Columbia River Project Water Use Plan

Columbia River White Sturgeon Management Plan

CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works: Physical works options to address white sturgeon recruitment failure in the lower Columbia River

Constructed Works Close Out Report

Prepared by:
WSP Canada Inc,
201 Columbia Ave., Castlegar, BC
V1N 1A8

September 26, 2023

REPORT

CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works

Constructed Works Close Out Report

Submitted to:

BC Hydro and Power Authority

Attention: Teri Neighbour and James Crossman
6911 Southpoint Drive
Burnaby, BC V3N 4X8

Submitted by:

WSP Canada Inc.
201 Columbia Ave, Castlegar, BC, V1N 1A8

+1 604 296 4200

20449674-020-R-Rev0

26 September 2023

Distribution List

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APPENDICES

1.0 INTRODUCTION

Golder Associates Ltd. (WSP Golder), now WSP Canada Inc. (WSP), was engaged by BC Hydro to provide IFT and IFC drawings (4 October 2022), tendering and construction support, test result review and interpretation, sampling, water quality analysis, field review, construction completion reporting, and record drawings for the Phase 3 CLBWORKS-27 Lower Columbia White Sturgeon Physical Works Project (the Project).

The Project objective is to enhance White Sturgeon (*Acipenser transmontanus*) spawning substrate at the Keenleyside White Sturgeon spawning area (Project Area) by placing a mixture of multiple grain size substrate that will be stable and resistant to infilling by sedimentation. The Project Area is shown in Appendix A.

This report describes WSP's observations during the four field reviews and provides record drawings based on both the field reviews and information provided to WSP by others. Applicable site observations by BC Hydro which have been provided to WSP have also been included. Field reviews are not supervision of the implementation or construction of work, nor are they a guarantee that all deficient work will be identified by WSP. BC Hydro and Splatsin Construction Services LPP (SCS) are responsible for supervising the work, delivering work that is in conformity with the specifications, and deciding the means and methods for doing so.

The scope of WSP's services described in this report are limited to hydrotechnical engineering aspects only and do not include any geotechnical engineering, environmental, or regulatory permit aspects. The scope is further detailed in WSP's Scope Change Request for this work (WSP Golder 2022a), which includes consulting services for the following:

- Field reviews (4)
- Review of spawning substrate mixture
- Construction Completion Reporting
- Record Drawings

An additional change in scope was approved 20 September 2022 pertaining to toxicity testing of the substrate mixture. Additional detail regarding the scope is detailed in WSP's Scope Change Request for the work (WSP Golder 2022b). The outcomes of the toxicity testing have been provided in previous reporting (see APPENDIX D) and are considered in this report.

This Report shall be read in conjunction with the "Study Limitations" which is included above. The reader's attention is specifically drawn to this information as it is essential that it is followed for the proper use and interpretation of this Report.

2.0 CONSTRUCTION SCHEDULE AND SITE CONDITIONS

Construction was completed by SCS using an excavator stationed on an anchored barge above the placement area. Material (4,716 m^3) was stockpiled at a laydown area on shore and transported to the placement area using a barge and tug (BC Hydro 2023b). Construction was completed according to the schedule shown in Figure 1, as indicated by BC Hydro (2023a, b, d). Site conditions are also included in Figure 1, based on information from BC Hydro (2023c).

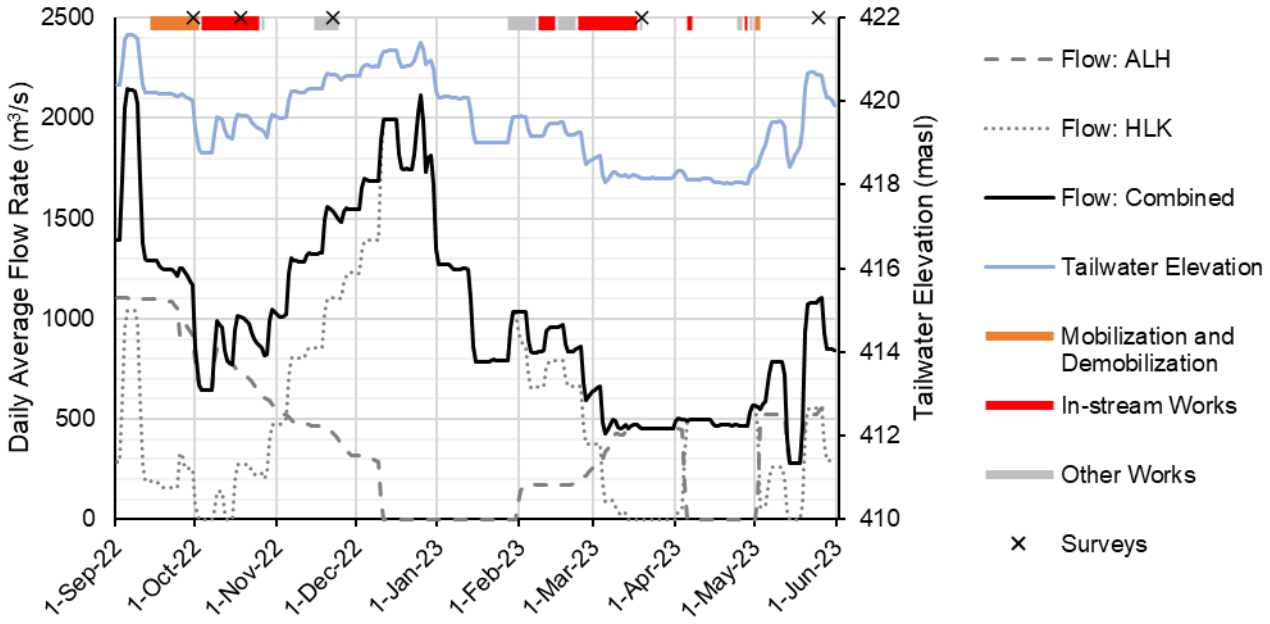

Figure 1: Site Conditions and Construction Schedule

The target demobilization date for this project was 20 November 2022 (BC Hydro 2023a). Schedule delays can largely be attributed to barge installation, issues with placement methodology, flow conditions, and delays in receipt of survey data from SCS's subcontractor (BC Hydro 2023a). The actual demobilization date was 3 May 2023. Stops of works occurred between:

- 2022-10-27 to 2022-11-15 (revision of placement methodology)
- 2022-11-24 to 2023-01-27 (high flow period)
- 2023-03-19 to 2023-04-24 (awaiting bathymetric survey results)

3.0 QUALITY ASSURANCE

Quality Assurance (QA) was the responsibility of BC Hydro. WSP completed activities supporting QA for the project including but not limited to:

- Preparation of the design and specifications, including the public safety plan and environmental plan.
- Contract support.
- Planning for intermediate surveys.
- Planning for field reviews.

4.0 QUALITY CONTROL

Quality Control (QC) was the responsibility of BC Hydro and SCS. QC activities conducted by BC Hydro and SCS included but were not limited to:

- Material testing.
- Daily inspections and reporting.
- Bathymetric surveying and real-time placement verification by GPS instrumentation.

WSP completed activities supporting QC for the Project including:

- Field reviews and reporting (APPENDIX B).
- Technical review of substrate material sieve analysis reports by Kootenay Testing (APPENDIX C).
- Toxicity testing and reporting (APPENDIX D).
- Technical review of post-construction survey data (APPENDIX E).

Environmental monitoring services, including water sampling, were conducted by Ecofish.

5.0 CONSTRUCTION MATERIALS

The specified substrate for placement within the target area consisted of coarse, sub-rounded material meeting the gradation in Table 1 and free of clay and fines.

Table 1: Specified Substrate Gradation

Material Size (mm)	Percent Passing
300	100
200	80 +/- 10
125	50 +/- 10
100	40 +/- 10
20	0

Material was trucked to site from Hadean Aggregate Solutions (Nelson) 4-mile pit, approximately 45 min from the project site. Delivery of material was completed in November 2022 (BC Hydro 2023). Material was stockpiled at the laydown area prior to loading onto a barge using a rock truck. WSP observed during field reviews on 30 September 2022 and 14 February 2023 that while material brought to site was documented by Kootenay Testing (APPENDIX C) as conforming to IFC design size specifications, excessive fines were present in the stockpiled material (APPENDIX B). This was corroborated by observations of a turbidity plume during material placement (BC Hydro 2023). Following corrective action (see Section 8.2), material meeting specification was placed in the Project Area.

6.0 SURVEYS

6.1 Pre-construction

A pre-construction survey was conducted on 30 September 2022 by Doug Griffin. The survey identified limited discrepancies between the historic survey used for design (Grant Land Surveying Inc. 2018) and current site conditions, partially due to increased data resolution in the newer survey. Within the Project Area, differences were insignificant.

The original pre-construction survey was provided to BC Hydro by SCS on 01 October 2022. A revised pre-construction survey was provided on 3 April 2023. IFC designs were based on the original pre-construction survey issued 01 October 2022 as approved by BC Hydro based on a comparison of the two pre-construction surveys, which showed consistency between the surveys.

6.2 Intermediate

6.2.1 Progress Survey 1

A progress survey was completed by Doug Griffin on 18 October 2022. The survey showed that material had been placed outside of the Project Area, with localized areas with placement depths in excess of 1.5 m above the original grade. Within the Project Area, material had been placed primarily in the upstream areas.

6.2.2 Progress Survey 2

A progress survey was completed by Doug Griffin on 22 November 2022. The survey showed notable lumps within the Project Area where material was placed outside of the 0.6 m +/- 0.1 m tolerance. Little additional material coverage was observed compared to Progress Survey 1.

6.2.3 Progress Survey 3

A progress survey was completed by Doug Griffin on 19 March 2023. Similar to the previous survey, the survey showed notable lumps within the Project Area where material was placed outside of the 0.6 m +/- 0.1 m tolerance. Material placement was observed in approximately 75% of the project area.

6.3 Record Survey

A record survey of the final constructed surface was completed by Doug Griffin on 25 May 2023. The survey showed areas throughout the Project Area with thickness both in excess of and less than the specified 0.6 m +/- 0.1 m tolerance. In particular, the furthest downstream extent of the Project Area is under tolerance, with two localized high point in placed material up to approximately 0.6 m above tolerance. An assessment of the record survey (post-construction) data is shown in APPENDIX E.

7.0 RECORD DRAWINGS

Construction Record Drawings may be found in APPENDIX A. Record drawings were prepared by WSP based on the following:

- Issued for Construction Drawings by WSP Golder (4 October 2022)
- Post-construction survey data by Doug Griffin (25 May 2023)

8.0 DESIGN MODIFICATIONS AND DEFICIENCIES

8.1 Design Modifications

No modifications to the design were approved; however, it was agreed that areas with at least 0.3 m depth of placement would provide habitat value compared to bare ground and would be included in final payment amounts (BC Hydro 2023). Furthermore, BC Hydro accepted the final record survey as providing sufficient cover, placement depth, and smoothness over the Project Area to meet the habitat offsetting Project goals and approved the Project completion without additional re-work after the record survey.

8.2 Deficiencies and Remediation

WSP conducted four field reviews over the course of construction. Over the course of the field reviews and through analysis of other data provided to WSP, WSP identified deficiencies related to the design and as-constructed product. The identified deficiencies are as follows, and exclude those purely related to scheduling or construction methods:

- During the kickoff field review on 30 September 2022, it was noted that some particles were oversized (median axis dimension >300mm) and excessive fines were observed in the stockpile. Excessive fines were also observed during the field review on 14 February 2023, and concerns were raised with BC Hydro. It was confirmed that material brought to site met material specifications. As excessive fines were observed in the stockpile as early as 30 September, it is likely that fine gravel primarily entered the stockpile during handling of material on site, as the stockpile was placed directly on native fine gravel and sand material. To rectify the excess of fines, SCS used a skeleton bucket with a 0.75 in mesh to screen the stockpile. This method was approved by WSP following a demonstration by SCS during the field review on 23 February 2023, provided that mitigation efforts be monitored by BC Hydro and Ecofish. Effectiveness of the mitigation was verified during the field review on 16 March 2023. For more information, refer to the reports located in APPENDIX B and material testing results in APPENDIX C.

- Acid Rock Drainage / Metal Leaching testing results by Metro found that aluminum in Shake Flask Extraction (SFE) leachate test was consistently above the BC short-term (maximum) water quality guideline for the protection of aquatic health (0.1 mg/L) by up to 12 times. These results were found to be a product of the testing method, and not representative of field conditions. On-site toxicity testing using material placed in the Columbia River found aluminum concentrations below short-term (maximum) and long-term (30-day) water quality guidelines. For more information, the toxicity assessment report is included in APPENDIX D.
- The progress survey on 18 October 2022 identified that material had been placed outside the Project Area. Placement challenges were identified and SCS installed a “Topcon X-53x” GPS monitoring system onto the excavator conducting material placement on 18 November 2022 (BC Hydro 2022) to remedy the placement challenges. The selected GPS system was rated as to 5 mm vertical and 10 mm horizontal precision when utilized with RTK (Topcon 2018).
- The progress survey on 19 March 2023 showed that portions of the placement area were out of tolerance. SCS reworked areas that were out of tolerance, within the limitations of on-site equipment (BC Hydro 2023c).
- The record survey on 25 May 2023 identified zones throughout the Project Area with thickness both in excess of and less than the specified 0.6 m +/- 0.1 m tolerance. This variance is documented in the construction record drawings (APPENDIX A) and survey surface assessment (APPENDIX E). Minor isolated zones have less than 0.3 m of placed substrate (2% of total placement area). WSP has indicated the potential for mobilization of the substrate material in areas with coverage less than the designed thickness and tolerances to BC Hydro. BC Hydro has accepted variances outside of tolerance and is not requiring any further remedial action to the placed substrate material.

9.0 MONITORING AND MAINTENANCE RECOMMENDATIONS

While development of a monitoring and maintenance plan is outside WSP’s scope of work, the following monitoring measures are recommended to evaluate ongoing hydrotechnical performance of the spawning area:

- Annual detailed bathymetric and underwater photographic surveys of the Project Area and at least 100 m downstream of the Project Area to occur in early autumn, after high seasonal flow. This will help BC Hydro track movement of the placed substrate layer between each year and determine evolution of the substrate layer’s gradation (i.e., have the smaller size fractions been displaced). This will also help track whether any part of the placed substrate layer has thinned and requires placement of additional substrate.
- Three gabion baskets filled with clean gravel and containing devices for interstitial flow monitoring (heater-temperature sensors) were placed early in the construction program (BC Hydro 2023e). These devices should allow monitoring of the condition of placed substrate and suitability for spawning use. Interstitial space should be monitored for change annually. This can be used to measure changes to the placed material for biological assessments of suitability for spawning and review of potential maintenance requirements.
- Detailed bathymetric surveys and underwater photographic surveys of the Project Area following large flow events (e.g., 5-year flood or higher). The selected substrate mixture (Table 1) may mobilize during large flow events, as it was selected to provide spawning habitat value to White Sturgeon.

The following are potential triggers for review of the performance of the placed substrate layer that BC Hydro may consider when developing the physical and biological monitoring program:

- The bathymetric surveys suggest that the placed substrate layer has thinned to the minimum 300 mm thickness, or less, in >25% of the placement area. The record survey shows that 2% of the substrate placement area is less than 300 mm in thickness. If triggered, a review of White Sturgeon use and habitat performance is recommended to evaluate the potential need for replenishment of the substrate layer material.
- The underwater photographic surveys suggest that all the smaller size fraction of the placed substrate has displaced in >25% of the placement area and that White Sturgeon no longer preferentially using the substrate blanket for spawning in favor of areas where the smaller size fraction material has not displaced. Plan for maintenance immediately prior to the next spawning season to maximize the probability that White Sturgeon will benefit from the maintenance work.

10.0 CONCLUSIONS

The White Sturgeon spawning habitat construction substantially meets the intent of the design (Issued for Construction Drawings by WSP Golder [4 October 2022]) with the variations and deficiencies documented in this report.

The total volume of material placed within the placement area was 3,509 m^3 (including 1 m tolerance buffer). The required substrate volume estimated in the tender package was 3,540 m^3 (excluding 1 m tolerance buffer).

Upon completion of construction, the following summarizes the lessons learned and considerations recommended for future similar projects:

- Design / Contract Specifications
  - Increased collaboration between the design engineers and biologists to derive biological performance-based construction tolerances
  - Clear payment terms for volumes of substrate placed in areas that were outside of design tolerances.
- Construction
  - As part of the tendering processes, contractors should submit a construction plan for constructability review by BC Hydro and the design engineer for how design specifications and tolerances will be met. This should include items such as equipment to be used and real-time monitoring techniques.
  - Material testing (e.g., gradation and acid rock drainage) should take place prior to material transport to site with adequate allowance for subsequent testing or material sourcing prior to planned placement schedule.
  - To avoid mixing of imported material with underlying native material, barriers (such as rig mats) should be placed to separate stockpiles from native material.
- Monitoring
  - An additional survey after 5% placement would allow placement methodologies to be evaluated and corrected early in the construction phase to avoid construction delays.
  - Holds should be placed on further material placement until survey data is reviewed.
  - Future survey specifications should include an appropriate buffer for surveying outside the placement area to identify material placed in outside the designated area.
  - Increased frequency of engineering field reviews should be implemented. Specific to this project, additional field reviews may have identified ongoing inclusion of fines into stockpile.

11.0 CLOSURE

We trust this document meets your present requirements. Please direct any questions, comments, or concerns to the undersigned.

WSP Canada Inc.

Engineers & Geoscientists BC Permit #1000200

Richard Cunningham, MASc, P.Eng.
Junior Water Resources Engineer

Curtis VanWerkhoven, MASc, P.Eng.
Senior Water Resources Engineer, Lead

RC/CV/jts

https://golderassociates.sharepoint.com/sites/139832/project files/6 deliverables/issued to client_for wp/20449674-020-r-rev0/20449674-020-r-rev0-construction closeout rpt 26sep_23.docx

12.0 REFERENCES

BC Hydro (BC Hydro and Power Authority). 2022. RE: 30SEP2022 Inspection Report for CLBWORKS-27 Sturgeon Enhancement [Email]. From: Kelsey.Turner@bchydro.com. To: curtis.vanwerkhoven@WSP.com, teri.neighbour@bchydro.com. 15 November 2022.

BC Hydro. 2023a. Input to the Construction Report. British Columbia Hydro and Power Authority. 17 July 2023.

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WSP Golder. 2022b. CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works Phase 3: Implementation and Monitoring Support Scope Change Request #2 (RFP 11964). Prepared for BC Hydro. Vancouver BC: Golder Associates Ltd. 20 September 2022.

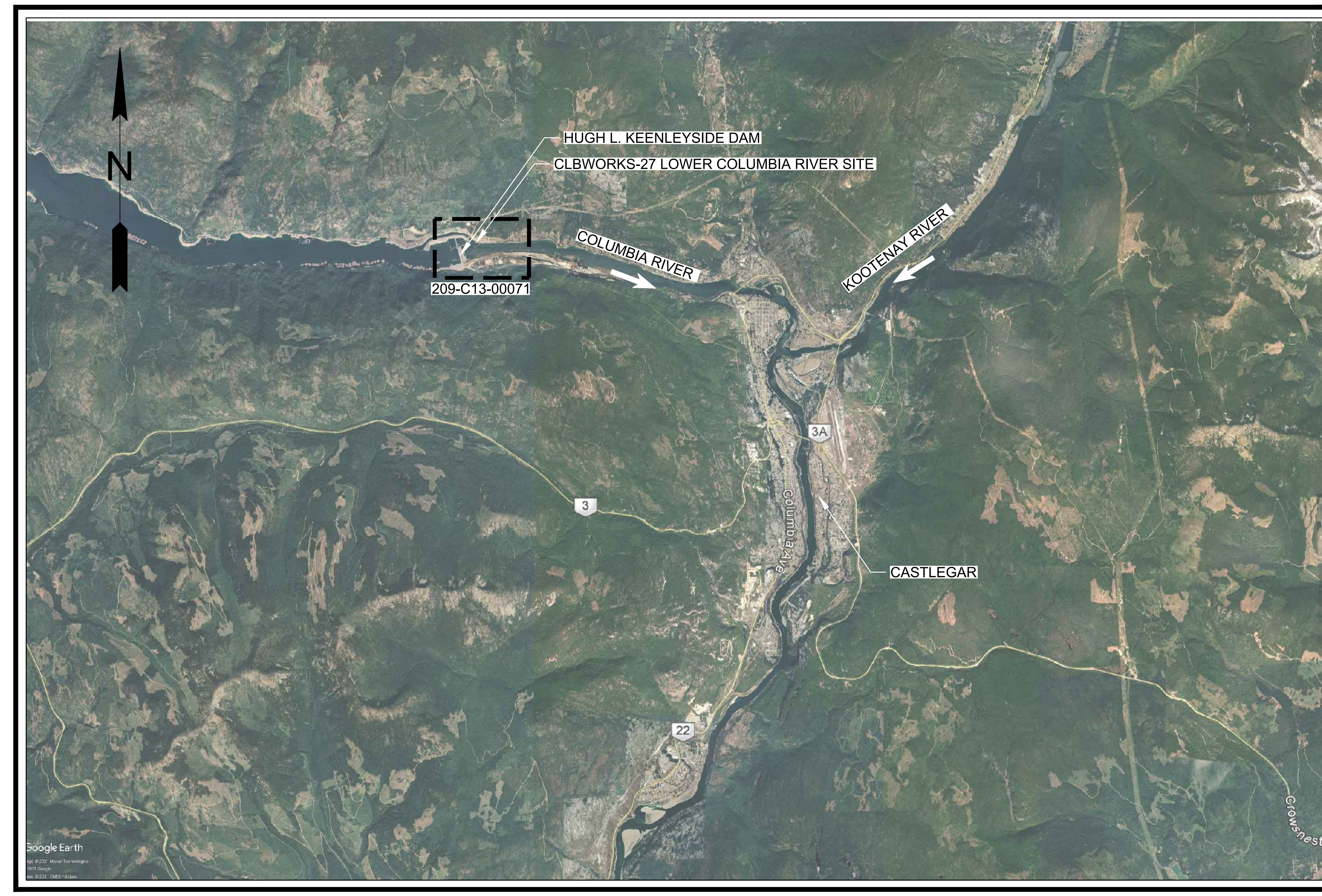
APPENDIX A

Construction Record Drawings

BC HYDRO - CLBWORKS-27 LOWER COLUMBIA
RIVER WHITE STURGEON PHYSICAL WORKS (PHASE 2)

DRAWING INDEX				
DRAWING No.	DRAWING TITLE	REVISION	DRAWING SET	DATE
209-C13-00070	PROJECT LOCATION AND DRAWING INDEX	2	RECORD DRAWING	2023-09-15
209-C13-00071	SITE PLAN	2	RECORD DRAWING	2023-09-15
209-C13-00072	CROSS SECTIONS	2	RECORD DRAWING	2023-09-15
209-C13-00073	CONSTRUCTION SPECIFICATION	2	RECORD DRAWING	2023-09-15

KEY PLAN
NOT TO SCALE



PROJECT LOCATION PLAN
NOT TO SCALE

NOTES:

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DRAWING IS NOT TO SCALE

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By .... Date ....
Hydro's Representative

RECORD ISSUE
Seal and signature subject to record drawing declaration.
Reference: ES00-A0010

NO	REMARKS
2	RECORD DRAWING
1	ISSUED FOR CONSTRUCTION
0	ISSUED FOR TENDER

REFERENCE DRAWINGS

REVISIONS

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD 83 - 11UTM	
BASE ACCURACY LEVEL:	
ASB ACCURACY LEVEL:	

DSGN	R. CUNNINGHAM
INDEP CHK	C. VANWERKHOVEN
DFTG	J.MURILLO GARCIA
DFTG CHK	
INSP	-
REV	R. CUNNINGHAM
ACPT	C. VANWERKHOVEN

wsp

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
PROJECT LOCATION AND DRAWING INDEX

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2023-09-15		209-C13-00070		01	D	2

SETOUT POINTS

POINT No.	EASTING (m)	NORTHING (m)
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3	444423.03	5465656.42
4	444415.72	5465645.81
5	444334.35	5465689.86
6	444265.86	5465740.11

LEGEND:

- EXISTING RIVER BED SURFACE
- SUBSTRATE PLACEMENT AREA
- TOPOGRAPHIC EXTENTS
- 2022 BATHYMETRY SURVEY LIMITS
- 2023 BATHYMETRY SURVEY LIMITS
- SETOUT POINT

NOTES:

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11.
3. EXISTING GROUND CONTOURS ARE SHOWN AT 1 m INTERVAL RELATIVE TO CGVD 2013.
4. CONSTRUCTION ACCESS SHALL BE VIA ARROW LAKES DR AND THE EXISTING ACCESS ROAD TO THE PROPOSED LAYDOWN AREA.
5. SUBSTRATE MATERIAL SHALL BE STOCKPILED IN THE LAYDOWN AREA AS-NEEDED.

REFERENCE:

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.
3. BATHYMETRY SURVEY WITHIN 2022 PLACEMENT AREA CONDUCTED BY LANDMARK SOLUTIONS, ON SEPTEMBER 30, 2022.
4. BATHYMETRY SURVEY WITHIN 2023 PLACEMENT AREA CONDUCTED BY SPLATSIN CONSTRUCTION SERVICES LLP, ON MAY 25, 2023.

RED-LINE MARK-UPS BASED ON CONSTRUCTION RECORD SURVEY CONDUCTED BY SPLATSIN CONSTRUCTION SERVICES LLP (25 MAY 2023)

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By .... Hydro's Representative Date ....

RECORD ISSUE

Seal and signature subject to record drawing declaration. Reference: ES00-A0010

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wsp

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
SITE PLAN

NO	REMARKS
2	RECORD DRAWING
1	ISSUED FOR CONSTRUCTION
0	ISSUED FOR TENDER

REFERENCE DRAWINGS — REVISIONS

DESIGN NUMBER

WORK ORDER NUMBER

CSA S250 ACCURACY NAD 83 - 11UTM

BASE ACCURACY LEVEL:

ASB ACCURACY LEVEL:

DSGN	R. CUNNINGHAM
INDEP CHK	C. VANWERKHOVEN
DFTG	J.MURILLO GARCIA
DFTG CHK	
INSP	-
REV	R. CUNNINGHAM
ACPT	C. VANWERKHOVEN

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
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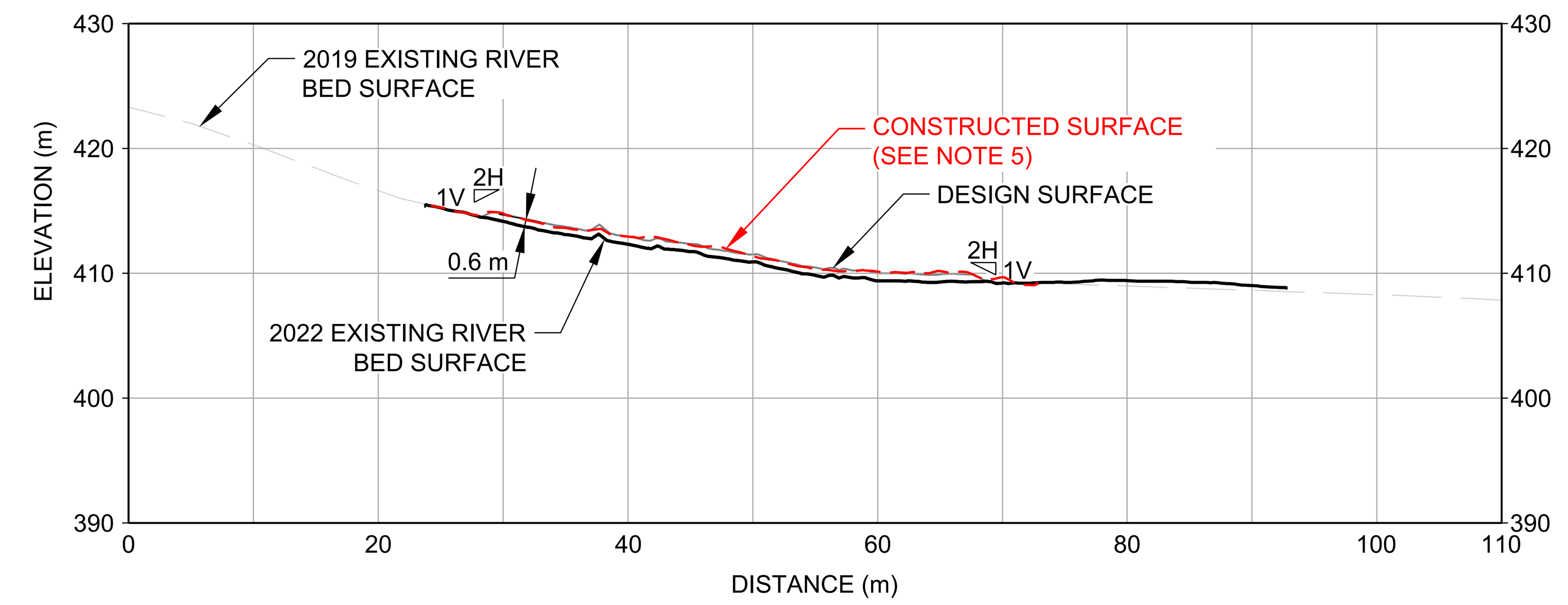

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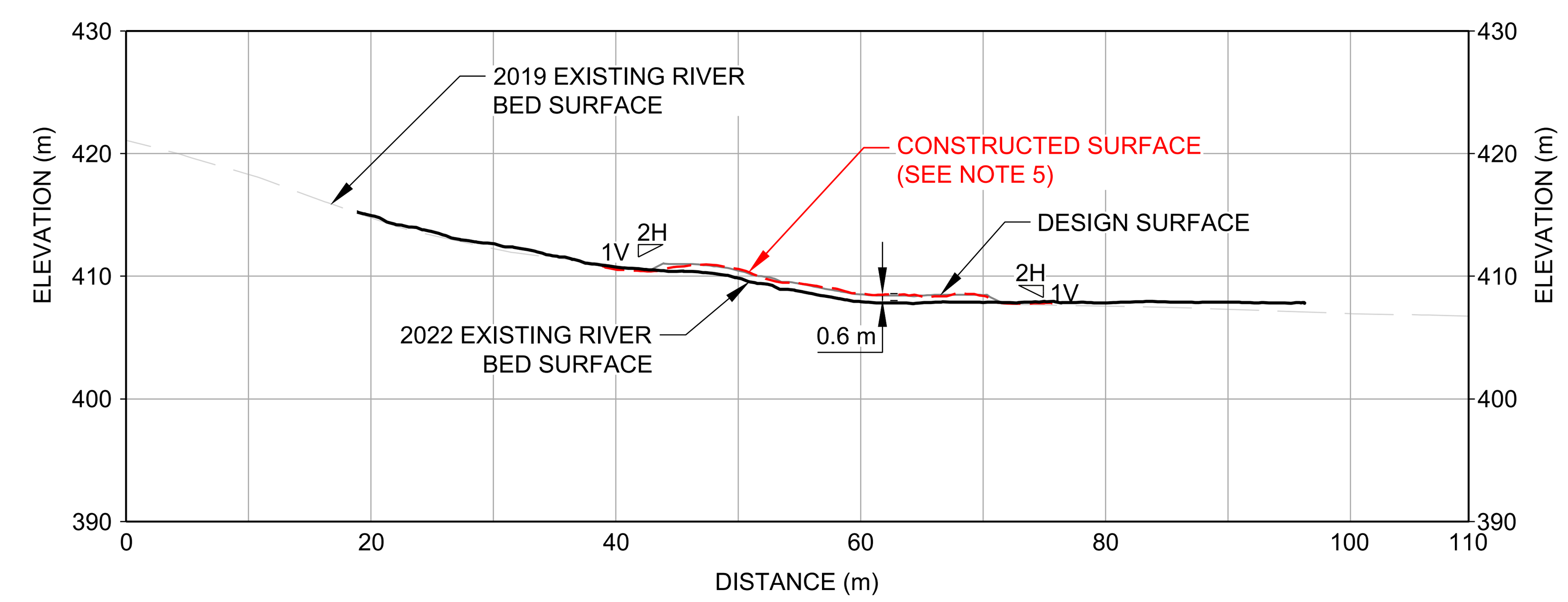

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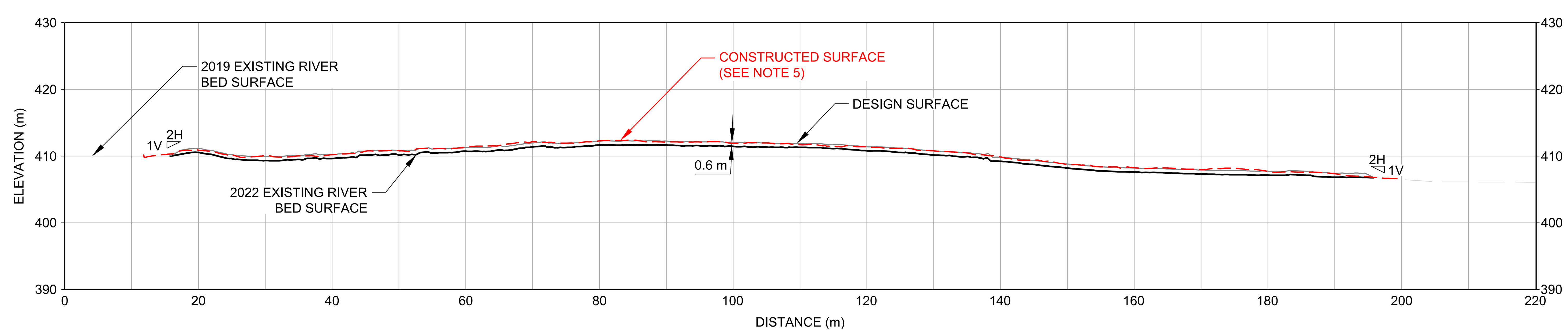

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LEGEND:

- 2022 EXISTING RIVER BED SURFACE
- 2019 EXISTING RIVER BED SURFACE
- CONSTRUCTED SURFACE
- DESIGN SURFACE

NOTES:

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11 ELEVATIONS RELATIVE TO CGVD 2013.
3. SUBSTRATE LAYER SIDE SLOPES ARE ASSUMED TO BE 2:1 (H:V) BASED ON ASSUMED ANGLES OF REPOSE.
4. CROSS-SECTIONS ARE SHOWN WITH NO VERTICAL EXAGGERATION.
5. DETAILED MAPPING OF CONSTRUCTED SURFACE INCLUDED IN CLBWORKS-27 LOWER COLUMBIA RIVER WHITE STURGEON PHYSICAL WORKS: CONSTRUCTED WORKS CLOSE OUT REPORT (APPENDIX E) (WSP 2023)

REFERENCE:

1. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.
3. BATHYMETRY SURVEY WITHIN 2022 PLACEMENT AREA CONDUCTED BY LANDMARK SOLUTIONS, ON SEPTEMBER 30, 2022.
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BC Hydro Contract No 4500051587
ACCEPTED

This review was for observing general conformity to contract only. B.C. Hydro accepts no legal responsibility for the content, accuracy of completness of this document even if it had been accepted with or without revision based on B.C. Hydro's observations.

By .... Date ....
Hydro's Representative

RECORD ISSUE
Seal and signature subject to record drawing declaration.
Reference: ES00-A0010

SCALE: 1:500 0 25m

wsp

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
CROSS SECTIONS

NO	REMARKS
2	RECORD DRAWING
1	ISSUED FOR CONSTRUCTION
0	ISSUED FOR TENDER

REFERENCE DRAWINGS
REVISIONS

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD 83 - 11UTM	
BASE ACCURACY LEVEL:	
ASB ACCURACY LEVEL:	

DSGN	R. CUNNINGHAM
INDEP CHK	C. VANWERKHOVEN
DFTG	J.MURILLO GARCIA
DFTG CHK	
INSP	-
REV	R. CUNNINGHAM
ACPT	C. VANWERKHOVEN

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2023-09-15		209-C13-00072		03	D	2

R:\Vancouver\CAD-GIS\Client\BC_Hydro\Hugh_Keenleyside_Dam\99_PROJECTS\20449674\10000\10300\DocXXX\02_PRODUCTION\DWG\20449674-10000-10300-03.dwg
Unknown drawing unit (6)
MURILLO GARCIA, JHASUA
9/15/2023 12:13 PM

GENERAL NOTES:

PROJECT WORKS

1. BC HYDRO REQUIRES THE PLACEMENT OF SUBSTRATE FILL MATERIAL DOWNSTREAM OF THE TAILRACE OF THE ARROW LAKES GENERATING STATION TO IMPROVE STURGEON HABITAT IN THE COLUMBIA RIVER.

GENERAL REQUIREMENTS

1. CONSTRUCT ALL WORK IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS, AND AS DIRECTED BY THE PROJECT ENGINEER.
2. DETAILED BATHYMETRIC SURVEYS ARE REQUIRED BEFORE AND AFTER SUBSTRATE MATERIAL PLACEMENT.

DIMENSIONS, ELEVATIONS AND COORDINATES

1. ALL DIMENSIONS SHOWN ARE IN METRES, UNLESS NOTED OTHERWISE. ELEVATIONS ARE IN METRES RELATIVE TO CGVD 2013. STATION VALUES ARE IN METRES.
2. ALL COORDINATES SHALL BE REFERENCED TO THE NAD83 UTM ZONE 11 GRID DATUM.

MATERIALS:

SUBSTRATE FILL MATERIAL

1. THE SUBSTRATE FILL MATERIAL MIXTURE SHALL CONSIST OF COURSE, SUB-ROUNDED MATERIAL MEETING THE FOLLOWING GRADATION.

MATERIAL SIZE (mm)	PERCENT PASSING
300	100
200	80
125	50
100	40
20.0	0

FINE CONTENT IN EXCEEDANCE OF THE SPECIFIED GRADATION WAS OBSERVED IN THE ON-SITE STOCKPILE DURING FIELD REVIEWS BY WSP (30 SEPTEMBER 2022 AND 14 FEBRUARY 2023) AND NOTED IN FILED REVIEW REPORTS. IT WAS CONFIRMED THAT MATERIAL BROUGHT TO SITE MET MATERIAL SPECIFICATIONS, AND THAT FINE GRAVEL ENTERED THE STOCKPILE DURING HANDLING OF MATERIAL ON SITE. TO RECTIFY THE EXCESS OF FINES, SCS USED A SKELETON BUCKET WITH A 0.75 IN MESH TO SCREEN THE STOCKPILE. THIS METHOD WAS APPROVED BY WSP FOLLOWING A DEMONSTRATION BY SCS DURING THE PROGRESS INSPECTION ON 23 FEBRUARY 2023, PROVIDED THAT MITIGATION EFFORTS BE MONITORED BY BC HYDRO AND ECOFISH. MATERIAL PLACED PRIOR TO 23 FEBRUARY 2023 MAY HAVE INCLUDED FINE CONTENT IN EXCEEDANCE OF MATERIAL SPECIFICATIONS.

RED-LINE MARK-UPS BASED ON CONSTRUCTION RECORD SURVEY CONDUCTED BY SPLATSIN CONSTRUCTION SERVICES LLP (25 MAY 2023)

THE UNDERSIGNED DOES NOT WARRANT OR GUARANTEE, NOR ACCEPT ANY RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE AS-CONSTRUCTED INFORMATION SUPPLIED BY OTHERS CONTAINED IN THESE DRAWINGS, BUT DOES, BY REVIEWING, CERTIFY THAT THE AS-CONSTRUCTED INFORMATION, IF ACCURATE, PROVIDES AND AS-CONSTRUCTED SYSTEM WHICH SUBSTANTIALLY COMPLIES WITH THE ORIGINAL DESIGN INTENT.

RECORD DRAWING

BC Hydro Contract No 4500051587

ACCEPTED

This review was for observing general conformity to contract only. B.C. Hydro accepts no legal responsibility for the content, accuracy of completness of this document even if it had been accepted with or without revision based on B.C. Hydro's observations.

By .... Hydro's Representative Date ....

RECORD ISSUE

Seal and signature subject to record drawing declaration. Reference: ES00-A0010

REFERENCE DRAWINGS

NO	REMARKS
2	RECORD DRAWING
1	ISSUED FOR CONSTRUCTION
0	ISSUED FOR TENDER

REVISIONS

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD 83 - 11UTM	
BASE ACCURACY LEVEL:	
ASB ACCURACY LEVEL:	

DSGN	R. CUNNINGHAM
INDEP CHK	C. VANWERKHOVEN
DFTG	J.MURILLO GARCIA
DFTG CHK	
INSP	-
REV	R. CUNNINGHAM
ACPT	C. VANWERKHOVEN

wsp

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
CONSTRUCTION SPECIFICATION

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2023-09-15		209-C13-00073		04	D	2

R:\Vancouver\CAD-GIS\Client\BC_Hydro\Hugh_Keenleyside_Dam\99_PROJECTS\20449674\10000\10300\DocXXX\02_PRODUCTION\DWG\20449674-10000-10300-04.dwg
Unknown drawing unit (6)
MURILLO GARCIA, JHASUA
9/15/2023 12:13 PM

APPENDIX B

Construction Field Review Reports

INSPECTION REPORT CLBWORKS-27 SITE

Project name:	CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works		
Project No:	20449674	**Visit Date:**	30 September 2022
Arrived on Site:	7:00 AM	**Report Date:**	07 October 2022
Departed Site:	9:30 AM	**Weather:**	Cloudy with Sunny Breaks
Total hours:	2.5 h + travel	**Temperature:**	13 – 21℃

BC Hydro requested that WSP Golder visit the CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works site at the Hugh Keenleyside Dam (the site) for a kick-off meeting at the commencement of substrate placement. The Golder representative (Chris Coles) was accompanied by a BC Hydro Representative (Kelsey Turner) throughout the site visit.

HEALTH AND SAFETY

- Golder completed a tailgate meeting upon arrival on site. PPE, potential hazards, and the day's activities were discussed in the tailgate meeting.

OBSERVATIONS

- During review of the material stockpile, it was observed that some particles were oversized (b-dimension >300mm). These particles were estimated to be in the range of 1% of the observed particles on the stockpile surface. It was also noted that the oversized particles were only observed within the most recently delivered loads. This will be raised with BC Hydro to discuss path forward, however, the contractor can proceed once this deficiency is corrected.
- The stockpiled material appeared to include more fines than anticipated. The stones were coated with a thin layer of grit with sand and traces of silt/clay. Based on discussions with the environmental monitor, it is not anticipated that the presence of the excess fines on the stockpiled substrate material would result in a measurable increase in turbidity during placement. This will be raised with BC Hydro to discuss path forward.
- Placement tolerance was discussed with the BC Hydro representative. It was agreed that the project team needs to discuss what should be done if the tolerance cannot be achieved.
- Pre-construction bathymetric surveying commenced at the time of the time of the site visit. It was noted that the preconstruction survey may differ from the design survey (different water level, equipment, and surveyor). It was agreed that the project team should discuss which design will govern when evaluating performance (design finished surface vs preconstruction surface plus 0.6 m). The BC Hydro representative indicated that the survey plan has not yet been provided/accepted.

