR-21
Coliform Bacteria - Fecal								
MET-DIS-ICP-CL		Water						
Batch	R5446358							
WG3528221-3	DUP	L2580623-3						
Calcium (Ca)-Dissolved		30.0	32.4		mg/L	7.8	20	03-MAY-21
Magnesium (Mg)-Dissolved		58.2	59.2		mg/L	1.7	20	03-MAY-21
WG3528221-2	LCS	TMRM	98.2		%		80-120	03-MAY-21
Calcium (Ca)-Dissolved								
Magnesium (Mg)-Dissolved			112.9		%		80-120	03-MAY-21
WG3528221-1	MB		<0.10		mg/L		0.1	03-MAY-21
Calcium (Ca)-Dissolved								
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	03-MAY-21
WG3528221-4	MS	L2580623-3	101.0		%		70-130	05-MAY-21
Calcium (Ca)-Dissolved								
Magnesium (Mg)-Dissolved			108.6		%		70-130	05-MAY-21



Workorder: L2580623

Page 2 of 4

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-L-F-CL		Water						
Batch	R5448846							
WG3528942-2	LCS							
Ammonia as N			104.1		%		85-115	04-MAY-21
WG3528942-1	MB							
Ammonia as N			<0.0050		mg/L		0.005	04-MAY-21
NO2-L-IC-N-CL		Water						
Batch	R5442562							
WG3525743-3	DUP	L2580623-3						
Nitrite (as N)			0.0044	0.0039	mg/L	12	20	27-APR-21
WG3525743-2	LCS							
Nitrite (as N)			98.5		%		90-110	27-APR-21
WG3525743-1	MB							
Nitrite (as N)			<0.0010		mg/L		0.001	27-APR-21
WG3525743-4	MS	L2580623-3						
Nitrite (as N)			114.8		%		75-125	27-APR-21
NO3-L-IC-N-CL		Water						
Batch	R5442562							
WG3525743-3	DUP	L2580623-3						
Nitrate (as N)			0.0252	0.0221	mg/L	13	20	27-APR-21
WG3525743-2	LCS							
Nitrate (as N)			98.4		%		90-110	27-APR-21
WG3525743-1	MB							
Nitrate (as N)			<0.0050		mg/L		0.005	27-APR-21
WG3525743-4	MS	L2580623-3						
Nitrate (as N)			111.2		%		75-125	27-APR-21
PH/EC/ALK-CL		Water						
Batch	R5446420							
WG3528269-5	LCS							
Conductivity (EC)			103.9		%		90-110	03-MAY-21
Alkalinity, Total (as CaCO3)			103.5		%		85-115	03-MAY-21
WG3528269-4	MB							
Conductivity (EC)			<2.0		uS/cm		2	03-MAY-21
Bicarbonate (HCO3)			<5.0		mg/L		5	03-MAY-21
Carbonate (CO3)			<5.0		mg/L		5	03-MAY-21
Hydroxide (OH)			<5.0		mg/L		5	03-MAY-21
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	03-MAY-21
SO4-L-IC-N-CL		Water						

Quality Control Report

Workorder: L2580623

Report Date: 05-MAY-21

Page 3 of 4

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-L-IC-N-CL								
Batch R5442562								
WG3525743-3	DUP	L2580623-3						
Sulfate (SO4)		6.68	6.71		mg/L	0.4	20	27-APR-21
WG3525743-2	LCS							
Sulfate (SO4)			98.8		%		85-115	27-APR-21
WG3525743-1	MB							
Sulfate (SO4)			<0.050		mg/L		0.05	27-APR-21
WG3525743-4	MS	L2580623-3						
Sulfate (SO4)			110.5		%		75-125	27-APR-21
TC-MPN-CL								
Batch R5442693								
WG3525854-4	MB							
MPN - Total Coliforms			<1		MPN/100mL		1	27-APR-21
TSS-L-CL								
Batch R5447581								
WG3528101-2	LCS							
Total Suspended Solids			89.0		%		85-115	03-MAY-21
WG3528101-1	MB							
Total Suspended Solids			<1.0		mg/L		1	03-MAY-21

Quality Control Report

Workorder: L2580623

Report Date: 05-MAY-21

Page 4 of 4

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

COC Number: 20 -

Page 1 of 1

Report To Contact and company name below will appear on the final report Company: Sperling Hansen Associates Inc. Contact: Scott Garthwaite Phone: 778-471-7088 Company address below will appear on the final report Street: 1225 East Keith Road City/Province: North Vancouver, B.C. Postal Code: V7J 1J3 Invoice To Same as Report To <input checked="" type="checkbox"/> YES <input checked="" type="checkbox"/> NO Copy of Invoice with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO Company: Contact:			Reports / Recipients Select Report Format: <input type="checkbox"/> PDF <input checked="" type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL) Merge QC/QCI Reports with COA <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX Email 1 or Fax: sgarthwaite@sperlinghansen.com Email 2: chetherington@sperlinghansen.com Email 3:			Turnaround Time (TAT) Requested <input checked="" type="checkbox"/> Routine [R] if received by 3pm M-F - no surcharges apply <input type="checkbox"/> 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum <input type="checkbox"/> 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum <input type="checkbox"/> 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum <input type="checkbox"/> 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum <input type="checkbox"/> Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush requests on weekends, statutory holidays and non-routine tests Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm For all tests with rush TATs requested, please contact your AM to confirm availability.			AFFIX ALS BARCODE LABEL HERE (ALS use only)																																			
Project Information ALS Account # / Quote #: Job #: 20050 Wasa PO / AFE: LSD:			Oil and Gas Required Fields (client use) AFE/Cost Center: PO# Major/Minor Code: Routing Code: Requisitioner: Location:			Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below																																						
ALS Lab Work Order # (ALS use only):			ALS Contact: Dean Watt Sampler: T. McBride			NUMBER OF CONTAINERS																																						
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Time (hh:mm)			Sample Type			<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>temperature, pH, conductivity</th> <th>Anions</th> <th>Total Alkalinity</th> <th>TSS</th> <th>Ammonia</th> <th>Fecal and Total Coliform</th> <th>nitrate, nitrite</th> <th>fluoride, chloride, sulfate</th> <th>hardness</th> </tr> <tr> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> </tr> <tr> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> </tr> <tr> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> </tr> </table>			temperature, pH, conductivity	Anions	Total Alkalinity	TSS	Ammonia	Fecal and Total Coliform	nitrate, nitrite	fluoride, chloride, sulfate	hardness	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
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Sperling Hansen Associates Inc.
ATTN: Scott Garthwaite
#8 - 1225 East Keith Road
North Vancouver BC V7J 1J3

Date Received: 27-JUL-21
Report Date: 09-AUG-21 14:41 (MT)
Version: FINAL

Client Phone: 604-986-7723

Certificate of Analysis

Lab Work Order #: L2619047
Project P.O. #: NOT SUBMITTED
Job Reference: 20050 WASA
C of C Numbers:
Legal Site Desc:

Patryk Wojciak, B.Sc., P.Chem.
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2619047-1 GROUNDWATER 26-JUL-21 12:00 E297130	L2619047-2 GROUNDWATER 26-JUL-21 12:00 E297151	L2619047-3 GROUNDWATER 26-JUL-21 12:00 E297152		
Grouping	Analyte					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	495	628	293		
	Temperature (Degree C)	18.0	18.0	18.0		
	Total Suspended Solids (mg/L)	18.9	170	479		
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	421	540	341		
	Ammonia as N (mg/L)	<0.0050	0.0111	0.240		
	Bicarbonate (HCO3) (mg/L)	514	658	416		
	Carbonate (CO3) (mg/L)	<5.0	<5.0	<5.0		
	Chloride (Cl) (mg/L)	12.2	47.9	3.06		
	Conductivity (EC) (uS/cm)	805	1090	513		
	Fluoride (F) (mg/L)	<0.020	<0.10 ^{D LDS}	0.065		
	Hydroxide (OH) (mg/L)	<5.0	<5.0	<5.0		
	Nitrate and Nitrite (as N) (mg/L)	6.94	18.9	0.142		
	Nitrate (as N) (mg/L)	6.93	18.9	0.124		
	Nitrite (as N) (mg/L)	0.0063	0.0101	0.0175		
	pH (pH)	7.66	7.70	7.71		
	Sulfate (SO4) (mg/L)	80.6	64.9	6.91		
Bacteriological Tests	Coliform Bacteria - Fecal (CFU/100mL)	<1	<10 ^{D LM}	<10 ^{D LM}		
	MPN - Total Coliforms (MPN/100mL)	<1	<1	<1		
Dissolved Metals	Dissolved Metals Filtration Location	LAB	LAB	LAB		
	Calcium (Ca)-Dissolved (mg/L)	56.5	54.9	32.4		
	Magnesium (Mg)-Dissolved (mg/L)	85.9	119	51.6		

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Qualifiers for Individual Parameters Listed:			
Qualifier	Description		
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.		
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).		

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-L-IC-N-CL	Water	Chloride in Water by IC Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	EPA 300.1 (mod)
F-L-IC-CL	Water	Fluoride	APHA 4110 B-Ion Chromatography
FCC-MF-CL	Water	Fecal Coliform Count-MF This analysis is carried out using procedures adapted from APHA Method 9222 "Membrane Filter Technique for Members of the Coliform Group". Coliform bacteria is enumerated by culturing and colony counting. A known sample volume is filtered through a 0.45 micron membrane filter. The test involves an initial 24 hour incubation at 44.5 degrees C of the filter with the appropriate growth medium. This method is specific for thermotolerant bacteria (Fecal) and is used for non-turbid water with a low background bacteria level.	APHA 9222D
HARDNESS-CALC-CL	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 2340 B
MET-DIS-ICP-CL	Water	Dissolved Metals by ICPOES "This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (APHA Method 3030B) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).	APHA 3030B/EPA 6010D
N2N3-CALC-CL	Water	Nitrate+Nitrite	CALCULATION
NH3-L-F-CL	Water	Ammonia, Total (as N) 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. Weston et al.	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
NO2-L-IC-N-CL	Water	Nitrite in Water by IC (Low Level) Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	EPA 300.1 (mod)
NO3-L-IC-N-CL	Water	Nitrate in Water by IC (Low Level) Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	EPA 300.1 (mod)
PH/EC/ALK-CL	Water	pH, Conductivity and Total Alkalinity All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current	APHA 4500H,2510,2320
SO4-L-IC-N-CL	Water	Sulfate in Water by IC Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	EPA 300.1 (mod)
TC-MPN-CL	Water	Total Coliform This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table. Recommended Holding Time: Sample: 1 day Reference: APHA	APHA 9223B
TEMP-CL	Water	Temperature	APHA 2550-Thermometer
TSS-L-CL	Water	Total Suspended Solids 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, and by drying the filter at 104 deg. C.	APHA 2540 D-Gravimetric

Reference Information

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

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 ww - 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.

Quality Control Report

Workorder: L2619047

Report Date: 09-AUG-21

Page 2 of 4

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO2-L-IC-N-CL	Water							
Batch	R5531009							
WG3585837-2 LCS								
Nitrite (as N)			100.4		%		90-110	27-JUL-21
WG3585837-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	27-JUL-21
NO3-L-IC-N-CL	Water							
Batch	R5531009							
WG3585837-2 LCS								
Nitrate (as N)			100.6		%		90-110	27-JUL-21
WG3585837-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	27-JUL-21
PH/EC/ALK-CL	Water							
Batch	R5540579							
WG3589092-2 LCS								
Conductivity (EC)			95.8		%		90-110	31-JUL-21
Alkalinity, Total (as CaCO3)			108.2		%		85-115	31-JUL-21
WG3589092-1 MB								
Conductivity (EC)			<2.0		uS/cm		2	31-JUL-21
Bicarbonate (HCO3)			<5.0		mg/L		5	31-JUL-21
Carbonate (CO3)			<5.0		mg/L		5	31-JUL-21
Hydroxide (OH)			<5.0		mg/L		5	31-JUL-21
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	31-JUL-21
SO4-L-IC-N-CL	Water							
Batch	R5531009							
WG3585837-2 LCS								
Sulfate (SO4)			102.3		%		85-115	27-JUL-21
WG3585837-1 MB								
Sulfate (SO4)			<0.050		mg/L		0.05	27-JUL-21
TC-MPN-CL	Water							
Batch	R5531036							
WG3585932-1 MB								
MPN - Total Coliforms			<1		MPN/100mL		1	27-JUL-21
TSS-L-CL	Water							
Batch	R5534796							
WG3586182-2 LCS								
Total Suspended Solids			96.3		%		85-115	29-JUL-21
WG3586182-1 MB								



Quality Control Report

Workorder: L2619047

Report Date: 09-AUG-21

Page 3 of 4

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TSS-L-CL	Water							
Batch	R5534796							
WG3586182-1 MB								
Total Suspended Solids			<1.0		mg/L		1	29-JUL-21

Quality Control Report

Workorder: L2619047

Report Date: 09-AUG-21

Page 4 of 4

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



COC Number: 20 -

Page 1 of 1

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REFER TO BACK PAGE FOR AIS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

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AUG 2020 FRO



Sperling Hansen Associates Inc.
ATTN: Scott Garthwaite
#8 - 1225 East Keith Road
North Vancouver BC V7J 1J3

Date Received: 09-NOV-21
Report Date: 18-NOV-21 18:29 (MT)
Version: FINAL

Client Phone: 604-986-7723

Certificate of Analysis

Lab Work Order #: L2660626
Project P.O. #: NOT SUBMITTED
Job Reference: 20050 WASA
C of C Numbers:
Legal Site Desc:

Patryk Wojciak, B.Sc., P.Chem.
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2660626-1 Groundwater 08-NOV-21 12:00 E297130	L2660626-2 Groundwater 08-NOV-21 12:00 E297151	L2660626-3 Groundwater 08-NOV-21 12:00 E297152		
Grouping	Analyte					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	471	690	306		
	Temperature (Degree C)	20.1	20.7	20.4		
	Total Suspended Solids (mg/L)	81.4	319	632		
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	409	606	362		
	Ammonia as N (mg/L)	0.0113	0.0418	0.136		
	Bicarbonate (HCO3) (mg/L)	409	606	362		
	Carbonate (CO3) (mg/L)	<5.0	<5.0	<5.0		
	Chloride (Cl) (mg/L)	16.4	54.5	2.55		
	Conductivity (EC) (uS/cm)	854	1340	575		
	Fluoride (F) (mg/L)	<0.020	<0.10 ^{DLS}	0.124		
	Hydroxide (OH) (mg/L)	<5.0	<5.0	<5.0		
	Nitrate and Nitrite (as N) (mg/L)	8.94	21.0	0.195		
	Nitrate (as N) (mg/L)	8.94	21.0	0.186		
	Nitrite (as N) (mg/L)	0.0018	0.0322	0.0089		
	pH (pH)	7.86	7.80	8.03		
	Sulfate (SO4) (mg/L)	59.7	64.9	7.38		
		^{DLM}	^{DLM}	^{DLM}		
Bacteriological Tests	Coliform Bacteria - Fecal (CFU/100mL)	<2	<2	<2		
	MPN - Total Coliforms (MPN/100mL)	7	1	16		
Dissolved Metals	Dissolved Metals Filtration Location	LAB	LAB	LAB		
	Calcium (Ca)-Dissolved (mg/L)	51.0	62.9	33.6		
	Magnesium (Mg)-Dissolved (mg/L)	83.4	129	53.8		