DISTRIBUTION

BC Hydro
WSP Golder

Hydrotechnical Professional of Record	Curtis VanWerkhoven, MASc, PEng
Reviewer	Chris Coles, MASc, PEng

INSPECTION PHOTOGRAPHY

Photo 1: Staging Area and Hugh Keenleyside Dam

Photo 2: Material stockpile and example of substrate material with excess fines

Photo 3: Barge loaded with material

Photo 4: Excavator for placing material

INSPECTION REPORT CLBWORKS-27 SITE

Project name:	CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works		
Project No:	20449674	**Visit Date:**	14 February 2023
Arrived on Site:	10:20 AM	**Report Date:**	21 February 2023
Departed Site:	11:05 AM	**Weather:**	Scattered clouds
Total hours:	0.75 h + travel	**Temperature:**	-3 to -1 ℃

BC Hydro requested that WSP (previously WSP Golder) visit the CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works site at the Hugh Keenleyside Dam (the site) for an inspection midway through placement of the substrate. The WSP representative (Curtis VanWerkhoven) was accompanied by representatives from BC Hydro (Paul Devine) and the contractor, Landmark (Reece Graham).

HEALTH AND SAFETY

- Golder completed a tailgate meeting upon arrival on site. PPE, potential hazards, and the day's activities were discussed in the tailgate meeting. No active construction was occurring during the site visit.

OBSERVATIONS

- The Contractor had stopped in-stream works prior to the arrival of WSP and was demobilizing prior to the next shift.
- During review of the stockpiled material, it was observed that significant fines (sands) were present in various locations along the material stockpile, particularly areas recently disturbed. A similar observation was raised during the kick-off site inspection.
- The technical specifications note that "All silt, clay sand, and other deleterious material must be removed from the Spawning Substrate Mixture" (SP3.3.1.2a). The specifications further note that "Gravel for Spawning Substrate Mixture shall be graded and thoroughly washed, as per SP3.3.2 prior to delivery to the Site" (SP3.2.2.3). The Grading Limits for the Spawning Substrate Mixture show that the percent passing for the 20 mm sieve is to be 0%, with a tolerance of 0%.
- Additional sieve analysis of the on-site stockpiled material is recommended in areas not "naturally washed" by weather to confirm adherence to the construction specifications. An acceptable area is indicated in the attached photography. Sampling of "naturally washed" areas on the surface of the stockpile would be contrary to the intent of this analysis, as material is to be clean prior to delivery to site. Furthermore, WSP recommends that no additional material be placed until confirmation that the stockpiled material meets specifications or an alternate approach for the contractor is approved.

DISTRIBUTION

BC Hydro
WSP

Hydrotechnical Professional of Record	Curtis VanWerkhoven, MASc, PEng
Reviewer	Chris Coles, MASc, PEng

INSPECTION PHOTOGRAPHY

Photo 1: Laydown area, showing stockpile. Photograph taken facing NNE

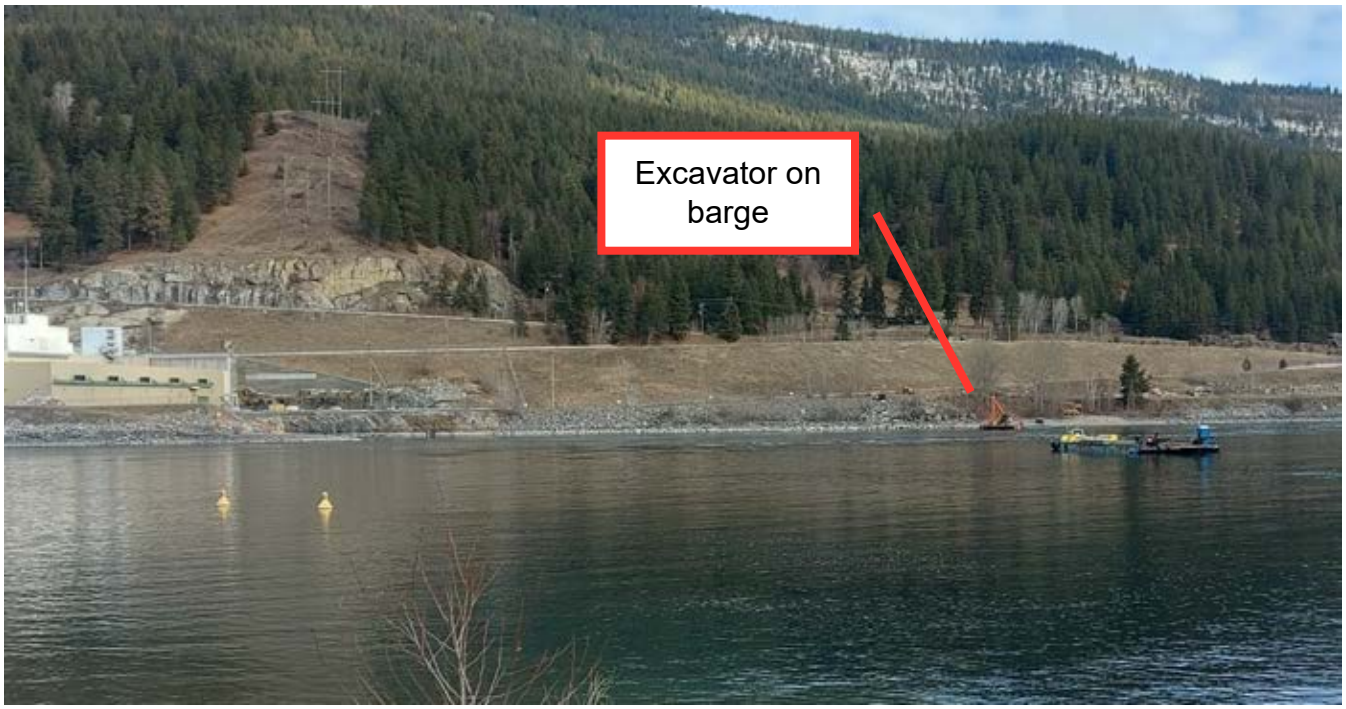


Photo 2: Excavator on barge at placement location in tailrace. Photograph taken facing NE

Photo 3: Substrate material stockpile. Photograph taken facing S

Photo 4: Evidence of fines (< 20 mm) in stockpile. Photograph taken facing SW

Photo 5: Additional evidence of fines (< 20 mm) in stockpile. Photograph taken facing NW

Photo 4: Recommended area for additional sieve analysis. Photograph taken facing NW

INSPECTION REPORT CLBWORKS-27 SITE

Project name:	CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works		
Project No:	20449674	**Visit Date:**	23 February 2023
Arrived on Site:	9:20 AM	**Report Date:**	24 February 2023
Departed Site:	9:50 AM	**Weather:**	Scattered clouds
Total hours:	0.5 h + travel	**Temperature:**	-12 ℃

BC Hydro requested that WSP (previously WSP Golder) visit the CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works site at the Hugh Keenleyside Dam (the site) for an inspection to review the proposed measures and results for cleaning the substrate material of sands and small gravel. WSP notified BC Hydro on 14 Feb 2023 that the spawning substrate material currently stockpiled on site no longer meets the specifications of gradation outlined in the contract documents. The WSP representative (Curtis VanWerkhoven) was accompanied by representatives from BC Hydro (Paul Devine), Kootenay Testing (Jerry McAlduff) and the contractor, Landmark (Reece Graham) for the 23 Feb 2023 inspection.

HEALTH AND SAFETY

- Golder completed a tailgate meeting upon arrival on site with sign on to Landmark's H&S documentation. PPE, potential hazards, and the day's activities were discussed in the tailgate meeting. No active construction was occurring during the site visit.

OBSERVATIONS

- It was confirmed by all present that material brought to Site met gradation specifications and that sand and fine gravel entered the stockpile during handling of the material on site.
- The Contractor had not re-started in-stream works prior to the arrival of WSP as they were on hold until BC Hydro approved the stockpile sieving methods and allowed for construction to commence.
- To rectify the fines (sands) that were present in various locations along the material stockpile (identified and documented in WSP's 14 Feb 2023 Inspection Report), Splatsin Construction Services LLP (Splatsin) proposed to use a skeleton bucket with a ¾" mesh to screen the entire stockpile immediately before loading into the rock truck (see photos 2 and 3). During this process, the operator will shake the material within the bucket to agitate the material and knock off any loose sandy material into a pile adjacent to the sieved substrate pile located on rig mats. Washing material was discussed but, due to sub-zero temperatures and environmental concerns, this was not the preferred method.
- A sample from a portion of the stockpile with visible inclusion of sand and fine gravel was selected (see photo 8) and the above method for cleaning by physical agitation and screening. The resulting material was visually inspected, and it appeared that the majority of the sand and fine gravel was removed. Sand and fine gravel screened out of the sample was observed adjacent to the sieved pile of substrate material (see photos 5, 6, and 7).
- Material segregation was noted in the sieved stockpile, and it is recommended that the material be mixed during loading into the dump truck and off the barge to provide well-mixed material for placement.
- Kootenay Testing confirmed that on-site washing or gradation testing of bulk samples was not feasible, therefore recommended ongoing visual inspections of the substrate material prior to placement.

- WSP approves of the above cleaning methodology with ongoing inspection and documentation of material placed by BC Hydro and Ecofish (Environmental Monitor) during each barge load to visual confirm material gradation meets the specifications.

DISTRIBUTION

BC Hydro
WSP

Hydrotechnical Professional of Record	Curtis VanWerkhoven, MASc, PEng
Reviewer	Chris Coles, MASc, PEng

INSPECTION PHOTOGRAPHY

Photo 1: Laydown area, showing stockpile

Photo 2: Excavator skeleton bucket with welded mesh

Photo 3: Mesh welded onto bucket with ¾" openings

Photo 4: Excavator and sieved stockpile

Photo 5: Sieved stockpile and material passing through bucket mesh (deposited sands and fine gravel observed in the soil pile)

Photo 6: Sieved stockpile material

Photo 7: Sieved stockpile material (close up)

Photo 8: Source location from the main stockpile for testing of sieving methodology. Note observed sand and fine gravel.

INSPECTION REPORT CLBWORKS-27 SITE

Project name:	CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works		
Project No:	20449674	**Visit Date:**	16 March 2023
Arrived on Site:	9:55 AM	**Report Date:**	1 June 2023
Departed Site:	10:30 AM	**Weather:**	Clear skies
Total hours:	0.5 h + travel	**Temperature:**	+2 ℃

BC Hydro requested that WSP (previously WSP Golder) visit the CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works site at the Hugh Keenleyside Dam (the site) for an inspection to review the proposed measures and results for cleaning the substrate material of sands and small gravel. The WSP representative (Curtis VanWerkhoven) was accompanied by representatives from BC Hydro (Paul Devine and Dave McLorie) and the contractor, Landmark (Reece Graham) for the 16 Mar 2023 inspection.

HEALTH AND SAFETY

- Golder completed a tailgate meeting upon arrival on site. PPE and potential hazards were discussed in the tailgate meeting. No active construction activities were occurring during the site visit.

OBSERVATIONS

- Reece Graham confirmed that use of the skeleton bucket with a ¾" mesh was used to screen the stockpiled material and that the material was mixed during loading into the dump truck prior to placement on the barge.
- Reece Graham confirmed that less sand material was mixed into the new material brought on site, as scraping of the sand below the delivered material during re-handling was avoided. Inspection of the stockpiled material visually confirmed this statement.
- Low water levels were prohibiting survey of the placed material in shallow portions of the placement area. It was agreed that shallow areas would not be included in the intermediate surveys, but would be included in the final survey once water levels increase to allow boat access to the shallower areas.

DISTRIBUTION

BC Hydro
WSP

Hydrotechnical Professional of Record	Curtis VanWerkhoven, MASc, PEng
Reviewer	Chris Coles, MASc, PEng

INSPECTION PHOTOGRAPHY

Photo 1: Laydown area, showing stockpile

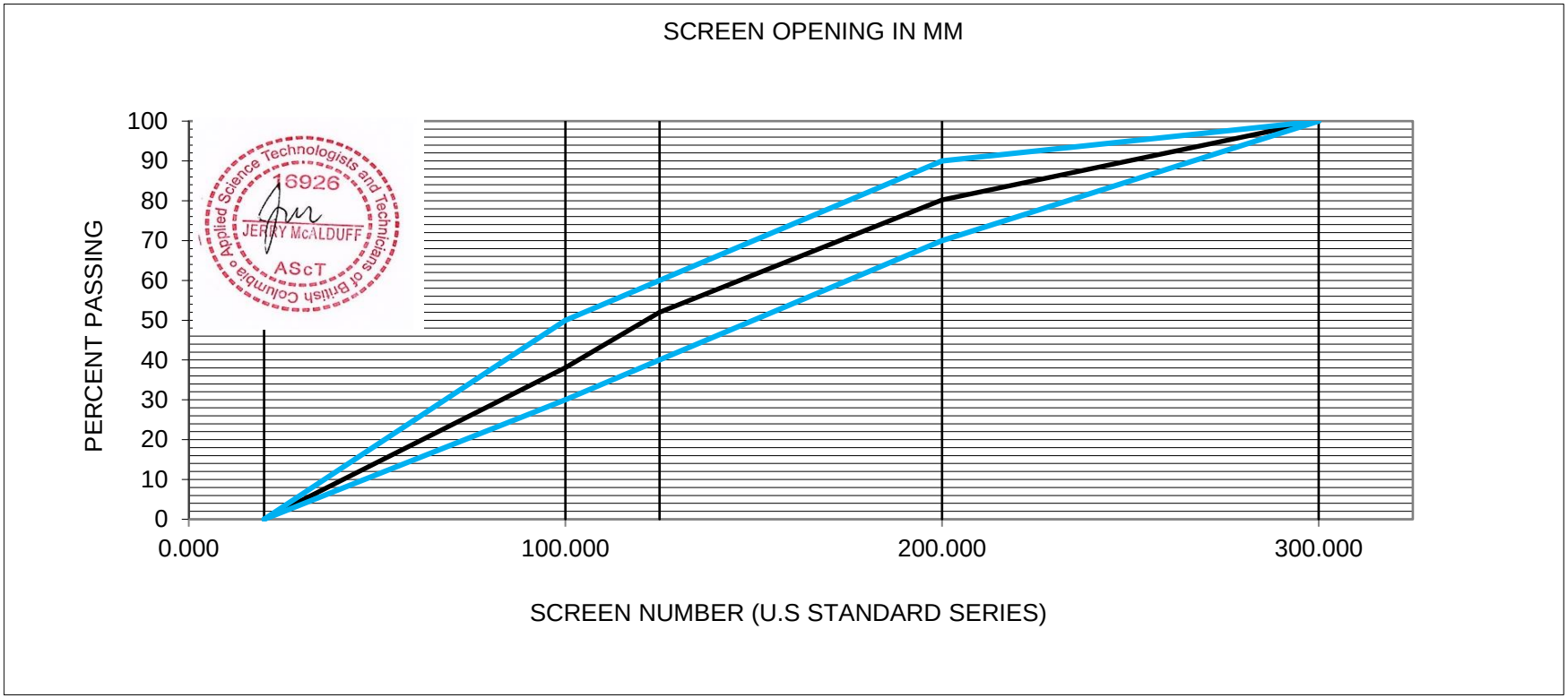
Photo 2: Stockpiled Material

Photo 3: Close-up of Stockpiled Material

APPENDIX C

Substrate Material Sieve Analysis Reports by Kootenay Testing

AGGREGATE CHART KOOTENAY TESTING

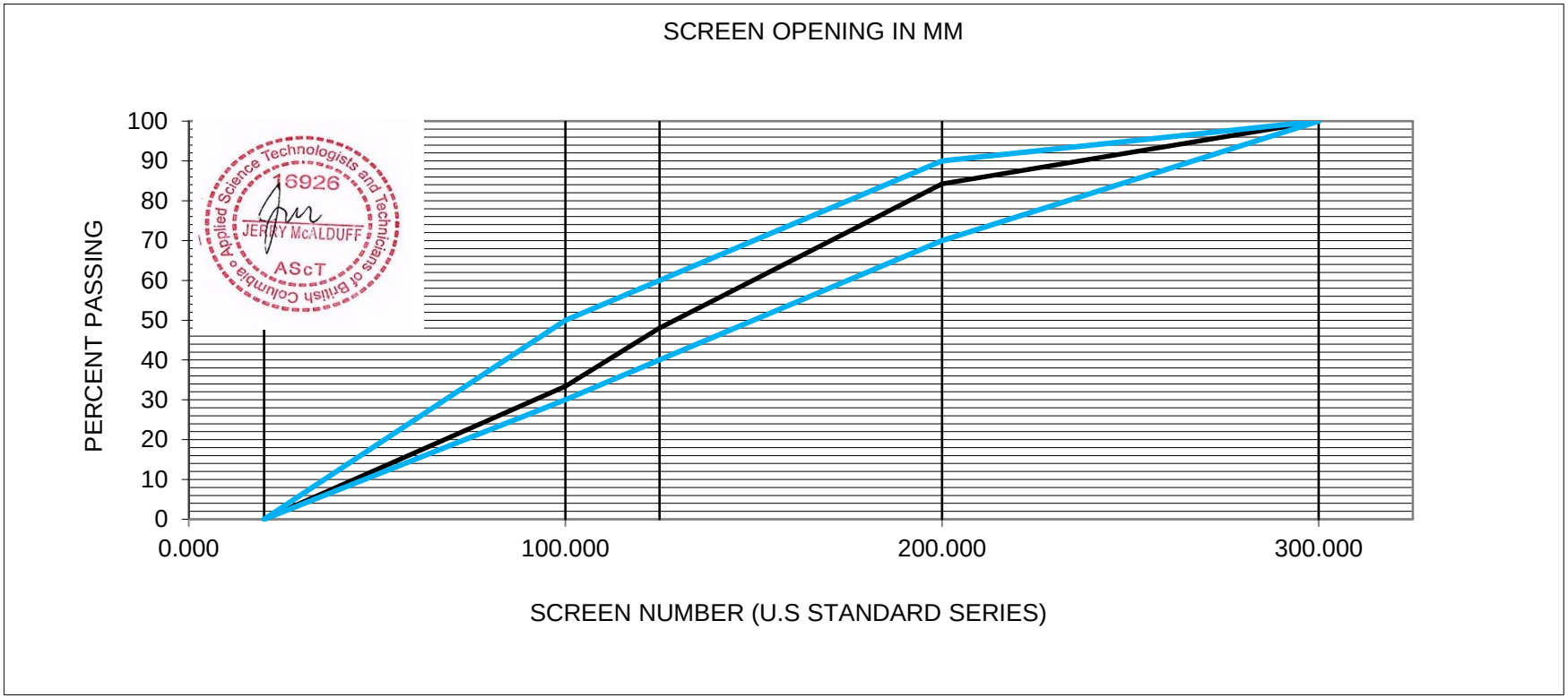


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	80.2	70-90
125.0	52.0	40-60
100.0	38.1	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	August 3, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

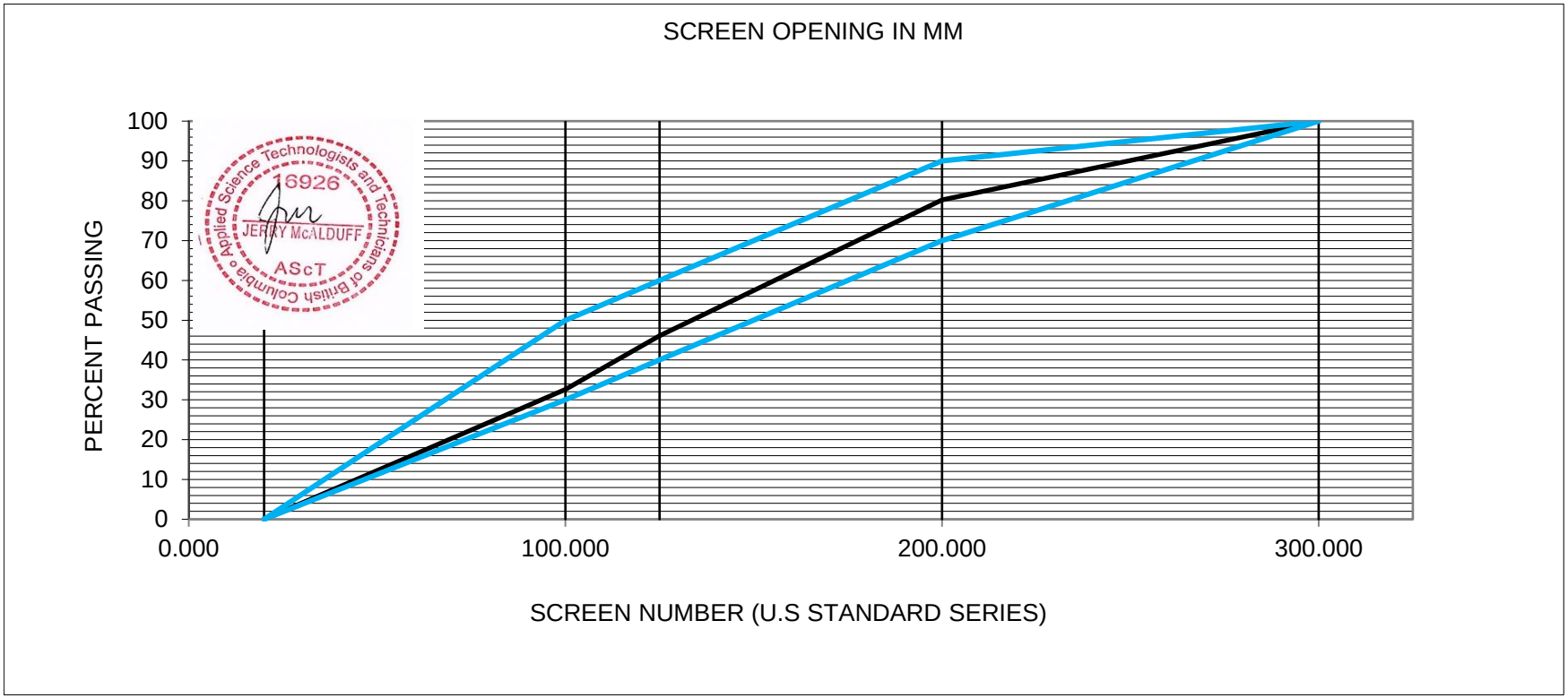


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	84.2	70-90
125.0	48.0	40-60
100.0	33.4	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	August 8, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

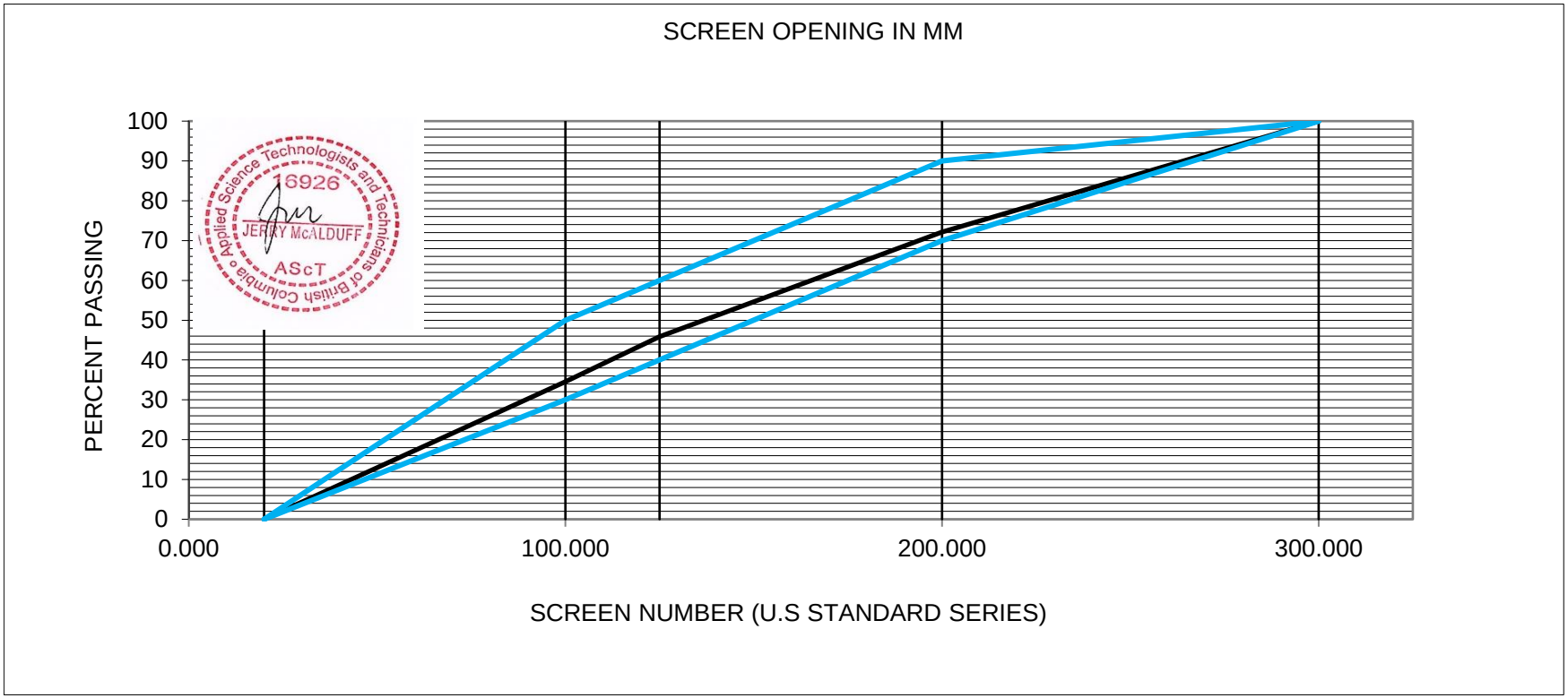


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	80.2	70-90
125.0	46.1	40-60
100.0	32.6	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	August 10, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

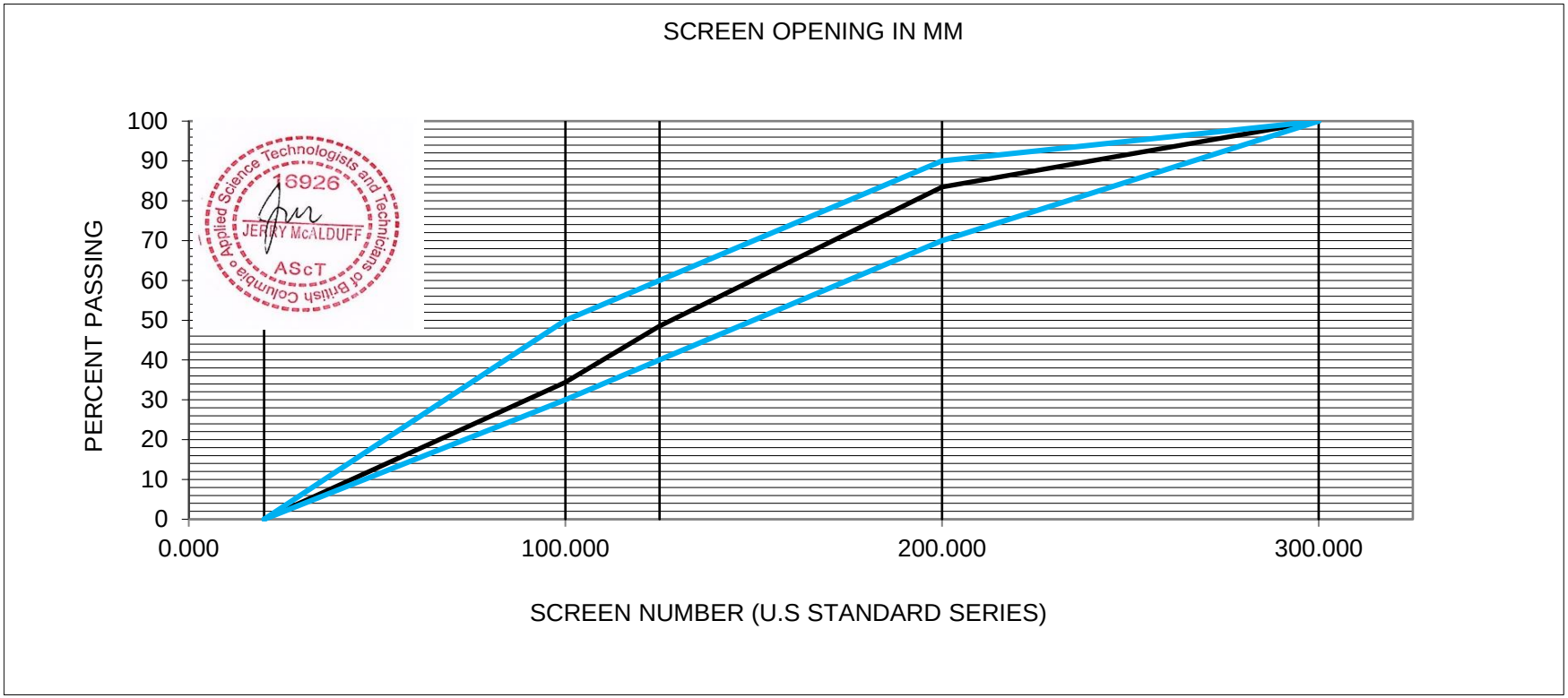


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	72.1	70-90
125.0	45.9	40-60
100.0	34.5	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	August 24, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

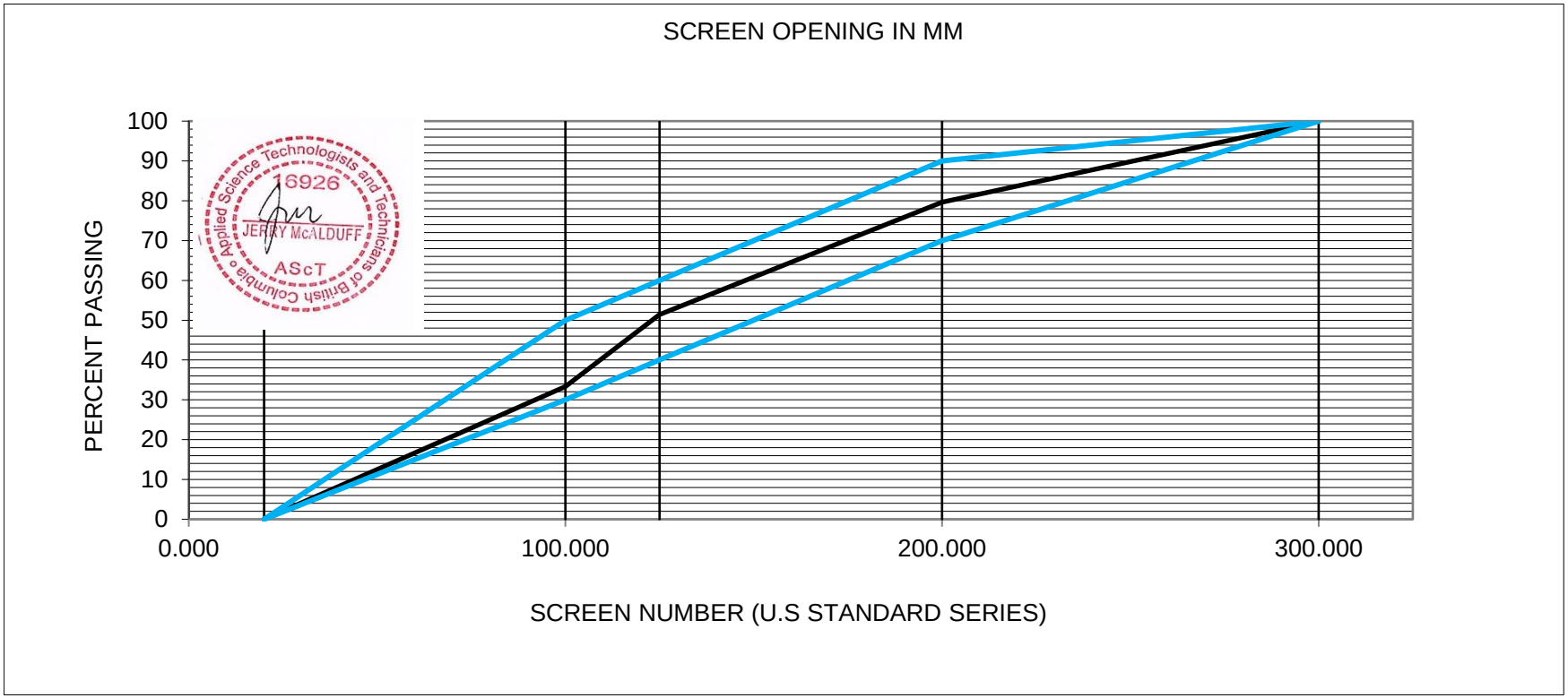


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	83.4	70-90
125.0	48.5	40-60
100.0	34.4	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	August 25, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

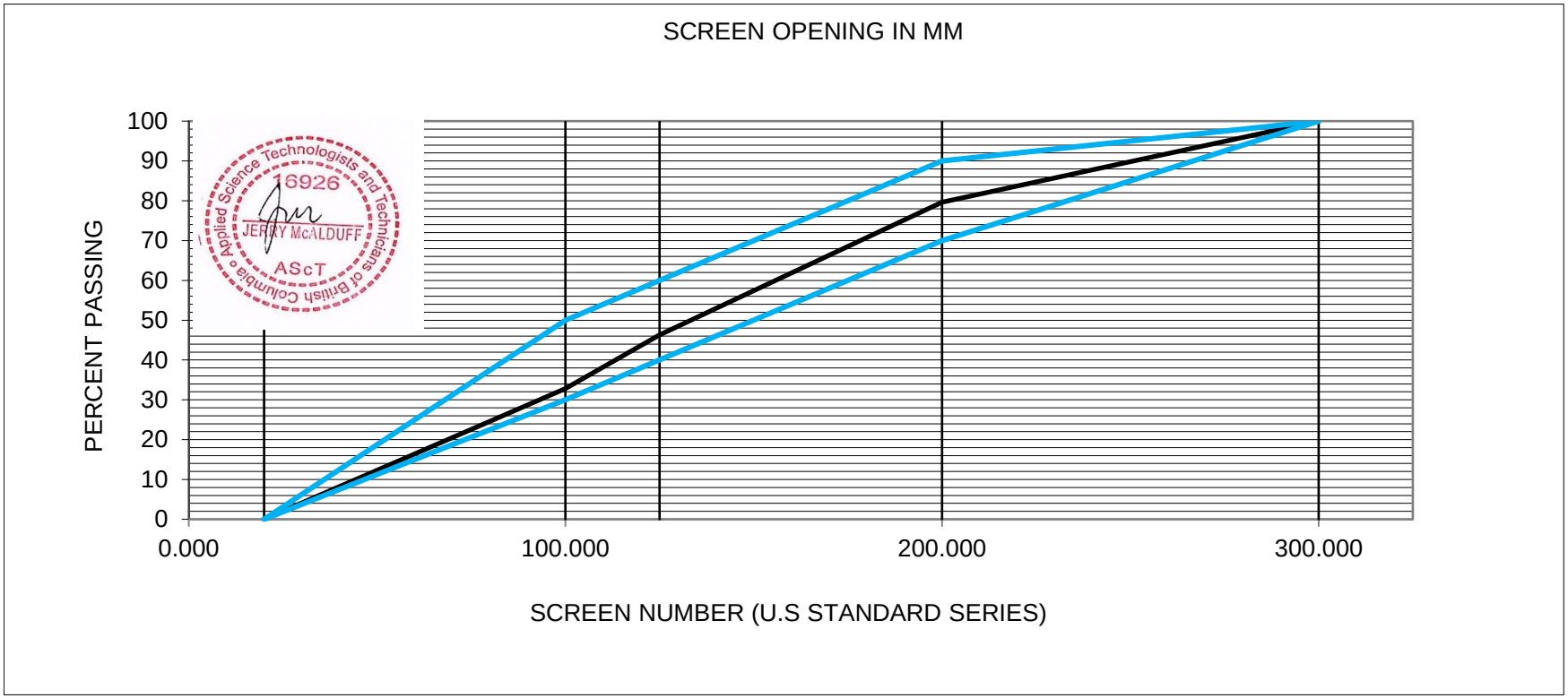


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	79.6	70-90
125.0	51.4	40-60
100.0	33.3	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	August 26, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

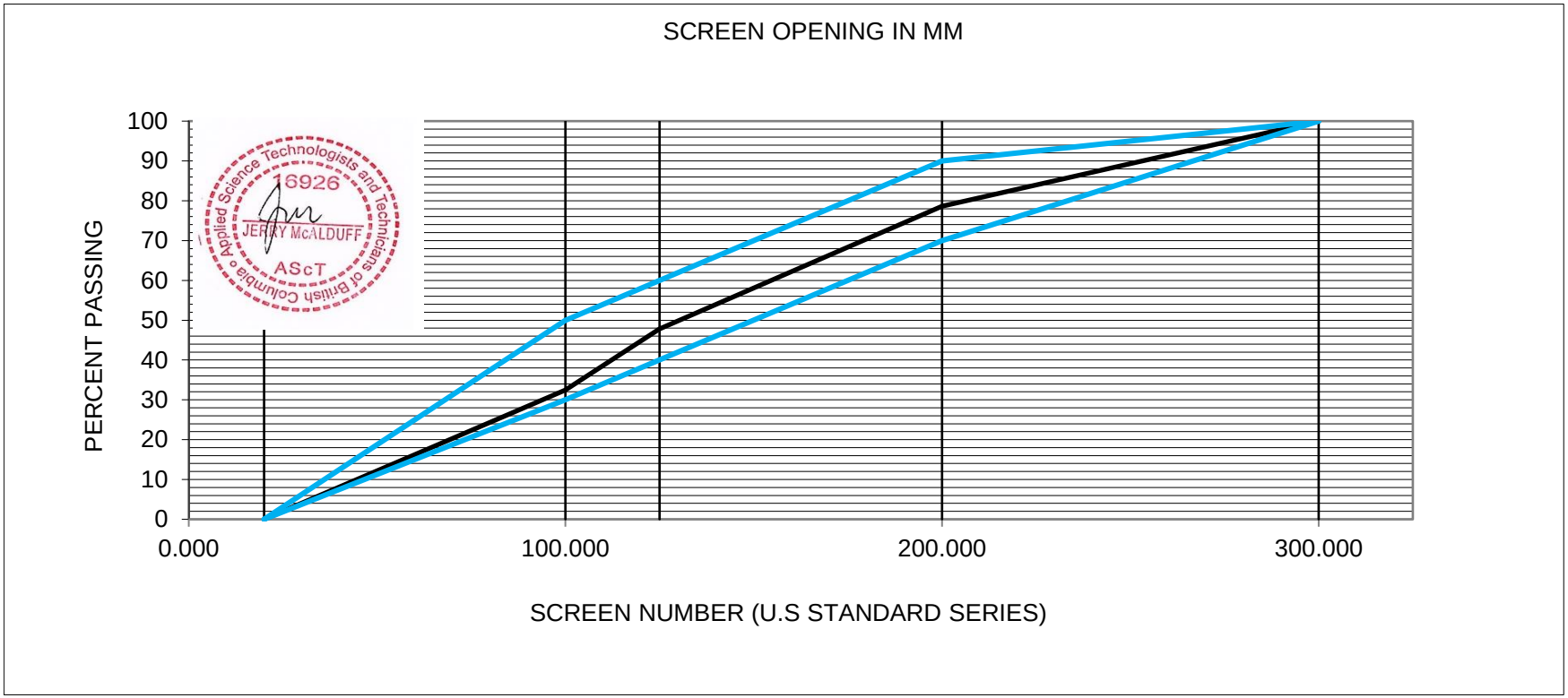


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	79.6	70-90
125.0	46.3	40-60
100.0	32.8	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	September 2, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

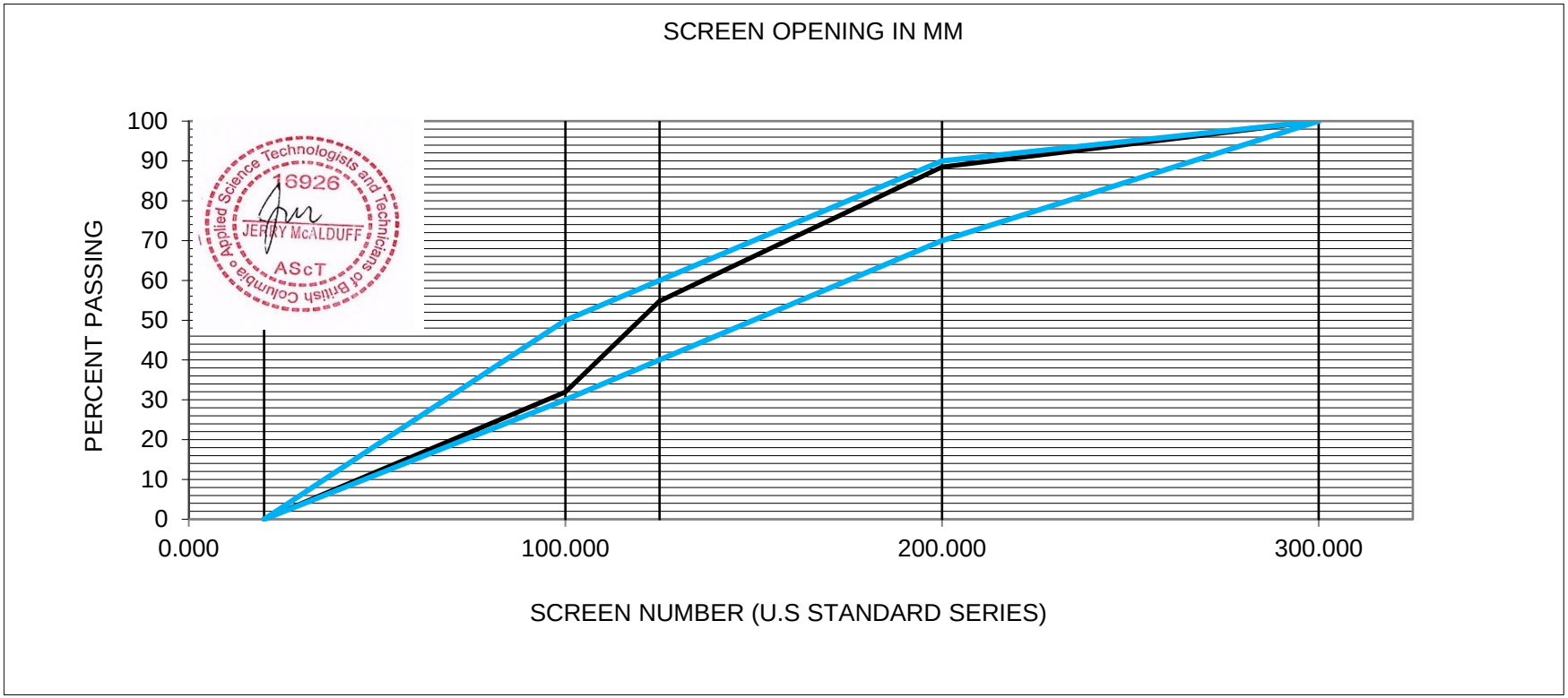


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	78.6	70-90
125.0	47.8	40-60
100.0	32.4	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	October 3, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