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Sulfate (SO4)	MS-B	L2660626-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-L-IC-N-CL	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
F-L-IC-CL	Water	Fluoride	APHA 4110 B-Ion Chromatography
FCC-MF-CL	Water	Fecal Coliform Count-MF	APHA 9222D
This analysis is carried out using procedures adapted from APHA Method 9222 "Membrane Filter Technique for Members of the Coliform Group". Coliform bacteria is enumerated by culturing and colony counting. A known sample volume is filtered through a 0.45 micron membrane filter. The test involves an initial 24 hour incubation at 44.5 degrees C of the filter with the appropriate growth medium. This method is specific for thermotolerant bacteria (Fecal) and is used for non-turbid water with a low background bacteria level.			
HARDNESS-CALC-CL	Water	Hardness	APHA 2340 B
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.			
MET-DIS-ICP-CL	Water	Dissolved Metals by ICPOES	APHA 3030B/EPA 6010D
"This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (APHA Method 3030B) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).			
N2N3-CALC-CL	Water	Nitrate+Nitrite	CALCULATION
NH3-L-F-CL	Water	Ammonia, Total (as N)	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.			
NO2-L-IC-N-CL	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.			
NO3-L-IC-N-CL	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.			
PH/EC/ALK-CL	Water	pH, Conductivity and Total Alkalinity	APHA 4500H,2510,2320
All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current			
SO4-L-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TC-MPN-CL	Water	Total Coliform	APHA 9223B
This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table. Recommended Holding Time: Sample: 1 day Reference: APHA			
TEMP-CL	Water	Temperature	APHA 2550-Thermometer
TSS-L-CL	Water	Total Suspended Solids	APHA 2540 D-Gravimetric

Reference Information

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, and by drying the filter at 104 deg. C.

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

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.

Quality Control Report

Workorder: L2660626

Report Date: 18-NOV-21

Page 2 of 3

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO3-L-IC-N-CL	Water							
Batch	R5643976							
WG3657216-2 LCS								
Nitrate (as N)			100.7		%		90-110	09-NOV-21
WG3657216-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	09-NOV-21
PH/EC/ALK-CL	Water							
Batch	R5641081							
WG3656090-5 LCS								
Conductivity (EC)			101.8		%		90-110	09-NOV-21
Alkalinity, Total (as CaCO3)			108.1		%		85-115	09-NOV-21
WG3656090-4 MB								
Conductivity (EC)			<2.0		uS/cm		2	09-NOV-21
Bicarbonate (HCO3)			<5.0		mg/L		5	09-NOV-21
Carbonate (CO3)			<5.0		mg/L		5	09-NOV-21
Hydroxide (OH)			<5.0		mg/L		5	09-NOV-21
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	09-NOV-21
SO4-L-IC-N-CL	Water							
Batch	R5643976							
WG3657216-2 LCS								
Sulfate (SO4)			100.4		%		85-115	09-NOV-21
WG3657216-1 MB								
Sulfate (SO4)			<0.050		mg/L		0.05	09-NOV-21
TC-MPN-CL	Water							
Batch	R5640698							
WG3656205-4 MB								
MPN - Total Coliforms			<1		MPN/100mL		1	09-NOV-21
TSS-L-CL	Water							
Batch	R5648777							
WG3657247-2 LCS								
Total Suspended Solids			93.8		%		85-115	13-NOV-21
WG3657247-1 MB								
Total Suspended Solids			<1.0		mg/L		1	13-NOV-21

Quality Control Report

Workorder: L2660626

Report Date: 18-NOV-21

Page 3 of 3

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

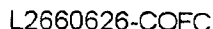
Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

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Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

**OC) / Analytical Request Form**

COC Number: 20 -

Call Free: 1 800 668 9878

Page of

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REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.



Sperling Hansen Associates Inc.
ATTN: Scott Garthwaite
#8 - 1225 East Keith Road
North Vancouver BC V7J 1J3

Date Received: 12-JAN-21
Report Date: 19-JAN-21 16:48 (MT)
Version: FINAL

Client Phone: 604-986-7723

Certificate of Analysis

Lab Work Order #: L2547260
Project P.O. #: NOT SUBMITTED
Job Reference: 20050 WASA
C of C Numbers:
Legal Site Desc:

Patryk Wojciak, B.Sc., P.Chem.
Account Manager

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ADDRESS: 2559 29 Street NE, Calgary, AB T1Y 7B5 Canada | Phone: +1 403 291 9897 | Fax: +1 403 291 0298
ALS CANADA LTD Part of the ALS Group An ALS Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L2547260-1 Groundwater 11-JAN-21 12:00 E297130	L2547260-2 Groundwater 11-JAN-21 12:00 E297151	L2547260-3 Groundwater 11-JAN-21 12:00 E297152		
Grouping	Analyte					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	499	699	297		
	Total Suspended Solids (mg/L)	172	978 ^{DLHC}	8620 ^{DLHC}		
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	398	580	361		
	Ammonia as N (mg/L)	<0.0050	<0.0050	0.149		
	Bicarbonate (HCO3) (mg/L)	485	708	440		
	Carbonate (CO3) (mg/L)	<5.0	<5.0	<5.0		
	Chloride (Cl) (mg/L)	18.4	59.2 ^{DLHC}	2.25		
	Conductivity (EC) (uS/cm)	852	1270	542		
	Fluoride (F) (mg/L)	<0.020	<0.10 ^{DLHC}	0.094		
	Hydroxide (OH) (mg/L)	<5.0	<5.0	<5.0		
	Nitrate and Nitrite (as N) (mg/L)	10.0	22.6	0.128		
	Nitrate (as N) (mg/L)	10.0	22.6 ^{DLHC}	0.112		
	Nitrite (as N) (mg/L)	0.0163	<0.0050 ^{DLHC}	0.0163		
	pH (pH)	8.09	7.98	8.14		
	Sulfate (SO4) (mg/L)	61.4	69.9 ^{DLHC}	6.78		
		^{HTA}	^{HTA}	^{HTA}		
Bacteriological Tests	MPN - E. Coli (MPN/100mL)	<5	<5	<5		
	Coliform Bacteria - Fecal (CFU/100mL)	<1	15 ^{DLM}	<5 ^{DLM}		
	MPN - Total Coliforms (MPN/100mL)	370 ^{HTA}	110 ^{HTA}	<5 ^{HTA}		
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0012	0.0025	0.0036		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00017	0.00017	0.00096		
	Barium (Ba)-Dissolved (mg/L)	0.0391	0.114	0.199		
	Beryllium (Be)-Dissolved (mg/L)	<0.000020	<0.000020	<0.000020		
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Boron (B)-Dissolved (mg/L)	0.022	0.029	0.016		
	Cadmium (Cd)-Dissolved (mg/L)	0.0000101	0.0000102	0.0000149		
	Calcium (Ca)-Dissolved (mg/L)	47.8	57.8	28.9		
	Chromium (Cr)-Dissolved (mg/L)	0.00060	0.00077	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00012	0.00016		
	Copper (Cu)-Dissolved (mg/L)	0.00075	0.00089	0.00081		
	Iron (Fe)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.0043	0.0198	0.0102		
	Magnesium (Mg)-Dissolved (mg/L)	92.1	135	54.6		