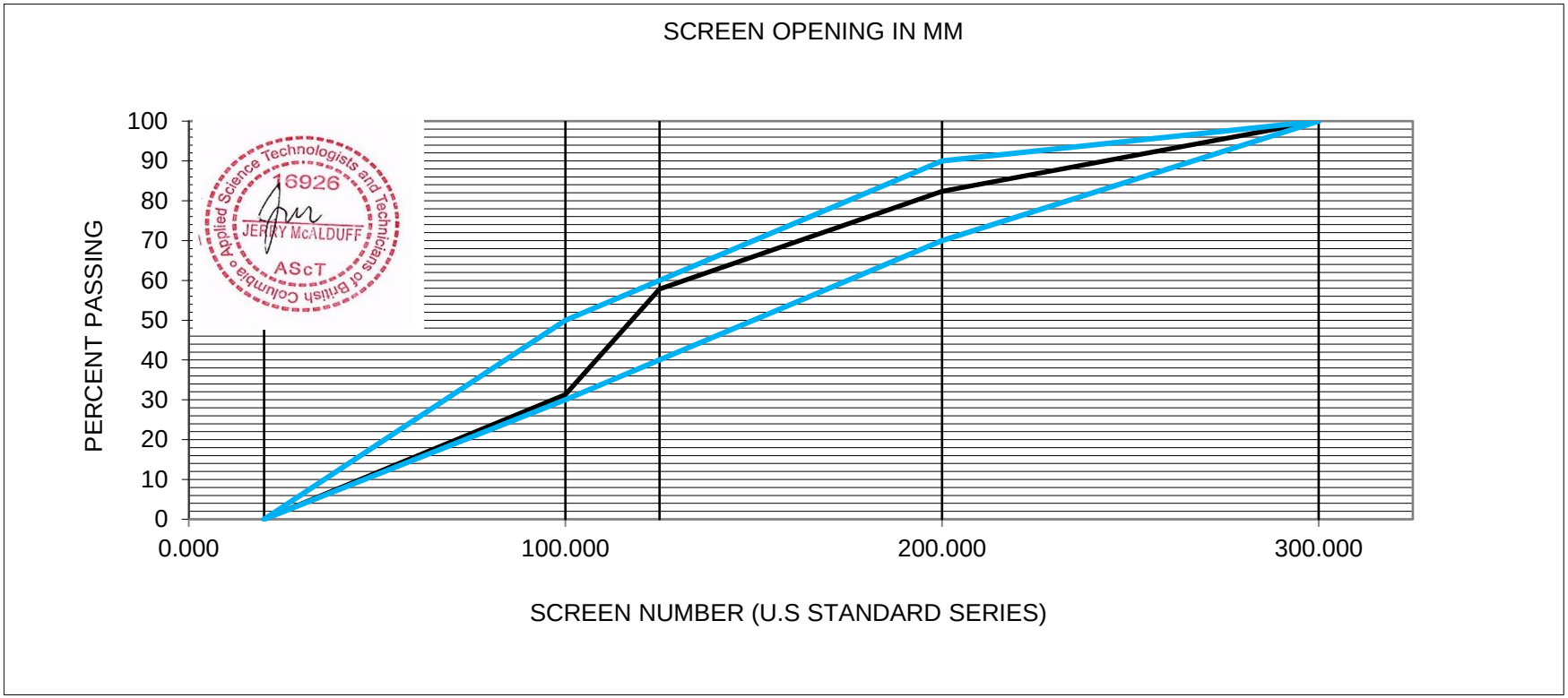


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	88.5	70-90
125.0	54.8	40-60
100.0	31.9	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	October 5, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

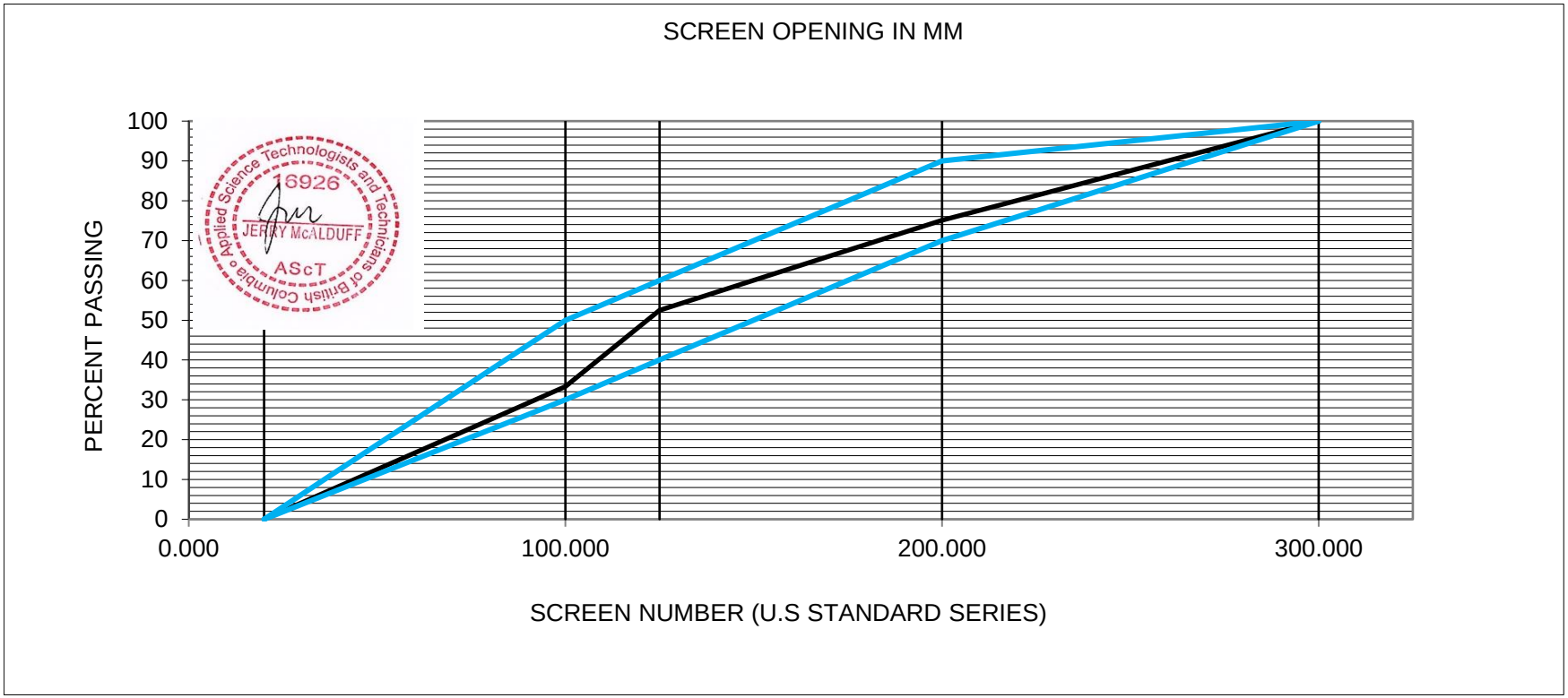


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	82.4	70-90
125.0	57.8	40-60
100.0	31.4	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	October 12, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

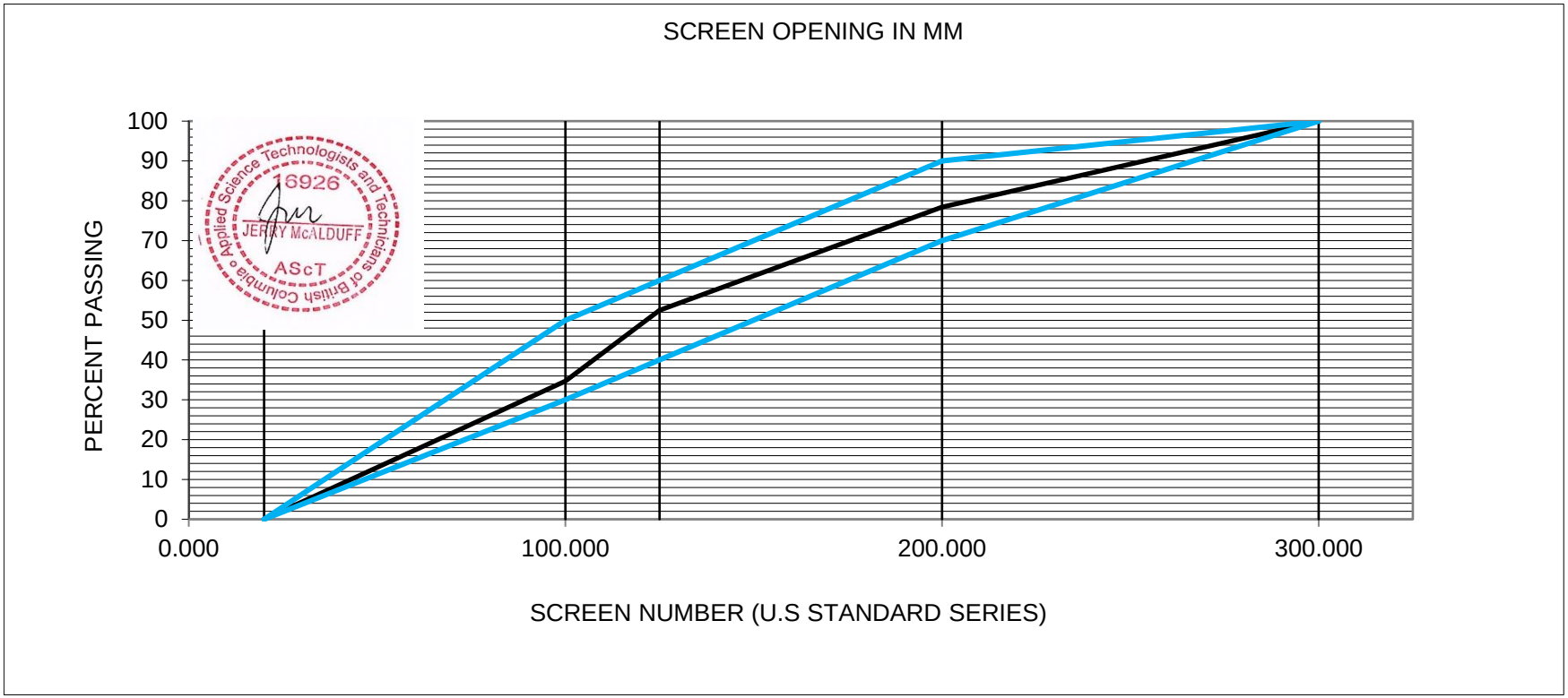


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	75.1	70-90
125.0	52.5	40-60
100.0	33.3	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	November 10, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

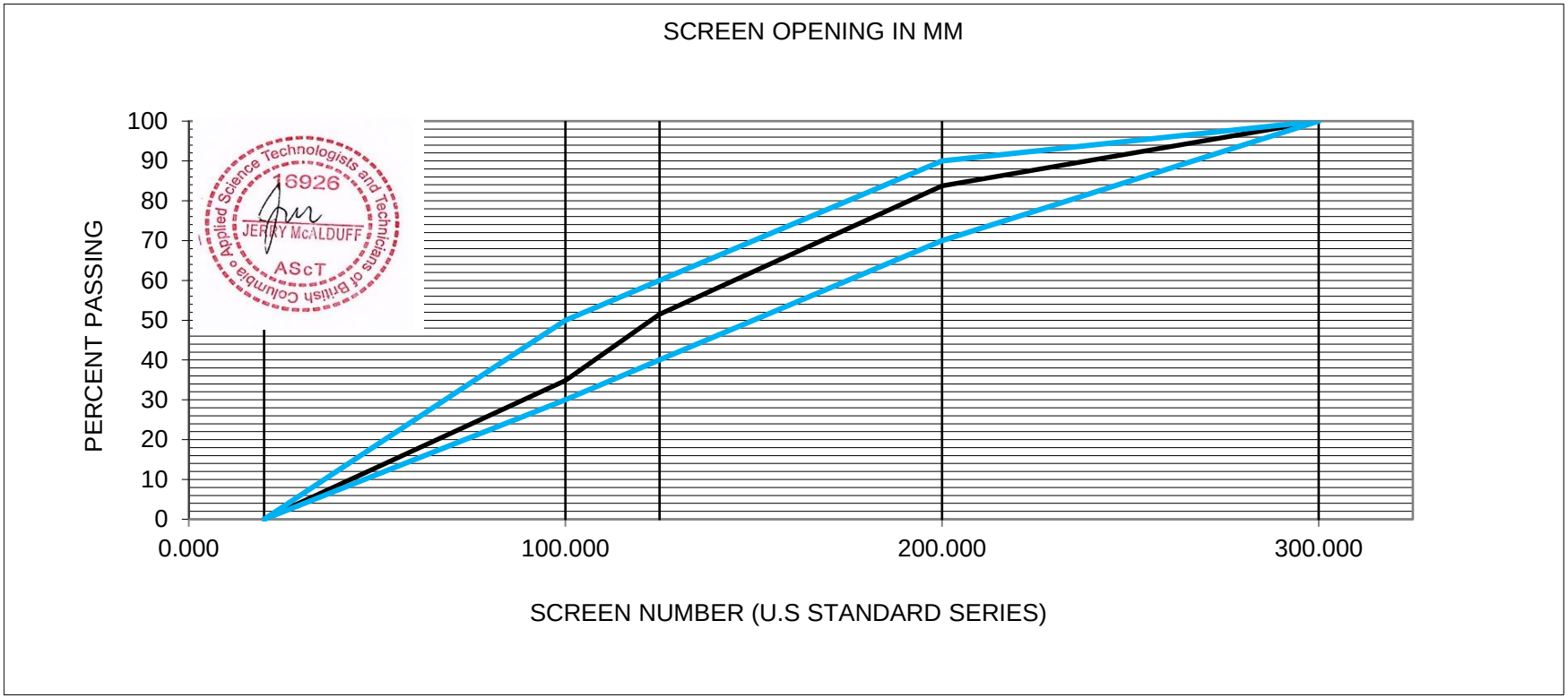


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	78.4	70-90
125.0	52.5	40-60
100.0	34.7	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	November 15, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

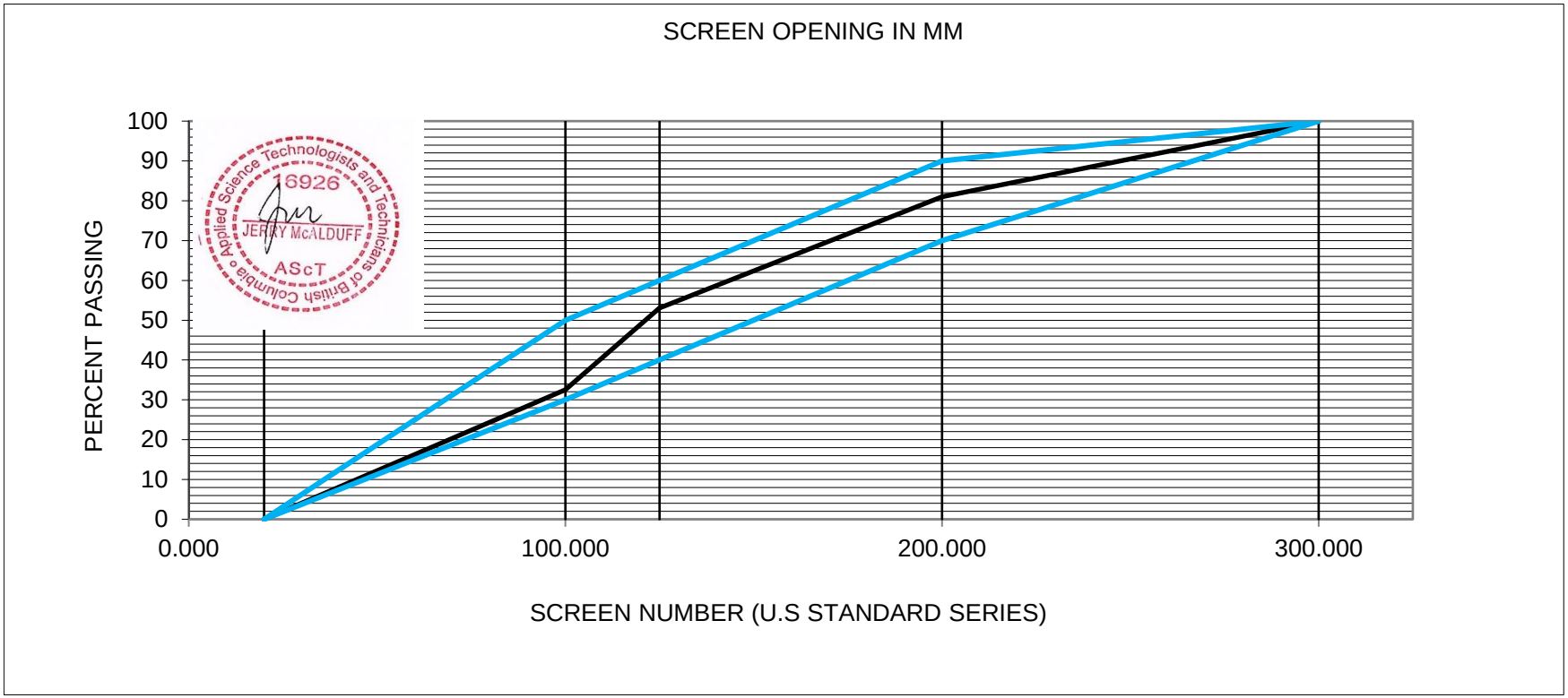


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	83.8	70-90
125.0	51.5	40-60
100.0	34.8	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	November 17, 2022
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING

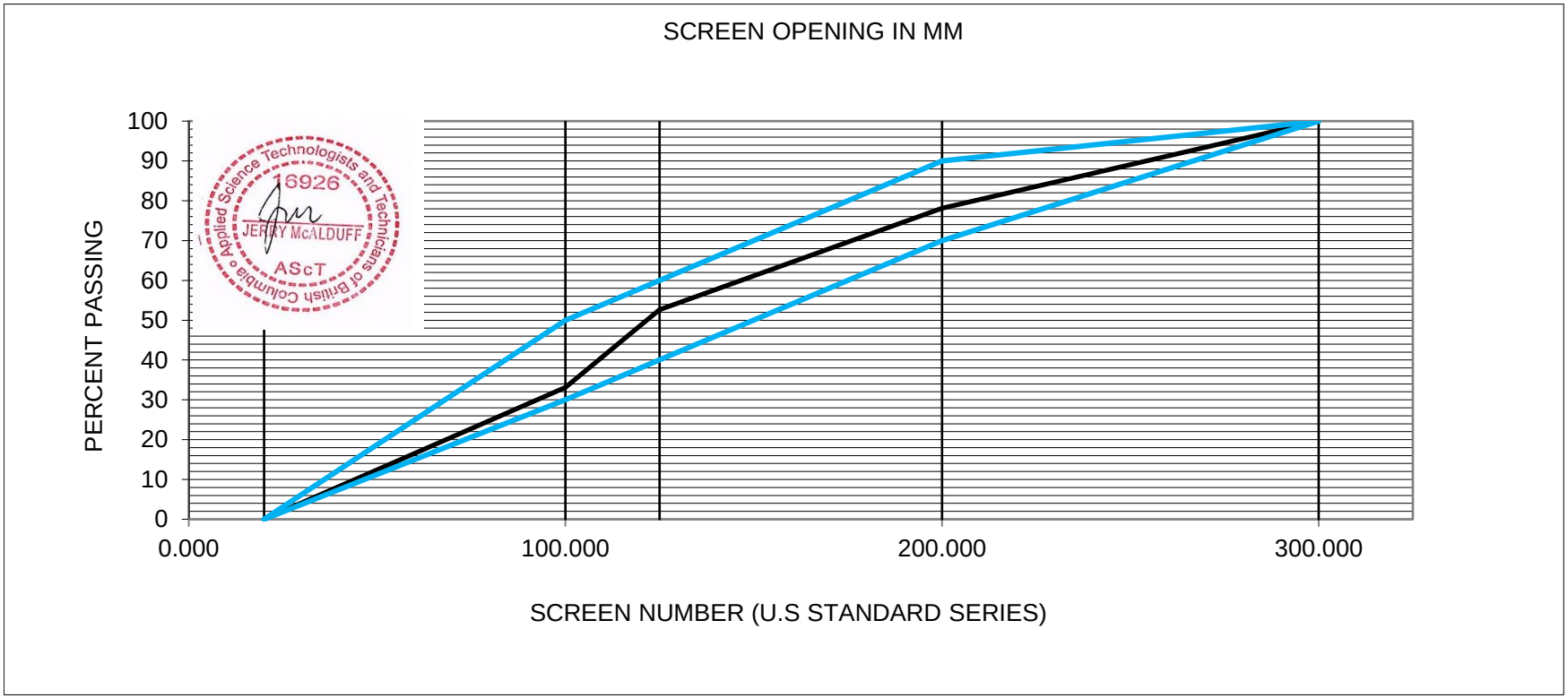


SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	81.0	70-90
125.0	53.1	40-60
100.0	32.5	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	March 13, 2023
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

AGGREGATE CHART KOOTENAY TESTING



SIEVE (mm)	% PASSING	% SPEC

SIEVE (mm)	% PASSING	% SPEC
300.0	100.0	100
200.0	78.1	70-90
125.0	52.6	40-60
100.0	33.1	30-50
20	0.0	0

IDENTIFICATION	
PROJECT NAME	BC Hydro Spawning Gravel
PROJECT NO.	85-003
DATE SIEVED	April 25, 2023
TESTED BY	Jerry McAlduff
SAMPLE LOCATION	Stockpile
DESCRIPTION	Spawning Substrate Mixture
LOCATION	4 Mile Pit
SPEC	

APPENDIX D

Toxicity Assessment

TECHNICAL MEMORANDUM

DATE 16 November 2022 **Reference No.** 20449674-014-TM-Rev0-10000

TO Teri Neighbour and Margo Sadler
BC Hydro

CC Curtis VanWerkhoven and Chris Coles

FROM Mikayla Donovan, Chris Schuh, Elaine Irving, and Lee Nikl **EMAIL elaine.irving@wsp.com**

CLBWORKS-27 LOWER COLUMBIA RIVER WHITE STURGEON PHYSICAL WORKS PHASE 3 (IMPLEMENTATION AND MONITORING SUPPORT): TECHNICAL REVIEW SERVICES AND TOXICITY STUDY

1.0 INTRODUCTION

WSP Golder is pleased to provide BC Hydro with technical review services and a toxicity study designed to provide supplemental information to assist BC Hydro in their decision making regarding the use of the Proposed Spawning Substrate Mixture (henceforth referred to as 'the proposed substrate') for the CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works Project (Phase 3). The proposed substrate is to be sourced from a gravel pit in Nelson, BC (4-mile Pit).

2.0 BACKGROUND

The CLBWORKS-27 Lower Columbia White Sturgeon Physical Works Project (the Project) was developed by the Upper Columbia White Sturgeon Recovery Initiative to enhance White Sturgeon (*Acipenser transmontanus*) recruitment in the Transboundary Reach. The project is split into three phases, with phases 1 and 2 already completed and phase 3 underway.

- Phase 1: Hydraulic Modelling and Restoration Option Development was undertaken prior to WSP Golder's involvement in the project. This phase included determination of the feasibility of spawning substrate restoration at three sites on the lower Columbia River and recommendation of a preferred site and substrate.
- Phase 2: Construction Design and Definition included further development of the project including design, environmental reporting, and planning based on the outcomes of Phase 1 and is the object of this report.
- Phase 3: Implementation focused on the completion of works outlined in Phase 2.

The selected restoration area is located approximately 8 km upstream of Castlegar along the Columbia River, downstream from the Hugh Keenleyside Dam.

Golder Associates Ltd.
Suite 200 - 2920 Virtual Way, Vancouver, British Columbia, V5M 0C4, Canada T: +1 604 296 4200 F: +1 604 298 5253

A cursory review of the substrate acid-rock drainage (ARD)/ metal leaching (ML) testing results provided in a summary report (Metro Testing + Engineering, Attachment 1 [Metro]), and supplied to WSP Golder by BC Hydro found elevated levels of potentially leachable aluminium. BC Hydro requested further review by WSP Golder with a specific focus on aluminum. WSP Golder then met with BC Hydro on 9 September 2022 to discuss the review findings. A customized toxicity testing program with standard test organisms was developed, and WSP Golder was retained by BC Hydro to implement the program using Columbia River water collected within the vicinity of the CLBWORKS-27 site and the substrate from the quarry in Nelson.

3.0 SUMMARY REPORT REVIEW FINDINGS

Acid rock drainage and ML testing was conducted by Metro on the proposed substrate. The report concluded that '*samples tested unlikely have the potential to produce acid rock drainage*' and that the '*Results of shake flask extraction (SFE) leachate test indicate the potential of metal leaching is low in general, except for one metal (aluminum) with elevated concentration for sub-samples 01&02*.' BC Hydro requested that WSP Golder provide additional interpretation on the reported levels of leachable aluminum.

Aluminum in the SFE leachate was consistently above the BC short-term (maximum) water quality guideline for the protection of aquatic health (0.1 mg/L) by up to 12 times. Review of the SFE test methods and results suggest that it is possible that the elevated aluminum concentrations in the shake flask leachate could be a product of the method and mineralogical characteristics of the test materials, subject to confirmation by mineralogical analysis. Shake flask extractions involve crushing the test material to a fine grain size, placing the material in a flask with water at a 3:1 liquid to solid ratio, and agitating the sample on a shake plate for 24 hours. The two samples (S01 and S02) with elevated aluminum concentrations in the SFE tests are granites, which could potentially contain higher concentrations of aluminum-bearing clay minerals. These minerals are typically very fine-grained and tend to occur in clumps. The clumps can potentially break apart during agitation in the SFE tests, possibly resulting in artificially elevated aluminum concentrations in the leachate, and an overestimation of aluminum and potentially other metals (depending on mineralogy).

Due to limitations regarding the Phase 3 construction schedule, mineralogical analysis which can take months to complete, was not considered a feasible option by BC Hydro. Discussion with BC Hydro identified the possibility that supplemental information relevant to the decision-making process could be obtained by conducting toxicity testing using field-collected water because this provides a direct measurement whether the increased aluminum levels in the laboratory SFE tests were reflected in adverse impacts in the field. The testing would be conducted on Columbia River water from the future construction site previously exposed to the proposed substrate or exposed to the proposed substrate during testing.

4.0 TOXICITY TESTING STUDY

4.1 Objective

The overall objective of the toxicity testing study was to determine if river water exposed to the proposed substrate, under simulated field conditions and conditions of ambient water quality has aluminum in bioavailable forms, as assessed through acute lethality testing using Rainbow Trout (*Oncorhynchus mykiss*) or the standard invertebrate toxicity testing species *Daphnia magna* in customized toxicity tests. The information and data collected was provided to BC Hydro to facilitate their decision-making process regarding the use of the substrate at the future construction site. Because WSP Golder did not design or oversee the full testing program, WSP Golder cannot provide BC Hydro or other parties with advice on whether or not to use the proposed substrate in the project. Ultimately, this is a risk-based decision for BC Hydro to make. The toxicity testing work provides an additional line of evidence to aid that decision-making but is not suitable for sole reliance.

4.2 Methods

4.2.1 Toxicity Testing

4.2.1.1 Sample Collection

River water was collected for toxicity testing on 17 September 2022 at the Columbia River downstream from the Hugh Keenleyside Dam (Figure 1). WSP Golder personnel moved approximately two meters into the river from the shore to collect the river water (see Figure 3). Water was collected from 30 centimetres below the surface, and three carboys were filled to exceed the volume requirements for the acute toxicity testing. Rock substrate from the 4-mile pit in Nelson BC was provided to WSP Golder by BC Hydro and was collected in three 20-L pails (Figure 2). WSP Golder has assumed that the rock tested is representative of the rock that will be used for the proposed substrate. The river water for toxicity testing and substrate samples were transported to Calgary, AB where they were submitted to Nautilus Environmental (Nautilus) for toxicity testing. The carboys were packed on ice, stored at approximately 4°C, and were received by the laboratory within the recommended holding time and in good condition.

Figure 1: Water Sampling Location at the Proposed Construction Site in the Columbia River Downstream from the Hugh Keenleyside Dam

Figure 2: "Typical" Rock for the Proposed Spawning Substrate Mixture Sourced from the 4-Mile Pit, Nelson, BC

4.2.1.2 Toxicity Testing

Two toxicity tests were performed to address the study objective: a Rainbow Trout 96-hour acute toxicity test and a *D. magna* 48-hour acute toxicity test. Each test included a laboratory control, a river water control (river water only), and test water previously exposed to the substrate or exposed during testing, as described below.

- *Rainbow trout test*: this test was set up using a vessel with the substrate at the bottom of the tank with the river water overlain. To prevent the fish from hiding in the substrate, an inert Nitex® screen was used to cover the substrate.
- *D. magna test*: an additional vessel was set up with the substrate, river water, and a Nitex screen. This vessel was left for 48 hours before the overlying river water was collected and used for the *D. magna* testing. This method was used because the *D. magna* test containers could not accommodate the size of the substrates.

Water quality samples were collected from the vessel at initiation (i.e., after vessel set up) and at completion (at 96 hours for the Rainbow Trout test and at 48 hours for the *D. magna* test). Water quality samples were submitted to ALS Environmental, Calgary, Alberta (ALS) for analysis of the following parameters:

- conventional parameters – laboratory pH, specific conductivity, total alkalinity (as $CaCO_3$), total suspended solids (TSS), and total dissolved solids (TDS)
- major ions
- nutrients – total ammonia, nitrate, and nitrite
- dissolved organic carbon (DOC)
- total and dissolved metals

The water quality dataset was screened against applicable BC Water Quality Guidelines for the protection of freshwater aquatic life (BC ENV 2021).

4.2.2 Supporting Field Water Quality Sample Collection

WSP Golder collected a water quality sample from the Columbia River on 17 September 2022. Water was collected from 30 centimetres below the surface. Field measurements were collected using a YSI Pro DSS. Water quality samples were submitted to ALS for analysis of the following parameters:

- conventional parameters – laboratory pH, specific conductivity, turbidity, total alkalinity (as $CaCO_3$), TSS, TDS
- major ions
- nutrients – total ammonia, total Kjeldahl nitrogen, nitrate, nitrite, and total and dissolved phosphorus
- total and dissolved organic carbon
- total and dissolved metals

The water quality dataset was screened against applicable BC Water Quality Guidelines for the protection of aquatic life (BC ENV 2021).

4.2.3 Quality Assurance and Quality Control

4.2.3.1 Sample Collection

A duplicate sample was prepared by Nautilus during the collection of the Rainbow Trout termination sample. The duplicate sample was prepared using the same method as the original sample. This quality control sample was used to measure variability in the vessel and the precision of sample collection methods and laboratory analyses.

A field blank was prepared during the river water collection and sampling event to detect potential contamination during sample collection, handling, shipping, and analyses. A set of sample bottles was filled with de-ionized water provided by ALS. The field blank was filtered and preserved, as required, following the same method as the primary water quality sample.

4.2.3.2 Data Evaluation

Differences between concentrations measured in the duplicate water sample were calculated as the relative percent difference (RPD) for each parameter. The RPD was calculated using the following formula:

$$Relative\ percent\ difference = \frac{|sample\ 1\ concentration - sample\ 2\ concentration|}{average\ concentration} \times 100\%$$

The RPD value for a given parameter was considered notable if:

- it was greater than 20%
- the concentrations in one or both samples were greater than or equal to five times the DL

The number of parameters with exceedances of the assessment criteria was compared with the total number of parameters analyzed to evaluate analytical precision. Analytical precision was rated as follows:

- high if less than 10% of the total number of parameters were notably different from one another
- moderate if 10 to 30% of the total number of parameters were notably different from one another
- low if more than 30% of the total number of parameters were notably different from one another

Concentrations in field blanks were considered notable if they were greater than or equal to five times the corresponding detection limit (DL).

5.0 RESULTS

5.1 Site Characterization

The Columbia River upstream of Castlegar is a large, fast-flowing river (Figure 3). In situ field measurements show that the river was slightly alkaline (pH of 7.9) and well oxygenated (dissolved oxygen saturation of 100%) at the time of sampling. The water depth at the sampling location was approximately 1 metre.

Figure 3: Columbia River Sampling Location at the Proposed Construction Site in the Columbia River Downstream from the Hugh Keenleyside Dam

5.2 Toxicity Testing

The toxicity test results provided in Attachment 2 confirm that standard validation criteria were met with 100% survival in the laboratory and river water controls for both the Rainbow Trout and *D. magna* tests. In summary, results of acute toxicity testing on Rainbow Trout and *D. magna* in river water exposed to the proposed substrate indicated no adverse effects for either organism. In both cases, the laboratory reported 100% survival in 100% (v/v) samples as well as no influence on the mobility of *D. magna* (Table 5.2).

Table 5.2: Rainbow Trout and *Daphnia magna* Toxicity Endpoints and Results, September 2022

Test Organism and Measurement	Concentration of Lake Water at Test Endpoint (as %vol/vol)
Rainbow Trout (*Oncorhynchus mykiss*)	
Survival LC_{50}	>100
Water flea (*Daphnia magna*)	
Survival LC_{50}	>100
Mobility IC_{25}	>100

LC = lethal concentration; IC = inhibition concentration.

5.3 Supporting Water Quality

Water quality results from both the river water sample collected at the sampling location and during the toxicity testing are provided in the Certificate of Analyses included in Attachment 3.

5.3.1 Columbia River Sampling Location

Parameter concentrations in the Columbia River sample are presented in Attachment 4, Table 1. The field and laboratory pH values (7.9 and 7.8) were within the guideline range of 6.5 to 9.0, and dissolved oxygen concentrations were above the long-term guideline for the protection of aquatic life (BC ENV 2021). Similarly, concentrations of major ions, nutrients, and metals were below all applicable BC short- and long-term guidelines for the protection of aquatic life.

5.3.2 Water Chemistry during Toxicity Testing

Aluminum concentrations measured during toxicity testing were an order of magnitude below those measured during the SFE tests, and concentrations were below both short- and long-term water quality guidelines. Water chemistry during toxicity testing was generally comparable to the river sample, with parameter concentrations measured below applicable water quality guidelines for the protection of aquatic life. For the few exceptions where long-term (30-day) water quality guideline exceedances were noted (Attachment 4, Table 2), measured concentrations were within ±20% of the guideline value, which is within the variability associated with the laboratory analysis and is therefore not reflective of a meaningful exceedance.

5.4 Quality Assurance and Quality Control

The results of the quality assurance/quality control assessment indicated that the water quality data collected were reliable for the purpose of this study. For the duplicate water sample, the RPD values were not notably different (i.e., <20%), with the exception of total titanium (Attachment 5, Table 1). Therefore, analytical precision was considered high and within-sample variability was considered low. Parameter concentrations in the field blank were below detection or within five times the DL, and results show no evidence of contamination during handling, transport, storage, and analyses (Attachment 5, Table 2).

6.0 SUMMARY

The results of the toxicity study indicated that leachable bioavailable aluminum in sufficient concentration to cause toxicity was not induced by the substrate in river water. The aluminum concentrations measured during toxicity testing were an order of magnitude below those measured in the leachate during the SFE tests and concentrations were below both short-term (maximum) and long-term (30-day) water quality guidelines.

The elevated aluminum concentrations observed in the SFE tests were likely the product of the SFE testing method, which is not representative of expected field conditions. Shake flask tests involve crushing the test material to a fine grain size, placing the material in a flask at a low liquid to solids ratio (3:1), and physically agitating the material for 24 hours. The SFE test conditions likely resulted in aluminum concentrations an order of magnitude higher than in the toxicity study that was conducted under test conditions more similar to field conditions.

7.0 STATEMENT OF LIMITATIONS

Standard of Care: Golder Associates Ltd. a member of WSP (WSP Golder) has prepared this technical memorandum in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this memorandum. No other warranty expressed or implied is made.

Basis and Use of the Technical Memorandum: This memorandum has been prepared for the specific objective, development and purpose described to WSP Golder by the Client. The factual data, and interpretations pertain to a specific project as described in this memorandum and are not applicable to any other project or site location. WSP Golder cannot be responsible for use of this memorandum, or portions thereof, unless WSP Golder is requested to review and, if necessary, revise the memorandum.

The information, recommendations and opinions expressed in this memorandum are for the sole benefit of the Client. No other party may use or rely on this memorandum or any portion thereof without WSP Golder's express written consent. Any other use of this memorandum by others is prohibited and is without responsibility to WSP Golder. The memorandum, all plans, data, drawings, and other documents as well as all electronic media prepared by WSP Golder are considered its professional work product and shall remain the copyright property of WSP Golder, who authorizes only the Client and Approved Users to make copies of the memorandum, but only in such quantities as are reasonably necessary for the use of the memorandum by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the memorandum or any portion thereof to any other party without the express written permission of WSP Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration, and incompatibility and therefore the Client cannot rely upon the electronic media versions of WSP Golder's memorandum or other work products.

The memorandum is of a summary nature and is not intended to stand alone without reference to the instructions given to WSP Golder by the Client, communications between WSP Golder and the Client, and to any other memorandums prepared by WSP Golder for the Client relative to the specific site described in the memorandum. In order to properly understand the suggestions, recommendations and opinions expressed in this memorandum, reference must be made to the whole of the memorandum. WSP Golder cannot be responsible for use of portions of the memorandum without reference to the entire memorandum.

Unless otherwise stated, the suggestions, recommendations and opinions given in this memorandum are intended only for the guidance of the Client in the design of the specific project.

8.0 CLOSURE

We trust that the information presented in this assessment meets the project requirements. If you have any questions or require additional clarification, please contact the undersigned.

Golder Associates Ltd.

Mikayla Donovan, B.Sc.
Environmental Scientist

Chris Schuh, Ph.D., G.I.T.
Geochemist

COLLEGE OF APPLIED BIOLOGISTS
Elaine Irving
RPBio 2685
CAB

16 November 2022

Elaine Irving, Ph.D., RPBio.
Senior Environmental Scientist, Principal

COLLEGE OF APPLIED BIOLOGY
Lee Nikl
RPBio 601
CAB

16 November 2022

Lee Nikl, M.Sc., RPBio.
Senior Environmental Scientist, Fellow

MD/CS/EI/LN/asd/it/ss

Attachments: Attachment 1: Metro Testing + Engineering Summary Report – ARD/ML Testing of Rock/Aggregate Samples
Attachment 2: Nautilus Environmental Toxicity Test Results
Attachment 3: ALS Environmental Laboratory Certificate of Analyses
Attachment 4: Water Quality Data and Guideline Comparison
Attachment 5: Quality Assurance and Quality Control Data

REFERENCE

BC ENV (British Columbia Ministry of Environment and Climate Change Strategy). 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture— Guideline Summary. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C.

ATTACHMENT 1

Metro Testing + Engineering Summary Report ARD/ML Testing of Rock/Aggregate Samples

#18-3275 McCallum Road, Abbotsford BC V2S 7W8
Phone: 1.888.855.9733 Email: dispatch-vte@metrotesting.ca

Our Project File: SA41331-R00
Date: August 26, 2022

LANDMARK SOLUTIONS LTD.
PO BOX 87, SALMON ARM,
BC V1E 4N2

Attention: Reece Graham (LSL)
cc: Dave Muir (Metro T&E)

RE: Summary Report – ARD/ML Testing of Rock/Aggregate Samples
Source: 4 Mile Pit, 2306 Crystal Springs Road, Nelson, BC

1. INTRODUCTION

As requested, Metro Testing & Engineering (Metro T&E) has tested & examined one sample (rock segments) as extracted from the above site by our Salmon-Arm Branch. The sample materials were delivered to Metro's Abbotsford facility on July 13, 2022. Rock segments were further separated into three sub-samples (assigned as S01, S02 and S03) based on lithologies. Please reference Appendix A1 for samples as received.

The purpose is to evaluate Acid Rock Drainage/Metal Leaching (ARD/ML) potential, if any as per BC Government Technical Circular T04/2013, and to determine the suitability of the material proposed for rip rap, or other applications. The sample materials are summarized in the table below.

Table 1. Summary of Materials and Testing

Sample ID	Material Type	Source	ARD/ML Potential	Note/Sample location	Intended Application
SA41331-S01	Rock segments	4-Mile Pit site	Low potential of ARD; Low ML in general (with comment on aluminium)	Sub sample	Rip rap, erosion control, aggregate/ backfill
SA41331-S02	Rock segments			Sub sample	
SA41331-S03	Rock segments		Low potential of ARD/ML	Sub sample	
Note: Location or Blast #: n/a. Date: 2022-07-10; Ref. Appendix A1- Photo					

Summary

ARD/ML testing (static test) was completed, ABA results are interpreted as indicating the rock samples tested unlikely have the potential to produce acid rock drainage. Results of shake flask extraction (SFE) leachate test indicate the potential of metal leaching is low in general, except for one metal (aluminium) with elevated concentration for sub-samples 01&02.

It is understood that the requested testing items included ABA, solid phase metals and SFE leachate test, which are basic parameters used to characterize ARD/ML. Additional sampling and/or other testing items may be required subject to project requirements.

2.0 METHODOLOGY

Acid rock drainage forms when sulphide minerals in rocks are exposed to oxidizing conditions in coal and metal mining, highway construction, and other large-scale excavations. After being exposed to air and water, oxidation of metal sulphides within the surrounding rock and overburden generates acidity.

To evaluate the potential of ARD/ML, Metro T&E evaluated the material as per Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia and Government of **BC *Technical Circular T-04/20131***[1]*.* The evaluation included acid-base accounting laboratory analysis.

Interpretation of ARD Data[1-2]

Acid-base accounting is based on the premise that the propensity for a site to produce acid rock drainage can be predicted by quantitatively determining the total amount of acidity and alkalinity material on a site can potentially produce. The maximum potential acidity (MPA) is calculated using the Total Sulphur value (S%) or the calculated Sulphide value, which is material potentially convertible to sulphuric acid. The neutralization potential (NP) is determined by treating and heating the sample with standardized hydrochloric acid. The net neutralization potential (NNP) is calculated by subtracting the MPA from the NP, resulting in a positive or negative number.

A negative NNP indicates that acid generation is possible; a positive number indicates the sample is most likely not an acid producer. The NP/MPA ratio is also used to evaluate a sample's acid generating potential. The following scenarios are detailed in Technical Circular T-04/13:

- Scenario 1 - If the ratio is <1, the sample could be an acid generator (high potential) and is deemed unsuitable.
- Scenario 2 - If the ratio is <2 but >1, this indicates uncertainty and additional testing and analysis is required
- Scenario 3 - **if the sample's ratio is >2, the sample has a low potential being an acid generator**.

The paste pH test, which accompanies the acid-base accounting test, indicates immediately whether the rock is acid or alkaline. Acid generation may have already begun if the pH is significantly acidic.

The Fizz Rating test is another aspect of the acid-base accounting testing. This test is performed by adding 1 to 2 drops of 25% HCl to a prepared sample. The “fizz” is rated on a scale from 0 to 3; 0 being no reaction, 1 slight reaction, 2 moderate reaction, and 3 strong reaction. There should be a correlation between the NP and the Fizz Rating; for example, with a Fizz Rating of 3 we should see a positive NP. With a Fizz Rating of 0, there should be a very low positive or even a negative NP.

In general, sulphide-rich and carbonate-poor materials are expected to produce acidic drainage. In contrast, alkaline-rich materials (such as limestone), even with significant sulphide mineralogy often produce alkaline conditions in water.

Shake Flask Extraction (SFE) Leachate Test:

Shake flask extraction (SFE) leachate test includes the extraction and analysis of leachate for

major parameters and dissolved metals. In the program data (leachable metals) were further compared to BC Hazardous Waste Regulation (BCHWR) and BC Water Quality Guidelines (BC WQGs) for Aquatic Life.

3.0 TESTING RESULTS

3.1 Visual Observation

The nominal size of rock samples was up to 150 mm minus. Rock samples were further crushed for geochemical analysis. A brief review indicates rock sample as received includes 3 sub-samples,

- S01 (~75% of total sample as estimated) and S02 (~15%) are of granitic rock (granite & diorite) with K-spar & plagioclase feldspar, fresh, pink/pale & black speckled.
- Sample S03 (weighted the remaining of the sample, ~10%) included mafic volcanics (basalt). No sulphide mineralogy was observed, dense, fresh, light to dark grey.

The risk of generating ARD for all three sub-samples is low based on rock minerology.

3.2 ARD/ML Potential

The samples were evaluated using acid-base accounting analysis (ABA) and metals. The results are summarized in Table 2. A certified copy of the analysis is attached in Appendix A.

Table 2. Summary of Acid-Base Accounting Data

Sample ID	S %	MPA t $CaCO_3$ /1000t	NP t $CaCO_3$ /1000t	NNP t $CaCO_3$ /1000t	NP/MPA ratio	Paste pH	Fizz Rating
SA41331-S01	0.06	<0.3	4.9	4.9	N/A (>/=16.3)	8.9	0
SA41331-S02	<0.01	<0.3	11.6	11.6	N/A (>/=38.7)	8.7	0
SA41331-S03	0.14	1.3	75.7	74.5	60.6	8.6	3

Note: MPA = 31.25 x S% (sulphide) and NNP=NP-MPA

The acid-base accounting test results show that the NNP values ranged from about 4.9 to 74.5 t$CaCO_3$/1000t rock. The positive NNP value indicates that the rock material is not likely to be acid producer.

When total sulphate content is low, the NP/MPA ratio is commonly calculated for reference only. All ratios including that in brackets were larger than 2, not indicating that the samples have a potential of generating acid. The paste pH values ranged from 8.6 to 8.9. The values show an alkaline condition and indicates the absence of acid rock generation if any. The materials -01 &02 had a fizz rating of 0, indicating no reaction; for sample -03 with a rating of 3, strong reaction with hydrochloric acid.

A review of “Metals by Aqua Regia Digestion with ICP-MS finish” indicates that the data, including calcium and sulphur concentration support the above findings in terms of NP and soluble sulphur.

Based on the above chemical analysis, it is our opinion that these samples are unlikely to have a potential for acid rock generation, i.e. all classified as non-PAG.

Additional static test: Shake flash extraction (SFE)

Please reference to **Appendix B,** a letter from Metro's Environmental division, including detailed SFE data and interpretation (a comparison with BC HWR and WQGs).

- The concentrations of metals were less than BC HWR leachate Quality Standards.
- When compared to BC WQGs requirements, noted, there some exceedance on Al, Cu, Fe, Zn. But all less than short-term max WQG, and/ 10x WQGs (guideline for long and/ short term) except for aluminium for Samples -01& 02. Therefore, the potential of metal leaching is considered low based on detected concentrations of leachable metals of the samples *excepted for aluminium elevated*.

It is understood that subject to requirements for a specific project, a different criterion or guideline may be applied for comparison.

4.0 CONCLUSIONS AND CLOSURE

A review of the results of ABA & SFE analysis indicates that for three (3) rock samples,

- the potential to produce acid rock drainage is low, classified as non-PAG;
- the potential of metal leaching is low, except for aluminium with elevated concentration as per SFE data.

Client should be aware that current round of testing of sample materials is for a basic indication of ARD/ML. Additional sampling and/or other testing items may be required subject to project requirements. The material source should be monitored on an on-going basis for the amount of sulphide mineralogy. If an increase in sulphide mineralogy is noted then the material sources should be re-evaluated for ARD/ML performance.

I trust this report meets your needs. Should you have any questions, please contact the office at your convenience.

Metro Testing & Engineering Ltd.

Yours truly,

Per:

Henry H. Xu Ph.D., P.Eng.
Sr. Materials Engineer
August 26, 2022

References:

1. Government of BC Technical Circular T-04/2013, “Evaluating the potential for ACID ROCK DRAINAGE AND METAL LEACHING at quarries, rock cut sites and from stockpiled rock or talus materials used by the MOTI”, 2013.
2. Guidelines for Metal Leaching and Acid Rock Drainage at Mine sites in British Columbia, August,1998.

Use of Report & Limitations:

Metro Testing & Engineering (Abbotsford) prepared the foregoing report for the exclusive use and information of **Landmark Solutions Ltd.** The information and data were collected and compiled in accordance with the general level of care and skill normally exercised by geoscience and engineering professionals practising under similar circumstances. The testing/investigation was limited to the scope of work specifically addressed in the report. Any use by a third party of the foregoing report, or any reliance upon or decisions made by a third party based upon them is the sole responsibility of such third parties. Metro accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on the foregoing report. All documentation contained in the foregoing report has been prepared in accordance with the requirements in the TC T-04/2013.

Appendix A1 Photos

(Images for reference only)

Photo 1 Rock Samples Collected for Testing (sub-sample -S01-S02 to S03, left to right)

Appendix A2

ABA & Metal Analysis Report /Certificate

Appendix B

SFE testing and data analysis (Letter)

Appendix A2

CERTIFICATE OF ANALYSIS ▪ COVER PAGE

Global ARD Testing Services Inc.

CLIENT INFORMATION	
Client:	Metro Testing & Engineering Ltd.
Project Manager:	Henry Xu
Mailing Address	3275 McCallum Rd, Suite 18
	Abbotsford, BC, V2S 7W8
Contact No:	(604) 855-6568

COMPANY INFORMATION	
Legal Name:	Global ARD Testing Services Inc.
Mailing Address:	6891 Antrim Avenue
	Burnaby, BC
	V5J 4M5
Contact No:	
	Main: (604) 428-2730
	Alternate: (604) 603-1359

PROJECT INFORMATION	
Project Name:	N/A
Project Number:	SA41331

REPORTING	
Global Project No:	2271
Report Version:	1
Pages (Including Cover):	4
Report Title:	COA x3 SA41331 Sample (rec'd 18-Jul22)
Analysis Reviewed By:	Prab Bhatia (Pbhatia@globalARDtesting.com)
Position:	Project Manager
Report Certified By:	Prab Bhatia
Signature:	Prab Bhatia

RESULTS		
Reported To:	**1**	Henry Xu (henryxu@metrotesting.ca)
	2	
	3	
	4	
Date Reported:		
	Version-1:	August 16, 2022

INVOICE		
Submitted To:	**1**	Sharla David (sdavid@metrotesting.ca)
	2	Henry Xu (henryxu@metrotesting.ca)
	3	
	4	
Global Invoice No:		ARD2271-0822A
Date Submitted:		August 16, 2022

NOTES
All samples and pulps are stored at no charge for 90 days past reporting date.
Please contact the lab if you would like to continue storage past 90 days.
Storage charges will apply.

CERTIFICATE OF ANALYSIS ▪ SAMPLE DETAILS

Global ARD Testing Services Inc.

GLOBAL PROJECT NO: 2271

CLIENT: Metro Testing & Engineering Ltd.

PROJECT NAME: N/A

PROJECT NO: SA41331

REPORT VERSION: 1

S. No.	Sample ID	Sample Description	Condition (Wet/Dry)	Wt. of Sample Rec'd (kg)	Global Notes (if any)
1	SA41331-01	Rock	Dry	1.45	
2	SA41331-02	Rock	Dry	1.35	
3	SA41331-03	Rock	Dry	1.45	

Total wt of sample rec'd (kg): **4.25**

Sample Receipt Info:	
Date Samples Received:	July 18, 2022
No. of Samples Received:	1
Samples Received By:	Garry

Analytical Instructions:	
From:	Henry Xu
Date:	as per email confirmation.
	July 18, 2022

CERTIFICATE OF ANALYSIS ▪ ABA RESULTS

Global
ARD Testing Services Inc.

GLOBAL PROJECT NO: 2271
CLIENT: Metro Testing & Engineering Ltd.
PROJECT NAME: N/A
PROJECT NO: SA41331
REPORT VERSION: 1

							Modified ASTM D2492-02 Method						
S. No.	**Sample ID**	**Paste pH**	**Fizz Rating**	**Total Inorganic C**	**$CaCO_3$ Equivalents[*1]**	**Total Sulphur**	**Sulphate Sulphur**	**Sulphide Sulphur**	**Non-Extractable Sulphur[*2]**	**AP[*3]**	**Mod. ABA NP**	**NNP[*4]**	**NPR[*5]**
	Units:	**pH Units**		**wt %**	**kg CaCO3/tonne**	**wt %**	**wt %**	**wt %**	**wt %**		**kg CaCO3/tonne**		
	Reported Detection Limit:	***0.1***		***0.02***	***1.7***	***0.01***	***0.01***	***0.01***	***0.01***	**0.3**	***0.5***		
1	SA41331-01	8.9	None	0.12	10.0	0.06	<0.01	<0.01	0.06	<0.3	4.9	4.9	N/A
1	SA41331-02	8.7	None	0.11	9.2	<0.01	<0.01	<0.01	<0.01	<0.3	11.6	11.6	N/A
1	SA41331-03	8.6	Strong	0.94	78.3	0.14	0.02	0.04	0.08	1.3	75.7	74.5	60.6
	QUALITY ASSURANCE / QUALITY CONTROL												
Pulp Replicates:													
	%RPD												
Reference Material Analysis:													
Reference Material		NBM-1		KZK-1			RTS-3a	KZK-1			1) NBM-1 (Slight) 2) NBM-1 (Moderate)		
Ref. Material Certified Value		**8.45**		**0.92**			**1.10**	**0.37**			**1) 46.6 2) 52.3**		
Reference Material Results		8.42		0.98		102%	1.02	0.34			1) 43.6 2) N/A		
Tolerance (+/-), Acceptance		***90% - 110%***		***80% - 120%***		***90% - 110%***	***90% - 110%***	***80% - 120%***			***90% - 110%***		
Method Blank Analysis:													
Method Blank Results				<0.02		<0.01	<0.01	<0.01					
GLOBAL SOP NO./METHOD:		*ARD-004*	*ARD-007*	*HCl Leach CO2 Coulometer*	*Calc.*	*LECO*	*ARD-013 (Seq. HCl/HNO3 leach)*		*Calc.*	*Calc.*	*ARD-005*	*Calc.*	*Calc.*

NOTES:
Job No: 22V924049

Date of Analysis (24 h): July 25-26, 2022
pH of DI water used (pH units): 5.68
EC of DI water used (µS/cm): 1.18

METHODS:
Total sulphur by Leco.
Total Inorganic Carbon (TIC): HCl leach, evolved CO_2 analysed by CO_2 Coulometer.

ABBREVIATIONS:
R = Rep = Replicate (a replicate is a sub-sample scooped from a single pulp sample bag produced per client sample)
D = Dup = Duplicate (a duplicate is 2nd sub-pulp sample bag produced by processing a 2nd split of the client sample. A duplicate pulp sample is prepared only at client request.
EC = Electric Conductivity
NP = Neutralization Potential
Calc. = Calculation
IND = Indeterminate
COA = Certificate Of Analysis
N/A = Not Applicable
NR = Not Reported

CALCULATIONS:
*1 $CaCO_3$ Equivalents: Is based on TIC (Total Inorganic Carbon)
*2 Non-Extractable Sulphur: Total sulphur - (sulphate sulphur + sulphide sulphur)
*3 AP (Acid Potential): Sulphide-sulphur x 31.25
*4 NNP (Net Neutralization Potential): NP - AP
*5 NPR (Neutralization Potential Ratio): NP/AP

REFERENCES:
Sample Preparation: ASTM E877-08; MEND Report 1.20.1, Version 0 (2009)
ABA: Air-dried, jaw-crushed, split by riffling and pulverized to 85% passing 200 mesh (75 µm).
Modified ABA (Sobek) NP: MEND Acid Rock Drainage Prediction Manual, MEND Project 1.16.1b (pages 6.2-11 to 17), March 1991.
Paste pH / Fizz Rating: Sobek, A.A., Schuller, W.A., Freeman, J.R. and Smith, R.M.; US EPA-600/2-78-054 (1978).
Sulphur Speciation: Modified ASTM D2492-02 Method. The S extracted is determined by analysing the extract for SO4 using UV-Vis Spectrophotometer (STD Method 4500-SO42- E).

Global
ARD Testing Services Inc.

CERTIFICATE OF ANALYSIS ▪ METALS RESULTS BY AQUA REGIA DIGEST & ICP-MS ANALYSIS ON SOLIDS (Code IMS-130)

GLOBAL PROJECT NO: 2271
CLIENT: Metro Testing & Engineering Ltd.
PROJECT NAME: N/A
PROJECT NO: SA41331
REPORT VERSION: 1

S. No.	Sample ID	Method	IMS-130																									
		Analyte	Silver (Ag)	Aluminum (Al)	Arsenic (As)	Gold (Au)	Boron (B)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Calcium (Ca)	Cadmium (Cd)	Cerium (Ce)	Cobalt (Co)	Chromium (Cr)	Cesium (Cs)	Copper (Cu)	Iron (Fe)	Gallium (Ga)	Germanium (Ge)	Hafnium (Hf)	Mercury (Hg)	Indium (In)	Potassium (K)	Lanthanum (La)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)
		Unit	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm
		MDL	0.01	0.01	0.1	0.0005	10	10	0.05	0.01	0.01	0.01	0.02	0.1	1	0.05	0.2	0.01	0.05	0.05	0.02	0.005	0.005	0.01	0.2	0.1	0.01	5
		Sample Type																										
1	SA41331-01	Pulp	0.18	0.32	0.7	<0.0005	<10	36	0.17	0.06	0.16	0.10	31.29	1.0	90	1.17	4.3	0.71	2.31	<0.05	0.05	<0.005	0.006	0.18	17.0	6.9	0.07	187
1	SA41331-02	Pulp	0.03	2.05	0.6	<0.0005	<10	130	0.10	0.02	0.62	0.08	12.08	13.1	85	2.16	5.4	3.14	7.50	0.10	0.08	<0.005	0.007	0.75	6.5	28.1	1.64	532
1	SA41331-03	Pulp	0.14	2.38	1.5	<0.0005	<10	683	0.68	0.06	2.48	0.07	63.81	24.2	146	2.94	34.9	5.02	12.98	0.17	0.63	<0.005	0.026	0.79	28.2	49.7	3.27	846
QUALITY ASSURANCE / QUALITY CONTROL																												
Pulp Replicates																												
Reference Material																												
STD OREAS 601			49.44	0.800	304.1	0.771	<10	283	0.62	20.41	1.06	7.82	44.5	4.60	45.0	1.99	1027.4	2.19	5.17	0.13	0.70	0.332	1.670	0.250	21.3	7.90	0.190	450
True Value STD OREAS 601			**49.40**	**0.826**	**305.0**	**0.774**	**<10**	2714	**0.62**	**20.60**	**1.07**	**7.81**	**44.8**	**4.70**	**44.2**	**1.98**	**1010.0**	**2.20**	**5.17**	<0.1	**<1**	**<3**	**1.680**	**0.251**	**21.2**	**7.95**	**0.195**	**450**
% Difference			0%	-3%	0%	0%			0%	-1%	-1%	0%	-1%	-2%	2%	1%	2%	0%	0%				-1%	0%	0%	-1%	-3%	0%
Method Blank:																												
Method Blank			<0.01	<0.01	<0.1	<0.0005	<10	<10	<0.05	<0.01	<0.01	<0.01	<0.02	<0.1	<1	<0.05	<0.2	<0.01	<0.05	<0.05	<0.02	<0.005	<0.005	<0.01	<0.2	<0.1	<0.01	<5

Notes:

Job No: YVR2210813

Analytical Methods (IMS-130):

A 0.5 g of pulp sample is leached in hot (95°C) 3:1 aqua regia followed by ICP-AES/ICP-MS analysis. Gold determinations by this method are semi-quantitative due to the small sample weight used (0.5 g).

Abbreviations:

R / Rep = Replicate (a replicate is a sub-sample scooped from a single sample bag produced per client sample)

D / Dup = Duplicate (a duplicate is 2nd sub-sample bag produced by processing a second split of the original client sample received)

MDL = Measurable Detection Limit

COA: Certificate Of Analysis.

IND = Indeterminate

NR: Not reported in COA

On CRM:

OREAS 601 was prepared from gold-silver-copper bearing ore from Evolution Mining's Mount Carlton Operation in Queensland, Australia and blended with argillic rhyodacite waste rock to achieve the desired grades. The mineralisation assemblage consists of pyrite, enargite/tennantite, tetrahedrite, digenite, covellite, sphalerite, galena, alunite, dickite, kaolinite and vuggy silica, hosted in advanced argillic altered rhyodacite containing sulphur-salts. OREAS 601 is one of a suite of six CRMs ranging in grades from 24ppm Ag, 0.2 ppm Au and 0.05% Cu to 980ppm Ag, 1.7ppm Au and 5.0% Cu.

On Tolerance:

Any one element in a run reporting outside tolerance limits does not constitute failure of the standard.

All 'True Values' indicated in green are indicative values as per Certificate Of Analysis (COA) - not certified values.

Global
ARD Testing Services Inc.

CERTIFICATE OF ANALYSIS ▪ METALS RESULTS BY AQUA REGIA DIGEST & ICP-MS ANALYSIS ON SOLIDS (Code IMS-130)

GLOBAL PROJECT NO: 2271
CLIENT: Metro Testing & Engineering Ltd.
PROJECT NAME: N/A
PROJECT NO: SA41331
REPORT VERSION: 1

S. No.	Sample ID	Method	IMS-130																										
		Analyte	Molybdenum (Mo)	Sodium (Na)	Niobium (Nb)	Nickel (Ni)	Phosphorous (P)	Lead (Pb)	Rubidium (Rb)	Rhenium (Re)	Sulphur (S)	Antimony (Sb)	Scandium (Sc)	Selenium (Se)	Tin (Sn)	Stronium (Sr)	Tantalum (Ta)	Tellurium (Te)	Thorium (Th)	Titanium (Ti)	Thallium (Tl)	Uranium (U)	Vandium (V)	Tungsten (W)	Yttrium (Y)	Zinc (Zn)	Zirconium (Zr)
		Unit	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
		MDL	0.05	0.01	0.05	0.2	10	0.2	0.1	0.001	0.01	0.05	0.1	0.2	0.2	0.2	0.01	0.01	0.2	0.005	0.02	0.05	1	0.05	0.05	1	0.5
		Sample Type																											
1	SA41331-01	Pulp	0.55	0.03	1.66	4.7	146	15.9	25.5	<0.001	0.07	0.07	0.8	0.3	0.8	14.4	<0.01	<0.01	16.3	0.028	0.17	3.39	5	0.11	6.34	29	1.1
1	SA41331-02	Pulp	0.33	0.03	0.34	31.6	1146	1.1	70.2	<0.001	<0.01	<0.05	2.7	<0.2	0.4	15.3	<0.01	<0.01	2.1	0.193	0.38	0.37	54	0.1	6.05	62	1.5
1	SA41331-03	Pulp	1.05	0.04	0.31	90.0	2693	6.0	50.8	<0.001	0.13	0.06	7.7	<0.2	0.5	194.9	<0.01	0.02	2.6	0.254	0.25	0.48	119	0.1	9.71	59	18.8
QUALITY ASSURANCE / QUALITY CONT																													
Pulp Replicates																													
Reference Material																													
STD OREAS 601			3.80	0.06	0.34	23.0	359	280.9	16.0	<0.001	1.04	21.11	1.80	12.2	2.60	36.1	<0.01	15.24	6.7	0.007	0.74	1.92	8.00	1.05	5.93	1281	26.6
True Value STD OREAS 601			**3.80**	**0.07**	**<1**	**24.1**	**360**	**283.0**	**16.0**	**<1**	**1.04**	**21.10**	**1.83**	**12.3**	**2.61**	**36.2**	**0.099**	**15.40**	**6.7**	**0.010**	**0.74**	**1.94**	**9.24**	**1.06**	**5.87**	**1293**	**26.7**
% Difference			0%	-14%		-5%	0%	-1%	0%		0%	0%	-2%	-1%	0%	0%		-1%	0%	-32%	0%	-1%	-13%	-1%	1%	-1%	0%
Method Blank:																													
Method Blank			<0.05	<0.01	<0.05	<0.2	<10	<0.2	<0.1	<0.001	<0.01	<0.05	<0.1	<0.2	<0.2	<0.2	<0.01	<0.01	<0.2	<0.005	<0.02	<0.05	<1	<0.05	<0.05	<1	<0.5

401 – 6741 Cariboo Road, Burnaby, BC V3N 4A3
t: 604.436.9111 **tf:** 1.844.732.2638

Project No.: SA41331
Date: 27 July 2022
Version: 1

Metro Testing & Engineering Ltd.
#18 – 3275 McCallum Road
Abbotsford BC
V2S 7W8

Attention: Mr. Hanfeng (Henry) Xu, Ph.D., P.Eng.

RE: Review of Shake Flask Extraction Data
4 Mile Pit, Nelson, BC

Metro Testing & Engineering Ltd. (Metro) is pleased to present the findings of the review of analytical data of three (3) aggregate samples (SA41331-S01, SA41331-S02, and SA41331-S03), collected from the above-referenced Site.

The aforementioned sample was delivered under a chain of custody to ALS Environmental Laboratories (Burnaby, BC) for analysis of metals by Shake Flask Extraction (SFE). The analytical data was compared to the BC Hazardous Waste Regulation (HWR)[1] Leachate Quality Standards and BC Approved[2] Water Quality Guidelines (WQGs) for Aquatic Life.

The analytical results are summarized below:

BC Approved Water Quality Guidelines (WQGs)						
Sample	**Parameters**	**Long-Term**	**Short-Term**	**10x Long-Term**	**10x Short-Term**	**HWR**
SA41331-S01	Aluminium	**>AS**	**>AS**	**>AS**	**>AS**	NS
	Copper	**DL>AS**	**DL>AS**	<AS	<AS	<AS
	Zinc	**DL>AS**	<AS	<AS	<AS	<AS
	Remaining Metals	<AS	<AS	<AS	<AS	<AS or NS
SA41331-S02	Aluminium	**>AS**	**>AS**	**>AS**	**>AS**	NS
	Copper	**>AS**	**>AS**	<AS	<AS	<AS
	Iron	NS	**>AS**	NS	<AS	NS
	Zinc	**DL>AS**	<AS	<AS	<AS	<AS
	Remaining Metals	<AS	<AS	<AS	<AS	<AS or NS

1 British Columbia Hazardous Waste Regulation; (BC Reg 63/88 including amendments up to BC Reg 64/2021); Dated 11 March 2021; BC Ministry of Environment and Climate Change Strategy, Victoria, British Columbia.
2 British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary; Water Quality Guideline Series WQG-20; Dated 2021; BC Ministry of Environment and Climate Change Strategy, Victoria, British Columbia.

BC Approved Water Quality Guidelines (WQGs)						
Sample	**Parameters**	**Long-Term**	**Short-Term**	**10x Long-Term**	**10x Short-Term**	**HWR**
SA41331-S03	Aluminium	**>AS**	**>AS**	<AS	<AS	NS
	Copper	**DL>AS**	**DL>AS**	<AS	<AS	<AS
	Zinc	**DL>AS**	<AS	<AS	<AS	<AS
	Remaining Metals	<AS	<AS	<AS	<AS	<AS or NS

Notes:
1. WQG varies with temperature, hardness, pH, and dissolved organic carbon (DOC); Temperature assumed to be 15°C; DOC assumed to range from 0.05 to 20 mg/L; Consult BC WQGs for further information.
2. <AS = Result(s) less than applicable standard/guideline; **>AS** = Result(s) exceeds applicable standard/guideline; **DL>AS** = Results less than laboratory detection limit, detection limit exceeds applicable standard/guideline; NS = No standard/guideline.

Analytical results are presented in Table 1, Attachment 1. The laboratory documents presented in Attachment 2.

If you have any further questions or require clarification, please feel free to contact the undersigned at 604-436-9111 or via email at enviro@metrotesting.ca.

Respectfully submitted,

Metro Testing & Engineering Ltd.

Prepared By:

Per: _____
Spencer Schoen, EPt
Environmental Scientist

Reviewed By:

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA U. NARANG

27/7/2022

Per: _____
Umaakant Narang, P.Eng.
Environmental Division Manager

Attachments:

1. Table 1 – Shake Flask Extraction Analytical Results
2. Laboratory Documents

PERMIT TO PRACTICE
METRO TESTING & ENGINEERING LTD.
RR SIGNATURE _____
RR EGBC ID # 122797
DATE 2022-07-27
PERMIT NUMBER: 1000648
Engineers and Geoscientists of British Columbia (EGBC)

Attachments

Attachment 1

Table 1 - Shake Flask Extraction Analytical Results

Sample No.	Leachate Quality Standards[1]	BC Approved WQG Long-term Average[2]	BC Approved WQG Short-term Maximum[2]	Calculated Long-term WQG	Calculated Short-term WQG	10x Long-term WQG	10x Short-term WQG	SA41331-S01	SA41331-S02	SA41331-S03
Date Sampled								17-Jul-2022	17-Jul-2022	17-Jul-2022
Lab Sample ID								VA22B6398-001	VA22B6398-002	VA22B6398-003
pH (Lab)								8.48	9.04	9.19
Hardness (mg/L)								23.0	13.6	17.3
Parameter										
Total Metals - SFE										
Aluminum[5]	NS	pH<6.5 = e(1.6-3.327*pH+0.402*pH^2)*1000 pH≥6.5 = 50	pH<6.5 = e(1.209-2.426*pH+0.286*pH^2)*1000 pH≥6.5 = 100	50.0	100.0	500	1,000	**1,100**	**1,200**	**248**
Antimony	NS	NS	NS	-	-	-	-	<0.1	<0.1	<0.1
Arsenic[6]	2,500	5	5	-	-	50	50	<1	<1	<1
Barium	100,000	NS	NS	-	-	-	-	21.9	10.2	103
Beryllium	NS	NS	NS	-	-	-	-	<0.5	<0.5	<0.5
Bismuth	NS	NS	NS	-	-	-	-	<0.5	<0.5	<0.5
Boron[6]	500,000	1,200	NS	-	-	12,000	12,000	<10	<10	<10
Cadmium	500	WQG = e[0.736 × ln(H) – 4.943]	WQG = e[1.03 × ln(H) – 5.274]	0.06	0.10	0.58	0.97	<0.05	<0.05	<0.05
Calcium	NS	NS	NS	-	-	-	-	8280	4320	5390
Chromium, total	5,000	NS	NS	-	-	-	-	<0.5	<1.02	<0.5
Cobalt[6]	NS	4	110	-	-	40	1,100	<0.1	0.3	<0.1
Copper[5]	100,000	Varies with Temperature, H, pH, and DOC[7]	Varies with Temperature, H, pH, and DOC[7]	0.2 - 11.1	1 - 66.4	2 - 111	10 - 664	**<1**	**1.2**	**<1**
Iron	NS	NS	350[5] / 1,000[6]	-	-	-	10,000	222	**557**	<30
Lead[6]	5,000	H≤8 = NS H>8 = 3.31 + e[1.273 ln (H) - 4.704]	H≤8 = 3 H>8 = e[1.273 ln (H) -1.460]	3.65	8.75	36.5	87.5	1.6	0.2	<0.1
Lithium	NS	NS	NS	-	-	-	-	<5	<5	<5
Magnesium	NS	NS	NS	-	-	-	-	554	684	941
Manganese[6]	NS	WQG = (0.0044*H+0.605)*1000	WQG = (0.01102*H+0.54)*1000	681.12	731	6,811	7,306	12.20	14.80	0.69
Mercury[6]	100	NS	WQG = 0.0001 / (MeHg/total Hg)	-	-	-	-	<0.05	<0.05	<0.05
Molybdenum[6]	NS	7,600	46,000	-	-	76,000	460,000	1.41	0.76	3.82
Nickel	NS	NS	NS	-	-	-	-	<0.5	0.63	<0.5
Phosphorus	NS	NS	NS	-	-	-	-	<300	<300	<300
Potassium	NS	NS	NS	-	-	-	-	3880	3280	4350
Selenium[6]	1,000	WQG = 2 Alert = 1	NS	-	-	10	-	0.65	<0.5	<0.5
Silicon	NS	NS	NS	-	-	-	-	5250	3290	2000
Silver[6]	5,000	H≤100 = 0.05 H>100 = 1.5	H≤100 = 0.1 H>100 = 3.0	1.5	3	15	30	<0.05	<0.05	<0.05
Sodium	NS	NS	NS	-	-	-	-	3060	1850	2620
Strontium	NS	NS	NS	-	-	-	-	42.2	24	105
Sulphur	NS	NS	NS	-	-	-	-	6210	<500	1400
Thallium	NS	NS	NS	-	-	-	-	<0.1	<0.1	<0.1
Tin	NS	NS	NS	-	-	-	-	<0.5	<0.5	<0.5
Titanium	NS	NS	NS	-	-	-	-	<10	39	<10
Uranium	10,000	NS	NS	-	-	-	-	0.816	0.196	0.02
Vanadium	NS	NS	NS	-	-	-	-	1.2	4.2	7.4
Zinc[6]	500,000	H≤90 = 7.5 H>100 = 7.5 + 0.75 (H - 90)	H≤90 = 33 H>100 = 33 + 0.75 (H - 90)	7.5	33	75	330	**<10**	**<10**	**<10**

Notes:

1. British Columbia Hazardous Waste Regulation; (BC Reg 63/88 including amendments up to BC Reg 64/2021); Dated 11 March 2021; BC Ministry of Environment and Climate Change Strategy, Victoria, British Columbia.
2. British Columbia Ministry of Environment and Climate Change Strategy. 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture - Guideline Summary. Water Quality Guideline Series, WQG-20. Prov. B.C., Victoria B.C.
3. All units are in µg/L unless otherwise specified.
4. **Definitions**
   Bold, underlined, and blue concentrations exceed the WQG.
   Bold, underlined, and red concentrations exceed 10x the WQG.
   Yellow shaded concentrations exceed the Leachate Quality Standards.
   Bold concentrations less than DL, but DL exceeds the WQG.
   DL = Laboratory detection limit.
   < - Less than laboratory detection limit
   - = Not analyzed
   NS = No standard
   N/A = Not applicable
   H means water hardness in mg/L $CaCO_3$.
5. Standard for dissolved concentrations.
6. Standard for total concentrations.
7. WQG varies with temperature, hardness, pH, and dissolved organic carbon (DOC). Temperature assumed to be 15°C. DOC assumed to range from 0.05 to 20 mg/L. Consult BC WQGs for further information.

Prepared By:SS
QAQC By: VA

Attachment 2

Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **VA22B6398**	Page	: 1 of 4
Client	: **Metro Testing & Engineering Ltd.**	Laboratory	: Vancouver - Environmental
Contact	: Henry Xu	Account Manager	: Sneha Sansare
Address	: 401-6741 Cariboo Rd. Burnaby BC Canada V3N 4A3	Address	: 8081 Lougheed Highway Burnaby BC Canada V5A 1W9
Telephone	: ----	Telephone	: +1 604 253 4188
Project	: Metro Project # SA41331	Date Samples Received	: 18-Jul-2022 10:10
PO	: ----	Date Analysis Commenced	: 19-Jul-2022
C-O-C number	: ----	Issue Date	: 25-Jul-2022 15:14
Sampler	: ----		
Site	: ----		
Quote number	: Standing Offer		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Angela Ren	Team Leader - Metals	Metals, Burnaby, British Columbia
Janice Leung	Supervisor - Organics Instrumentation	Organics, Burnaby, British Columbia
Lindsay Gung	Supervisor - Water Chemistry	Inorganics, Burnaby, British Columbia
Woochan Song	Lab Analyst	Metals, Burnaby, British Columbia

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
%	percent
mg/L	milligrams per litre
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior 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.

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

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

Sub-Matrix: **Crushed Rock**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	SA41331-S01	SA41331-S02	SA41331-S03	----	----
					Client sampling date / time	[17-Jul-2022]	[17-Jul-2022]	[17-Jul-2022]	----	----
						VA22B6398-001	VA22B6398-002	VA22B6398-003	--------	--------
						Result	Result	Result	----	----
Physical Tests										
moisture	----	E144	0.25	%		0.30	0.27	0.42	----	----
pH	----	E116	0.10	pH units		8.48	9.04	9.19	----	----
Leachable Metals										
aluminum, leachable	7429-90-5	E446	0.0050	mg/L		1.10	1.20	0.248	----	----
antimony, leachable	7440-36-0	E446	0.00010	mg/L		<0.00010	<0.00010	<0.00010	----	----
arsenic, leachable	7440-38-2	E446	0.0010	mg/L		<0.0010	<0.0010	<0.0010	----	----
barium, leachable	7440-39-3	E446	0.0010	mg/L		0.0219	0.0102	0.103	----	----
beryllium, leachable	7440-41-7	E446	0.00050	mg/L		<0.00050	<0.00050	<0.00050	----	----
bismuth, leachable	7440-69-9	E446	0.00050	mg/L		<0.00050	<0.00050	<0.00050	----	----
boron, leachable	7440-42-8	E446	0.010	mg/L		<0.010	<0.010	<0.010	----	----
cadmium, leachable	7440-43-9	E446	0.000050	mg/L		<0.000050	<0.000050	<0.000050	----	----
calcium, leachable	7440-70-2	E446	0.10	mg/L		8.28	4.32	5.39	----	----
chromium, leachable	7440-47-3	E446	0.00050	mg/L		<0.00050	0.00102	<0.00050	----	----
cobalt, leachable	7440-48-4	E446	0.00010	mg/L		<0.00010	0.00033	<0.00010	----	----
copper, leachable	7440-50-8	E446	0.0010	mg/L		<0.0010	0.0012	<0.0010	----	----
hardness (as CaCO3), dissolved	----	E446	0.60	mg/L		23.0	13.6	17.3	----	----
iron, leachable	7439-89-6	E446	0.030	mg/L		0.222	0.557	<0.030	----	----
lead, leachable	7439-92-1	E446	0.00010	mg/L		0.00156	0.00022	<0.00010	----	----
lithium, leachable	7439-93-2	E446	0.0050	mg/L		<0.0050	<0.0050	<0.0050	----	----
magnesium, leachable	7439-95-4	E446	0.050	mg/L		0.554	0.684	0.941	----	----
manganese, leachable	7439-96-5	E446	0.00050	mg/L		0.0122	0.0148	0.00069	----	----
mercury, leachable	7439-97-6	E515	0.000050	mg/L		<0.000050	<0.000050	<0.000050	----	----
molybdenum, leachable	7439-98-7	E446	0.00010	mg/L		0.00141	0.00076	0.00382	----	----
nickel, leachable	7440-02-0	E446	0.00050	mg/L		<0.00050	0.00063	<0.00050	----	----
phosphorus, leachable	7723-14-0	E446	0.30	mg/L		<0.30	<0.30	<0.30	----	----
potassium, leachable	7440-09-7	E446	0.050	mg/L		3.88	3.28	4.35	----	----
selenium, leachable	7782-49-2	E446	0.00050	mg/L		0.00065	<0.00050	<0.00050	----	----
silicon, leachable	7440-21-3	E446	0.050	mg/L		5.25	3.29	2.00	----	----
silver, leachable	7440-22-4	E446	0.000050	mg/L		<0.000050	<0.000050	<0.000050	----	----
sodium, leachable	7440-23-5	E446	0.050	mg/L		3.06	1.85	2.62	----	----
strontium, leachable	7440-24-6	E446	0.00050	mg/L		0.0422	0.0240	0.105	----	----

Analytical Results

Sub-Matrix: **Crushed Rock**
(Matrix: **Soil/Solid**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	SA41331-S01	SA41331-S02	SA41331-S03	----	----
					Client sampling date / time	[17-Jul-2022]	[17-Jul-2022]	[17-Jul-2022]	----	----
						VA22B6398-001	VA22B6398-002	VA22B6398-003	--------	--------
						Result	Result	Result	----	----
Leachable Metals										
sulfur, leachable	7704-34-9	E446	0.50	mg/L		6.21	<0.50	1.40	----	----
thallium, leachable	7440-28-0	E446	0.00010	mg/L		<0.00010	<0.00010	<0.00010	----	----
tin, leachable	7440-31-5	E446	0.00050	mg/L		<0.00050	<0.00050	<0.00050	----	----
titanium, leachable	7440-32-6	E446	0.010	mg/L		<0.010	0.039	<0.010	----	----
uranium, leachable	7440-61-1	E446	0.000010	mg/L		0.000816	0.000196	0.000020	----	----
vanadium, leachable	7440-62-2	E446	0.0010	mg/L		0.0012	0.0042	0.0074	----	----
zinc, leachable	7440-66-6	E446	0.010	mg/L		<0.010	<0.010	<0.010	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **VA22B6398**	Page	: 1 of 10
Client	: Metro Testing & Engineering Ltd.	Laboratory	: Vancouver - Environmental
Contact	: Henry Xu	Account Manager	: Sneha Sansare
Address	: 401-6741 Cariboo Rd. Burnaby BC Canada V3N 4A3	Address	: 8081 Lougheed Highway Burnaby, British Columbia Canada V5A 1W9
Telephone	: ----	Telephone	: +1 604 253 4188
Project	: Metro Project # SA41331	Date Samples Received	: 18-Jul-2022 10:10
PO	: ----	Date Analysis Commenced	: 19-Jul-2022
C-O-C number	: ----	Issue Date	: 25-Jul-2022 15:14
Sampler	: ----		
Site	: ----		
Quote number	: Standing Offer		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Angela Ren	Team Leader - Metals	Vancouver Metals, Burnaby, British Columbia
Janice Leung	Supervisor - Organics Instrumentation	Vancouver Organics, Burnaby, British Columbia
Lindsay Gung	Supervisor - Water Chemistry	Vancouver Inorganics, Burnaby, British Columbia
Woochan Song	Lab Analyst	Vancouver Metals, Burnaby, British Columbia

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include 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 predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 568265)											
VA22B5824-001	Anonymous	moisture	----	E144	0.25	%	40.3	46.0	13.2%	20%	----
Physical Tests (QC Lot: 573220)											
WR2200720-001	Anonymous	pH	----	E116	0.10	pH units	7.72	7.75	0.388%	5%	----
Leachable Metals (QC Lot: 573219)											
WR2200720-001	Anonymous	mercury, leachable	7439-97-6	E515	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
Leachable Metals (QC Lot: 573221)											
WR2200720-001	Anonymous	aluminum, leachable	7429-90-5	E446	0.0050	mg/L	0.315	0.232	30.4%	30%	DUP-H
		antimony, leachable	7440-36-0	E446	0.00010	mg/L	0.00041	0.00041	0.000005	Diff <2x LOR	----
		arsenic, leachable	7440-38-2	E446	0.0010	mg/L	0.0013	0.0011	0.0002	Diff <2x LOR	----
		barium, leachable	7440-39-3	E446	0.0010	mg/L	0.0053	0.0052	0.00006	Diff <2x LOR	----
		beryllium, leachable	7440-41-7	E446	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		bismuth, leachable	7440-69-9	E446	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		boron, leachable	7440-42-8	E446	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----
		cadmium, leachable	7440-43-9	E446	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		calcium, leachable	7440-70-2	E446	0.10	mg/L	25.8	28.9	11.5%	30%	----
		chromium, leachable	7440-47-3	E446	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		cobalt, leachable	7440-48-4	E446	0.00010	mg/L	0.00070	0.00054	0.00016	Diff <2x LOR	----
		copper, leachable	7440-50-8	E446	0.0010	mg/L	0.0036	0.0028	0.0009	Diff <2x LOR	----
		iron, leachable	7439-89-6	E446	0.030	mg/L	0.696	0.485	35.8%	40%	----
		lead, leachable	7439-92-1	E446	0.00010	mg/L	0.00093	0.00067	32.8%	30%	DUP-H
		lithium, leachable	7439-93-2	E446	0.0050	mg/L	<0.0050	<0.0050	0	Diff <2x LOR	----
		magnesium, leachable	7439-95-4	E446	0.050	mg/L	1.73	1.82	4.80%	30%	----
		manganese, leachable	7439-96-5	E446	0.00050	mg/L	0.0327	0.0301	8.27%	30%	----
		molybdenum, leachable	7439-98-7	E446	0.00010	mg/L	0.00049	0.00048	0.000005	Diff <2x LOR	----
		nickel, leachable	7440-02-0	E446	0.00050	mg/L	0.00082	0.00069	0.00012	Diff <2x LOR	----
		phosphorus, leachable	7723-14-0	E446	0.30	mg/L	<0.30	<0.30	0	Diff <2x LOR	----
		potassium, leachable	7440-09-7	E446	0.050	mg/L	1.35	1.33	1.49%	30%	----
		selenium, leachable	7782-49-2	E446	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		silicon, leachable	7440-21-3	E446	0.050	mg/L	1.90	1.86	1.68%	40%	----
		silver, leachable	7440-22-4	E446	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		sodium, leachable	7440-23-5	E446	0.050	mg/L	1.10	1.14	3.27%	30%	----

Sub-Matrix: **Soil/Solid**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Leachable Metals (QC Lot: 573221) - continued											
WR2200720-001	Anonymous	strontium, leachable	7440-24-6	E446	0.00050	mg/L	0.0636	0.0691	8.34%	30%	----
		sulfur, leachable	7704-34-9	E446	0.50	mg/L	15.2	16.2	6.37%	30%	----
		thallium, leachable	7440-28-0	E446	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		tin, leachable	7440-31-5	E446	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		titanium, leachable	7440-32-6	E446	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----
		uranium, leachable	7440-61-1	E446	0.000010	mg/L	0.000186	0.000192	2.91%	30%	----
		vanadium, leachable	7440-62-2	E446	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
		zinc, leachable	7440-66-6	E446	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----

Qualifiers

Qualifier	*Description*
DUP-H	*Duplicate results outside ALS DQO, due to sample heterogeneity.*