* 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		L2547260-1 Groundwater 11-JAN-21 12:00 E297130	L2547260-2 Groundwater 11-JAN-21 12:00 E297151	L2547260-3 Groundwater 11-JAN-21 12:00 E297152		
Grouping	Analyte					
WATER						
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)	0.00040	0.00084	0.0361		
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050		
	Molybdenum (Mo)-Dissolved (mg/L)	0.000362	0.000241	0.00533		
	Nickel (Ni)-Dissolved (mg/L)	0.00052	0.00112	<0.00050		
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050		
	Potassium (K)-Dissolved (mg/L)	2.15	2.50	1.37		
	Selenium (Se)-Dissolved (mg/L)	0.000117	0.000714	0.000177		
	Silicon (Si)-Dissolved (mg/L)	7.50	8.26	5.70		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	20.0	42.7	17.5		
	Strontium (Sr)-Dissolved (mg/L)	0.369	0.700	0.696		
	Sulfur (S)-Dissolved (mg/L)	23.1	22.3	3.04		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	0.00012	0.00023	0.00012		
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		
	Uranium (U)-Dissolved (mg/L)	0.00564	0.00980	0.00482		
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Zinc (Zn)-Dissolved (mg/L)	0.0150	0.0214	0.0021		
	Zirconium (Zr)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030		

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2547260-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2547260-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
HTA	Analytical holding time was exceeded.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
BE-D-L-CCMS-CL	Water	Diss. Be (low) in Water by CRC ICPMS	APHA 3030B/6020A (mod)
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.			
CL-L-IC-N-CL	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
F-L-IC-CL	Water	Fluoride	APHA 4110 B-Ion Chromatography
FCC-MF-CL	Water	Fecal Coliform Count-MF	APHA 9222D
This analysis is carried out using procedures adapted from APHA Method 9222 "Membrane Filter Technique for Members of the Coliform Group". Coliform bacteria is enumerated by culturing and colony counting. A known sample volume is filtered through a 0.45 micron membrane filter. The test involves an initial 24 hour incubation at 44.5 degrees C of the filter with the appropriate growth medium. This method is specific for thermotolerant bacteria (Fecal) and is used for non-turbid water with a low background bacteria level.			
HARDNESS-CALC-CL	Water	Hardness	APHA 2340 B
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.			
HG-D-CVAA-CL	Water	Dissolved Mercury in Water by CVAAS	APHA 3030B/EPA 1631E (mod)
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.			
MET-D-CCMS-CL	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
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.			
N2N3-CALC-CL	Water	Nitrate+Nitrite	CALCULATION
NH3-L-F-CL	Water	Ammonia, Total (as N)	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.			
NO2-L-IC-N-CL	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.			
NO3-L-IC-N-CL	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.			
PH/EC/ALK-CL	Water	pH, Conductivity and Total Alkalinity	APHA 4500H,2510,2320
All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current			
SO4-L-IC-N-CL	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
TC-EC-MPN-CL	Water	Total Coliforms and E. Coli by MPN	APHA METHOD 9223

Reference Information

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

TSS-L-CL Water Total Suspended Solids 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, and by drying the filter at 104 deg. C.

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

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 ww - 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.



Workorder: L2547260

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Contact: Scott Garthwaite

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
BE-D-L-CCMS-CL		Water						
Batch	R5342756							
WG3472472-3	DUP	L2547260-3						
Beryllium (Be)-Dissolved		<0.000020	<0.000020	RPD-NA	mg/L	N/A	20	12-JAN-21
WG3472472-2	LCS	TMRM						
Beryllium (Be)-Dissolved			100.0		%		80-120	12-JAN-21
WG3472472-1	MB							
Beryllium (Be)-Dissolved			<0.000020		mg/L		0.00002	12-JAN-21
WG3472472-4	MS	L2547260-3						
Beryllium (Be)-Dissolved			107.7		%		70-130	12-JAN-21
CL-L-IC-N-CL		Water						
Batch	R5344822							
WG3472980-2	LCS							
Chloride (Cl)			105.0		%		85-115	12-JAN-21
WG3472980-1	MB							
Chloride (Cl)			<0.10		mg/L		0.1	12-JAN-21
F-L-IC-CL		Water						
Batch	R5344822							
WG3472980-2	LCS							
Fluoride (F)			98.4		%		85-115	12-JAN-21
WG3472980-1	MB							
Fluoride (F)			<0.020		mg/L		0.02	12-JAN-21
FCC-MF-CL		Water						
Batch	R5345085							
WG3473087-2	DUP	L2547260-1						
Coliform Bacteria - Fecal		<1	<1	RPD-NA	CFU/100mL	N/A	65	12-JAN-21
WG3473087-1	MB							
Coliform Bacteria - Fecal			<1		CFU/100mL		1	12-JAN-21
HG-D-CVAA-CL		Water						
Batch	R5353916							
WG3475612-2	LCS							
Mercury (Hg)-Dissolved			101.0		%		80-120	19-JAN-21
WG3475612-1	MB							
Mercury (Hg)-Dissolved			<0.000005C		mg/L		0.000005	19-JAN-21
WG3475612-4	MS	L2547260-1						
Mercury (Hg)-Dissolved			86.1		%		70-130	19-JAN-21
MET-D-CCMS-CL		Water						

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-CL		Water						
Batch	R5342756							
WG3472472-3	DUP	L2547260-3						
Aluminum (Al)-Dissolved		0.0036	0.0023	J	mg/L	0.0013	0.002	12-JAN-21
Antimony (Sb)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	12-JAN-21
Arsenic (As)-Dissolved		0.00096	0.00094		mg/L	2.2	20	12-JAN-21
Barium (Ba)-Dissolved		0.199	0.196		mg/L	1.9	20	12-JAN-21
Bismuth (Bi)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	12-JAN-21
Boron (B)-Dissolved		0.016	0.016		mg/L	0.2	20	12-JAN-21
Cadmium (Cd)-Dissolved		0.0000149	0.0000165		mg/L	9.7	20	12-JAN-21
Calcium (Ca)-Dissolved		28.9	29.2		mg/L	0.9	20	12-JAN-21
Chromium (Cr)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	12-JAN-21
Cobalt (Co)-Dissolved		0.00016	0.00015		mg/L	2.1	20	12-JAN-21
Copper (Cu)-Dissolved		0.00081	0.00080		mg/L	0.6	20	12-JAN-21
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	12-JAN-21
Lead (Pb)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	12-JAN-21
Lithium (Li)-Dissolved		0.0102	0.0102		mg/L	0.0	20	12-JAN-21
Magnesium (Mg)-Dissolved		54.6	53.5		mg/L	2.0	20	12-JAN-21
Manganese (Mn)-Dissolved		0.0361	0.0362		mg/L	0.3	20	12-JAN-21
Molybdenum (Mo)-Dissolved		0.00533	0.00523		mg/L	1.9	20	12-JAN-21
Nickel (Ni)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	12-JAN-21
Phosphorus (P)-Dissolved		<0.050	<0.050	RPD-NA	mg/L	N/A	20	12-JAN-21
Potassium (K)-Dissolved		1.37	1.37		mg/L	0.4	20	12-JAN-21
Selenium (Se)-Dissolved		0.000177	0.000189		mg/L	6.5	20	12-JAN-21
Silicon (Si)-Dissolved		5.70	5.62		mg/L	1.3	20	12-JAN-21
Silver (Ag)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	12-JAN-21
Sodium (Na)-Dissolved		17.5	17.0		mg/L	2.6	20	12-JAN-21
Strontium (Sr)-Dissolved		0.696	0.693		mg/L	0.5	20	12-JAN-21
Sulfur (S)-Dissolved		3.04	3.06		mg/L	0.5	20	12-JAN-21
Thallium (Tl)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	12-JAN-21
Tin (Sn)-Dissolved		0.00012	0.00017	J	mg/L	0.00004	0.0002	12-JAN-21
Titanium (Ti)-Dissolved		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	12-JAN-21
Uranium (U)-Dissolved		0.00482	0.00482		mg/L	0.0	20	12-JAN-21
Vanadium (V)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	12-JAN-21
Zinc (Zn)-Dissolved		0.0021	0.0024		mg/L	16	20	12-JAN-21
Zirconium (Zr)-Dissolved		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	12-JAN-21
WG3472472-2	LCS	TMRM						



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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-CL		Water						
Batch	R5342756							
WG3472472-2	LCS	TMRM						
Aluminum (Al)-Dissolved			107.7		%		80-120	12-JAN-21
Antimony (Sb)-Dissolved			107.1		%		80-120	12-JAN-21
Arsenic (As)-Dissolved			103.5		%		80-120	12-JAN-21
Barium (Ba)-Dissolved			108.4		%		80-120	12-JAN-21
Bismuth (Bi)-Dissolved			113.0		%		80-120	12-JAN-21
Boron (B)-Dissolved			105.1		%		80-120	12-JAN-21
Cadmium (Cd)-Dissolved			106.0		%		80-120	12-JAN-21
Calcium (Ca)-Dissolved			100.6		%		80-120	12-JAN-21
Chromium (Cr)-Dissolved			106.6		%		80-120	12-JAN-21
Cobalt (Co)-Dissolved			105.6		%		80-120	12-JAN-21
Copper (Cu)-Dissolved			103.4		%		80-120	12-JAN-21
Iron (Fe)-Dissolved			104.3		%		80-120	12-JAN-21
Lead (Pb)-Dissolved			112.3		%		80-120	12-JAN-21
Lithium (Li)-Dissolved			104.0		%		80-120	12-JAN-21
Magnesium (Mg)-Dissolved			108.7		%		80-120	12-JAN-21
Manganese (Mn)-Dissolved			108.1		%		80-120	12-JAN-21
Molybdenum (Mo)-Dissolved			113.1		%		80-120	12-JAN-21
Nickel (Ni)-Dissolved			105.1		%		80-120	12-JAN-21
Phosphorus (P)-Dissolved			109.2		%		70-130	12-JAN-21
Potassium (K)-Dissolved			106.6		%		80-120	12-JAN-21
Selenium (Se)-Dissolved			100.3		%		80-120	12-JAN-21
Silicon (Si)-Dissolved			100.6		%		60-140	12-JAN-21
Silver (Ag)-Dissolved			109.8		%		80-120	12-JAN-21
Sodium (Na)-Dissolved			107.5		%		80-120	12-JAN-21
Strontium (Sr)-Dissolved			114.1		%		80-120	12-JAN-21
Sulfur (S)-Dissolved			105.0		%		80-120	12-JAN-21
Thallium (Tl)-Dissolved			109.7		%		80-120	12-JAN-21
Tin (Sn)-Dissolved			109.6		%		80-120	12-JAN-21
Titanium (Ti)-Dissolved			99.1		%		80-120	12-JAN-21
Uranium (U)-Dissolved			110.5		%		80-120	12-JAN-21
Vanadium (V)-Dissolved			106.8		%		80-120	12-JAN-21
Zinc (Zn)-Dissolved			100.4		%		80-120	12-JAN-21
Zirconium (Zr)-Dissolved			110.7		%		80-120	12-JAN-21
WG3472472-1	MB							

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-CL	Water							
Batch	R5342756							
WG3472472-1 MB								
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	12-JAN-21
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	12-JAN-21
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	12-JAN-21
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	12-JAN-21
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	12-JAN-21
Boron (B)-Dissolved			<0.010		mg/L		0.01	12-JAN-21
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	12-JAN-21
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	12-JAN-21
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	12-JAN-21
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	12-JAN-21
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	12-JAN-21
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	12-JAN-21
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	12-JAN-21
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	12-JAN-21
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	12-JAN-21
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	12-JAN-21
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	12-JAN-21
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	12-JAN-21
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	12-JAN-21
Potassium (K)-Dissolved			<0.050		mg/L		0.05	12-JAN-21
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	12-JAN-21
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	12-JAN-21
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	12-JAN-21
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	12-JAN-21
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	12-JAN-21
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	12-JAN-21
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	12-JAN-21
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	12-JAN-21
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	12-JAN-21
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	12-JAN-21
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	12-JAN-21
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	12-JAN-21
Zirconium (Zr)-Dissolved			<0.00020		mg/L		0.0002	12-JAN-21
WG3472472-4 MS		L2547260-3						

Quality Control Report

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-CL	Water							
Batch	R5342756							
WG3472472-4 MS		L2547260-3						
Aluminum (Al)-Dissolved			109.6		%		70-130	12-JAN-21
Antimony (Sb)-Dissolved			113.6		%		70-130	12-JAN-21
Arsenic (As)-Dissolved			106.7		%		70-130	12-JAN-21
Barium (Ba)-Dissolved			101.4		%		70-130	12-JAN-21
Bismuth (Bi)-Dissolved			118.6		%		70-130	12-JAN-21
Boron (B)-Dissolved			115.3		%		70-130	12-JAN-21
Cadmium (Cd)-Dissolved			114.0		%		70-130	12-JAN-21
Calcium (Ca)-Dissolved			104.0		%		70-130	12-JAN-21
Chromium (Cr)-Dissolved			111.8		%		70-130	12-JAN-21
Cobalt (Co)-Dissolved			111.9		%		70-130	12-JAN-21
Copper (Cu)-Dissolved			110.0		%		70-130	12-JAN-21
Iron (Fe)-Dissolved			110.1		%		70-130	12-JAN-21
Lead (Pb)-Dissolved			114.8		%		70-130	12-JAN-21
Lithium (Li)-Dissolved			102.9		%		70-130	12-JAN-21
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	12-JAN-21
Manganese (Mn)-Dissolved			111.8		%		70-130	12-JAN-21
Molybdenum (Mo)-Dissolved			114.2		%		70-130	12-JAN-21
Nickel (Ni)-Dissolved			111.7		%		70-130	12-JAN-21
Phosphorus (P)-Dissolved			114.1		%		70-130	12-JAN-21
Potassium (K)-Dissolved			113.2		%		70-130	12-JAN-21
Selenium (Se)-Dissolved			112.2		%		70-130	12-JAN-21
Silicon (Si)-Dissolved			102.5		%		70-130	12-JAN-21
Silver (Ag)-Dissolved			116.1		%		70-130	12-JAN-21
Sodium (Na)-Dissolved			111.4		%		70-130	12-JAN-21
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	12-JAN-21
Thallium (Tl)-Dissolved			113.4		%		70-130	12-JAN-21
Tin (Sn)-Dissolved			112.8		%		70-130	12-JAN-21
Titanium (Ti)-Dissolved			107.2		%		70-130	12-JAN-21
Uranium (U)-Dissolved			117.0		%		70-130	12-JAN-21
Vanadium (V)-Dissolved			109.7		%		70-130	12-JAN-21
Zinc (Zn)-Dissolved			111.5		%		70-130	12-JAN-21
Zirconium (Zr)-Dissolved			116.0		%		70-130	12-JAN-21
NH3-L-F-CL	Water							