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 568265)						
moisture	----	E144	0.25	%	<0.25	----
Leachable Metals (QCLot: 573219)						
mercury, leachable	7439-97-6	E515	0.00005	mg/L	<0.000050	----
Leachable Metals (QCLot: 573221)						
aluminum, leachable	7429-90-5	E446	0.005	mg/L	<0.0050	----
antimony, leachable	7440-36-0	E446	0.0001	mg/L	<0.00010	----
arsenic, leachable	7440-38-2	E446	0.001	mg/L	<0.0010	----
barium, leachable	7440-39-3	E446	0.001	mg/L	<0.0010	----
beryllium, leachable	7440-41-7	E446	0.0005	mg/L	<0.00050	----
bismuth, leachable	7440-69-9	E446	0.0005	mg/L	<0.00050	----
boron, leachable	7440-42-8	E446	0.01	mg/L	<0.010	----
cadmium, leachable	7440-43-9	E446	0.00005	mg/L	<0.000050	----
calcium, leachable	7440-70-2	E446	0.1	mg/L	<0.10	----
chromium, leachable	7440-47-3	E446	0.0005	mg/L	<0.00050	----
cobalt, leachable	7440-48-4	E446	0.0001	mg/L	<0.00010	----
copper, leachable	7440-50-8	E446	0.001	mg/L	<0.0010	----
iron, leachable	7439-89-6	E446	0.03	mg/L	<0.030	----
lead, leachable	7439-92-1	E446	0.0001	mg/L	<0.00010	----
lithium, leachable	7439-93-2	E446	0.005	mg/L	<0.0050	----
magnesium, leachable	7439-95-4	E446	0.05	mg/L	<0.050	----
manganese, leachable	7439-96-5	E446	0.0005	mg/L	<0.00050	----
molybdenum, leachable	7439-98-7	E446	0.0001	mg/L	<0.00010	----
nickel, leachable	7440-02-0	E446	0.0005	mg/L	<0.00050	----
phosphorus, leachable	7723-14-0	E446	0.3	mg/L	<0.30	----
potassium, leachable	7440-09-7	E446	0.05	mg/L	<0.050	----
selenium, leachable	7782-49-2	E446	0.0005	mg/L	<0.00050	----
silicon, leachable	7440-21-3	E446	0.05	mg/L	<0.050	----
silver, leachable	7440-22-4	E446	0.00005	mg/L	<0.000050	----
sodium, leachable	7440-23-5	E446	0.05	mg/L	<0.050	----
strontium, leachable	7440-24-6	E446	0.0005	mg/L	<0.00050	----
sulfur, leachable	7704-34-9	E446	0.5	mg/L	<0.50	----
thallium, leachable	7440-28-0	E446	0.0001	mg/L	<0.00010	----
tin, leachable	7440-31-5	E446	0.0005	mg/L	<0.00050	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Leachable Metals (QCLot: 573221) - continued						
titanium, leachable	7440-32-6	E446	0.01	mg/L	<0.010	----
uranium, leachable	7440-61-1	E446	0.00001	mg/L	<0.000010	----
vanadium, leachable	7440-62-2	E446	0.001	mg/L	<0.0010	----
zinc, leachable	7440-66-6	E446	0.01	mg/L	<0.010	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 568265)									
moisture	----	E144	0.25	%	50 %	100	90.0	110	----
Physical Tests (QCLot: 573220)									
pH	----	E116	----	pH units	7.04 pH units	99.6	95.0	105	----
Leachable Metals (QCLot: 573219)									
mercury, leachable	7439-97-6	E515	0.00005	mg/L	0.0005 mg/L	84.1	50.0	130	----
Leachable Metals (QCLot: 573221)									
aluminum, leachable	7429-90-5	E446	0.005	mg/L	0.2 mg/L	87.6	70.0	130	----
antimony, leachable	7440-36-0	E446	0.0001	mg/L	0.1 mg/L	98.2	70.0	130	----
arsenic, leachable	7440-38-2	E446	0.001	mg/L	0.1 mg/L	93.1	70.0	130	----
barium, leachable	7440-39-3	E446	0.001	mg/L	0.025 mg/L	87.9	70.0	130	----
beryllium, leachable	7440-41-7	E446	0.0005	mg/L	0.01 mg/L	87.3	70.0	130	----
bismuth, leachable	7440-69-9	E446	0.0005	mg/L	0.1 mg/L	79.6	50.0	130	----
boron, leachable	7440-42-8	E446	0.01	mg/L	0.1 mg/L	82.9	70.0	130	----
cadmium, leachable	7440-43-9	E446	0.00005	mg/L	0.01 mg/L	90.3	70.0	130	----
calcium, leachable	7440-70-2	E446	0.1	mg/L	5 mg/L	83.0	70.0	130	----
chromium, leachable	7440-47-3	E446	0.0005	mg/L	0.025 mg/L	87.3	70.0	130	----
cobalt, leachable	7440-48-4	E446	0.0001	mg/L	0.025 mg/L	88.5	70.0	130	----
copper, leachable	7440-50-8	E446	0.001	mg/L	0.025 mg/L	92.8	70.0	130	----
iron, leachable	7439-89-6	E446	0.03	mg/L	0.1 mg/L	89.4	70.0	130	----
lead, leachable	7439-92-1	E446	0.0001	mg/L	0.05 mg/L	89.4	70.0	130	----
lithium, leachable	7439-93-2	E446	0.005	mg/L	0.025 mg/L	82.6	70.0	130	----
magnesium, leachable	7439-95-4	E446	0.05	mg/L	5 mg/L	88.8	70.0	130	----
manganese, leachable	7439-96-5	E446	0.0005	mg/L	0.025 mg/L	88.6	70.0	130	----
molybdenum, leachable	7439-98-7	E446	0.0001	mg/L	0.025 mg/L	92.3	70.0	130	----
nickel, leachable	7440-02-0	E446	0.0005	mg/L	0.05 mg/L	89.7	70.0	130	----
phosphorus, leachable	7723-14-0	E446	0.3	mg/L	1 mg/L	93.6	70.0	130	----
potassium, leachable	7440-09-7	E446	0.05	mg/L	5 mg/L	93.2	70.0	130	----
selenium, leachable	7782-49-2	E446	0.0005	mg/L	0.1 mg/L	87.4	70.0	130	----
silicon, leachable	7440-21-3	E446	0.05	mg/L	1 mg/L	90.6	70.0	130	----
silver, leachable	7440-22-4	E446	0.00005	mg/L	0.01 mg/L	84.9	50.0	130	----
sodium, leachable	7440-23-5	E446	0.05	mg/L	5 mg/L	93.9	70.0	130	----
strontium, leachable	7440-24-6	E446	0.0005	mg/L	0.025 mg/L	96.5	70.0	130	----
sulfur, leachable	7704-34-9	E446	0.5	mg/L	5 mg/L	86.7	70.0	130	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	Qualifier
Leachable Metals (QCLot: 573221) - continued									
thallium, leachable	7440-28-0	E446	0.0001	mg/L	0.11 mg/L	77.5	70.0	130	----
tin, leachable	7440-31-5	E446	0.0005	mg/L	0.05 mg/L	90.1	50.0	130	----
titanium, leachable	7440-32-6	E446	0.01	mg/L	0.025 mg/L	89.8	50.0	130	----
uranium, leachable	7440-61-1	E446	0.00001	mg/L	0.0005 mg/L	92.9	70.0	130	----
vanadium, leachable	7440-62-2	E446	0.001	mg/L	0.05 mg/L	90.9	70.0	130	----
zinc, leachable	7440-66-6	E446	0.01	mg/L	0.05 mg/L	95.2	70.0	130	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Leachable Metals (QCLot: 573219)										
WR2200720-002	Anonymous	mercury, leachable	7439-97-6	E515	0.000091 mg/L	0.0001 mg/L	91.1	70.0	130	----
Leachable Metals (QCLot: 573221)										
WR2200720-002	Anonymous	aluminum, leachable	7429-90-5	E446	0.168 mg/L	0.2 mg/L	84.1	70.0	130	----
		antimony, leachable	7440-36-0	E446	0.0214 mg/L	0.02 mg/L	107	70.0	130	----
		arsenic, leachable	7440-38-2	E446	0.0186 mg/L	0.02 mg/L	93.0	70.0	130	----
		barium, leachable	7440-39-3	E446	0.0185 mg/L	0.02 mg/L	92.3	70.0	130	----
		beryllium, leachable	7440-41-7	E446	0.0390 mg/L	0.04 mg/L	97.5	70.0	130	----
		bismuth, leachable	7440-69-9	E446	0.00978 mg/L	0.01 mg/L	97.8	70.0	130	----
		boron, leachable	7440-42-8	E446	0.091 mg/L	0.1 mg/L	91.1	70.0	130	----
		cadmium, leachable	7440-43-9	E446	0.00386 mg/L	0.004 mg/L	96.6	70.0	130	----
		calcium, leachable	7440-70-2	E446	ND mg/L	4 mg/L	ND	70.0	130	----
		chromium, leachable	7440-47-3	E446	0.0370 mg/L	0.04 mg/L	92.5	70.0	130	----
		cobalt, leachable	7440-48-4	E446	0.0186 mg/L	0.02 mg/L	92.8	70.0	130	----
		copper, leachable	7440-50-8	E446	0.0183 mg/L	0.02 mg/L	91.6	70.0	130	----
		iron, leachable	7439-89-6	E446	1.74 mg/L	2 mg/L	86.9	70.0	130	----
		lead, leachable	7439-92-1	E446	0.0193 mg/L	0.02 mg/L	96.6	70.0	130	----
		lithium, leachable	7439-93-2	E446	0.0936 mg/L	0.1 mg/L	93.6	70.0	130	----
		magnesium, leachable	7439-95-4	E446	ND mg/L	1 mg/L	ND	70.0	130	----
		manganese, leachable	7439-96-5	E446	ND mg/L	0.02 mg/L	ND	70.0	130	----
		molybdenum, leachable	7439-98-7	E446	0.0206 mg/L	0.02 mg/L	103	70.0	130	----
		nickel, leachable	7440-02-0	E446	0.0375 mg/L	0.04 mg/L	93.8	70.0	130	----
		phosphorus, leachable	7723-14-0	E446	9.50 mg/L	10 mg/L	95.0	70.0	130	----
		potassium, leachable	7440-09-7	E446	3.71 mg/L	4 mg/L	92.7	70.0	130	----
		selenium, leachable	7782-49-2	E446	0.0389 mg/L	0.04 mg/L	97.2	70.0	130	----
		silicon, leachable	7440-21-3	E446	9.19 mg/L	10 mg/L	91.9	70.0	130	----
		silver, leachable	7440-22-4	E446	0.00416 mg/L	0.004 mg/L	104	70.0	130	----
		sodium, leachable	7440-23-5	E446	1.79 mg/L	2 mg/L	89.4	70.0	130	----
		strontium, leachable	7440-24-6	E446	ND mg/L	0.02 mg/L	ND	70.0	130	----
		sulfur, leachable	7704-34-9	E446	ND mg/L	20 mg/L	ND	70.0	130	----
		thallium, leachable	7440-28-0	E446	0.00364 mg/L	0.004 mg/L	91.0	70.0	130	----
		tin, leachable	7440-31-5	E446	0.0192 mg/L	0.02 mg/L	96.2	70.0	130	----
		titanium, leachable	7440-32-6	E446	0.037 mg/L	0.04 mg/L	92.6	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Leachable Metals (QCLot: 573221) - continued										
WR2200720-002	Anonymous	uranium, leachable	7440-61-1	E446	0.00408 mg/L	0.004 mg/L	102	70.0	130	----
		vanadium, leachable	7440-62-2	E446	0.0940 mg/L	0.1 mg/L	94.0	70.0	130	----
		zinc, leachable	7440-66-6	E446	0.379 mg/L	0.4 mg/L	94.9	70.0	130	----

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **VA22B6398**	Page	: 1 of 7
Client	: **Metro Testing & Engineering Ltd.**	Laboratory	: Vancouver - Environmental
Contact	: Henry Xu	Account Manager	: Sneha Sansare
Address	: 401-6741 Cariboo Rd. Burnaby BC Canada V3N 4A3	Address	: 8081 Lougheed Highway Burnaby, British Columbia Canada V5A 1W9
Telephone	: ----	Telephone	: +1 604 253 4188
Project	: Metro Project # SA41331	Date Samples Received	: 18-Jul-2022 10:10
PO	: ----	Issue Date	: 25-Jul-2022 15:14
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: Standing Offer		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- Duplicate outliers occur - please see following pages for full details.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **Soil/Solid**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Duplicate (DUP) RPDs								
Leachable Metals	Anonymous	Anonymous	aluminum, leachable	7429-90-5	E446	30.4 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.
Leachable Metals	Anonymous	Anonymous	lead, leachable	7439-92-1	E446	32.8 % DUP-H	30%	Duplicate RPD does not meet the DQO for this test.

Result Qualifiers

Qualifier	*Description*
DUP-H	*Duplicate results outside ALS DQO, due to sample heterogeneity.*

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Leachable Metals : Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)										
LDPE bag SA41331-S01	E515	17-Jul-2022	22-Jul-2022	28 days	5 days	✓	24-Jul-2022	23 days	2 days	✓
Leachable Metals : Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)										
LDPE bag SA41331-S02	E515	17-Jul-2022	22-Jul-2022	28 days	5 days	✓	24-Jul-2022	23 days	2 days	✓
Leachable Metals : Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)										
LDPE bag SA41331-S03	E515	17-Jul-2022	22-Jul-2022	28 days	5 days	✓	24-Jul-2022	23 days	2 days	✓
Leachable Metals : Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)										
LDPE bag SA41331-S01	E446	17-Jul-2022	22-Jul-2022	180 days	5 days	✓	24-Jul-2022	175 days	2 days	✓
Leachable Metals : Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)										
LDPE bag SA41331-S02	E446	17-Jul-2022	22-Jul-2022	180 days	5 days	✓	24-Jul-2022	175 days	2 days	✓
Leachable Metals : Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)										
LDPE bag SA41331-S03	E446	17-Jul-2022	22-Jul-2022	180 days	5 days	✓	24-Jul-2022	175 days	2 days	✓
Physical Tests : Moisture Content by Gravimetry										
LDPE bag SA41331-S01	E144	17-Jul-2022	----	----	----		19-Jul-2022	----	----	

Matrix: **Soil/Solid**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Moisture Content by Gravimetry										
LDPE bag SA41331-S02	E144	17-Jul-2022	----	----	----		19-Jul-2022	----	----	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag SA41331-S03	E144	17-Jul-2022	----	----	----		19-Jul-2022	----	----	
Physical Tests : pH by Electrode (Shakeflask, 3:1 Ratio with Water)										
LDPE bag SA41331-S01	E116	17-Jul-2022	22-Jul-2022	30 days	5 days	✓	24-Jul-2022	25 days	2 days	✓
Physical Tests : pH by Electrode (Shakeflask, 3:1 Ratio with Water)										
LDPE bag SA41331-S02	E116	17-Jul-2022	22-Jul-2022	30 days	5 days	✓	24-Jul-2022	25 days	2 days	✓
Physical Tests : pH by Electrode (Shakeflask, 3:1 Ratio with Water)										
LDPE bag SA41331-S03	E116	17-Jul-2022	22-Jul-2022	30 days	5 days	✓	24-Jul-2022	25 days	2 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	573219	1	9	11.1	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	573221	1	9	11.1	5.0	✓
Moisture Content by Gravimetry	E144	568265	1	12	8.3	5.0	✓
pH by Electrode (Shakeflask, 3:1 Ratio with Water)	E116	573220	1	9	11.1	5.0	✓
Laboratory Control Samples (LCS)							
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	573219	1	9	11.1	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	573221	1	9	11.1	5.0	✓
Moisture Content by Gravimetry	E144	568265	1	12	8.3	5.0	✓
pH by Electrode (Shakeflask, 3:1 Ratio with Water)	E116	573220	1	9	11.1	5.0	✓
Method Blanks (MB)							
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	573219	1	9	11.1	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	573221	1	9	11.1	5.0	✓
Moisture Content by Gravimetry	E144	568265	1	12	8.3	5.0	✓
Matrix Spikes (MS)							
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515	573219	1	9	11.1	5.0	✓
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446	573221	1	9	11.1	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
pH by Electrode (Shakeflask, 3:1 Ratio with Water)	E116 Vancouver - Environmental	Soil/Solid	MEND (mod)/APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) on an extract from a soil sample that has been added in a 3:1 ratio of deionized water to soil, then leached and the extract filtered prior to analysis. The pH is then measured by a standard pH probe. .
Moisture Content by Gravimetry	E144 Vancouver - Environmental	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Metals by CRC ICPMS (Shakeflask, 3:1 Ratio with Water)	E446 Vancouver - Environmental	Soil/Solid	BC MINISTRY OF ENERGY AND MINES/EPA 6020B (mod)	A sample is extracted with water at a 3:1 liquid to solid ratio for 24 hours, then filtered through a 0.45 micron membrane filter. Analysis is by Collision/Reaction Cell ICPMS. This extraction is an empirical procedure with pre-defined characteristics. Recovery of some elements (Ag, Bi, and Sn) by this method can be variable due to the neutral pH of the extraction fluid, and therefore the LCS DQOs has been established at 50-130% for these elements.
Mercury by CVAAS (Shakeflask, 3:1 Ratio with Water)	E515 Vancouver - Environmental	Soil/Solid	BC MINISTRY OF ENERGY AND MINES/EPA 1631E (mod)	A sample is extracted with water at a 3:1 liquid to solid ratio for 24 hours, then filtered through a 0.45 micron membrane filter. Analysis is by CVAAS. This extraction is an empirical procedure with pre-defined characteristics. Recovery of mercury can be variable due to the neutral pH of the extraction fluid, and therefore the LCS DQO has been established at 50-130%.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Shakeflask Leachate Preparation (3:1 Ratio with Water)	EP446 Vancouver - Environmental	Soil/Solid	BC MINISTRY OF ENERGY AND MINES	A sample is extracted with water at a 3:1 liquid to solids ratio for 24 hours, then filtered through a 0.45 micron membrane filter.

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Metro File: SA41331

ATACHMENT 2

Nautilus Environmental Toxicity Test Results

Acute Toxicity Test Results

Sample collected September 17, 2022

Final Report

September 29, 2022

Submitted to: **Golder Associates Ltd.**
Calgary, AB

10823 27 Street SE, Calgary, AB T2Z 3V9

SAMPLE INFORMATION

Sample ID/ Internal ID	Dates				Receipt temperature
	Collected	Received	Rainbow trout test initiation	*Daphnia magna* test initiation	
Columbia River-D/S HKD / 2223-0187	17-Sept-22 at 1500h	19-Sept-22 at 0830h	19-Sept-22 at 1515h	21-Sept-22 at 1505h	4.1°C

TEST TYPES

- Modified Rainbow trout 96-h single concentration screening test
- Modified *Daphnia magna* 48-h single concentration screening test

METHODS

Modified acute toxicity tests were performed for Golder Associates Ltd. (Golder) in order to evaluate the effect of a river water sample when a rock substrate is added. Rock substrate was submitted alongside the sample in three 20-L plastic pails.

Each test included a laboratory control, a river water control (Columbia River-D/S HKD alone), and a test solution that combined the river water with the rock substrate (Columbia River-D/S HKD + rock substrate). Test solutions were prepared on the same day of sample receipt.

To prepare the rainbow trout test solution, the bottom of a test vessel was covered with rock substrate and then overlaid with river water using an application rate of 0.6 kg rock substrate/L of river water. The rock substrate remained in the test vessel for the duration of the test. To prevent fish being hidden or caught between rocks, an inert Nitex screen was used to cover the rock substrate. To prepare the *D. magna* test solution, an additional vessel was prepared using the same application rate of 0.6 kg rock substrate/L of river water. This test solution was permitted to acclimate for 48 hours prior to testing. After this period, the overlying water was collected and used for *D. magna* testing.

RESULTS

Toxicity test results

Sample ID	Percent survival in 100% (v/v) sample
	Rainbow trout
Columbia River-D/S HKD	100
Columbia River-D/S HKD + rock substrate	100

Sample ID	*Daphnia magna*	
	Percent survival in 100% (v/v) sample	Percent Immobility in 100% (v/v) sample
Columbia River-D/S HKD	100	0
Columbia River-D/S HKD + rock substrate	100	0

QA/QC

QA/QC summary	Rainbow trout	*Daphnia magna*
Reference toxicant LC50 (95% CL)	4.0 (3.5-4.4) g/L KCl[1]	6.9 (6.6-7.2) g/L NaCl[2]
Reference toxicant historical mean (2 SD Range)	3.6 (2.7-4.8) g/L KCl	6.1 (5.2-7.2) g/L NaCl
Reference toxicant CV	9.4%	5.5%
Organism health history	Acceptable	Acceptable
Protocol deviations	None	None
Water quality range deviations	None	None
Control performance	Acceptable	Acceptable
Test performance	Valid	Valid

[1] Test date, August 30, 2022; [2] Test date September 21, 2022

LC = Lethal Concentration; CL = Confidence Limit; SD = Standard Deviation; CV = Coefficient of Variation

Report By:
Émilie Viczko, MSc
Project Biologist

Reviewed By:
Leila Oosterbroek, P Biol
Environmental Scientist

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 96-h rainbow trout (*Oncorhynchus mykiss*) survival test.

Test species	*Oncorhynchus mykiss*
Organism source	Fish Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	5 gallon glass aquariums
Test volume	10 – 20 L, depending on size of fish
Test solution depth	Minimum 15 cm
Test concentrations	100% (undiluted) sample plus laboratory control and river water control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	De-chlorinated City of Calgary tap water
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light/8 hours dark
Aeration	6.5 ±1 mL/min/L
Test Measurements	pH, conductivity, dissolved oxygen and temperature were measured at test initiation and test completion; salinity measured at test initiation; evaluated for survival daily
Test protocol	Environment Canada (2000), EPS 1/RM/13, with 2007 & 2016 amendments
Statistical software	None
Test endpoints	Percent survival
Test acceptability criteria for controls	Survival ≥ 90%
Reference toxicant	Potassium chloride (KCl)

Table 3. Summary of test conditions: 48-h *Daphnia magna* survival test.

Test species	*Daphnia magna*
Organism source	In-house culture
Organism age	<24 hours
Test type	Static
Test duration	48 hours
Test vessel	385 mL plastic vessels
Test volume	150 mL
Test concentrations	100% (undiluted) sample plus laboratory control and river water control
Test replicates	3 per treatment
Number of organisms	10 per replicate
Control/dilution water	De-chlorinated City of Calgary tap water amended with 4 mg/L KCl and with B12 (2 µg/L) and Na_2SeO_4 (2 µg Se/L)
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light/8 hours dark
Aeration	None
Test measurements	pH, conductivity, dissolved oxygen and temperature measured at test initiation and completion; salinity and hardness measured at test initiation in undiluted sample; evaluated daily for survival
Test protocol	Environment Canada (2000), EPS 1/RM/14
Statistical software	None
Test endpoints	Mean percent survival
Test acceptability criteria for controls	Survival ≥ 90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

NAUTILUS

Trout Bench Sheet

Method TRS-mod Client GAL 100 Reference 2223-0187 Chamber 1

Test Log

Day	Date	Time	Initial	Chem. Cart	Daily Data Review
0	2022/09/19	1515 *	ML/KO	1/7	ec
1	2022/09/20	0730	AM	-	maf
2	2022/09/21	0800	(X)	-	JC
3	2022/09/22	0830	AI	-	JC
4	2022/09/23	1016	CD/KCRM	1/7	AM

Note: * ; time when the test was loaded with fish

Sample Information

Initial pH: 8.0
Initial EC (µS/cm): 213 ML 111
Salinity (ppt): 0

Sample Pre-Aeration

Aeration rate adjusted to 6.5 +/- 1 mL/min/L (yes)/no

Preaeration time	0 hours	0.5 hours	1 hour	1.5 hours	2 hours
DO(mg/L) of 100%	8.9	8.9			
Temp (°C) of 100%	14				

DO in mg/L (70% - 100% saturation)**
6.2 mg/L - 8.9 mg/L at 14°C
6.1 mg/L - 8.8 mg/L at 15°C
6.0 mg/L - 8.6 mg/L at 16°C
**corrected for altitude

Test Chemistry and Biology

Conc.	CTL	River CTL	River+ Rocks					
pH (units) (range: 5.5-8.5)								
Day 0	7.7	7.9	7.9					
Day 4	8.2	~~8.1~~ Kcrm 7.7	~~7.9~~ Kcrm 7.7					
EC (uS/cm)								
Day 0	419	108	107					
Day 4	406	~~118~~ Kcrm 110	~~162~~ Kcrm 113					
DO (mg/L) (70-100% saturation at test temp.)								
Day 0	8.6	8.9	8.9					
Day 4	~~8.5~~ CD 8.6	8.6	8.6					
Temperature (°C) (range: 14-16°C)								
Day 0	16	14	14					
Day 4	16	16	16					
Number Alive (In brackets number stressed)								
Day 0	10	10	10					
Day 1	10	10	10					
Day 2	10	10	10					
Day 3	10	10	10					
Day 4	10	10	~~10~~ Kcrm 10					

Validity Criteria: must be ≤ 10% mortality and/or stressed behavior in the control
Unless otherwise noted, behavior is considered to be normal

Control Organism Data

Control Fish	Length (cm)	Weight (g)
1	3.4	0.5
2	3.4	0.4
3	2.8	0.2
4	3.0	0.3
5	3.5	0.5
6	3.0	0.3
7	3.0	0.3
8	3.1	0.3
9	3.3	0.4
10	3.1	0.3

Loading Density (g/L): 0.2
(must be ≤0.5 g/L)
Mean Length (cm): 3.2
Length Range (cm): 2.8-3.5
Mean Weight (g): 0.4
(Must be ≥0.3g)
Weight Range: (g): 0.2-0.5

Test Organism Information

Batch 20220708TR
Source Troutlodge
Tank # 1
Days Held at 15± 2°C (must be ≥14 days) 55
Percent stock mortality (7 days prior to test, must be <2%) 0.52
Test Volume (L) 14.4 ~~10~~ ML

Comments :

Reviewed By: ~~JS~~ EV
Date Reviewed: 2022/09/~~08~~ 27 EV

Written by SG on 1995/05/12
Revised by MF on 2022/04/13

Nautilus Environmental (Calgary)

File: TR Bench Sheet
F051

NAUTILUS ENVIRONMENTAL

Daphnia Bench Sheet

Method: DAS-mod Client: GAL100 Reference: 2223-0187

Test Log

Day	Date	Time	Technician	Chem. Cart	Daily Data Review
0	2022/09/21	1505	EV/AG/AI	3	DM
1	2022/09/22	0817	AG	-	LC
2	2022/09/23	0940	BS	2	DM

Sample Information

Initial pH:	8.0
Initial EC (µS/cm):	111
Salinity (ppt):	0

Lab Code	CTL A	CTL B	CTL C	River CTL A	River CTL B	River CTL C	Rock A	Rock B	Rock C

pH (units) (range: 6.0-8.5)

day										
0	8.0	7.9	7.9	7.9	7.8	7.9	7.8	7.8	7.7	
2	~~7.9~~ BS	8.0	8.0	~~7.9~~ BS	8.0	7.9	7.8	~~7.9~~ BS 8.0	7.7	

The pH of the sample was not adjusted prior to test setting, unless noted in the comments below

EC (uS/cm)

0	390	411	413	104	108	108	110	109	111	
2	407	424	429	110	111	110	134	118	117	

DO (mg/L) (**40-100% saturation at test temp.**)

0	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	
2	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	

Temperature (°C) (range: **18-22 °C**)

0	20	20	20	20	20	20	20	20	20	
2	20	20	7 60 BS	20	20	20	20	20	20	

Number Alive (I, immobile)

0	10	10	10	10	10	10	10	10	10	
1	10	10	10	10	10	10	10	10	10	
2	10	10	10	10	10	10	10	10	10	

Validity Criteria: must be ≤ 10% mortality and/or abnormal behavior in the control

Notes: Immobile; daphnid can't swim after 60 sec. even if antenna still move

Unless otherwise noted, behaviour is considered to be normal

Culture

Young jar: Wed D1 Jar(s) mortality 7 days prior to test (must be ≤25%): 5%

QA (previous month)

Days to first brood (≤12 days): 9

Average number of young produced (≥15 young): 41

Were test treatments randomized on test tray? (Yes) / No

Control Validity Criteria

Mean % mortality at 48 hours - (must be ≤10%): 0%

Sample

DO (mg/L) of sample prior to aeration: 7.9

Temperature (°C) of sample prior to aeration: 20

DO % of sample prior to aeration: 100

Is aeration required (<40% or >100%)? **Yes or (No)**

Duration of aeration (37.5 +/- 12.5 mL/min/L) :

Filtered with 110um screen prior to testing **Yes or (No)**

Hardness (mg $CaCO_3$/L) of 100% : 70

Is hardness adjustment required (<25 mg $CaCO_3$/L)? **Yes or (No)**

Hardness of sample after adjustment (must be between 25 - 30 mg $CaCO_3$/L): —

Alkalinity of 100% sample (mg $CaCO_3$/L): —

Dilution Water

Pail label / preparation date: P4:09/16

Hardness of dilution water (mg/L): 167

DO Levels (40-100% saturation) - corrected for altitude -

3.3 to 8.2 mg/L at 18°C	3.1 to 7.7 mg/L at 21°C
3.2 to 8.1 mg/L at 19°C	3.0 to 7.6 mg/L at 22°C
3.2 to 7.9 mg/L at 20°C	

Comments/Observations:

Reviewed By: EV Date Reviewed: 2022/09/27

APPENDIX C – Chain-of-custody form

NAUTILUS ENVIRONMENTAL

TESTING LOCATION (Please Circle)

Burnaby ( )
8664 Commerce Court
Burnaby, British Columbia, Canada
V5A 4N7
Phone 604.420.8773

Calgary (•)
10823 27 Street SE
Calgary, Alberta, Canada
T2Z 3V9
Phone 403.253.7121

Point Edward ( )
704 Mara Street, Suite 122
Point Edward, Ontario, Canada
N7V 1X4
Phone 519.339.8787

Chain of Custody

Date 17-Sep-22 Page 1 of 1

Report to:

Company	Golder Associates
Address	2800, 700 2 St W
City/Prov/PC	Calgary, Alberta
Contact	Elaine Irving
Phone	(604) 356-4629
Email	elaine.irving@wsp.com, mikayla.donovan@wsp.com

Invoice To:

Company	Golder Associates
Address	2800, 700 2 St W
City/Prov/PC	Calgary, Alberta
Contact	Elaine Irving
Phone	(604) 356-4629
Email	elaine.irving@wsp.com, mikayla.donovan@wsp.com
PO No.	

Sample Collection By:

Sample Type: Grab (•) OR Composite ( )

	SAMPLE ID	DATE (DD/MM/YY)	TIME	MATRIX	# OF CONTAINERS AND VOLUME (e.g. 1 x 20 L)	COMMENTS	ANALYSES REQUIRED: Rainbow Trout	Daphnia magna	Receipt Temperature (°C)
1	Columbia River - D/S HKD	17/09/22	15:00	Water	4 x 20L		✔	✔	
2	2022-0167								
3	2022/09/19								
4	08:30								
5	Golder								
6	JC								
7	4x20L cartoons								
8	NaS/NaI								
9	Good Cond.								
10	4.1°C								

SPECIAL INSTRUCTIONS/COMMENTS (CLIENT)

Customized acute tests – see Émilie Viczko

SAMPLE RECEIPT DETAILS (LABORATORY)

1. Total No. of Containers		4. Ice Present in Cooler?	Y / N
2. Courier		5. Seal Present?	Y / N
3. Good Condition?	Y / N	6. Initials Present on Seal?	Y / N

SAMPLE DESCRIPTION AND COMMENTS (LABORATORY)

RELINQUISHED BY (CLIENT)

(Printed Name) Nishat Rahman (Signature) NishatR

(Company) Golder 8:00 (Date DD/MM/YY and Time) 19/09/22

RECEIVED BY (LABORATORY)

(Printed Name) (Signature)

(Company) (Date DD/MM/YY and Time)

Our liability is limited to the cost of the test requested. The test results only relate to the sample as received. No liability in whole or in part is assumed for the collection, handling, or transport of the sample, application or interpretation of the test data or results in part or in whole.

Additional costs may be required for sample disposal or storage. Payment net 30 unless otherwise contracted.

END OF REPORT

ATTACHMENT 3

ALS Environmental Laboratory Certificate of Analyses

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **CG2212738**	Page	: 1 of 6
Amendment	: **4**		
Client	: **Golder Associates Ltd.**	Laboratory	: Calgary - Environmental
Contact	: Mikayla Donovan	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary AB Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: BC Hydro	Date Samples Received	: 19-Sep-2022 09:30
PO	: ----	Date Analysis Commenced	: 19-Sep-2022
C-O-C number	: ----	Issue Date	: 12-Oct-2022 17:06
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Anthony Calero	Supervisor - Inorganic	Inorganics, Calgary, Alberta
Anthony Calero	Supervisor - Inorganic	Metals, Calgary, Alberta
Elke Tabora		Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Metals, Calgary, Alberta
Millicent Brentnall	Laboratory Analyst	Metals, Calgary, Alberta
Parker Sgarbossa	Laboratory Analyst	Inorganics, Calgary, Alberta
Ruifang Zheng	Analyst	Inorganics, Calgary, Alberta
Sara Niroomand		Inorganics, Calgary, Alberta
Summie Lo	Lab Assistant	Metals, Calgary, Alberta
Vladka Stamenova	Analyst	Inorganics, Calgary, Alberta

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit
%	percent
µS/cm	Microsiemens per centimetre
meq/L	milliequivalents per litre
mg/L	milligrams per litre
NTU	nephelometric turbidity units
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior 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.

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

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
DLB	*Detection Limit Raised. Analyte detected at comparable level in Method Blank.*
DTC	*Dissolved concentration exceeds total. Results were confirmed by re-analysis.*
RRV	*Reported result verified by repeat analysis.*

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	Columbia River - D/S HKD	Field Blank	----	----	----
					Client sampling date / time	17-Sep-2022 13:30	17-Sep-2022 14:00	----	----	----
						CG2212738-001	CG2212738-002	--------	--------	--------
						Result	Result	----	----	----
Physical Tests										
hardness (as CaCO3), dissolved	----	EC100	0.50	mg/L		45.7	<0.50	----	----	----
hardness (as CaCO3), from total Ca/Mg	----	EC100A	0.60	mg/L		43.9	<0.60	----	----	----
solids, total dissolved [TDS]	----	E162	10	mg/L		73	<10	----	----	----
solids, total suspended [TSS]	----	E160-L	1.0	mg/L		<1.0	<1.0	----	----	----
turbidity	----	E121	0.10	NTU		0.74	<0.10	----	----	----
conductivity	----	E100	2.0	µS/cm		97.9	<2.0	----	----	----
pH	----	E108	0.10	pH units		7.77	5.33	----	----	----
alkalinity, bicarbonate (as HCO3)	71-52-3	E290	1.0	mg/L		55.4	<1.0	----	----	----
alkalinity, carbonate (as CO3)	3812-32-6	E290	1.0	mg/L		<1.0	<1.0	----	----	----
alkalinity, hydroxide (as OH)	14280-30-9	E290	1.0	mg/L		<1.0	<1.0	----	----	----
alkalinity, total (as CaCO3)	----	E290	2.0	mg/L		45.4	<2.0	----	----	----
solids, total dissolved [TDS], calculated	----	EC103	1.0	mg/L		57.7	<1.0	----	----	----
Anions and Nutrients										
ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L		0.0056	0.0051 RRV	----	----	----
phosphorus, total	7723-14-0	E372-U	0.0020	mg/L		0.0023	<0.0020	----	----	----
phosphorus, total dissolved	7723-14-0	E375-T	0.0020	mg/L		<0.0020	<0.0020	----	----	----
Kjeldahl nitrogen, total [TKN]	----	E318	0.200	mg/L		<0.200	<0.200	----	----	----
chloride	16887-00-6	E235.Cl	0.50	mg/L		<0.50	<0.50	----	----	----
fluoride	16984-48-8	E235.F	0.020	mg/L		0.040	<0.020	----	----	----
nitrate (as N)	14797-55-8	E235.NO3	0.020	mg/L		0.089	<0.020	----	----	----
nitrite (as N)	14797-65-0	E235.NO2	0.010	mg/L		<0.010	<0.010	----	----	----
sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L		7.96	<0.30	----	----	----
nitrate + nitrite (as N)	----	EC235.N+N	0.0500	mg/L		0.0890	<0.0500	----	----	----
Organic / Inorganic Carbon										
carbon, dissolved organic [DOC]	----	E358-L	0.50	mg/L		0.73	<0.50	----	----	----
carbon, total organic [TOC]	----	E355-L	0.50	mg/L		0.77	<0.50	----	----	----
Ion Balance										
anion sum	----	EC101	0.10	meq/L		1.08	<0.10	----	----	----
cation sum	----	EC101	0.10	meq/L		0.96	<0.10	----	----	----
ion balance (APHA)	----	EC101	0.010	%		5.88	<0.010	----	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	Columbia River - D/S HKD	Field Blank	----	----	----
					Client sampling date / time	17-Sep-2022 13:30	17-Sep-2022 14:00	----	----	----
						CG2212738-001	CG2212738-002	--------	--------	--------
						Result	Result	----	----	----
Ion Balance										
ion balance (cations/anions)	----	EC101	0.010	%		88.9	100 RRV	----	----	----
Total Metals										
aluminum, total	7429-90-5	E420	0.0030	mg/L		0.0167 DLB	<0.0030	----	----	----
antimony, total	7440-36-0	E420	0.00010	mg/L		<0.00010	<0.00010	----	----	----
arsenic, total	7440-38-2	E420	0.00010	mg/L		0.00014	<0.00010	----	----	----
barium, total	7440-39-3	E420	0.00010	mg/L		0.0123	<0.00010	----	----	----
beryllium, total	7440-41-7	E420	0.000100	mg/L		<0.000100	<0.000100	----	----	----
bismuth, total	7440-69-9	E420	0.000050	mg/L		<0.000050	<0.000050	----	----	----
boron, total	7440-42-8	E420	0.010	mg/L		<0.010	<0.010	----	----	----
cadmium, total	7440-43-9	E420	0.0000050	mg/L		0.0000086	<0.0000050	----	----	----
calcium, total	7440-70-2	E420	0.050	mg/L		13.3	<0.050	----	----	----
cesium, total	7440-46-2	E420	0.000010	mg/L		0.000014	<0.000010	----	----	----
chromium, total	7440-47-3	E420	0.00050	mg/L		<0.00050	<0.00050	----	----	----
cobalt, total	7440-48-4	E420	0.00010	mg/L		<0.00010	<0.00010	----	----	----
copper, total	7440-50-8	E420	0.00050	mg/L		<0.00050	<0.00050	----	----	----
iron, total	7439-89-6	E420	0.010	mg/L		<0.010	<0.010	----	----	----
lead, total	7439-92-1	E420	0.000050	mg/L		<0.000050	<0.000050	----	----	----
lithium, total	7439-93-2	E420	0.0010	mg/L		0.0010	<0.0010	----	----	----
magnesium, total	7439-95-4	E420	0.0050	mg/L		2.59	<0.0050	----	----	----
manganese, total	7439-96-5	E420	0.00010	mg/L		0.00053	<0.00010	----	----	----
mercury, total	7439-97-6	E508	0.0000050	mg/L		<0.0000050	<0.0000050	----	----	----
molybdenum, total	7439-98-7	E420	0.000050	mg/L		0.000497 DTC, RRV	<0.000050	----	----	----
nickel, total	7440-02-0	E420	0.00050	mg/L		<0.00050	<0.00050	----	----	----
phosphorus, total	7723-14-0	E420	0.050	mg/L		<0.050	<0.050	----	----	----
potassium, total	7440-09-7	E420	0.050	mg/L		0.536	<0.050	----	----	----
rubidium, total	7440-17-7	E420	0.00020	mg/L		0.00115	<0.00020	----	----	----
selenium, total	7782-49-2	E420	0.000050	mg/L		0.000061	<0.000050	----	----	----
silicon, total	7440-21-3	E420	0.10	mg/L		1.34	<0.10	----	----	----
silver, total	7440-22-4	E420	0.000010	mg/L		<0.000010	<0.000010	----	----	----
sodium, total	7440-23-5	E420	0.050	mg/L		0.671	<0.050	----	----	----
strontium, total	7440-24-6	E420	0.00020	mg/L		0.0865	<0.00020	----	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	Columbia River - D/S HKD	Field Blank	----	----	----
					Client sampling date / time	17-Sep-2022 13:30	17-Sep-2022 14:00	----	----	----
						CG2212738-001	CG2212738-002	--------	--------	--------
						Result	Result	----	----	----
Total Metals										
sulfur, total	7704-34-9	E420	0.50	mg/L		2.64	<0.50	----	----	----
tellurium, total	13494-80-9	E420	0.00020	mg/L		<0.00020	<0.00020	----	----	----
thallium, total	7440-28-0	E420	0.000010	mg/L		<0.000010	<0.000010	----	----	----
thorium, total	7440-29-1	E420	0.00010	mg/L		<0.00010	<0.00010	----	----	----
tin, total	7440-31-5	E420	0.00010	mg/L		<0.00010	<0.00010	----	----	----
titanium, total	7440-32-6	E420	0.00030	mg/L		<0.00030	<0.00030	----	----	----
tungsten, total	7440-33-7	E420	0.00010	mg/L		<0.00010	<0.00010	----	----	----
uranium, total	7440-61-1	E420	0.000010	mg/L		0.000300	<0.000010	----	----	----
vanadium, total	7440-62-2	E420	0.00050	mg/L		0.00074	<0.00050	----	----	----
zinc, total	7440-66-6	E420	0.0030	mg/L		<0.0030	<0.0030	----	----	----
zirconium, total	7440-67-7	E420	0.00020	mg/L		<0.00020	<0.00020	----	----	----
Dissolved Metals										
aluminum, dissolved	7429-90-5	E421	0.0010	mg/L		0.0099	<0.0010	----	----	----
antimony, dissolved	7440-36-0	E421	0.00010	mg/L		<0.00010	<0.00010	----	----	----
arsenic, dissolved	7440-38-2	E421	0.00010	mg/L		0.00010	<0.00010	----	----	----
barium, dissolved	7440-39-3	E421	0.00010	mg/L		0.0134	<0.00010	----	----	----
beryllium, dissolved	7440-41-7	E421	0.000020	mg/L		<0.000020	<0.000020	----	----	----
bismuth, dissolved	7440-69-9	E421	0.000050	mg/L		<0.000050	<0.000050	----	----	----
boron, dissolved	7440-42-8	E421	0.010	mg/L		<0.010	<0.010	----	----	----
cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L		<0.0000050	<0.0000050	----	----	----
calcium, dissolved	7440-70-2	E421	0.050	mg/L		13.8	<0.050	----	----	----
cesium, dissolved	7440-46-2	E421	0.000010	mg/L		<0.000010	<0.000010	----	----	----
chromium, dissolved	7440-47-3	E421	0.00050	mg/L		<0.00050	<0.00050	----	----	----
cobalt, dissolved	7440-48-4	E421	0.00010	mg/L		<0.00010	<0.00010	----	----	----
copper, dissolved	7440-50-8	E421	0.00020	mg/L		<0.00020	<0.00020	----	----	----
iron, dissolved	7439-89-6	E421	0.010	mg/L		<0.010	<0.010	----	----	----
lead, dissolved	7439-92-1	E421	0.000050	mg/L		<0.000050	<0.000050	----	----	----
lithium, dissolved	7439-93-2	E421	0.0010	mg/L		0.0012	<0.0010	----	----	----
magnesium, dissolved	7439-95-4	E421	0.0050	mg/L		2.74	<0.0050	----	----	----
manganese, dissolved	7439-96-5	E421	0.00010	mg/L		0.00018	<0.00010	----	----	----
mercury, dissolved	7439-97-6	E509	0.0000050	mg/L		<0.0000050	<0.0000050	----	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	Columbia River - D/S HKD	Field Blank	----	----	----
					Client sampling date / time	17-Sep-2022 13:30	17-Sep-2022 14:00	----	----	----
						CG2212738-001	CG2212738-002	--------	--------	--------
						Result	Result	----	----	----
Dissolved Metals										
molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L		0.000701 DTC, RRV	<0.000050	----	----	----
nickel, dissolved	7440-02-0	E421	0.00050	mg/L		<0.00050	<0.00050	----	----	----
phosphorus, dissolved	7723-14-0	E421	0.050	mg/L		<0.050	<0.050	----	----	----
potassium, dissolved	7440-09-7	E421	0.050	mg/L		0.600	<0.050	----	----	----
rubidium, dissolved	7440-17-7	E421	0.00020	mg/L		0.00127	<0.00020	----	----	----
selenium, dissolved	7782-49-2	E421	0.000050	mg/L		0.000079	<0.000050	----	----	----
silicon, dissolved	7440-21-3	E421	0.050	mg/L		1.31	<0.050	----	----	----
silver, dissolved	7440-22-4	E421	0.000010	mg/L		<0.000010	<0.000010	----	----	----
sodium, dissolved	7440-23-5	E421	0.050	mg/L		0.625	<0.050	----	----	----
strontium, dissolved	7440-24-6	E421	0.00020	mg/L		0.0880	<0.00020	----	----	----
sulfur, dissolved	7704-34-9	E421	0.50	mg/L		3.14	<0.50	----	----	----
tellurium, dissolved	13494-80-9	E421	0.00020	mg/L		<0.00020	<0.00020	----	----	----
thallium, dissolved	7440-28-0	E421	0.000010	mg/L		<0.000010	<0.000010	----	----	----
thorium, dissolved	7440-29-1	E421	0.00010	mg/L		<0.00010	<0.00010	----	----	----
tin, dissolved	7440-31-5	E421	0.00010	mg/L		<0.00010	<0.00010	----	----	----
titanium, dissolved	7440-32-6	E421	0.00030	mg/L		<0.00030	<0.00030	----	----	----
tungsten, dissolved	7440-33-7	E421	0.00010	mg/L		<0.00010	<0.00010	----	----	----
uranium, dissolved	7440-61-1	E421	0.000010	mg/L		0.000181	<0.000010	----	----	----
vanadium, dissolved	7440-62-2	E421	0.00050	mg/L		<0.00050	<0.00050	----	----	----
zinc, dissolved	7440-66-6	E421	0.0010	mg/L		<0.0010	<0.0010	----	----	----
zirconium, dissolved	7440-67-7	E421	0.00020	mg/L		<0.00020	<0.00020	----	----	----
dissolved mercury filtration location	----	EP509	-	-		Field	Field	----	----	----
dissolved metals filtration location	----	EP421	-	-		Field	Field	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **CG2212738**	Page	: 1 of 14
Amendment	: 4		
Client	: **Golder Associates Ltd.**	Laboratory	: Calgary - Environmental
Contact	: Mikayla Donovan	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary, Alberta Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: BC Hydro	Date Samples Received	: 19-Sep-2022 09:30
PO	: ----	Issue Date	: 12-Oct-2022 17:06
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- Method Blank value outliers occur - please see following pages for full details.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **Water**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Method Blank (MB) Values								
Total Metals	QC-MRG2-660261001	----	aluminum, total	7429-90-5	E420	0.0034 MB-LOR mg/L	0.003 mg/L	Blank result exceeds permitted value

Result Qualifiers

Qualifier	Description
MB-LOR	*Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.*

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
Columbia River - D/S HKD	E298	17-Sep-2022	20-Sep-2022	----	----		20-Sep-2022	28 days	3 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
Field Blank	E298	17-Sep-2022	20-Sep-2022	----	----		20-Sep-2022	28 days	3 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE										
Columbia River - D/S HKD	E235.Cl	17-Sep-2022	19-Sep-2022	----	----		19-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE										
Field Blank	E235.Cl	17-Sep-2022	19-Sep-2022	----	----		19-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE										
Columbia River - D/S HKD	E235.F	17-Sep-2022	19-Sep-2022	----	----		19-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE										
Field Blank	E235.F	17-Sep-2022	19-Sep-2022	----	----		19-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Nitrate in Water by IC										
HDPE										
Columbia River - D/S HKD	E235.NO3	17-Sep-2022	19-Sep-2022	----	----		19-Sep-2022	3 days	2 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Nitrate in Water by IC										
HDPE										
Field Blank	E235.NO3	17-Sep-2022	19-Sep-2022	----	----		19-Sep-2022	3 days	2 days	✓
Anions and Nutrients : Nitrite in Water by IC										
HDPE										
Columbia River - D/S HKD	E235.NO2	17-Sep-2022	19-Sep-2022	----	----		19-Sep-2022	3 days	2 days	✓
Anions and Nutrients : Nitrite in Water by IC										
HDPE										
Field Blank	E235.NO2	17-Sep-2022	19-Sep-2022	----	----		19-Sep-2022	3 days	2 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE										
Columbia River - D/S HKD	E235.SO4	17-Sep-2022	19-Sep-2022	----	----		19-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE										
Field Blank	E235.SO4	17-Sep-2022	19-Sep-2022	----	----		19-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Total Dissolved Phosphorus by Colourimetry (0.002 mg/L)										
Amber glass dissolved (sulfuric acid)										
Columbia River - D/S HKD	E375-T	17-Sep-2022	20-Sep-2022	----	----		22-Sep-2022	28 days	5 days	✓
Anions and Nutrients : Total Dissolved Phosphorus by Colourimetry (0.002 mg/L)										
Amber glass dissolved (sulfuric acid)										
Field Blank	E375-T	17-Sep-2022	20-Sep-2022	----	----		22-Sep-2022	28 days	5 days	✓
Anions and Nutrients : Total Kjeldahl Nitrogen by Fluorescence (Low Level)										
Amber glass total (sulfuric acid)										
Columbia River - D/S HKD	E318	17-Sep-2022	22-Sep-2022	----	----		22-Sep-2022	28 days	5 days	✓
Anions and Nutrients : Total Kjeldahl Nitrogen by Fluorescence (Low Level)										
Amber glass total (sulfuric acid)										
Field Blank	E318	17-Sep-2022	22-Sep-2022	----	----		22-Sep-2022	28 days	5 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Total Phosphorus by Colourimetry (0.002 mg/L)										
Amber glass total (sulfuric acid) Columbia River - D/S HKD	E372-U	17-Sep-2022	21-Sep-2022	----	----		23-Sep-2022	28 days	6 days	✓
Anions and Nutrients : Total Phosphorus by Colourimetry (0.002 mg/L)										
Amber glass total (sulfuric acid) Field Blank	E372-U	17-Sep-2022	21-Sep-2022	----	----		23-Sep-2022	28 days	6 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid) Columbia River - D/S HKD	E509	17-Sep-2022	23-Sep-2022	----	----		23-Sep-2022	28 days	6 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid) Field Blank	E509	17-Sep-2022	23-Sep-2022	----	----		23-Sep-2022	28 days	6 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) Columbia River - D/S HKD	E421	17-Sep-2022	22-Sep-2022	----	----		22-Sep-2022	180 days	5 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) Field Blank	E421	17-Sep-2022	22-Sep-2022	----	----		22-Sep-2022	180 days	5 days	✓
Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)										
Amber glass dissolved (sulfuric acid) Columbia River - D/S HKD	E358-L	17-Sep-2022	19-Sep-2022	----	----		20-Sep-2022	28 days	2 days	✓
Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)										
Amber glass dissolved (sulfuric acid) Field Blank	E358-L	17-Sep-2022	19-Sep-2022	----	----		20-Sep-2022	28 days	2 days	✓
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid) Columbia River - D/S HKD	E355-L	17-Sep-2022	19-Sep-2022	----	----		20-Sep-2022	28 days	2 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Organic / Inorganic Carbon : Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)										
Amber glass total (sulfuric acid)										
Field Blank	E355-L	17-Sep-2022	19-Sep-2022	----	----		20-Sep-2022	28 days	2 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE										
Columbia River - D/S HKD	E290	17-Sep-2022	22-Sep-2022	----	----		22-Sep-2022	14 days	5 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE										
Field Blank	E290	17-Sep-2022	22-Sep-2022	----	----		22-Sep-2022	14 days	5 days	✓
Physical Tests : Conductivity in Water										
HDPE										
Columbia River - D/S HKD	E100	17-Sep-2022	22-Sep-2022	----	----		22-Sep-2022	28 days	5 days	✓
Physical Tests : Conductivity in Water										
HDPE										
Field Blank	E100	17-Sep-2022	22-Sep-2022	----	----		22-Sep-2022	28 days	5 days	✓
Physical Tests : pH by Meter										
HDPE										
Columbia River - D/S HKD	E108	17-Sep-2022	22-Sep-2022	----	----		22-Sep-2022	0.25 hrs	0.25 hrs	× EHTR-FM
Physical Tests : pH by Meter										
HDPE										
Field Blank	E108	17-Sep-2022	22-Sep-2022	----	----		22-Sep-2022	0.25 hrs	0.25 hrs	× EHTR-FM
Physical Tests : TDS by Gravimetry										
HDPE										
Columbia River - D/S HKD	E162	17-Sep-2022	----	----	----		22-Sep-2022	7 days	5 days	✓
Physical Tests : TDS by Gravimetry										
HDPE										
Field Blank	E162	17-Sep-2022	----	----	----		22-Sep-2022	7 days	5 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : TSS by Gravimetry (Low Level)										
HDPE Columbia River - D/S HKD	E160-L	17-Sep-2022	----	----	----		22-Sep-2022	7 days	5 days	✓
Physical Tests : TSS by Gravimetry (Low Level)										
HDPE Field Blank	E160-L	17-Sep-2022	----	----	----		22-Sep-2022	7 days	5 days	✓
Physical Tests : Turbidity by Nephelometry										
HDPE Columbia River - D/S HKD	E121	17-Sep-2022	----	----	----		19-Sep-2022	3 days	2 days	✓
Physical Tests : Turbidity by Nephelometry										
HDPE Field Blank	E121	17-Sep-2022	----	----	----		19-Sep-2022	3 days	2 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid) Columbia River - D/S HKD	E508	17-Sep-2022	23-Sep-2022	----	----		23-Sep-2022	28 days	6 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid) Field Blank	E508	17-Sep-2022	23-Sep-2022	----	----		23-Sep-2022	28 days	6 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid) Columbia River - D/S HKD	E420	17-Sep-2022	23-Sep-2022	----	----		23-Sep-2022	180 days	6 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid) Field Blank	E420	17-Sep-2022	23-Sep-2022	----	----		23-Sep-2022	180 days	6 days	✓

Legend & Qualifier Definitions

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Alkalinity Species by Titration	E290	660740	1	20	5.0	5.0	✓
Ammonia by Fluorescence	E298	655806	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	654172	1	16	6.2	5.0	✓
Conductivity in Water	E100	660739	1	20	5.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	661863	1	19	5.2	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	660198	1	19	5.2	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	654263	1	10	10.0	5.0	✓
Fluoride in Water by IC	E235.F	654169	1	14	7.1	5.0	✓
Nitrate in Water by IC	E235.NO3	654170	1	16	6.2	5.0	✓
Nitrite in Water by IC	E235.NO2	654171	1	16	6.2	5.0	✓
pH by Meter	E108	660738	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	654173	1	16	6.2	5.0	✓
TDS by Gravimetry	E162	660288	1	20	5.0	5.0	✓
Total Dissolved Phosphorus by Colourimetry (0.002 mg/L)	E375-T	655521	1	20	5.0	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	657821	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	661799	1	17	5.8	5.0	✓
Total metals in Water by CRC ICPMS	E420	660262	1	6	16.6	5.0	✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	654264	1	18	5.5	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	657685	1	20	5.0	5.0	✓
Turbidity by Nephelometry	E121	654352	1	12	8.3	5.0	✓
Laboratory Control Samples (LCS)							
Alkalinity Species by Titration	E290	660740	1	20	5.0	5.0	✓
Ammonia by Fluorescence	E298	655806	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	654172	1	16	6.2	5.0	✓
Conductivity in Water	E100	660739	1	20	5.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	661863	1	19	5.2	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	660198	1	19	5.2	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	654263	1	10	10.0	5.0	✓
Fluoride in Water by IC	E235.F	654169	1	14	7.1	5.0	✓
Nitrate in Water by IC	E235.NO3	654170	1	16	6.2	5.0	✓
Nitrite in Water by IC	E235.NO2	654171	1	16	6.2	5.0	✓
pH by Meter	E108	660738	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	654173	1	16	6.2	5.0	✓
TDS by Gravimetry	E162	660288	1	20	5.0	5.0	✓
Total Dissolved Phosphorus by Colourimetry (0.002 mg/L)	E375-T	655521	1	20	5.0	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	657821	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	661799	1	17	5.8	5.0	✓

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Control Samples (LCS) - Continued							
Total metals in Water by CRC ICPMS	E420	660262	1	6	16.6	5.0	✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	654264	1	18	5.5	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	657685	1	20	5.0	5.0	✓
TSS by Gravimetry (Low Level)	E160-L	660279	1	20	5.0	5.0	✓
Turbidity by Nephelometry	E121	654352	1	12	8.3	5.0	✓
Method Blanks (MB)							
Alkalinity Species by Titration	E290	660740	1	20	5.0	5.0	✓
Ammonia by Fluorescence	E298	655806	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	654172	1	16	6.2	5.0	✓
Conductivity in Water	E100	660739	1	20	5.0	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	661863	1	19	5.2	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	660198	1	19	5.2	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	654263	1	10	10.0	5.0	✓
Fluoride in Water by IC	E235.F	654169	1	14	7.1	5.0	✓
Nitrate in Water by IC	E235.NO3	654170	1	16	6.2	5.0	✓
Nitrite in Water by IC	E235.NO2	654171	1	16	6.2	5.0	✓
Sulfate in Water by IC	E235.SO4	654173	1	16	6.2	5.0	✓
TDS by Gravimetry	E162	660288	1	20	5.0	5.0	✓
Total Dissolved Phosphorus by Colourimetry (0.002 mg/L)	E375-T	655521	1	20	5.0	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	657821	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	661799	1	17	5.8	5.0	✓
Total metals in Water by CRC ICPMS	E420	660262	1	6	16.6	5.0	✓
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	654264	1	18	5.5	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	657685	1	20	5.0	5.0	✓
TSS by Gravimetry (Low Level)	E160-L	660279	1	20	5.0	5.0	✓
Turbidity by Nephelometry	E121	654352	1	12	8.3	5.0	✓
Matrix Spikes (MS)							
Ammonia by Fluorescence	E298	655806	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	654172	1	16	6.2	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	661863	1	19	5.2	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	660198	1	19	5.2	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	654263	1	10	10.0	5.0	✓
Fluoride in Water by IC	E235.F	654169	1	14	7.1	5.0	✓
Nitrate in Water by IC	E235.NO3	654170	1	16	6.2	5.0	✓
Nitrite in Water by IC	E235.NO2	654171	1	16	6.2	5.0	✓
Sulfate in Water by IC	E235.SO4	654173	1	16	6.2	5.0	✓
Total Dissolved Phosphorus by Colourimetry (0.002 mg/L)	E375-T	655521	1	20	5.0	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	657821	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	661799	1	17	5.8	5.0	✓
Total metals in Water by CRC ICPMS	E420	660262	1	6	16.6	5.0	✓

Matrix: **Water**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Matrix Spikes (MS) - Continued							
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L	654264	1	18	5.5	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	657685	1	20	5.0	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Water	E100 Calgary - Environmental	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 Calgary - Environmental	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
Turbidity by Nephelometry	E121 Calgary - Environmental	Water	APHA 2130 B (mod)	Turbidity is measured by the nephelometric method, by measuring the intensity of light scatter under defined conditions.
TSS by Gravimetry (Low Level)	E160-L Calgary - Environmental	Water	APHA 2540 D (mod)	Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, following by drying of the filter at 104 ± 1°C, with gravimetric measurement of the filtered solids. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.
TDS by Gravimetry	E162 Calgary - Environmental	Water	APHA 2540 C (mod)	Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, with evaporation of the filtrate at 180 ± 2°C for 16 hours or to constant weight, with gravimetric measurement of the residue.
Chloride in Water by IC	E235.Cl Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Fluoride in Water by IC	E235.F Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrite in Water by IC	E235.NO2 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC	E235.NO3 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration	E290 Calgary - Environmental	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
Ammonia by Fluorescence	E298 Calgary - Environmental	Water	Method Fialab 100, 2018	Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021)
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318 Calgary - Environmental	Water	Method Fialab 100, 2018	TKN in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021).

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Total Organic Carbon (Non-Purgeable) by Combustion (Low Level)	E355-L Calgary - Environmental	Water	APHA 5310 B (mod)	Total Organic Carbon (Non-Purgeable), also known as NPOC (total), is a direct measurement of TOC after an acidified sample has been purged to remove inorganic carbon (IC). Analysis is by high temperature combustion with infrared detection of CO_2. NPOC does not include volatile organic species that are purged off with IC. For samples where the majority of total carbon (TC) is comprised of IC (which is common), this method is more accurate and more reliable than the TOC by subtraction method (i.e. TC minus TIC).
Dissolved Organic Carbon by Combustion (Low Level)	E358-L Calgary - Environmental	Water	APHA 5310 B (mod)	Dissolved Organic Carbon (Non-Purgeable), also known as NPOC (dissolved), is a direct measurement of DOC after a filtered (0.45 micron) sample has been acidified and purged to remove inorganic carbon (IC). Analysis is by high temperature combustion with infrared detection of CO_2. NPOC does not include volatile organic species that are purged off with IC. For samples where the majority of DC (dissolved carbon) is comprised of IC (which is common), this method is more accurate and more reliable than the DOC by subtraction method (i.e. DC minus DIC).
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U Calgary - Environmental	Water	APHA 4500-P E (mod).	Total Phosphorus is determined colourimetrically using a discrete analyzer after heated persulfate digestion of the sample.
Total Dissolved Phosphorus by Colourimetry (0.002 mg/L)	E375-T Calgary - Environmental	Water	APHA 4500-P E (mod).	Total Dissolved Phosphorus is determined colourimetrically using a discrete analyzer after filtration through a 0.45 micron filter followed by heated persulfate digestion of the sample.
Total metals in Water by CRC ICPMS	E420 Calgary - Environmental	Water	EPA 200.2/6020B (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Dissolved Metals in Water by CRC ICPMS	E421 Calgary - Environmental	Water	APHA 3030B/EPA 6020B (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Total Mercury in Water by CVAAS	E508 Calgary - Environmental	Water	EPA 1631E (mod)	Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS
Dissolved Mercury in Water by CVAAS	E509 Calgary - Environmental	Water	APHA 3030B/EPA 1631E (mod)	Water samples are filtered (0.45 um), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.
Dissolved Hardness (Calculated)	EC100 Calgary - Environmental	Water	APHA 2340B	“Hardness (as $CaCO_3$), dissolved” is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. “Total Hardness” refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Hardness (Calculated) from Total Ca/Mg	EC100A Calgary - Environmental	Water	APHA 2340B	"Hardness (as CaCO3), from total Ca/Mg" is calculated from the sum of total Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. "Total Hardness" refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. Hardness from total Ca/Mg is normally comparable to Dissolved Hardness in non-turbid waters.
Ion Balance using Dissolved Metals	EC101 Calgary - Environmental	Water	APHA 1030E	Cation Sum, Anion Sum, and Ion Balance are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present. Ion Balance cannot be calculated accurately for waters with very low electrical conductivity (EC).
TDS in Water (Calculation)	EC103 Calgary - Environmental	Water	APHA 1030E (mod)	Total Dissolved Solids is calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present.
Nitrate and Nitrite (as N) (Calculation)	EC235.N+N Calgary - Environmental	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Ammonia	EP298 Calgary - Environmental	Water		Sample preparation for Preserved Nutrients Water Quality Analysis.
Digestion for TKN in water	EP318 Calgary - Environmental	Water	APHA 4500-Norg D (mod)	Samples are digested at high temperature using Sulfuric Acid with Copper catalyst, which converts organic nitrogen sources to Ammonia, which is then quantified by the analytical method as TKN. This method is unsuitable for samples containing high levels of nitrate. If nitrate exceeds TKN concentration by ten times or more, results may be biased low.
Preparation for Total Organic Carbon by Combustion	EP355 Calgary - Environmental	Water		Preparation for Total Organic Carbon by Combustion
Preparation for Dissolved Organic Carbon for Combustion	EP358 Calgary - Environmental	Water	APHA 5310 B (mod)	Preparation for Dissolved Organic Carbon
Digestion for Total Phosphorus in water	EP372 Calgary - Environmental	Water	APHA 4500-P E (mod).	Samples are heated with a persulfate digestion reagent.
Digestion for Dissolved Phosphorus in water	EP375 Calgary - Environmental	Water	APHA 4500-P E (mod).	Samples are filtered through a 0.45 micron membrane filter and then heated with a persulfate digestion reagent.
Dissolved Metals Water Filtration	EP421 Calgary - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO3.
Dissolved Mercury Water Filtration	EP509 Calgary - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HCl.

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **CG2212738**	Page	: 1 of 18
Amendment	: **4**		
Client	: Golder Associates Ltd.	Laboratory	: Calgary - Environmental
Contact	: Mikayla Donovan	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary, Alberta Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: BC Hydro	Date Samples Received	: 19-Sep-2022 09:30
PO	: ----	Date Analysis Commenced	: 19-Sep-2022
C-O-C number	: ----	Issue Date	: 12-Oct-2022 17:06
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 2		
No. of samples analysed	: 2		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Anthony Calero	Supervisor - Inorganic	Calgary Inorganics, Calgary, Alberta
Anthony Calero	Supervisor - Inorganic	Calgary Metals, Calgary, Alberta
Elke Tabora		Calgary Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Calgary Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Calgary Metals, Calgary, Alberta
Millicent Brentnall	Laboratory Analyst	Calgary Metals, Calgary, Alberta
Parker Sgarbossa	Laboratory Analyst	Calgary Inorganics, Calgary, Alberta
Ruifang Zheng	Analyst	Calgary Inorganics, Calgary, Alberta
Sara Niroomand		Calgary Inorganics, Calgary, Alberta
Summie Lo	Lab Assistant	Calgary Metals, Calgary, Alberta
Vladka Stamenova	Analyst	Calgary Inorganics, Calgary, Alberta

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include 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 predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 654352)											
CG2212706-001	Anonymous	turbidity	----	E121	0.10	NTU	2.26	2.29	1.32%	15%	----
Physical Tests (QC Lot: 660288)											
CG2212694-001	Anonymous	solids, total dissolved [TDS]	----	E162	20	mg/L	180	196	16	Diff <2x LOR	----
Physical Tests (QC Lot: 660738)											
CG2212738-001	Columbia River - D/S HKD	pH	----	E108	0.10	pH units	7.77	7.81	0.513%	4%	----
Physical Tests (QC Lot: 660739)											
CG2212738-001	Columbia River - D/S HKD	conductivity	----	E100	2.0	µS/cm	97.9	97.4	0.512%	10%	----
Physical Tests (QC Lot: 660740)											
CG2212738-001	Columbia River - D/S HKD	alkalinity, total (as CaCO3)	----	E290	2.0	mg/L	45.4	45.0	0.885%	20%	----
Anions and Nutrients (QC Lot: 654169)											
CG2212714-003	Anonymous	fluoride	16984-48-8	E235.F	0.100	mg/L	<0.100	<0.100	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 654170)											
CG2212714-003	Anonymous	nitrate (as N)	14797-55-8	E235.NO3	0.100	mg/L	2.57	2.61	1.38%	20%	----
Anions and Nutrients (QC Lot: 654171)											
CG2212714-003	Anonymous	nitrite (as N)	14797-65-0	E235.NO2	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 654172)											
CG2212714-003	Anonymous	chloride	16887-00-6	E235.Cl	2.50	mg/L	2760	2760	0.178%	20%	----
Anions and Nutrients (QC Lot: 654173)											
CG2212714-003	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	1.50	mg/L	61.1	62.0	1.46%	20%	----
Anions and Nutrients (QC Lot: 655521)											
CG2212529-001	Anonymous	phosphorus, total dissolved	7723-14-0	E375-T	0.0020	mg/L	0.0461	0.0455	1.37%	20%	----
Anions and Nutrients (QC Lot: 655806)											
CG2212680-001	Anonymous	ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	0.0433	0.0422	0.0011	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 657685)											
CG2212718-008	Anonymous	phosphorus, total	7723-14-0	E372-U	0.0020	mg/L	<0.0020	<0.0020	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 657821)											
CG2212700-001	Anonymous	Kjeldahl nitrogen, total [TKN]	----	E318	0.200	mg/L	3.20	2.86	11.2%	20%	----
Organic / Inorganic Carbon (QC Lot: 654263)											
CG2212728-001	Anonymous	carbon, dissolved organic [DOC]	----	E358-L	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
Organic / Inorganic Carbon (QC Lot: 654264)											

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Organic / Inorganic Carbon (QC Lot: 654264) - continued											
CG2212728-001	Anonymous	carbon, total organic [TOC]	----	E355-L	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
Total Metals (QC Lot: 660262)											
CG2212647-001	Anonymous	aluminum, total	7429-90-5	E420	0.0030	mg/L	<0.0150	0.0095	0.0055	Diff <2x LOR	----
		antimony, total	7440-36-0	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		arsenic, total	7440-38-2	E420	0.00010	mg/L	0.00015	0.00018	0.00003	Diff <2x LOR	----
		barium, total	7440-39-3	E420	0.00010	mg/L	0.0634	0.0621	1.96%	20%	----
		beryllium, total	7440-41-7	E420	0.000020	mg/L	<0.020 µg/L	<0.000020	0	Diff <2x LOR	----
		bismuth, total	7440-69-9	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		boron, total	7440-42-8	E420	0.010	mg/L	0.016	0.016	0.0002	Diff <2x LOR	----
		cadmium, total	7440-43-9	E420	0.0000050	mg/L	0.0061 µg/L	0.0000088	0.0000027	Diff <2x LOR	----
		calcium, total	7440-70-2	E420	0.050	mg/L	49.2	49.0	0.500%	20%	----
		cesium, total	7440-46-2	E420	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		cobalt, total	7440-48-4	E420	0.00010	mg/L	<0.10 µg/L	<0.00010	0	Diff <2x LOR	----
		copper, total	7440-50-8	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		iron, total	7439-89-6	E420	0.010	mg/L	0.017	0.018	0.0006	Diff <2x LOR	----
		lead, total	7439-92-1	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		lithium, total	7439-93-2	E420	0.0010	mg/L	0.0073	0.0072	0.00003	Diff <2x LOR	----
		magnesium, total	7439-95-4	E420	0.0050	mg/L	18.1	17.6	2.80%	20%	----
		manganese, total	7439-96-5	E420	0.00010	mg/L	0.00378	0.00370	2.33%	20%	----
		molybdenum, total	7439-98-7	E420	0.000050	mg/L	0.00134	0.00136	0.949%	20%	----
		nickel, total	7440-02-0	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		phosphorus, total	7723-14-0	E420	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
		potassium, total	7440-09-7	E420	0.050	mg/L	0.653	0.628	3.92%	20%	----
		rubidium, total	7440-17-7	E420	0.00020	mg/L	0.00037	0.00033	0.00004	Diff <2x LOR	----
		selenium, total	7782-49-2	E420	0.000050	mg/L	1.82 µg/L	0.00190	4.25%	20%	----
		silicon, total	7440-21-3	E420	0.10	mg/L	2.88	2.82	2.04%	20%	----
		silver, total	7440-22-4	E420	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		sodium, total	7440-23-5	E420	0.050	mg/L	2.56	2.48	2.95%	20%	----
		strontium, total	7440-24-6	E420	0.00020	mg/L	0.189	0.187	0.901%	20%	----
		sulfur, total	7704-34-9	E420	0.50	mg/L	15.5	15.3	1.22%	20%	----
		tellurium, total	13494-80-9	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		thallium, total	7440-28-0	E420	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		thorium, total	7440-29-1	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		tin, total	7440-31-5	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Total Metals (QC Lot: 660262) - continued											
CG2212647-001	Anonymous	titanium, total	7440-32-6	E420	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
		tungsten, total	7440-33-7	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		uranium, total	7440-61-1	E420	0.000010	mg/L	0.000918	0.000909	0.998%	20%	----
		vanadium, total	7440-62-2	E420	0.00050	mg/L	0.00068	0.00068	0.000003	Diff <2x LOR	----
		zinc, total	7440-66-6	E420	0.0030	mg/L	<0.0030	<0.0030	0	Diff <2x LOR	----
		zirconium, total	7440-67-7	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
Total Metals (QC Lot: 661799)											
CG2212718-005	Anonymous	mercury, total	7439-97-6	E508	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
Dissolved Metals (QC Lot: 660198)											
CG2212731-001	Anonymous	aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	0.0282	0.0281	0.160%	20%	----
		antimony, dissolved	7440-36-0	E421	0.00010	mg/L	0.00045	0.00047	0.00001	Diff <2x LOR	----
		arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.00073	0.00067	0.00006	Diff <2x LOR	----
		barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.279	0.284	1.67%	20%	----
		beryllium, dissolved	7440-41-7	E421	0.000020	mg/L	<0.000020	<0.000020	0	Diff <2x LOR	----
		bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		boron, dissolved	7440-42-8	E421	0.010	mg/L	0.012	0.012	0.0007	Diff <2x LOR	----
		cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	0.0000174	0.0000218	0.0000043	Diff <2x LOR	----
		calcium, dissolved	7440-70-2	E421	0.050	mg/L	29.7	30.5	2.89%	20%	----
		cesium, dissolved	7440-46-2	E421	0.000010	mg/L	0.000025	0.000026	0.0000007	Diff <2x LOR	----
		chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	0.00032	0.00032	0.000004	Diff <2x LOR	----
		copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.00043	0.00042	0.000006	Diff <2x LOR	----
		iron, dissolved	7439-89-6	E421	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----
		lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		lithium, dissolved	7439-93-2	E421	0.0010	mg/L	0.932	0.980	4.95%	20%	----
		magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	17.9	18.2	1.80%	20%	----
		manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.0889	0.0906	1.85%	20%	----
		molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.0244	0.0255	4.54%	20%	----
		nickel, dissolved	7440-02-0	E421	0.00050	mg/L	0.00301	0.00312	0.00011	Diff <2x LOR	----
		phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
		potassium, dissolved	7440-09-7	E421	0.050	mg/L	3.65	3.68	0.986%	20%	----
		rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	0.00305	0.00348	12.9%	20%	----
		selenium, dissolved	7782-49-2	E421	0.000050	mg/L	0.00129	0.00149	14.2%	20%	----
		silicon, dissolved	7440-21-3	E421	0.050	mg/L	2.65	3.12	16.3%	20%	----
		silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Dissolved Metals (QC Lot: 660198) - continued											
CG2212731-001	Anonymous	sodium, dissolved	7440-23-5	E421	0.050	mg/L	85.1	86.7	1.82%	20%	----
		strontium, dissolved	7440-24-6	E421	0.00020	mg/L	0.272	0.282	3.58%	20%	----
		sulfur, dissolved	7704-34-9	E421	0.50	mg/L	8.75	10.6	19.2%	20%	----
		tellurium, dissolved	13494-80-9	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		thallium, dissolved	7440-28-0	E421	0.000010	mg/L	0.000014	0.000013	0.0000003	Diff <2x LOR	----
		thorium, dissolved	7440-29-1	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		tin, dissolved	7440-31-5	E421	0.00010	mg/L	0.00016	0.00016	0.000004	Diff <2x LOR	----
		titanium, dissolved	7440-32-6	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
		tungsten, dissolved	7440-33-7	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		uranium, dissolved	7440-61-1	E421	0.000010	mg/L	0.00136	0.00142	4.48%	20%	----
		vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		zinc, dissolved	7440-66-6	E421	0.0010	mg/L	0.0016	0.0017	0.00006	Diff <2x LOR	----
		zirconium, dissolved	7440-67-7	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
Dissolved Metals (QC Lot: 661863)											
CG2212729-003	Anonymous	mercury, dissolved	7439-97-6	E509	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 654352)						
turbidity	----	E121	0.1	NTU	<0.10	----
Physical Tests (QCLot: 660279)						
solids, total suspended [TSS]	----	E160-L	1	mg/L	<1.0	----
Physical Tests (QCLot: 660288)						
solids, total dissolved [TDS]	----	E162	10	mg/L	<10	----
Physical Tests (QCLot: 660739)						
conductivity	----	E100	1	µS/cm	1.0	----
Physical Tests (QCLot: 660740)						
alkalinity, total (as CaCO3)	----	E290	1	mg/L	<1.0	----
Anions and Nutrients (QCLot: 654169)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 654170)						
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 654171)						
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	<0.010	----
Anions and Nutrients (QCLot: 654172)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 654173)						
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 655521)						
phosphorus, total dissolved	7723-14-0	E375-T	0.002	mg/L	<0.0020	----
Anions and Nutrients (QCLot: 655806)						
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	<0.0050	----
Anions and Nutrients (QCLot: 657685)						
phosphorus, total	7723-14-0	E372-U	0.002	mg/L	<0.0020	----
Anions and Nutrients (QCLot: 657821)						
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	<0.050	----
Organic / Inorganic Carbon (QCLot: 654263)						
carbon, dissolved organic [DOC]	----	E358-L	0.5	mg/L	<0.50	----
Organic / Inorganic Carbon (QCLot: 654264)						
carbon, total organic [TOC]	----	E355-L	0.5	mg/L	<0.50	----
Total Metals (QCLot: 660262)						
aluminum, total	7429-90-5	E420	0.003	mg/L	# 0.0034	MB-LOR

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 660262) - continued						
antimony, total	7440-36-0	E420	0.0001	mg/L	<0.00010	----
arsenic, total	7440-38-2	E420	0.0001	mg/L	<0.00010	----
barium, total	7440-39-3	E420	0.0001	mg/L	<0.00010	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	<0.000020	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	<0.000050	----
boron, total	7440-42-8	E420	0.01	mg/L	<0.010	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	<0.0000050	----
calcium, total	7440-70-2	E420	0.05	mg/L	<0.050	----
cesium, total	7440-46-2	E420	0.00001	mg/L	<0.000010	----
chromium, total	7440-47-3	E420	0.0005	mg/L	<0.00050	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	<0.00010	----
copper, total	7440-50-8	E420	0.0005	mg/L	<0.00050	----
iron, total	7439-89-6	E420	0.01	mg/L	<0.010	----
lead, total	7439-92-1	E420	0.00005	mg/L	<0.000050	----
lithium, total	7439-93-2	E420	0.001	mg/L	<0.0010	----
magnesium, total	7439-95-4	E420	0.005	mg/L	<0.0050	----
manganese, total	7439-96-5	E420	0.0001	mg/L	<0.00010	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	<0.000050	----
nickel, total	7440-02-0	E420	0.0005	mg/L	<0.00050	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	<0.050	----
potassium, total	7440-09-7	E420	0.05	mg/L	<0.050	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	<0.00020	----
selenium, total	7782-49-2	E420	0.00005	mg/L	<0.000050	----
silicon, total	7440-21-3	E420	0.1	mg/L	<0.10	----
silver, total	7440-22-4	E420	0.00001	mg/L	<0.000010	----
sodium, total	7440-23-5	E420	0.05	mg/L	<0.050	----
strontium, total	7440-24-6	E420	0.0002	mg/L	<0.00020	----
sulfur, total	7704-34-9	E420	0.5	mg/L	<0.50	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	<0.00020	----
thallium, total	7440-28-0	E420	0.00001	mg/L	<0.000010	----
thorium, total	7440-29-1	E420	0.0001	mg/L	<0.00010	----
tin, total	7440-31-5	E420	0.0001	mg/L	<0.00010	----
titanium, total	7440-32-6	E420	0.0003	mg/L	<0.00030	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	<0.00010	----
uranium, total	7440-61-1	E420	0.00001	mg/L	<0.000010	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	<0.00050	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 660262) - continued						
zinc, total	7440-66-6	E420	0.003	mg/L	<0.0030	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	<0.00020	----
Total Metals (QCLot: 661799)						
mercury, total	7439-97-6	E508	0.000005	mg/L	<0.0000050	----
Dissolved Metals (QCLot: 660198)						
aluminum, dissolved	7429-90-5	E421	0.001	mg/L	<0.0010	----
antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	----
arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	----
barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	----
beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	<0.000020	----
bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	<0.000050	----
boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	----
cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	----
calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	----
cesium, dissolved	7440-46-2	E421	0.00001	mg/L	<0.000010	----
chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	----
cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	<0.00010	----
copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	----
lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----
lithium, dissolved	7439-93-2	E421	0.001	mg/L	<0.0010	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	<0.000050	----
nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----
phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	<0.050	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	<0.00020	----
selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
silicon, dissolved	7440-21-3	E421	0.05	mg/L	<0.050	----
silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
strontium, dissolved	7440-24-6	E421	0.0002	mg/L	<0.00020	----
sulfur, dissolved	7704-34-9	E421	0.5	mg/L	<0.50	----
tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	<0.00020	----
thallium, dissolved	7440-28-0	E421	0.00001	mg/L	<0.000010	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals (QCLot: 660198) - continued						
thorium, dissolved	7440-29-1	E421	0.0001	mg/L	<0.00010	----
tin, dissolved	7440-31-5	E421	0.0001	mg/L	<0.00010	----
titanium, dissolved	7440-32-6	E421	0.0003	mg/L	<0.00030	----
tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	<0.00010	----
uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	----
vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	<0.00050	----
zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	----
zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	<0.00020	----
Dissolved Metals (QCLot: 661863)						
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	<0.0000050	----

Qualifiers

Qualifier	Description
MB-LOR	*Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.*

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 654352)									
turbidity	----	E121	0.1	NTU	200 NTU	108	85.0	115	----
Physical Tests (QCLot: 660279)									
solids, total suspended [TSS]	----	E160-L	1	mg/L	150 mg/L	94.7	85.0	115	----
Physical Tests (QCLot: 660288)									
solids, total dissolved [TDS]	----	E162	10	mg/L	1000 mg/L	99.1	85.0	115	----
Physical Tests (QCLot: 660738)									
pH	----	E108	----	pH units	7 pH units	101	98.6	101	----
Physical Tests (QCLot: 660739)									
conductivity	----	E100	1	µS/cm	146.9 µS/cm	100	90.0	110	----
Physical Tests (QCLot: 660740)									
alkalinity, total (as CaCO3)	----	E290	1	mg/L	500 mg/L	103	85.0	115	----
Anions and Nutrients (QCLot: 654169)									
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	103	90.0	110	----
Anions and Nutrients (QCLot: 654170)									
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	2.5 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 654171)									
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	0.5 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 654172)									
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 654173)									
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 655521)									
phosphorus, total dissolved	7723-14-0	E375-T	0.002	mg/L	0.03 mg/L	102	80.0	120	----
Anions and Nutrients (QCLot: 655806)									
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	0.2 mg/L	104	85.0	115	----
Anions and Nutrients (QCLot: 657685)									
phosphorus, total	7723-14-0	E372-U	0.002	mg/L	0.03 mg/L	97.8	80.0	120	----
Anions and Nutrients (QCLot: 657821)									
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	4 mg/L	107	75.0	125	----
Organic / Inorganic Carbon (QCLot: 654263)									
carbon, dissolved organic [DOC]	----	E358-L	0.5	mg/L	8.57 mg/L	89.8	80.0	120	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report: Spike Concentration	Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High	Qualifier
Organic / Inorganic Carbon (QCLot: 654264)									
carbon, total organic [TOC]	----	E355-L	0.5	mg/L	8.57 mg/L	102	80.0	120	----
Total Metals (QCLot: 660262)									
aluminum, total	7429-90-5	E420	0.003	mg/L	2 mg/L	96.2	80.0	120	----
antimony, total	7440-36-0	E420	0.0001	mg/L	1 mg/L	104	80.0	120	----
arsenic, total	7440-38-2	E420	0.0001	mg/L	1 mg/L	94.3	80.0	120	----
barium, total	7440-39-3	E420	0.0001	mg/L	0.25 mg/L	96.0	80.0	120	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	0.1 mg/L	90.9	80.0	120	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	1 mg/L	96.4	80.0	120	----
boron, total	7440-42-8	E420	0.01	mg/L	1 mg/L	84.8	80.0	120	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	0.1 mg/L	94.0	80.0	120	----
calcium, total	7440-70-2	E420	0.05	mg/L	50 mg/L	89.6	80.0	120	----
cesium, total	7440-46-2	E420	0.00001	mg/L	0.05 mg/L	93.3	80.0	120	----
chromium, total	7440-47-3	E420	0.0005	mg/L	0.25 mg/L	94.1	80.0	120	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	0.25 mg/L	94.7	80.0	120	----
copper, total	7440-50-8	E420	0.0005	mg/L	0.25 mg/L	93.0	80.0	120	----
iron, total	7439-89-6	E420	0.01	mg/L	1 mg/L	106	80.0	120	----
lead, total	7439-92-1	E420	0.00005	mg/L	0.5 mg/L	96.1	80.0	120	----
lithium, total	7439-93-2	E420	0.001	mg/L	0.25 mg/L	96.4	80.0	120	----
magnesium, total	7439-95-4	E420	0.005	mg/L	50 mg/L	89.6	80.0	120	----
manganese, total	7439-96-5	E420	0.0001	mg/L	0.25 mg/L	95.7	80.0	120	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.25 mg/L	99.9	80.0	120	----
nickel, total	7440-02-0	E420	0.0005	mg/L	0.5 mg/L	93.8	80.0	120	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	10 mg/L	98.8	70.0	130	----
potassium, total	7440-09-7	E420	0.05	mg/L	50 mg/L	95.1	80.0	120	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	0.1 mg/L	96.2	80.0	120	----
selenium, total	7782-49-2	E420	0.00005	mg/L	1 mg/L	88.2	80.0	120	----
silicon, total	7440-21-3	E420	0.1	mg/L	10 mg/L	95.9	60.0	140	----
silver, total	7440-22-4	E420	0.00001	mg/L	0.1 mg/L	88.7	80.0	120	----
sodium, total	7440-23-5	E420	0.05	mg/L	50 mg/L	94.9	80.0	120	----
strontium, total	7440-24-6	E420	0.0002	mg/L	0.25 mg/L	97.7	80.0	120	----
sulfur, total	7704-34-9	E420	0.5	mg/L	50 mg/L	89.0	80.0	120	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	0.1 mg/L	90.1	80.0	120	----
thallium, total	7440-28-0	E420	0.00001	mg/L	1 mg/L	96.4	80.0	120	----
thorium, total	7440-29-1	E420	0.0001	mg/L	0.1 mg/L	86.8	80.0	120	----
tin, total	7440-31-5	E420	0.0001	mg/L	0.5 mg/L	99.1	80.0	120	----
titanium, total	7440-32-6	E420	0.0003	mg/L	0.25 mg/L	94.2	80.0	120	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	0.1 mg/L	91.4	80.0	120	----