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-L-F-CL	Water							
Batch	R5345160							
WG3473038-14 LCS								
Ammonia as N			100.7		%		85-115	12-JAN-21
WG3473038-13 MB								
Ammonia as N			<0.0050		mg/L		0.005	12-JAN-21
NO2-L-IC-N-CL	Water							
Batch	R5344822							
WG3472980-2 LCS								
Nitrite (as N)			99.8		%		90-110	12-JAN-21
WG3472980-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	12-JAN-21
NO3-L-IC-N-CL	Water							
Batch	R5344822							
WG3472980-2 LCS								
Nitrate (as N)			105.2		%		90-110	12-JAN-21
WG3472980-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	12-JAN-21
PH/EC/ALK-CL	Water							
Batch	R5345177							
WG3473096-14 LCS								
Conductivity (EC)			97.8		%		90-110	12-JAN-21
Alkalinity, Total (as CaCO3)			104.2		%		85-115	12-JAN-21
WG3473096-13 MB								
Conductivity (EC)			<2.0		uS/cm		2	12-JAN-21
Bicarbonate (HCO3)			<5.0		mg/L		5	12-JAN-21
Carbonate (CO3)			<5.0		mg/L		5	12-JAN-21
Hydroxide (OH)			<5.0		mg/L		5	12-JAN-21
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	12-JAN-21
SO4-L-IC-N-CL	Water							
Batch	R5344822							
WG3472980-2 LCS								
Sulfate (SO4)			102.3		%		85-115	12-JAN-21
WG3472980-1 MB								
Sulfate (SO4)			<0.050		mg/L		0.05	12-JAN-21
TC-EC-MPN-CL	Water							

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TC-EC-MPN-CL								
Batch R5348340								
WG3474076-1 MB								
MPN - E. Coli			<1		MPN/100mL		1	14-JAN-21
MPN - Total Coliforms			<1		MPN/100mL		1	14-JAN-21
TSS-L-CL								
Batch R5348797								
WG3473868-4 LCS								
Total Suspended Solids			89.8		%		85-115	15-JAN-21
WG3473868-3 MB								
Total Suspended Solids			<1.0		mg/L		1	15-JAN-21

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Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

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Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Bacteriological Tests							
Total Coliforms and E. Coli by MPN							
	1	11-JAN-21 12:00	14-JAN-21 10:30	30	71	hours	EHTL
	2	11-JAN-21 12:00	14-JAN-21 10:30	30	71	hours	EHTL
	3	11-JAN-21 12:00	14-JAN-21 10:30	30	71	hours	EHTL

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:

Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2547260 were received on 12-JAN-21 08:40.

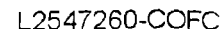
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



Canada Toll Free: 1 800 668 9878



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.

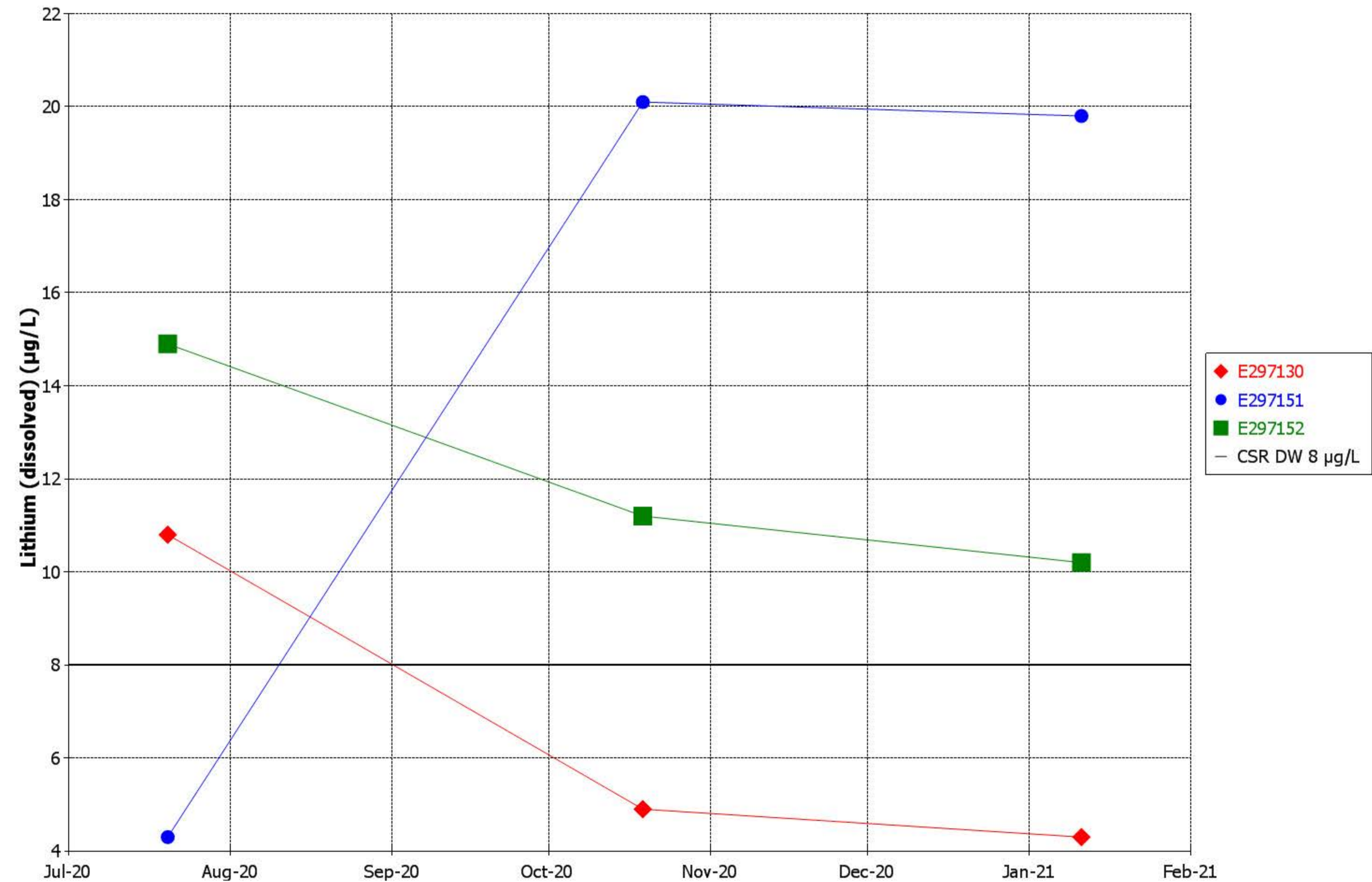
1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