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Total Metals (QCLot: 660262) - continued									
uranium, total	7440-61-1	E420	0.00001	mg/L	0.005 mg/L	92.5	80.0	120	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	0.5 mg/L	97.1	80.0	120	----
zinc, total	7440-66-6	E420	0.003	mg/L	0.5 mg/L	88.0	80.0	120	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	0.1 mg/L	98.7	80.0	120	----
Total Metals (QCLot: 661799)									
mercury, total	7439-97-6	E508	0.000005	mg/L	0.0001 mg/L	111	80.0	120	----
Dissolved Metals (QCLot: 660198)									
aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	98.4	80.0	120	----
antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	101	80.0	120	----
arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	98.1	80.0	120	----
barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	101	80.0	120	----
beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.1 mg/L	95.2	80.0	120	----
bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	1 mg/L	98.7	80.0	120	----
boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	98.1	80.0	120	----
cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	102	80.0	120	----
calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	97.2	80.0	120	----
cesium, dissolved	7440-46-2	E421	0.00001	mg/L	0.05 mg/L	94.6	80.0	120	----
chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	97.6	80.0	120	----
cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.25 mg/L	97.7	80.0	120	----
copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	96.4	80.0	120	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	109	80.0	120	----
lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	96.5	80.0	120	----
lithium, dissolved	7439-93-2	E421	0.001	mg/L	0.25 mg/L	95.5	80.0	120	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	93.3	80.0	120	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	96.5	80.0	120	----
molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.25 mg/L	100	80.0	120	----
nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	95.3	80.0	120	----
phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	10 mg/L	100	70.0	130	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	97.2	80.0	120	----
rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	0.1 mg/L	99.9	80.0	120	----
selenium, dissolved	7782-49-2	E421	0.00005	mg/L	1 mg/L	91.5	80.0	120	----
silicon, dissolved	7440-21-3	E421	0.05	mg/L	10 mg/L	98.6	60.0	140	----
silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	90.9	80.0	120	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	96.8	80.0	120	----
strontium, dissolved	7440-24-6	E421	0.0002	mg/L	0.25 mg/L	95.1	80.0	120	----
sulfur, dissolved	7704-34-9	E421	0.5	mg/L	50 mg/L	104	80.0	120	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	Qualifier
Dissolved Metals (QCLot: 660198) - continued									
tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	0.1 mg/L	91.6	80.0	120	----
thallium, dissolved	7440-28-0	E421	0.00001	mg/L	1 mg/L	96.8	80.0	120	----
thorium, dissolved	7440-29-1	E421	0.0001	mg/L	0.1 mg/L	91.6	80.0	120	----
tin, dissolved	7440-31-5	E421	0.0001	mg/L	0.5 mg/L	101	80.0	120	----
titanium, dissolved	7440-32-6	E421	0.0003	mg/L	0.25 mg/L	80.0	80.0	120	----
tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	0.1 mg/L	98.8	80.0	120	----
uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	93.8	80.0	120	----
vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.5 mg/L	98.5	80.0	120	----
zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	97.3	80.0	120	----
zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	0.1 mg/L	100.0	80.0	120	----
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	0.0001 mg/L	100	80.0	120	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Anions and Nutrients (QCLot: 654169)										
CG2212738-002	Field Blank	fluoride	16984-48-8	E235.F	1.10 mg/L	1 mg/L	110	75.0	125	----
Anions and Nutrients (QCLot: 654170)										
CG2212738-002	Field Blank	nitrate (as N)	14797-55-8	E235.NO3	2.70 mg/L	2.5 mg/L	108	75.0	125	----
Anions and Nutrients (QCLot: 654171)										
CG2212738-002	Field Blank	nitrite (as N)	14797-65-0	E235.NO2	0.547 mg/L	0.5 mg/L	109	75.0	125	----
Anions and Nutrients (QCLot: 654172)										
CG2212738-002	Field Blank	chloride	16887-00-6	E235.Cl	108 mg/L	100 mg/L	108	75.0	125	----
Anions and Nutrients (QCLot: 654173)										
CG2212738-002	Field Blank	sulfate (as SO4)	14808-79-8	E235.SO4	109 mg/L	100 mg/L	109	75.0	125	----
Anions and Nutrients (QCLot: 655521)										
CG2212537-001	Anonymous	phosphorus, total dissolved	7723-14-0	E375-T	0.0419 mg/L	0.05 mg/L	83.9	70.0	130	----
Anions and Nutrients (QCLot: 655806)										
CG2212680-002	Anonymous	ammonia, total (as N)	7664-41-7	E298	0.109 mg/L	0.1 mg/L	109	75.0	125	----
Anions and Nutrients (QCLot: 657685)										
CG2212718-009	Anonymous	phosphorus, total	7723-14-0	E372-U	0.0434 mg/L	0.05 mg/L	86.7	70.0	130	----
Anions and Nutrients (QCLot: 657821)										
CG2212700-002	Anonymous	Kjeldahl nitrogen, total [TKN]	----	E318	ND mg/L	2.5 mg/L	ND	70.0	130	----
Organic / Inorganic Carbon (QCLot: 654263)										
CG2212728-001	Anonymous	carbon, dissolved organic [DOC]	----	E358-L	5.32 mg/L	5 mg/L	106	70.0	130	----
Organic / Inorganic Carbon (QCLot: 654264)										
CG2212728-001	Anonymous	carbon, total organic [TOC]	----	E355-L	6.17 mg/L	5 mg/L	123	70.0	130	----
Total Metals (QCLot: 660262)										
CG2212647-002	Anonymous	aluminum, total	7429-90-5	E420	2.37 mg/L	2 mg/L	118	70.0	130	----
		antimony, total	7440-36-0	E420	0.228 mg/L	0.2 mg/L	114	70.0	130	----
		arsenic, total	7440-38-2	E420	0.230 mg/L	0.2 mg/L	115	70.0	130	----
		barium, total	7440-39-3	E420	0.234 mg/L	0.2 mg/L	117	70.0	130	----
		beryllium, total	7440-41-7	E420	0.482 mg/L	0.4 mg/L	120	70.0	130	----
		bismuth, total	7440-69-9	E420	0.115 mg/L	0.1 mg/L	115	70.0	130	----
		boron, total	7440-42-8	E420	1.09 mg/L	1 mg/L	109	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Total Metals (QCLot: 660262) - continued										
CG2212647-002	Anonymous	cadmium, total	7440-43-9	E420	0.0485 mg/L	0.04 mg/L	121	70.0	130	----
		calcium, total	7440-70-2	E420	46.8 mg/L	40 mg/L	117	70.0	130	----
		cesium, total	7440-46-2	E420	0.115 mg/L	0.1 mg/L	115	70.0	130	----
		chromium, total	7440-47-3	E420	0.480 mg/L	0.4 mg/L	120	70.0	130	----
		cobalt, total	7440-48-4	E420	0.242 mg/L	0.2 mg/L	121	70.0	130	----
		copper, total	7440-50-8	E420	0.245 mg/L	0.2 mg/L	122	70.0	130	----
		iron, total	7439-89-6	E420	23.8 mg/L	20 mg/L	119	70.0	130	----
		lead, total	7439-92-1	E420	0.240 mg/L	0.2 mg/L	120	70.0	130	----
		lithium, total	7439-93-2	E420	1.21 mg/L	1 mg/L	121	70.0	130	----
		magnesium, total	7439-95-4	E420	11.3 mg/L	10 mg/L	113	70.0	130	----
		manganese, total	7439-96-5	E420	0.240 mg/L	0.2 mg/L	120	70.0	130	----
		molybdenum, total	7439-98-7	E420	0.226 mg/L	0.2 mg/L	113	70.0	130	----
		nickel, total	7440-02-0	E420	0.484 mg/L	0.4 mg/L	121	70.0	130	----
		phosphorus, total	7723-14-0	E420	114 mg/L	100 mg/L	114	70.0	130	----
		potassium, total	7440-09-7	E420	46.4 mg/L	40 mg/L	116	70.0	130	----
		rubidium, total	7440-17-7	E420	0.234 mg/L	0.2 mg/L	117	70.0	130	----
		selenium, total	7782-49-2	E420	0.468 mg/L	0.4 mg/L	117	70.0	130	----
		silicon, total	7440-21-3	E420	89.6 mg/L	100 mg/L	89.6	70.0	130	----
		silver, total	7440-22-4	E420	0.0495 mg/L	0.04 mg/L	124	70.0	130	----
		sodium, total	7440-23-5	E420	24.1 mg/L	20 mg/L	120	70.0	130	----
		strontium, total	7440-24-6	E420	0.239 mg/L	0.2 mg/L	119	70.0	130	----
		sulfur, total	7704-34-9	E420	216 mg/L	200 mg/L	108	70.0	130	----
		tellurium, total	13494-80-9	E420	0.447 mg/L	0.4 mg/L	112	70.0	130	----
		thallium, total	7440-28-0	E420	0.0454 mg/L	0.04 mg/L	114	70.0	130	----
		thorium, total	7440-29-1	E420	0.243 mg/L	0.2 mg/L	122	70.0	130	----
		tin, total	7440-31-5	E420	0.228 mg/L	0.2 mg/L	114	70.0	130	----
		titanium, total	7440-32-6	E420	0.440 mg/L	0.4 mg/L	110	70.0	130	----
		tungsten, total	7440-33-7	E420	0.210 mg/L	0.2 mg/L	105	70.0	130	----
		uranium, total	7440-61-1	E420	0.0468 mg/L	0.04 mg/L	117	70.0	130	----
		vanadium, total	7440-62-2	E420	1.20 mg/L	1 mg/L	120	70.0	130	----
		zinc, total	7440-66-6	E420	4.62 mg/L	4 mg/L	116	70.0	130	----
		zirconium, total	7440-67-7	E420	0.456 mg/L	0.4 mg/L	114	70.0	130	----
Total Metals (QCLot: 661799)										
CG2212718-006	Anonymous	mercury, total	7439-97-6	E508	0.000102 mg/L	0.0001 mg/L	102	70.0	130	----
Dissolved Metals (QCLot: 660198)										
CG2212731-002	Anonymous	aluminum, dissolved	7429-90-5	E421	2.04 mg/L	2 mg/L	102	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Dissolved Metals (QCLot: 660198) - continued										
CG2212731-002	Anonymous	antimony, dissolved	7440-36-0	E421	0.206 mg/L	0.2 mg/L	103	70.0	130	----
		arsenic, dissolved	7440-38-2	E421	0.202 mg/L	0.2 mg/L	101	70.0	130	----
		barium, dissolved	7440-39-3	E421	ND mg/L	0.2 mg/L	ND	70.0	130	----
		beryllium, dissolved	7440-41-7	E421	0.403 mg/L	0.4 mg/L	101	70.0	130	----
		bismuth, dissolved	7440-69-9	E421	0.0890 mg/L	0.1 mg/L	89.0	70.0	130	----
		boron, dissolved	7440-42-8	E421	0.990 mg/L	1 mg/L	99.0	70.0	130	----
		cadmium, dissolved	7440-43-9	E421	0.0413 mg/L	0.04 mg/L	103	70.0	130	----
		calcium, dissolved	7440-70-2	E421	ND mg/L	40 mg/L	ND	70.0	130	----
		cesium, dissolved	7440-46-2	E421	0.0946 mg/L	0.1 mg/L	94.6	70.0	130	----
		chromium, dissolved	7440-47-3	E421	0.397 mg/L	0.4 mg/L	99.3	70.0	130	----
		cobalt, dissolved	7440-48-4	E421	0.199 mg/L	0.2 mg/L	99.5	70.0	130	----
		copper, dissolved	7440-50-8	E421	0.195 mg/L	0.2 mg/L	97.4	70.0	130	----
		iron, dissolved	7439-89-6	E421	19.0 mg/L	20 mg/L	94.9	70.0	130	----
		lead, dissolved	7439-92-1	E421	0.183 mg/L	0.2 mg/L	91.4	70.0	130	----
		lithium, dissolved	7439-93-2	E421	ND mg/L	1 mg/L	ND	70.0	130	----
		magnesium, dissolved	7439-95-4	E421	ND mg/L	10 mg/L	ND	70.0	130	----
		manganese, dissolved	7439-96-5	E421	ND mg/L	0.2 mg/L	ND	70.0	130	----
		molybdenum, dissolved	7439-98-7	E421	0.201 mg/L	0.2 mg/L	100	70.0	130	----
		nickel, dissolved	7440-02-0	E421	0.383 mg/L	0.4 mg/L	95.7	70.0	130	----
		phosphorus, dissolved	7723-14-0	E421	100.0 mg/L	100 mg/L	100.0	70.0	130	----
		potassium, dissolved	7440-09-7	E421	38.9 mg/L	40 mg/L	97.4	70.0	130	----
		rubidium, dissolved	7440-17-7	E421	0.200 mg/L	0.2 mg/L	99.8	70.0	130	----
		selenium, dissolved	7782-49-2	E421	0.383 mg/L	0.4 mg/L	95.8	70.0	130	----
		silicon, dissolved	7440-21-3	E421	95.3 mg/L	100 mg/L	95.3	70.0	130	----
		silver, dissolved	7440-22-4	E421	0.0408 mg/L	0.04 mg/L	102	70.0	130	----
		sodium, dissolved	7440-23-5	E421	ND mg/L	20 mg/L	ND	70.0	130	----
		strontium, dissolved	7440-24-6	E421	ND mg/L	0.2 mg/L	ND	70.0	130	----
		sulfur, dissolved	7704-34-9	E421	202 mg/L	200 mg/L	101	70.0	130	----
		tellurium, dissolved	13494-80-9	E421	0.372 mg/L	0.4 mg/L	93.1	70.0	130	----
		thallium, dissolved	7440-28-0	E421	0.0356 mg/L	0.04 mg/L	89.0	70.0	130	----
		thorium, dissolved	7440-29-1	E421	0.188 mg/L	0.2 mg/L	94.0	70.0	130	----
		tin, dissolved	7440-31-5	E421	0.197 mg/L	0.2 mg/L	98.5	70.0	130	----
		titanium, dissolved	7440-32-6	E421	0.343 mg/L	0.4 mg/L	85.8	70.0	130	----
		tungsten, dissolved	7440-33-7	E421	0.197 mg/L	0.2 mg/L	98.5	70.0	130	----
		uranium, dissolved	7440-61-1	E421	0.0368 mg/L	0.04 mg/L	92.0	70.0	130	----
		vanadium, dissolved	7440-62-2	E421	1.00 mg/L	1 mg/L	100	70.0	130	----
		zinc, dissolved	7440-66-6	E421	3.91 mg/L	4 mg/L	97.7	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Dissolved Metals (QCLot: 660198) - continued										
CG2212731-002	Anonymous	zirconium, dissolved	7440-67-7	E421	0.403 mg/L	0.4 mg/L	101	70.0	130	----
Dissolved Metals (QCLot: 661863)										
CG2212729-004	Anonymous	mercury, dissolved	7439-97-6	E509	0.0000998 mg/L	0.0001 mg/L	99.8	70.0	130	----

Chain of Custody (COC) / Analytical Request Form

COC Number: 20 - 929727

Canada Toll Free: 1 800 668 9878

Page of

www.alsglobal.com

Environmental Division Calgary Work Order Reference CG2212738

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates
Contact:	Mikayla Donovan
Phone:	778-246-6157
	Company address below will appear on the final report
Street:	2800, 700 - 2nd St SW
City/Province:	Calgary, Alberta
Postal Code:	T2G 0R1
Invoice To	Same as Report To ☑ YES ☑ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☑ PDF ☑ EXCEL ☑ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☑ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: elaine.irving@wsp.com

Email 2: mikayla.donovan@wsp.com

Email 3:

Invoice Recipients

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: gaven.tang@wsp.com

Email 2:

Turnaround Time (TAT) Requested

☐ Routine [R] if received by 3pm M-F - no surcharges apply

☑ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum

☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum

☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum

☐ 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.

AFFIX ALS BARCODE LABEL HE (ALS use only)

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.

Project Information

ALS Account # / Quote #: CG22-GOLD100-0012

Job #:

PO / AFE:

LSD:

ALS Lab Work Order # (ALS use only):

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Contact: Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Routine	Total Nutrients (P)	Dissolved Nutrients (F/P)	Total Metals (P)	Total Mercury (F)	Dissolved Metals (F/P)	Dissolved Mercury (F/P)	OLD	SE REQUIRED	SUSPECTED HAZARD (see notes)
	Columbia River - D/S HKD	17-Sep-22	13:30	SW		✓	✓	✓	✓	✓	✓	✓			
	Field Blank	17-Sep-22	14:00	SW		✓	✓	✓	✓	✓	✓	✓			

Environmental Division Calgary
Work Order Reference
CG2212738

Telephone : +1 403 407 1800

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☑ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:
Nishat Rahman	19/09/22	9:26

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:
	9/19	930

FINAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

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.

CERTIFICATE OF ANALYSIS

Work Order	: **CG2212837**	Page	: 1 of 7
Amendment	: **4**		
Client	: **Golder Associates Ltd.**	Laboratory	: Calgary - Environmental
Contact	: Elaine Irving	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary AB Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: WO# 20449674/9000	Date Samples Received	: 20-Sep-2022 10:00
PO	: WO# 20449674/9000	Date Analysis Commenced	: 20-Sep-2022
C-O-C number	: ----	Issue Date	: 12-Oct-2022 17:09
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Anthony Calero	Supervisor - Inorganic	Inorganics, Calgary, Alberta
Anthony Calero	Supervisor - Inorganic	Metals, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Inorganics, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Metals, Calgary, Alberta
Elke Tabora		Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Metals, Calgary, Alberta
Kevin Baxter		Metals, Calgary, Alberta
Parker Sgarbossa	Laboratory Analyst	Inorganics, Calgary, Alberta
Sara Niroomand		Inorganics, Calgary, Alberta
Sara Niroomand		Metals, Calgary, Alberta
Vladka Stamenova	Analyst	Inorganics, Calgary, Alberta

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit
%	percent
µS/cm	Microsiemens per centimetre
meq/L	milliequivalents per litre
mg/L	milligrams per litre
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior 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.

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

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
RRV	*Reported result verified by repeat analysis.*

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	COLUMBIA RIVER + ROCK - TR INITIATION (A)	----	----	----	----
					Client sampling date / time	19-Sep-2022 16:00	----	----	----	----
						CG2212837-001	--------	--------	--------	--------
						Result	----	----	----	----
Physical Tests										
hardness (as CaCO3), dissolved	----	EC100	0.50	mg/L		48.8	----	----	----	----
hardness (as CaCO3), from total Ca/Mg	----	EC100A	0.60	mg/L		47.8	----	----	----	----
solids, total suspended [TSS]	----	E160-L	1.0	mg/L		3.7	----	----	----	----
conductivity	----	E100	2.0	µS/cm		102	----	----	----	----
pH	----	E108	0.10	pH units		7.65	----	----	----	----
alkalinity, bicarbonate (as HCO3)	71-52-3	E290	1.0	mg/L		56.5	----	----	----	----
alkalinity, carbonate (as CO3)	3812-32-6	E290	1.0	mg/L		<1.0	----	----	----	----
alkalinity, hydroxide (as OH)	14280-30-9	E290	1.0	mg/L		<1.0	----	----	----	----
alkalinity, total (as CaCO3)	----	E290	2.0	mg/L		46.3	----	----	----	----
solids, total dissolved [TDS], calculated	----	EC103	1.0	mg/L		59.0	----	----	----	----
Anions and Nutrients										
ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L		0.0123	----	----	----	----
chloride	16887-00-6	E235.Cl	0.50	mg/L		<0.50	----	----	----	----
fluoride	16984-48-8	E235.F	0.020	mg/L		0.044	----	----	----	----
nitrate (as N)	14797-55-8	E235.NO3	0.020	mg/L		0.096	----	----	----	----
nitrite (as N)	14797-65-0	E235.NO2	0.010	mg/L		<0.010	----	----	----	----
sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L		8.17	----	----	----	----
nitrate + nitrite (as N)	----	EC235.N+N	0.0500	mg/L		0.0960	----	----	----	----
Organic / Inorganic Carbon										
carbon, dissolved organic [DOC]	----	E358-L	0.50	mg/L		<0.50	----	----	----	----
Ion Balance										
anion sum	----	EC101	0.10	meq/L		1.10	----	----	----	----
cation sum	----	EC101	0.10	meq/L		1.03	----	----	----	----
ion balance (APHA)	----	EC101	0.010	%		3.29	----	----	----	----
ion balance (cations/anions)	----	EC101	0.010	%		93.6	----	----	----	----
Total Metals										
aluminum, total	7429-90-5	E420	0.0030	mg/L		0.0340	----	----	----	----
antimony, total	7440-36-0	E420	0.00010	mg/L		<0.00010	----	----	----	----
arsenic, total	7440-38-2	E420	0.00010	mg/L		0.00024	----	----	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID: COLUMBIA RIVER + ROCK - TR INITIATION (A)	----	----	----	----
					Client sampling date / time: 19-Sep-2022 16:00	----	----	----	----
					CG2212837-001	--------	--------	--------	--------
					Result	----	----	----	----
Total Metals									
barium, total	7440-39-3	E420	0.00010	mg/L	0.0149	----	----	----	----
beryllium, total	7440-41-7	E420	0.000100	mg/L	<0.000100	----	----	----	----
bismuth, total	7440-69-9	E420	0.000050	mg/L	<0.000050	----	----	----	----
boron, total	7440-42-8	E420	0.010	mg/L	<0.010	----	----	----	----
cadmium, total	7440-43-9	E420	0.0000050	mg/L	0.0000103	----	----	----	----
calcium, total	7440-70-2	E420	0.050	mg/L	14.3	----	----	----	----
cesium, total	7440-46-2	E420	0.000010	mg/L	0.000018	----	----	----	----
chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	----	----	----	----
cobalt, total	7440-48-4	E420	0.00010	mg/L	<0.00010	----	----	----	----
copper, total	7440-50-8	E420	0.00050	mg/L	<0.00050	----	----	----	----
iron, total	7439-89-6	E420	0.010	mg/L	0.026	----	----	----	----
lead, total	7439-92-1	E420	0.000050	mg/L	<0.000050	----	----	----	----
lithium, total	7439-93-2	E420	0.0010	mg/L	<0.0010	----	----	----	----
magnesium, total	7439-95-4	E420	0.0050	mg/L	2.95	----	----	----	----
manganese, total	7439-96-5	E420	0.00010	mg/L	0.00221	----	----	----	----
mercury, total	7439-97-6	E508	0.0000050	mg/L	0.0000079 RRV	----	----	----	----
molybdenum, total	7439-98-7	E420	0.000050	mg/L	0.000577	----	----	----	----
nickel, total	7440-02-0	E420	0.00050	mg/L	0.00052	----	----	----	----
phosphorus, total	7723-14-0	E420	0.050	mg/L	<0.050	----	----	----	----
potassium, total	7440-09-7	E420	0.050	mg/L	0.624	----	----	----	----
rubidium, total	7440-17-7	E420	0.00020	mg/L	0.00137	----	----	----	----
selenium, total	7782-49-2	E420	0.000050	mg/L	0.000077	----	----	----	----
silicon, total	7440-21-3	E420	0.10	mg/L	1.49	----	----	----	----
silver, total	7440-22-4	E420	0.000010	mg/L	<0.000010	----	----	----	----
sodium, total	7440-23-5	E420	0.050	mg/L	0.815	----	----	----	----
strontium, total	7440-24-6	E420	0.00020	mg/L	0.0884	----	----	----	----
sulfur, total	7704-34-9	E420	0.50	mg/L	3.11	----	----	----	----
tellurium, total	13494-80-9	E420	0.00020	mg/L	<0.00020	----	----	----	----
thallium, total	7440-28-0	E420	0.000010	mg/L	<0.000010	----	----	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID: COLUMBIA RIVER + ROCK - TR INITIATION (A)	----	----	----	----
					Client sampling date / time: 19-Sep-2022 16:00	----	----	----	----
					CG2212837-001	--------	--------	--------	--------
					Result	----	----	----	----
Total Metals									
thorium, total	7440-29-1	E420	0.00010	mg/L	<0.00010	----	----	----	----
tin, total	7440-31-5	E420	0.00010	mg/L	0.00047	----	----	----	----
titanium, total	7440-32-6	E420	0.00030	mg/L	0.00169	----	----	----	----
tungsten, total	7440-33-7	E420	0.00010	mg/L	<0.00010	----	----	----	----
uranium, total	7440-61-1	E420	0.000010	mg/L	0.000343	----	----	----	----
vanadium, total	7440-62-2	E420	0.00050	mg/L	0.00135	----	----	----	----
zinc, total	7440-66-6	E420	0.0030	mg/L	<0.0030	----	----	----	----
zirconium, total	7440-67-7	E420	0.00020	mg/L	<0.00020	----	----	----	----
Dissolved Metals									
aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	0.0120	----	----	----	----
antimony, dissolved	7440-36-0	E421	0.00010	mg/L	<0.00010	----	----	----	----
arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.00013	----	----	----	----
barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.0168	----	----	----	----
beryllium, dissolved	7440-41-7	E421	0.000020	mg/L	<0.000020	----	----	----	----
bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	----	----	----	----
boron, dissolved	7440-42-8	E421	0.010	mg/L	<0.010	----	----	----	----
cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	<0.0000050	----	----	----	----
calcium, dissolved	7440-70-2	E421	0.050	mg/L	14.3	----	----	----	----
cesium, dissolved	7440-46-2	E421	0.000010	mg/L	0.000012	----	----	----	----
chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	----	----	----	----
cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	<0.00010	----	----	----	----
copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.00045	----	----	----	----
iron, dissolved	7439-89-6	E421	0.010	mg/L	<0.010	----	----	----	----
lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.000050	----	----	----	----
lithium, dissolved	7439-93-2	E421	0.0010	mg/L	<0.0010	----	----	----	----
magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	3.18	----	----	----	----
manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.00077	----	----	----	----
mercury, dissolved	7439-97-6	E509	0.0000050	mg/L	0.0000062 RRV	----	----	----	----
molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.000506	----	----	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID: COLUMBIA RIVER + ROCK - TR INITIATION (A)	----	----	----	----
					Client sampling date / time: 19-Sep-2022 16:00	----	----	----	----
					CG2212837-001	--------	--------	--------	--------
					Result	----	----	----	----
Dissolved Metals									
nickel, dissolved	7440-02-0	E421	0.00050	mg/L	0.00054	----	----	----	----
phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	<0.050	----	----	----	----
potassium, dissolved	7440-09-7	E421	0.050	mg/L	0.668	----	----	----	----
rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	0.00126	----	----	----	----
selenium, dissolved	7782-49-2	E421	0.000050	mg/L	0.000084	----	----	----	----
silicon, dissolved	7440-21-3	E421	0.050	mg/L	1.30	----	----	----	----
silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	----	----	----	----
sodium, dissolved	7440-23-5	E421	0.050	mg/L	0.908	----	----	----	----
strontium, dissolved	7440-24-6	E421	0.00020	mg/L	0.0915	----	----	----	----
sulfur, dissolved	7704-34-9	E421	0.50	mg/L	2.69	----	----	----	----
tellurium, dissolved	13494-80-9	E421	0.00020	mg/L	<0.00020	----	----	----	----
thallium, dissolved	7440-28-0	E421	0.000010	mg/L	<0.000010	----	----	----	----
thorium, dissolved	7440-29-1	E421	0.00010	mg/L	<0.00010	----	----	----	----
tin, dissolved	7440-31-5	E421	0.00010	mg/L	0.00043	----	----	----	----
titanium, dissolved	7440-32-6	E421	0.00030	mg/L	<0.00030	----	----	----	----
tungsten, dissolved	7440-33-7	E421	0.00010	mg/L	<0.00010	----	----	----	----
uranium, dissolved	7440-61-1	E421	0.000010	mg/L	0.000345	----	----	----	----
vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	<0.00050	----	----	----	----
zinc, dissolved	7440-66-6	E421	0.0010	mg/L	0.0035	----	----	----	----
zirconium, dissolved	7440-67-7	E421	0.00020	mg/L	<0.00020	----	----	----	----
dissolved mercury filtration location	----	EP509	-	-	Field	----	----	----	----
dissolved metals filtration location	----	EP421	-	-	Field	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **CG2212837**	Page	: 1 of 10
Amendment	: 4		
Client	: **Golder Associates Ltd.**	Laboratory	: Calgary - Environmental
Contact	: Elaine Irving	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary, Alberta Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: WO# 20449674/9000	Date Samples Received	: 20-Sep-2022 10:00
PO	: WO# 20449674/9000	Issue Date	: 12-Oct-2022 17:09
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- Method Blank value outliers occur - please see following pages for full details.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **Water**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Method Blank (MB) Values								
Total Metals	QC-MRG2-6631350 01	----	vanadium, total	7440-62-2	E420	0.00104 MB-LOR mg/L	0.0005 mg/L	Blank result exceeds permitted value

Result Qualifiers

Qualifier	Description
MB-LOR	*Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.*

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
COLUMBIA RIVER + ROCK - TR INITIATION (A)	E298	19-Sep-2022	21-Sep-2022	----	----		21-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE										
COLUMBIA RIVER + ROCK - TR INITIATION (A)	E235.Cl	19-Sep-2022	20-Sep-2022	----	----		20-Sep-2022	28 days	1 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE										
COLUMBIA RIVER + ROCK - TR INITIATION (A)	E235.F	19-Sep-2022	20-Sep-2022	----	----		20-Sep-2022	28 days	1 days	✓
Anions and Nutrients : Nitrate in Water by IC										
HDPE										
COLUMBIA RIVER + ROCK - TR INITIATION (A)	E235.NO3	19-Sep-2022	20-Sep-2022	----	----		20-Sep-2022	3 days	1 days	✓
Anions and Nutrients : Nitrite in Water by IC										
HDPE										
COLUMBIA RIVER + ROCK - TR INITIATION (A)	E235.NO2	19-Sep-2022	20-Sep-2022	----	----		20-Sep-2022	3 days	1 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE										
COLUMBIA RIVER + ROCK - TR INITIATION (A)	E235.SO4	19-Sep-2022	20-Sep-2022	----	----		20-Sep-2022	28 days	1 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid)										
COLUMBIA RIVER + ROCK - TR INITIATION (A)	E509	19-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	6 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid) COLUMBIA RIVER + ROCK - TR INITIATION (A)	E421	19-Sep-2022	24-Sep-2022	----	----		24-Sep-2022	180 days	5 days	✓
Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)										
Amber glass dissolved (sulfuric acid) COLUMBIA RIVER + ROCK - TR INITIATION (A)	E358-L	19-Sep-2022	20-Sep-2022	----	----		22-Sep-2022	28 days	3 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE COLUMBIA RIVER + ROCK - TR INITIATION (A)	E290	19-Sep-2022	24-Sep-2022	----	----		24-Sep-2022	14 days	5 days	✓
Physical Tests : Conductivity in Water										
HDPE COLUMBIA RIVER + ROCK - TR INITIATION (A)	E100	19-Sep-2022	24-Sep-2022	----	----		24-Sep-2022	28 days	5 days	✓
Physical Tests : pH by Meter										
HDPE COLUMBIA RIVER + ROCK - TR INITIATION (A)	E108	19-Sep-2022	24-Sep-2022	----	----		24-Sep-2022	0.25 hrs	0.26 hrs	× EHTR-FM
Physical Tests : TSS by Gravimetry (Low Level)										
HDPE COLUMBIA RIVER + ROCK - TR INITIATION (A)	E160-L	19-Sep-2022	----	----	----		23-Sep-2022	7 days	4 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid) COLUMBIA RIVER + ROCK - TR INITIATION (A)	E508	19-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	6 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid) COLUMBIA RIVER + ROCK - TR INITIATION (A)	E420	19-Sep-2022	24-Sep-2022	----	----		24-Sep-2022	180 days	5 days	✓

Legend & Qualifier Definitions

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Alkalinity Species by Titration	E290	663940	1	16	6.2	5.0	✓
Ammonia by Fluorescence	E298	657754	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	656720	1	14	7.1	5.0	✓
Conductivity in Water	E100	663939	1	16	6.2	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	664326	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	664252	1	18	5.5	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	656634	1	20	5.0	5.0	✓
Fluoride in Water by IC	E235.F	656722	1	10	10.0	5.0	✓
Nitrate in Water by IC	E235.NO3	656723	1	10	10.0	5.0	✓
Nitrite in Water by IC	E235.NO2	656724	1	13	7.6	5.0	✓
pH by Meter	E108	663938	1	17	5.8	5.0	✓
Sulfate in Water by IC	E235.SO4	656721	1	14	7.1	5.0	✓
Total Mercury in Water by CVAAS	E508	664824	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	663135	1	20	5.0	5.0	✓
Laboratory Control Samples (LCS)							
Alkalinity Species by Titration	E290	663940	1	16	6.2	5.0	✓
Ammonia by Fluorescence	E298	657754	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	656720	1	14	7.1	5.0	✓
Conductivity in Water	E100	663939	1	16	6.2	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	664326	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	664252	1	18	5.5	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	656634	1	20	5.0	5.0	✓
Fluoride in Water by IC	E235.F	656722	1	10	10.0	5.0	✓
Nitrate in Water by IC	E235.NO3	656723	1	10	10.0	5.0	✓
Nitrite in Water by IC	E235.NO2	656724	1	13	7.6	5.0	✓
pH by Meter	E108	663938	1	17	5.8	5.0	✓
Sulfate in Water by IC	E235.SO4	656721	1	14	7.1	5.0	✓
Total Mercury in Water by CVAAS	E508	664824	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	663135	1	20	5.0	5.0	✓
TSS by Gravimetry (Low Level)	E160-L	658114	1	20	5.0	5.0	✓
Method Blanks (MB)							
Alkalinity Species by Titration	E290	663940	1	16	6.2	5.0	✓
Ammonia by Fluorescence	E298	657754	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	656720	1	14	7.1	5.0	✓
Conductivity in Water	E100	663939	1	16	6.2	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	664326	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	664252	1	18	5.5	5.0	✓

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Method Blanks (MB) - Continued							
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	656634	1	20	5.0	5.0	✓
Fluoride in Water by IC	E235.F	656722	1	10	10.0	5.0	✓
Nitrate in Water by IC	E235.NO3	656723	1	10	10.0	5.0	✓
Nitrite in Water by IC	E235.NO2	656724	1	13	7.6	5.0	✓
Sulfate in Water by IC	E235.SO4	656721	1	14	7.1	5.0	✓
Total Mercury in Water by CVAAS	E508	664824	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	663135	1	20	5.0	5.0	✓
TSS by Gravimetry (Low Level)	E160-L	658114	1	20	5.0	5.0	✓
Matrix Spikes (MS)							
Ammonia by Fluorescence	E298	657754	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	656720	1	14	7.1	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	664326	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	664252	1	18	5.5	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	656634	1	20	5.0	5.0	✓
Fluoride in Water by IC	E235.F	656722	1	10	10.0	5.0	✓
Nitrate in Water by IC	E235.NO3	656723	1	10	10.0	5.0	✓
Nitrite in Water by IC	E235.NO2	656724	1	13	7.6	5.0	✓
Sulfate in Water by IC	E235.SO4	656721	1	14	7.1	5.0	✓
Total Mercury in Water by CVAAS	E508	664824	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	663135	1	20	5.0	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Water	E100 Calgary - Environmental	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 Calgary - Environmental	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
TSS by Gravimetry (Low Level)	E160-L Calgary - Environmental	Water	APHA 2540 D (mod)	Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, following by drying of the filter at 104 ± 1°C, with gravimetric measurement of the filtered solids. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.
Chloride in Water by IC	E235.Cl Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Fluoride in Water by IC	E235.F Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrite in Water by IC	E235.NO2 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC	E235.NO3 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration	E290 Calgary - Environmental	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
Ammonia by Fluorescence	E298 Calgary - Environmental	Water	Method Fialab 100, 2018	Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021)
Dissolved Organic Carbon by Combustion (Low Level)	E358-L Calgary - Environmental	Water	APHA 5310 B (mod)	Dissolved Organic Carbon (Non-Purgeable), also known as NPOC (dissolved), is a direct measurement of DOC after a filtered (0.45 micron) sample has been acidified and purged to remove inorganic carbon (IC). Analysis is by high temperature combustion with infrared detection of CO2. NPOC does not include volatile organic species that are purged off with IC. For samples where the majority of DC (dissolved carbon) is comprised of IC (which is common), this method is more accurate and more reliable than the DOC by subtraction method (i.e. DC minus DIC).

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Total metals in Water by CRC ICPMS	E420 Calgary - Environmental	Water	EPA 200.2/6020B (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Dissolved Metals in Water by CRC ICPMS	E421 Calgary - Environmental	Water	APHA 3030B/EPA 6020B (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Total Mercury in Water by CVAAS	E508 Calgary - Environmental	Water	EPA 1631E (mod)	Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS
Dissolved Mercury in Water by CVAAS	E509 Calgary - Environmental	Water	APHA 3030B/EPA 1631E (mod)	Water samples are filtered (0.45 um), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.
Dissolved Hardness (Calculated)	EC100 Calgary - Environmental	Water	APHA 2340B	“Hardness (as CaCO3), dissolved” is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. “Total Hardness” refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations.
Hardness (Calculated) from Total Ca/Mg	EC100A Calgary - Environmental	Water	APHA 2340B	“Hardness (as CaCO3), from total Ca/Mg” is calculated from the sum of total Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. “Total Hardness” refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. Hardness from total Ca/Mg is normally comparable to Dissolved Hardness in non-turbid waters.
Ion Balance using Dissolved Metals	EC101 Calgary - Environmental	Water	APHA 1030E	Cation Sum, Anion Sum, and Ion Balance are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present. Ion Balance cannot be calculated accurately for waters with very low electrical conductivity (EC).
TDS in Water (Calculation)	EC103 Calgary - Environmental	Water	APHA 1030E (mod)	Total Dissolved Solids is calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present.
Nitrate and Nitrite (as N) (Calculation)	EC235.N+N Calgary - Environmental	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Ammonia	EP298 Calgary - Environmental	Water		Sample preparation for Preserved Nutrients Water Quality Analysis.
Preparation for Dissolved Organic Carbon for Combustion	EP358 Calgary - Environmental	Water	APHA 5310 B (mod)	Preparation for Dissolved Organic Carbon

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Dissolved Metals Water Filtration	EP421 Calgary - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO3.
Dissolved Mercury Water Filtration	EP509 Calgary - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HCl.