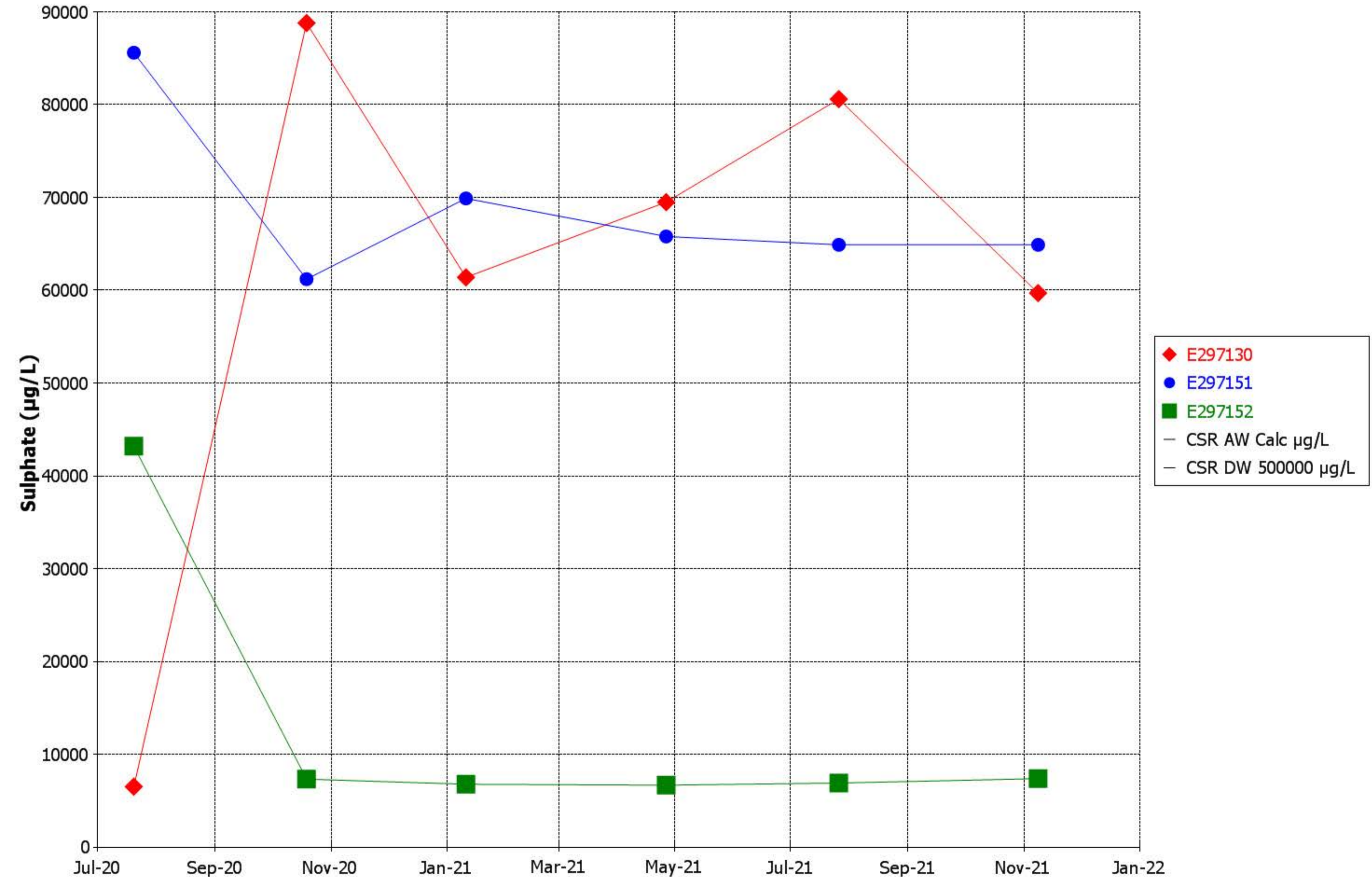
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APPENDIX D
Trending Figures

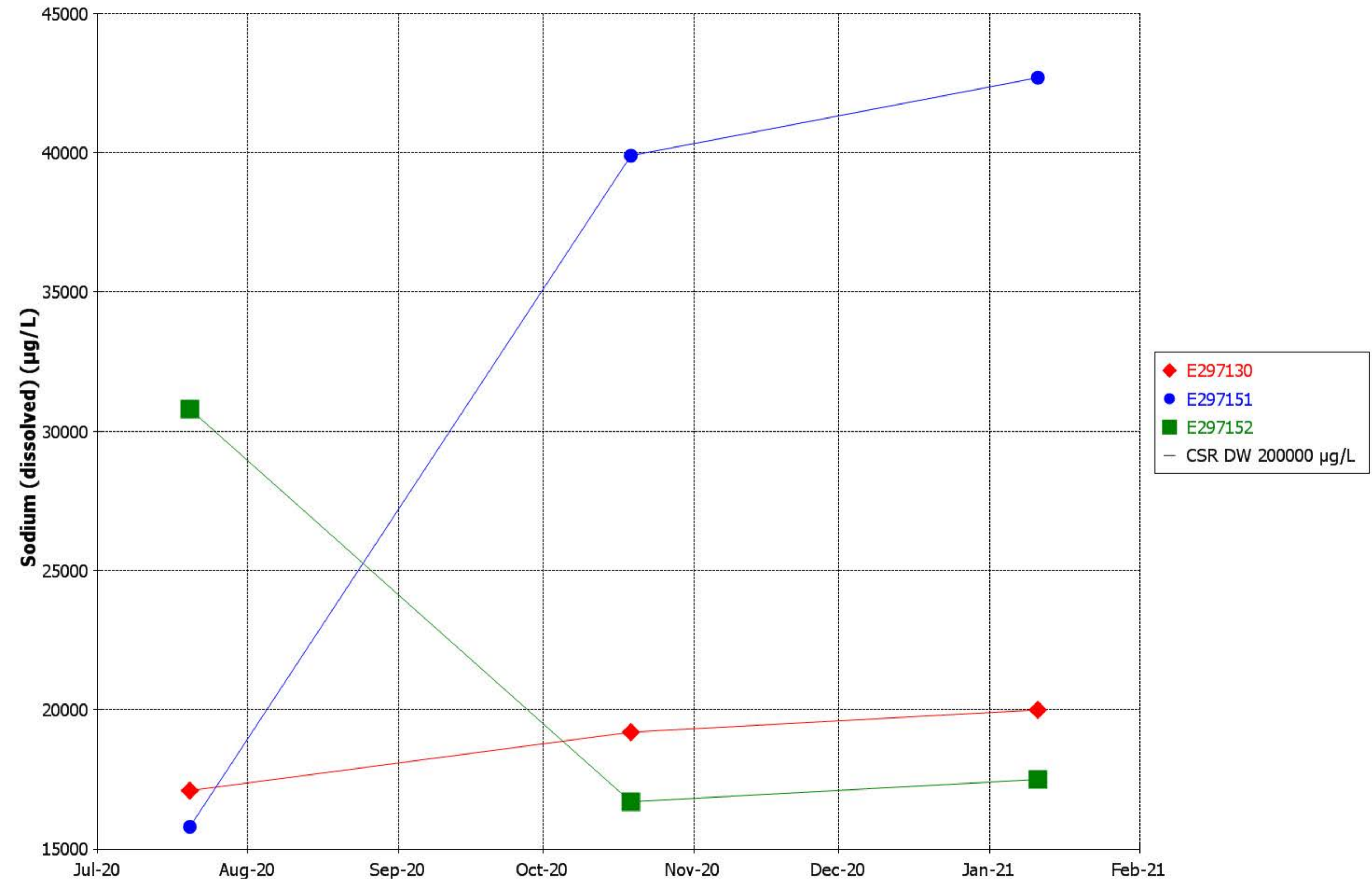
Time Series Plot For Lithium (dissolved) Wasa Exfiltration Site



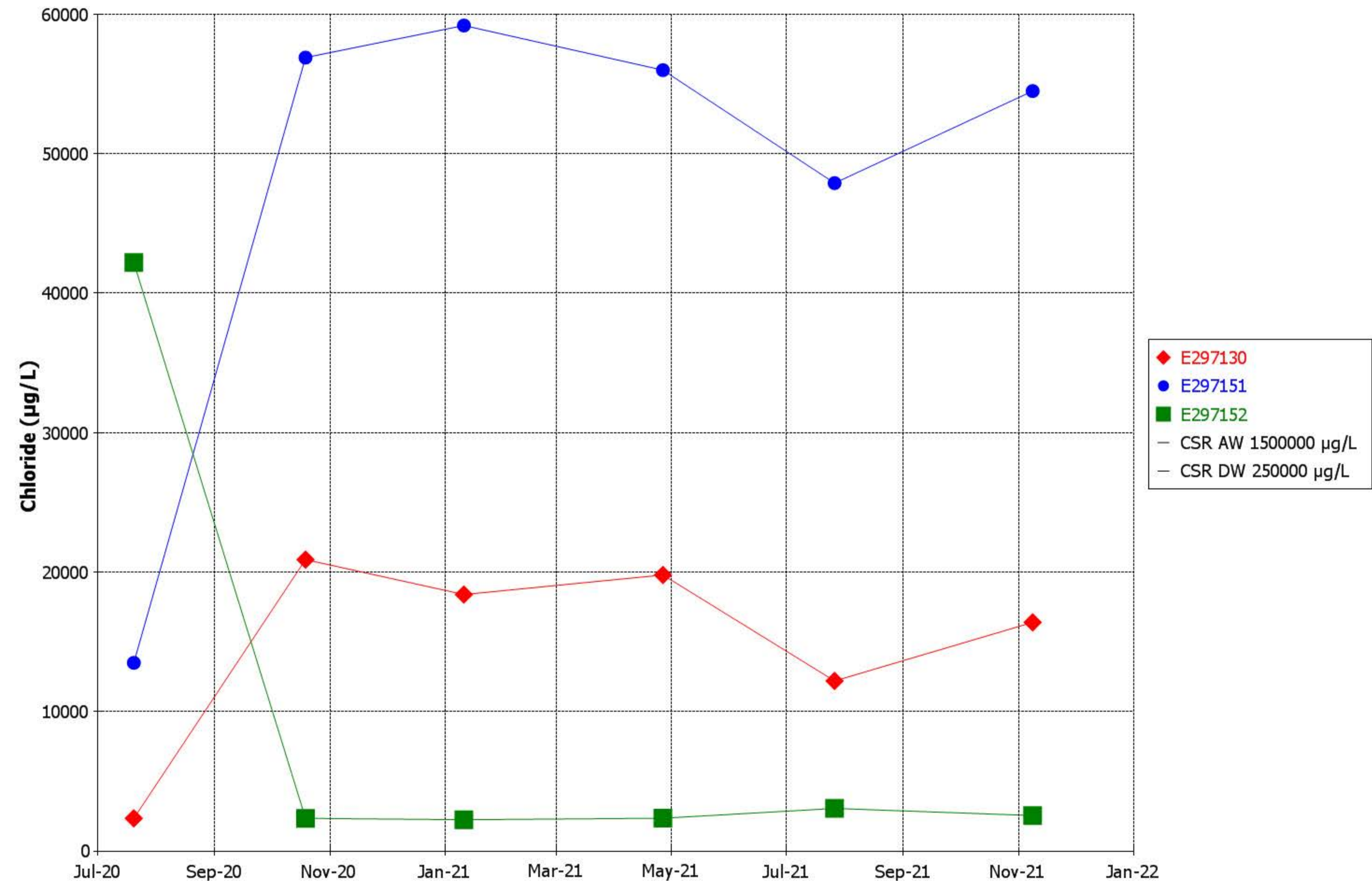
Time Series Plot For Sulphate Wasa Exfiltration Site



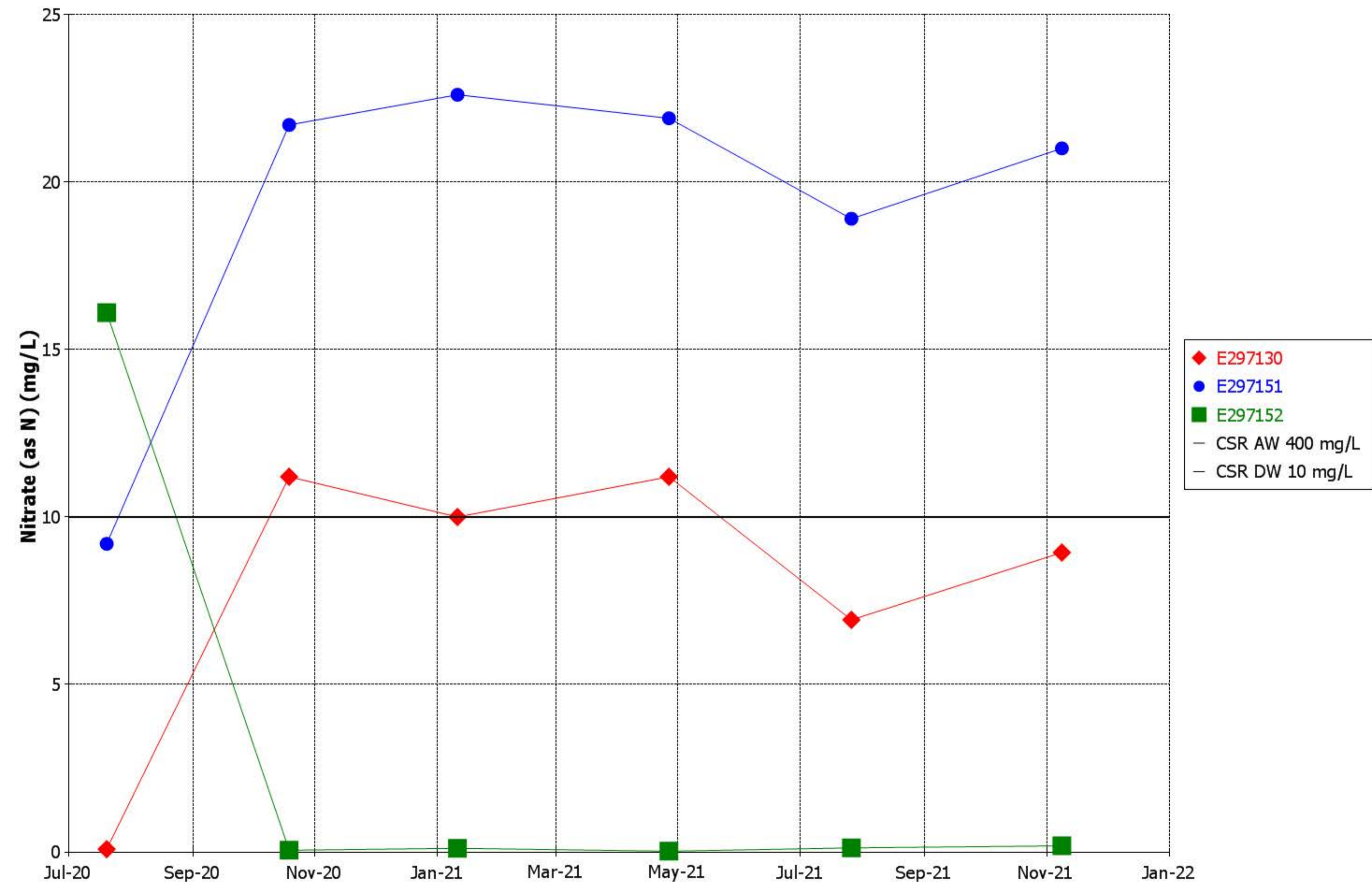
Time Series Plot For Sodium (dissolved) Wasa Exfiltration Site



Time Series Plot For Chloride Wasa Exfiltration Site



**Time Series Plot For Nitrate (as N)
Wasa Exfiltration Site**



**Time Series Plot For Conductivity
Wasa Exfiltration Site**