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **CG2212837**	Page	: 1 of 17
Amendment	: **4**		
Client	: Golder Associates Ltd.	Laboratory	: Calgary - Environmental
Contact	: Elaine Irving	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary, Alberta Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: WO# 20449674/9000	Date Samples Received	: 20-Sep-2022 10:00
PO	: WO# 20449674/9000	Date Analysis Commenced	: 20-Sep-2022
C-O-C number	: ----	Issue Date	: 12-Oct-2022 17:09
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Anthony Calero	Supervisor - Inorganic	Calgary Inorganics, Calgary, Alberta
Anthony Calero	Supervisor - Inorganic	Calgary Metals, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Calgary Inorganics, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Calgary Metals, Calgary, Alberta
Elke Tabora		Calgary Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Calgary Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Calgary Metals, Calgary, Alberta
Kevin Baxter		Calgary Metals, Calgary, Alberta
Parker Sgarbossa	Laboratory Analyst	Calgary Inorganics, Calgary, Alberta
Sara Niroomand		Calgary Inorganics, Calgary, Alberta
Sara Niroomand		Calgary Metals, Calgary, Alberta
Vladka Stamenova	Analyst	Calgary Inorganics, Calgary, Alberta

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include 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 predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 663938)											
CG2212783-022	Anonymous	pH	----	E108	0.10	pH units	7.98	8.01	0.375%	4%	----
Physical Tests (QC Lot: 663939)											
CG2212783-023	Anonymous	conductivity	----	E100	2.0	µS/cm	99.6	98.7	0.908%	10%	----
Physical Tests (QC Lot: 663940)											
CG2212783-023	Anonymous	alkalinity, total (as CaCO3)	----	E290	2.0	mg/L	59.0	62.7	6.08%	20%	----
Anions and Nutrients (QC Lot: 656720)											
CG2212827-001	Anonymous	chloride	16887-00-6	E235.Cl	2.50	mg/L	234	233	0.625%	20%	----
Anions and Nutrients (QC Lot: 656721)											
CG2212827-001	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	1.50	mg/L	1.95	1.98	0.02	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 656722)											
CG2212827-001	Anonymous	fluoride	16984-48-8	E235.F	0.100	mg/L	0.154	0.147	0.007	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 656723)											
CG2212827-001	Anonymous	nitrate (as N)	14797-55-8	E235.NO3	0.100	mg/L	<0.100	<0.100	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 656724)											
CG2212827-001	Anonymous	nitrite (as N)	14797-65-0	E235.NO2	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 657754)											
CG2212791-001	Anonymous	ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	<0.0050	<0.0050	0	Diff <2x LOR	----
Organic / Inorganic Carbon (QC Lot: 656634)											
CG2212837-001	COLUMBIA RIVER + ROCK - TR INITIATION (A)	carbon, dissolved organic [DOC]	----	E358-L	0.50	mg/L	<0.50	<0.50	0	Diff <2x LOR	----
Total Metals (QC Lot: 663135)											
CG2212840-001	Anonymous	aluminum, total	7429-90-5	E420	0.0150	mg/L	<0.0150	<0.0150	0	Diff <2x LOR	----
		antimony, total	7440-36-0	E420	0.00050	mg/L	0.00455	0.00458	0.00003	Diff <2x LOR	----
		arsenic, total	7440-38-2	E420	0.00050	mg/L	0.00222	0.00218	0.00004	Diff <2x LOR	----
		barium, total	7440-39-3	E420	0.00050	mg/L	0.0205	0.0203	1.13%	20%	----
		beryllium, total	7440-41-7	E420	0.000100	mg/L	<0.100 µg/L	<0.000100	0	Diff <2x LOR	----
		bismuth, total	7440-69-9	E420	0.000250	mg/L	<0.000250	<0.000250	0	Diff <2x LOR	----
		boron, total	7440-42-8	E420	0.050	mg/L	0.118	0.116	0.001	Diff <2x LOR	----
		cadmium, total	7440-43-9	E420	0.0000250	mg/L	0.483 µg/L	0.000520	7.43%	20%	----
		calcium, total	7440-70-2	E420	0.250	mg/L	481	481	0.0710%	20%	----
		cesium, total	7440-46-2	E420	0.000050	mg/L	0.000638	0.000621	2.56%	20%	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Total Metals (QC Lot: 663135) - continued											
CG2212840-001	Anonymous	chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		cobalt, total	7440-48-4	E420	0.00050	mg/L	51.7 µg/L	0.0516	0.241%	20%	----
		copper, total	7440-50-8	E420	0.00250	mg/L	<0.00250	<0.00250	0	Diff <2x LOR	----
		iron, total	7439-89-6	E420	0.050	mg/L	0.154	0.154	0.0002	Diff <2x LOR	----
		lead, total	7439-92-1	E420	0.000250	mg/L	<0.000250	<0.000250	0	Diff <2x LOR	----
		lithium, total	7439-93-2	E420	0.0050	mg/L	1.41	1.42	0.791%	20%	----
		magnesium, total	7439-95-4	E420	0.0250	mg/L	261	259	0.675%	20%	----
		manganese, total	7439-96-5	E420	0.00050	mg/L	0.237	0.236	0.554%	20%	----
		molybdenum, total	7439-98-7	E420	0.000250	mg/L	0.0198	0.0199	0.543%	20%	----
		nickel, total	7440-02-0	E420	0.00250	mg/L	0.321	0.316	1.42%	20%	----
		phosphorus, total	7723-14-0	E420	0.250	mg/L	<0.250	<0.250	0	Diff <2x LOR	----
		potassium, total	7440-09-7	E420	0.250	mg/L	19.4	19.3	0.508%	20%	----
		rubidium, total	7440-17-7	E420	0.00100	mg/L	0.0316	0.0305	3.55%	20%	----
		selenium, total	7782-49-2	E420	0.000250	mg/L	65.5 µg/L	0.0641	2.24%	20%	----
		silicon, total	7440-21-3	E420	0.50	mg/L	3.56	3.51	0.05	Diff <2x LOR	----
		silver, total	7440-22-4	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		sodium, total	7440-23-5	E420	0.250	mg/L	54.7	54.2	0.776%	20%	----
		strontium, total	7440-24-6	E420	0.00100	mg/L	1.35	1.36	0.555%	20%	----
		sulfur, total	7704-34-9	E420	2.50	mg/L	452	453	0.176%	20%	----
		tellurium, total	13494-80-9	E420	0.00100	mg/L	<0.00100	<0.00100	0	Diff <2x LOR	----
		thallium, total	7440-28-0	E420	0.000050	mg/L	0.000293	0.000303	0.000010	Diff <2x LOR	----
		thorium, total	7440-29-1	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		tin, total	7440-31-5	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		titanium, total	7440-32-6	E420	0.00150	mg/L	<0.00150	<0.00150	0	Diff <2x LOR	----
		tungsten, total	7440-33-7	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		uranium, total	7440-61-1	E420	0.000050	mg/L	0.0428	0.0428	0.0145%	20%	----
		vanadium, total	7440-62-2	E420	0.00250	mg/L	<0.00250	<0.00250	0	Diff <2x LOR	----
		zinc, total	7440-66-6	E420	0.0150	mg/L	0.0345	0.0335	0.0010	Diff <2x LOR	----
		zirconium, total	7440-67-7	E420	0.00100	mg/L	<0.00100	<0.00100	0	Diff <2x LOR	----
Total Metals (QC Lot: 664824)											
CG2212837-001	COLUMBIA RIVER + ROCK - TR INITIATION (A)	mercury, total	7439-97-6	E508	0.0000050	mg/L	0.0000079	0.0000086	0.0000006	Diff <2x LOR	----
Dissolved Metals (QC Lot: 664252)											
CG2212922-001	Anonymous	aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	0.0022	0.0022	0.00004	Diff <2x LOR	----
		antimony, dissolved	7440-36-0	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Dissolved Metals (QC Lot: 664252) - continued											
CG2212922-001	Anonymous	arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.00011	0.00011	0.000004	Diff <2x LOR	----
		barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.0335	0.0332	0.802%	20%	----
		beryllium, dissolved	7440-41-7	E421	0.000020	mg/L	<0.020 µg/L	<0.000020	0	Diff <2x LOR	----
		bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		boron, dissolved	7440-42-8	E421	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----
		cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	0.0098 µg/L	0.0000108	0.0000010	Diff <2x LOR	----
		calcium, dissolved	7440-70-2	E421	0.050	mg/L	66.6	65.5	1.69%	20%	----
		cesium, dissolved	7440-46-2	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	<0.10 µg/L	<0.00010	0	Diff <2x LOR	----
		copper, dissolved	7440-50-8	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		iron, dissolved	7439-89-6	E421	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----
		lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		lithium, dissolved	7439-93-2	E421	0.0010	mg/L	0.0106	0.0102	4.20%	20%	----
		magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	29.9	29.3	1.88%	20%	----
		manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.00196	0.00200	2.48%	20%	----
		molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.00102	0.000987	3.42%	20%	----
		nickel, dissolved	7440-02-0	E421	0.00050	mg/L	0.00086	0.00088	0.00002	Diff <2x LOR	----
		phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
		potassium, dissolved	7440-09-7	E421	0.050	mg/L	0.842	0.833	1.02%	20%	----
		rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	0.00060	0.00054	0.00006	Diff <2x LOR	----
		selenium, dissolved	7782-49-2	E421	0.000050	mg/L	26.0 µg/L	0.0265	2.12%	20%	----
		silicon, dissolved	7440-21-3	E421	0.050	mg/L	1.43	1.41	1.50%	20%	----
		silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		sodium, dissolved	7440-23-5	E421	0.050	mg/L	0.670	0.662	1.14%	20%	----
		strontium, dissolved	7440-24-6	E421	0.00020	mg/L	0.125	0.124	0.762%	20%	----
		sulfur, dissolved	7704-34-9	E421	0.50	mg/L	48.6	47.6	1.92%	20%	----
		tellurium, dissolved	13494-80-9	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		thallium, dissolved	7440-28-0	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		thorium, dissolved	7440-29-1	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		tin, dissolved	7440-31-5	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		titanium, dissolved	7440-32-6	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
		tungsten, dissolved	7440-33-7	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		uranium, dissolved	7440-61-1	E421	0.000010	mg/L	0.00128	0.00124	2.74%	20%	----
		vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Dissolved Metals (QC Lot: 664252) - continued											
CG2212922-001	Anonymous	zinc, dissolved	7440-66-6	E421	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----
		zirconium, dissolved	7440-67-7	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
Dissolved Metals (QC Lot: 664326)											
CG2212783-025	Anonymous	mercury, dissolved	7439-97-6	E509	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 658114)						
solids, total suspended [TSS]	----	E160-L	1	mg/L	<1.0	----
Physical Tests (QCLot: 663939)						
conductivity	----	E100	1	µS/cm	<1.0	----
Physical Tests (QCLot: 663940)						
alkalinity, total (as CaCO3)	----	E290	1	mg/L	<1.0	----
Anions and Nutrients (QCLot: 656720)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 656721)						
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 656722)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 656723)						
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 656724)						
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	<0.010	----
Anions and Nutrients (QCLot: 657754)						
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	<0.0050	----
Organic / Inorganic Carbon (QCLot: 656634)						
carbon, dissolved organic [DOC]	----	E358-L	0.5	mg/L	<0.50	----
Total Metals (QCLot: 663135)						
aluminum, total	7429-90-5	E420	0.003	mg/L	<0.0030	----
antimony, total	7440-36-0	E420	0.0001	mg/L	<0.00010	----
arsenic, total	7440-38-2	E420	0.0001	mg/L	<0.00010	----
barium, total	7440-39-3	E420	0.0001	mg/L	<0.00010	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	<0.000020	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	<0.000050	----
boron, total	7440-42-8	E420	0.01	mg/L	<0.010	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	<0.0000050	----
calcium, total	7440-70-2	E420	0.05	mg/L	<0.050	----
cesium, total	7440-46-2	E420	0.00001	mg/L	<0.000010	----
chromium, total	7440-47-3	E420	0.0005	mg/L	<0.00050	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	<0.00010	----
copper, total	7440-50-8	E420	0.0005	mg/L	<0.00050	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 663135) - continued						
iron, total	7439-89-6	E420	0.01	mg/L	<0.010	----
lead, total	7439-92-1	E420	0.00005	mg/L	<0.000050	----
lithium, total	7439-93-2	E420	0.001	mg/L	<0.0010	----
magnesium, total	7439-95-4	E420	0.005	mg/L	<0.0050	----
manganese, total	7439-96-5	E420	0.0001	mg/L	<0.00010	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	<0.000050	----
nickel, total	7440-02-0	E420	0.0005	mg/L	<0.00050	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	<0.050	----
potassium, total	7440-09-7	E420	0.05	mg/L	<0.050	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	<0.00020	----
selenium, total	7782-49-2	E420	0.00005	mg/L	<0.000050	----
silicon, total	7440-21-3	E420	0.1	mg/L	<0.10	----
silver, total	7440-22-4	E420	0.00001	mg/L	<0.000010	----
sodium, total	7440-23-5	E420	0.05	mg/L	<0.050	----
strontium, total	7440-24-6	E420	0.0002	mg/L	<0.00020	----
sulfur, total	7704-34-9	E420	0.5	mg/L	<0.50	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	<0.00020	----
thallium, total	7440-28-0	E420	0.00001	mg/L	<0.000010	----
thorium, total	7440-29-1	E420	0.0001	mg/L	<0.00010	----
tin, total	7440-31-5	E420	0.0001	mg/L	<0.00010	----
titanium, total	7440-32-6	E420	0.0003	mg/L	<0.00030	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	<0.00010	----
uranium, total	7440-61-1	E420	0.00001	mg/L	<0.000010	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	# 0.00104	MB-LOR
zinc, total	7440-66-6	E420	0.003	mg/L	<0.0030	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	<0.00020	----
Total Metals (QCLot: 664824)						
mercury, total	7439-97-6	E508	0.000005	mg/L	<0.0000050	----
Dissolved Metals (QCLot: 664252)						
aluminum, dissolved	7429-90-5	E421	0.001	mg/L	<0.0010	----
antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	----
arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	----
barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	----
beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	<0.000020	----
bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	<0.000050	----
boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals (QCLot: 664252) - continued						
cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	----
calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	----
cesium, dissolved	7440-46-2	E421	0.00001	mg/L	<0.000010	----
chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	----
cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	<0.00010	----
copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	----
lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----
lithium, dissolved	7439-93-2	E421	0.001	mg/L	<0.0010	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	<0.000050	----
nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----
phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	<0.050	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	<0.00020	----
selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
silicon, dissolved	7440-21-3	E421	0.05	mg/L	<0.050	----
silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
strontium, dissolved	7440-24-6	E421	0.0002	mg/L	<0.00020	----
sulfur, dissolved	7704-34-9	E421	0.5	mg/L	<0.50	----
tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	<0.00020	----
thallium, dissolved	7440-28-0	E421	0.00001	mg/L	<0.000010	----
thorium, dissolved	7440-29-1	E421	0.0001	mg/L	<0.00010	----
tin, dissolved	7440-31-5	E421	0.0001	mg/L	<0.00010	----
titanium, dissolved	7440-32-6	E421	0.0003	mg/L	<0.00030	----
tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	<0.00010	----
uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	----
vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	<0.00050	----
zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	----
zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	<0.00020	----
Dissolved Metals (QCLot: 664326)						
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	<0.0000050	----

Qualifiers

Qualifier	Description
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 658114)									
solids, total suspended [TSS]	----	E160-L	1	mg/L	150 mg/L	93.6	85.0	115	----
Physical Tests (QCLot: 663938)									
pH	----	E108	----	pH units	7 pH units	101	98.6	101	----
Physical Tests (QCLot: 663939)									
conductivity	----	E100	1	µS/cm	146.9 µS/cm	103	90.0	110	----
Physical Tests (QCLot: 663940)									
alkalinity, total (as CaCO3)	----	E290	1	mg/L	500 mg/L	104	85.0	115	----
Anions and Nutrients (QCLot: 656720)									
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	99.7	90.0	110	----
Anions and Nutrients (QCLot: 656721)									
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 656722)									
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 656723)									
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	2.5 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 656724)									
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	0.5 mg/L	99.4	90.0	110	----
Anions and Nutrients (QCLot: 657754)									
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	0.2 mg/L	97.4	85.0	115	----
Organic / Inorganic Carbon (QCLot: 656634)									
carbon, dissolved organic [DOC]	----	E358-L	0.5	mg/L	8.57 mg/L	89.8	80.0	120	----
Total Metals (QCLot: 663135)									
aluminum, total	7429-90-5	E420	0.003	mg/L	2 mg/L	96.4	80.0	120	----
antimony, total	7440-36-0	E420	0.0001	mg/L	1 mg/L	111	80.0	120	----
arsenic, total	7440-38-2	E420	0.0001	mg/L	1 mg/L	94.3	80.0	120	----
barium, total	7440-39-3	E420	0.0001	mg/L	0.25 mg/L	96.8	80.0	120	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	0.1 mg/L	99.4	80.0	120	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	1 mg/L	100	80.0	120	----
boron, total	7440-42-8	E420	0.01	mg/L	1 mg/L	103	80.0	120	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	0.1 mg/L	96.1	80.0	120	----
calcium, total	7440-70-2	E420	0.05	mg/L	50 mg/L	91.6	80.0	120	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report: Spike Concentration	Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High	Qualifier
Total Metals (QCLot: 663135) - continued									
cesium, total	7440-46-2	E420	0.00001	mg/L	0.05 mg/L	96.0	80.0	120	----
chromium, total	7440-47-3	E420	0.0005	mg/L	0.25 mg/L	95.8	80.0	120	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	0.25 mg/L	95.7	80.0	120	----
copper, total	7440-50-8	E420	0.0005	mg/L	0.25 mg/L	94.3	80.0	120	----
iron, total	7439-89-6	E420	0.01	mg/L	1 mg/L	108	80.0	120	----
lead, total	7439-92-1	E420	0.00005	mg/L	0.5 mg/L	101	80.0	120	----
lithium, total	7439-93-2	E420	0.001	mg/L	0.25 mg/L	107	80.0	120	----
magnesium, total	7439-95-4	E420	0.005	mg/L	50 mg/L	95.7	80.0	120	----
manganese, total	7439-96-5	E420	0.0001	mg/L	0.25 mg/L	96.8	80.0	120	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.25 mg/L	105	80.0	120	----
nickel, total	7440-02-0	E420	0.0005	mg/L	0.5 mg/L	93.4	80.0	120	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	10 mg/L	107	70.0	130	----
potassium, total	7440-09-7	E420	0.05	mg/L	50 mg/L	98.0	80.0	120	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	0.1 mg/L	101	80.0	120	----
selenium, total	7782-49-2	E420	0.00005	mg/L	1 mg/L	99.6	80.0	120	----
silicon, total	7440-21-3	E420	0.1	mg/L	10 mg/L	105	60.0	140	----
silver, total	7440-22-4	E420	0.00001	mg/L	0.1 mg/L	91.1	80.0	120	----
sodium, total	7440-23-5	E420	0.05	mg/L	50 mg/L	95.8	80.0	120	----
strontium, total	7440-24-6	E420	0.0002	mg/L	0.25 mg/L	90.9	80.0	120	----
sulfur, total	7704-34-9	E420	0.5	mg/L	50 mg/L	94.6	80.0	120	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	0.1 mg/L	104	80.0	120	----
thallium, total	7440-28-0	E420	0.00001	mg/L	1 mg/L	101	80.0	120	----
thorium, total	7440-29-1	E420	0.0001	mg/L	0.1 mg/L	93.8	80.0	120	----
tin, total	7440-31-5	E420	0.0001	mg/L	0.5 mg/L	96.2	80.0	120	----
titanium, total	7440-32-6	E420	0.0003	mg/L	0.25 mg/L	99.7	80.0	120	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	0.1 mg/L	97.3	80.0	120	----
uranium, total	7440-61-1	E420	0.00001	mg/L	0.005 mg/L	96.5	80.0	120	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	0.5 mg/L	95.5	80.0	120	----
zinc, total	7440-66-6	E420	0.003	mg/L	0.5 mg/L	83.0	80.0	120	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	0.1 mg/L	102	80.0	120	----
Total Metals (QCLot: 664824)									
mercury, total	7439-97-6	E508	0.000005	mg/L	0.0001 mg/L	97.5	80.0	120	----
Dissolved Metals (QCLot: 664252)									
aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	106	80.0	120	----
antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	99.0	80.0	120	----
arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	104	80.0	120	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	Qualifier
Dissolved Metals (QCLot: 664252) - continued									
barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	104	80.0	120	----
beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.1 mg/L	100	80.0	120	----
bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	1 mg/L	99.5	80.0	120	----
boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	88.3	80.0	120	----
cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	99.8	80.0	120	----
calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	96.4	80.0	120	----
cesium, dissolved	7440-46-2	E421	0.00001	mg/L	0.05 mg/L	103	80.0	120	----
chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	99.2	80.0	120	----
cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.25 mg/L	101	80.0	120	----
copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	100.0	80.0	120	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	108	80.0	120	----
lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	97.9	80.0	120	----
lithium, dissolved	7439-93-2	E421	0.001	mg/L	0.25 mg/L	101	80.0	120	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	105	80.0	120	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	102	80.0	120	----
molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.25 mg/L	99.0	80.0	120	----
nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	99.1	80.0	120	----
phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	10 mg/L	103	70.0	130	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	104	80.0	120	----
rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	0.1 mg/L	104	80.0	120	----
selenium, dissolved	7782-49-2	E421	0.00005	mg/L	1 mg/L	95.4	80.0	120	----
silicon, dissolved	7440-21-3	E421	0.05	mg/L	10 mg/L	91.4	60.0	140	----
silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	93.6	80.0	120	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	106	80.0	120	----
strontium, dissolved	7440-24-6	E421	0.0002	mg/L	0.25 mg/L	101	80.0	120	----
sulfur, dissolved	7704-34-9	E421	0.5	mg/L	50 mg/L	116	80.0	120	----
tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	0.1 mg/L	91.6	80.0	120	----
thallium, dissolved	7440-28-0	E421	0.00001	mg/L	1 mg/L	97.9	80.0	120	----
thorium, dissolved	7440-29-1	E421	0.0001	mg/L	0.1 mg/L	98.2	80.0	120	----
tin, dissolved	7440-31-5	E421	0.0001	mg/L	0.5 mg/L	100	80.0	120	----
titanium, dissolved	7440-32-6	E421	0.0003	mg/L	0.25 mg/L	105	80.0	120	----
tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	0.1 mg/L	95.6	80.0	120	----
uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	98.7	80.0	120	----
vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.5 mg/L	102	80.0	120	----
zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	98.3	80.0	120	----
zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	0.1 mg/L	95.5	80.0	120	----
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	0.0001 mg/L	94.7	80.0	120	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Anions and Nutrients (QCLot: 656720)										
CG2212827-002	Anonymous	chloride	16887-00-6	E235.Cl	ND mg/L	100 mg/L	ND	75.0	125	----
Anions and Nutrients (QCLot: 656721)										
CG2212827-002	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	89.4 mg/L	100 mg/L	89.4	75.0	125	----
Anions and Nutrients (QCLot: 656722)										
CG2212827-002	Anonymous	fluoride	16984-48-8	E235.F	0.927 mg/L	1 mg/L	92.7	75.0	125	----
Anions and Nutrients (QCLot: 656723)										
CG2212827-002	Anonymous	nitrate (as N)	14797-55-8	E235.NO3	2.23 mg/L	2.5 mg/L	89.2	75.0	125	----
Anions and Nutrients (QCLot: 656724)										
CG2212827-002	Anonymous	nitrite (as N)	14797-65-0	E235.NO2	0.447 mg/L	0.5 mg/L	89.4	75.0	125	----
Anions and Nutrients (QCLot: 657754)										
CG2212791-002	Anonymous	ammonia, total (as N)	7664-41-7	E298	0.105 mg/L	0.1 mg/L	105	75.0	125	----
Organic / Inorganic Carbon (QCLot: 656634)										
CG2212837-001	COLUMBIA RIVER + ROCK - TR INITIATION (A)	carbon, dissolved organic [DOC]	----	E358-L	5.75 mg/L	5 mg/L	115	70.0	130	----
Total Metals (QCLot: 663135)										
CG2212840-003	Anonymous	aluminum, total	7429-90-5	E420	2.04 mg/L	2 mg/L	102	70.0	130	----
		antimony, total	7440-36-0	E420	0.214 mg/L	0.2 mg/L	107	70.0	130	----
		arsenic, total	7440-38-2	E420	0.191 mg/L	0.2 mg/L	95.5	70.0	130	----
		barium, total	7440-39-3	E420	0.202 mg/L	0.2 mg/L	101	70.0	130	----
		beryllium, total	7440-41-7	E420	0.418 mg/L	0.4 mg/L	104	70.0	130	----
		bismuth, total	7440-69-9	E420	0.0938 mg/L	0.1 mg/L	93.8	70.0	130	----
		boron, total	7440-42-8	E420	1.05 mg/L	1 mg/L	105	70.0	130	----
		cadmium, total	7440-43-9	E420	0.0408 mg/L	0.04 mg/L	102	70.0	130	----
		calcium, total	7440-70-2	E420	ND mg/L	40 mg/L	ND	70.0	130	----
		cesium, total	7440-46-2	E420	0.100 mg/L	0.1 mg/L	100	70.0	130	----
		chromium, total	7440-47-3	E420	0.409 mg/L	0.4 mg/L	102	70.0	130	----
		cobalt, total	7440-48-4	E420	0.198 mg/L	0.2 mg/L	99.0	70.0	130	----
		copper, total	7440-50-8	E420	0.200 mg/L	0.2 mg/L	99.8	70.0	130	----
		iron, total	7439-89-6	E420	20.5 mg/L	20 mg/L	102	70.0	130	----
		lead, total	7439-92-1	E420	0.195 mg/L	0.2 mg/L	97.7	70.0	130	----
		lithium, total	7439-93-2	E420	ND mg/L	1 mg/L	ND	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Total Metals (QCLot: 663135) - continued										
CG2212840-003	Anonymous	magnesium, total	7439-95-4	E420	ND mg/L	10 mg/L	ND	70.0	130	----
		manganese, total	7439-96-5	E420	ND mg/L	0.2 mg/L	ND	70.0	130	----
		molybdenum, total	7439-98-7	E420	0.216 mg/L	0.2 mg/L	108	70.0	130	----
		nickel, total	7440-02-0	E420	0.382 mg/L	0.4 mg/L	95.4	70.0	130	----
		phosphorus, total	7723-14-0	E420	105 mg/L	100 mg/L	105	70.0	130	----
		potassium, total	7440-09-7	E420	41.0 mg/L	40 mg/L	102	70.0	130	----
		rubidium, total	7440-17-7	E420	0.200 mg/L	0.2 mg/L	99.9	70.0	130	----
		selenium, total	7782-49-2	E420	0.440 mg/L	0.4 mg/L	110	70.0	130	----
		silicon, total	7440-21-3	E420	105 mg/L	100 mg/L	105	70.0	130	----
		silver, total	7440-22-4	E420	0.0419 mg/L	0.04 mg/L	105	70.0	130	----
		sodium, total	7440-23-5	E420	ND mg/L	20 mg/L	ND	70.0	130	----
		strontium, total	7440-24-6	E420	ND mg/L	0.2 mg/L	ND	70.0	130	----
		sulfur, total	7704-34-9	E420	ND mg/L	200 mg/L	ND	70.0	130	----
		tellurium, total	13494-80-9	E420	0.429 mg/L	0.4 mg/L	107	70.0	130	----
		thallium, total	7440-28-0	E420	0.0378 mg/L	0.04 mg/L	94.5	70.0	130	----
		thorium, total	7440-29-1	E420	0.218 mg/L	0.2 mg/L	109	70.0	130	----
		tin, total	7440-31-5	E420	0.196 mg/L	0.2 mg/L	98.0	70.0	130	----
		titanium, total	7440-32-6	E420	0.418 mg/L	0.4 mg/L	105	70.0	130	----
		tungsten, total	7440-33-7	E420	0.200 mg/L	0.2 mg/L	99.8	70.0	130	----
		uranium, total	7440-61-1	E420	ND mg/L	0.04 mg/L	ND	70.0	130	----
		vanadium, total	7440-62-2	E420	0.989 mg/L	1 mg/L	98.9	70.0	130	----
		zinc, total	7440-66-6	E420	3.20 mg/L	4 mg/L	79.9	70.0	130	----
		zirconium, total	7440-67-7	E420	0.425 mg/L	0.4 mg/L	106	70.0	130	----
Total Metals (QCLot: 664824)										
CG2212856-001	Anonymous	mercury, total	7439-97-6	E508	0.000102 mg/L	0.0001 mg/L	102	70.0	130	----
Dissolved Metals (QCLot: 664252)										
CG2212922-002	Anonymous	aluminum, dissolved	7429-90-5	E421	2.00 mg/L	2 mg/L	99.8	70.0	130	----
		antimony, dissolved	7440-36-0	E421	0.200 mg/L	0.2 mg/L	99.9	70.0	130	----
		arsenic, dissolved	7440-38-2	E421	0.207 mg/L	0.2 mg/L	104	70.0	130	----
		barium, dissolved	7440-39-3	E421	0.197 mg/L	0.2 mg/L	98.7	70.0	130	----
		beryllium, dissolved	7440-41-7	E421	0.404 mg/L	0.4 mg/L	101	70.0	130	----
		bismuth, dissolved	7440-69-9	E421	0.101 mg/L	0.1 mg/L	101	70.0	130	----
		boron, dissolved	7440-42-8	E421	0.890 mg/L	1 mg/L	89.0	70.0	130	----
		cadmium, dissolved	7440-43-9	E421	0.0410 mg/L	0.04 mg/L	102	70.0	130	----
		calcium, dissolved	7440-70-2	E421	ND mg/L	40 mg/L	ND	70.0	130	----
		cesium, dissolved	7440-46-2	E421	0.105 mg/L	0.1 mg/L	105	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Dissolved Metals (QCLot: 664252) - continued										
CG2212922-002	Anonymous	chromium, dissolved	7440-47-3	E421	0.405 mg/L	0.4 mg/L	101	70.0	130	----
		cobalt, dissolved	7440-48-4	E421	0.206 mg/L	0.2 mg/L	103	70.0	130	----
		copper, dissolved	7440-50-8	E421	0.204 mg/L	0.2 mg/L	102	70.0	130	----
		iron, dissolved	7439-89-6	E421	20.2 mg/L	20 mg/L	101	70.0	130	----
		lead, dissolved	7439-92-1	E421	0.194 mg/L	0.2 mg/L	97.0	70.0	130	----
		lithium, dissolved	7439-93-2	E421	1.00 mg/L	1 mg/L	100	70.0	130	----
		magnesium, dissolved	7439-95-4	E421	ND mg/L	10 mg/L	ND	70.0	130	----
		manganese, dissolved	7439-96-5	E421	ND mg/L	0.2 mg/L	ND	70.0	130	----
		molybdenum, dissolved	7439-98-7	E421	0.199 mg/L	0.2 mg/L	99.7	70.0	130	----
		nickel, dissolved	7440-02-0	E421	0.408 mg/L	0.4 mg/L	102	70.0	130	----
		phosphorus, dissolved	7723-14-0	E421	102 mg/L	100 mg/L	102	70.0	130	----
		potassium, dissolved	7440-09-7	E421	39.5 mg/L	40 mg/L	98.7	70.0	130	----
		rubidium, dissolved	7440-17-7	E421	0.210 mg/L	0.2 mg/L	105	70.0	130	----
		selenium, dissolved	7782-49-2	E421	0.379 mg/L	0.4 mg/L	94.7	70.0	130	----
		silicon, dissolved	7440-21-3	E421	77.3 mg/L	100 mg/L	77.3	70.0	130	----
		silver, dissolved	7440-22-4	E421	0.0283 mg/L	0.04 mg/L	70.7	70.0	130	----
		sodium, dissolved	7440-23-5	E421	ND mg/L	20 mg/L	ND	70.0	130	----
		strontium, dissolved	7440-24-6	E421	ND mg/L	0.2 mg/L	ND	70.0	130	----
		sulfur, dissolved	7704-34-9	E421	174 mg/L	200 mg/L	87.0	70.0	130	----
		tellurium, dissolved	13494-80-9	E421	0.369 mg/L	0.4 mg/L	92.2	70.0	130	----
		thallium, dissolved	7440-28-0	E421	0.0394 mg/L	0.04 mg/L	98.5	70.0	130	----
		thorium, dissolved	7440-29-1	E421	0.212 mg/L	0.2 mg/L	106	70.0	130	----
		tin, dissolved	7440-31-5	E421	0.198 mg/L	0.2 mg/L	99.2	70.0	130	----
		titanium, dissolved	7440-32-6	E421	0.408 mg/L	0.4 mg/L	102	70.0	130	----
		tungsten, dissolved	7440-33-7	E421	0.192 mg/L	0.2 mg/L	96.1	70.0	130	----
		uranium, dissolved	7440-61-1	E421	0.0402 mg/L	0.04 mg/L	100	70.0	130	----
		vanadium, dissolved	7440-62-2	E421	1.01 mg/L	1 mg/L	101	70.0	130	----
		zinc, dissolved	7440-66-6	E421	4.07 mg/L	4 mg/L	102	70.0	130	----
		zirconium, dissolved	7440-67-7	E421	0.387 mg/L	0.4 mg/L	96.8	70.0	130	----
Dissolved Metals (QCLot: 664326)										
CG2212783-027	Anonymous	mercury, dissolved	7439-97-6	E509	0.0000899 mg/L	0.0001 mg/L	89.9	70.0	130	----

Chain of Custody (COC) / Analytical Request Form

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Environmental Division Calgary
Work Order Reference
CG2212837

Telephone : +1 403 407 1800

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	Elaine Irving
Phone:	Elaine_Irving@golder.com
	Company address below will appear on the final report
Street:	2920 Virtual Way, Suite 200
City/Province:	Vancouver, BC
Postal Code:	
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Golder Associates
Contact:	

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Email 2: Mikayla_Donovan@golder.com
Email 3: emilie@nautilusenvironmental.ca

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Select Service Level Below - Contact your AM to confi

Regular [R] ☐ Standard TAT if received by 3 pm - bus

PRIORITY (Business Days): 4 day [P4-20%] ☑ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐
EMERGENCY: 1 Business day | Same Day, Week | (Laboratory oper

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:	CG22-GOLD100-0012 BC Hydro
Job #:	WO# 20449674/9000
PO / AFE:	WO# 20449674/9000
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Routine (PR01)	DOC (E358-L)	Total Metals + Hg (BC11)	Dissolved Metals + Hg (BC10)	TSS (E160-L)	Ammonia (E298)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Columbia River + Rock - TR Initiation (A)	19-Sep-22	16:00	Water	7	P4	P4	P4	P4	P4	P4		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?
☐ YES ☐ NO

Are samples for human consumption/ use?
☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations: Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ | Custody seal intact: Yes ☐ No ☐
Cooling Initiated ☐

? INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
9.1							

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date: 9/22	Time: 1000	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2019 FRONT

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**.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **CG2212924**	Page	: 1 of 6
Amendment	: **4**		
Client	: **Golder Associates Ltd.**	Laboratory	: Calgary - Environmental
Contact	: Elaine Irving	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary AB Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: WO# 20449674/9000	Date Samples Received	: 21-Sep-2022 14:35
PO	: WO#20449674/9000	Date Analysis Commenced	: 21-Sep-2022
C-O-C number	: ----	Issue Date	: 12-Oct-2022 17:07
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Anthony Calero	Supervisor - Inorganic	Metals, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Inorganics, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Metals, Calgary, Alberta
Elke Tabora		Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Metals, Calgary, Alberta
Naeun Kim	Analyst	Metals, Calgary, Alberta
Parker Sgarbossa	Laboratory Analyst	Inorganics, Calgary, Alberta
Sara Niroomand		Inorganics, Calgary, Alberta
Sara Niroomand		Metals, Calgary, Alberta
Vladka Stamenova	Analyst	Inorganics, Calgary, Alberta

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit
%	percent
µS/cm	Microsiemens per centimetre
meq/L	milliequivalents per litre
mg/L	milligrams per litre
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior 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.

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

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
RRV	*Reported result verified by repeat analysis.*

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID: Columbia River + Rock - DA Initiation (A)	----	----	----	----
					Client sampling date / time: 21-Sep-2022 00:10	----	----	----	----
					CG2212924-001	--------	--------	--------	--------
					Result	----	----	----	----
Physical Tests									
hardness (as CaCO3), dissolved	----	EC100	0.50	mg/L	46.9	----	----	----	----
hardness (as CaCO3), from total Ca/Mg	----	EC100A	0.60	mg/L	52.7	----	----	----	----
solids, total suspended [TSS]	----	E160-L	1.0	mg/L	9.0	----	----	----	----
conductivity	----	E100	2.0	µS/cm	101	----	----	----	----
pH	----	E108	0.10	pH units	7.56	----	----	----	----
alkalinity, bicarbonate (as HCO3)	71-52-3	E290	1.0	mg/L	55.5	----	----	----	----
alkalinity, carbonate (as CO3)	3812-32-6	E290	1.0	mg/L	<1.0	----	----	----	----
alkalinity, hydroxide (as OH)	14280-30-9	E290	1.0	mg/L	<1.0	----	----	----	----
alkalinity, total (as CaCO3)	----	E290	2.0	mg/L	45.5	----	----	----	----
solids, total dissolved [TDS], calculated	----	EC103	1.0	mg/L	61.2	----	----	----	----
Anions and Nutrients									
ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	0.0343	----	----	----	----
chloride	16887-00-6	E235.Cl	0.50	mg/L	<0.50	----	----	----	----
fluoride	16984-48-8	E235.F	0.020	mg/L	0.065	----	----	----	----
nitrate (as N)	14797-55-8	E235.NO3	0.020	mg/L	0.155	----	----	----	----
nitrite (as N)	14797-65-0	E235.NO2	0.010	mg/L	0.014	----	----	----	----
sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	8.11	----	----	----	----
nitrate + nitrite (as N)	----	EC235.N+N	0.0500	mg/L	0.169	----	----	----	----
Organic / Inorganic Carbon									
carbon, dissolved organic [DOC]	----	E358-L	0.50	mg/L	2.41	----	----	----	----
Ion Balance									
anion sum	----	EC101	0.10	meq/L	1.09	----	----	----	----
cation sum	----	EC101	0.10	meq/L	0.99	----	----	----	----
ion balance (APHA)	----	EC101	0.010	%	4.81	----	----	----	----
ion balance (cations/anions)	----	EC101	0.010	%	90.8	----	----	----	----
Total Metals									
aluminum, total	7429-90-5	E420	0.0030	mg/L	0.0926	----	----	----	----
antimony, total	7440-36-0	E420	0.00010	mg/L	0.00037	----	----	----	----
arsenic, total	7440-38-2	E420	0.00010	mg/L	0.00018	----	----	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	Columbia River + Rock - DA Initiation (A)	----	----	----	----
					Client sampling date / time	21-Sep-2022 00:10	----	----	----	----
						CG2212924-001	--------	--------	--------	--------
						Result	----	----	----	----
Total Metals										
barium, total	7440-39-3	E420	0.00010	mg/L		0.0218	----	----	----	----
beryllium, total	7440-41-7	E420	0.000100	mg/L		<0.000100	----	----	----	----
bismuth, total	7440-69-9	E420	0.000050	mg/L		<0.000050	----	----	----	----
boron, total	7440-42-8	E420	0.010	mg/L		0.035	----	----	----	----
cadmium, total	7440-43-9	E420	0.0000050	mg/L		0.0000248	----	----	----	----
calcium, total	7440-70-2	E420	0.050	mg/L		15.9	----	----	----	----
cesium, total	7440-46-2	E420	0.000010	mg/L		0.000031	----	----	----	----
chromium, total	7440-47-3	E420	0.00050	mg/L		<0.00050	----	----	----	----
cobalt, total	7440-48-4	E420	0.00010	mg/L		0.00011	----	----	----	----
copper, total	7440-50-8	E420	0.00050	mg/L		0.00107	----	----	----	----
iron, total	7439-89-6	E420	0.010	mg/L		0.111	----	----	----	----
lead, total	7439-92-1	E420	0.000050	mg/L		0.000211	----	----	----	----
lithium, total	7439-93-2	E420	0.0010	mg/L		0.0010	----	----	----	----
magnesium, total	7439-95-4	E420	0.0050	mg/L		3.16	----	----	----	----
manganese, total	7439-96-5	E420	0.00010	mg/L		0.0227	----	----	----	----
mercury, total	7439-97-6	E508	0.0000050	mg/L		0.0000217	----	----	----	----
molybdenum, total	7439-98-7	E420	0.000050	mg/L		0.000894	----	----	----	----
nickel, total	7440-02-0	E420	0.00050	mg/L		0.00083	----	----	----	----
phosphorus, total	7723-14-0	E420	0.050	mg/L		<0.050	----	----	----	----
potassium, total	7440-09-7	E420	0.050	mg/L		0.709	----	----	----	----
rubidium, total	7440-17-7	E420	0.00020	mg/L		0.00133	----	----	----	----
selenium, total	7782-49-2	E420	0.000050	mg/L		0.000097	----	----	----	----
silicon, total	7440-21-3	E420	0.10	mg/L		1.52	----	----	----	----
silver, total	7440-22-4	E420	0.000010	mg/L		<0.000010	----	----	----	----
sodium, total	7440-23-5	E420	0.050	mg/L		0.836	----	----	----	----
strontium, total	7440-24-6	E420	0.00020	mg/L		0.103	----	----	----	----
sulfur, total	7704-34-9	E420	0.50	mg/L		3.20	----	----	----	----
tellurium, total	13494-80-9	E420	0.00020	mg/L		<0.00020	----	----	----	----
thallium, total	7440-28-0	E420	0.000010	mg/L		<0.000010	----	----	----	----
thorium, total	7440-29-1	E420	0.00010	mg/L		<0.00010	----	----	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID: Columbia River + Rock - DA Initiation (A)	----	----	----	----
					Client sampling date / time: 21-Sep-2022 00:10	----	----	----	----
					CG2212924-001	--------	--------	--------	--------
					Result	----	----	----	----
Total Metals									
tin, total	7440-31-5	E420	0.00010	mg/L	0.00045	----	----	----	----
titanium, total	7440-32-6	E420	0.00030	mg/L	0.00691	----	----	----	----
tungsten, total	7440-33-7	E420	0.00010	mg/L	<0.00010	----	----	----	----
uranium, total	7440-61-1	E420	0.000010	mg/L	0.000818	----	----	----	----
vanadium, total	7440-62-2	E420	0.00050	mg/L	0.00053	----	----	----	----
zinc, total	7440-66-6	E420	0.0030	mg/L	0.0080	----	----	----	----
zirconium, total	7440-67-7	E420	0.00020	mg/L	<0.00020	----	----	----	----
Dissolved Metals									
aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	0.0080	----	----	----	----
antimony, dissolved	7440-36-0	E421	0.00010	mg/L	0.00036	----	----	----	----
arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.00016	----	----	----	----
barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.0175	----	----	----	----
beryllium, dissolved	7440-41-7	E421	0.000020	mg/L	<0.000020	----	----	----	----
bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	----	----	----	----
boron, dissolved	7440-42-8	E421	0.010	mg/L	0.034	----	----	----	----
cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	0.0000155	----	----	----	----
calcium, dissolved	7440-70-2	E421	0.050	mg/L	14.3	----	----	----	----
cesium, dissolved	7440-46-2	E421	0.000010	mg/L	<0.000010	----	----	----	----
chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	----	----	----	----
cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	<0.00010	----	----	----	----
copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.00063	----	----	----	----
iron, dissolved	7439-89-6	E421	0.010	mg/L	<0.010	----	----	----	----
lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.000050	----	----	----	----
lithium, dissolved	7439-93-2	E421	0.0010	mg/L	<0.0010	----	----	----	----
magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	2.73	----	----	----	----
manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.0103	----	----	----	----
mercury, dissolved	7439-97-6	E509	0.0000050	mg/L	0.0000098 RRV	----	----	----	----
molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.000845	----	----	----	----
nickel, dissolved	7440-02-0	E421	0.00050	mg/L	<0.00050	----	----	----	----
phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	<0.050	----	----	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	Columbia River + Rock - DA Initiation (A)	----	----	----	----
					Client sampling date / time	21-Sep-2022 00:10	----	----	----	----
						CG2212924-001	--------	--------	--------	--------
						Result	----	----	----	----
Dissolved Metals										
potassium, dissolved	7440-09-7	E421	0.050	mg/L		0.653	----	----	----	----
rubidium, dissolved	7440-17-7	E421	0.00020	mg/L		0.00091	----	----	----	----
selenium, dissolved	7782-49-2	E421	0.000050	mg/L		0.000152	----	----	----	----
silicon, dissolved	7440-21-3	E421	0.050	mg/L		1.49	----	----	----	----
silver, dissolved	7440-22-4	E421	0.000010	mg/L		<0.000010	----	----	----	----
sodium, dissolved	7440-23-5	E421	0.050	mg/L		0.780	----	----	----	----
strontium, dissolved	7440-24-6	E421	0.00020	mg/L		0.0927	----	----	----	----
sulfur, dissolved	7704-34-9	E421	0.50	mg/L		2.99	----	----	----	----
tellurium, dissolved	13494-80-9	E421	0.00020	mg/L		<0.00020	----	----	----	----
thallium, dissolved	7440-28-0	E421	0.000010	mg/L		<0.000010	----	----	----	----
thorium, dissolved	7440-29-1	E421	0.00010	mg/L		<0.00010	----	----	----	----
tin, dissolved	7440-31-5	E421	0.00010	mg/L		0.00042	----	----	----	----
titanium, dissolved	7440-32-6	E421	0.00030	mg/L		<0.00030	----	----	----	----
tungsten, dissolved	7440-33-7	E421	0.00010	mg/L		<0.00010	----	----	----	----
uranium, dissolved	7440-61-1	E421	0.000010	mg/L		0.000757	----	----	----	----
vanadium, dissolved	7440-62-2	E421	0.00050	mg/L		<0.00050	----	----	----	----
zinc, dissolved	7440-66-6	E421	0.0010	mg/L		0.0065	----	----	----	----
zirconium, dissolved	7440-67-7	E421	0.00020	mg/L		<0.00020	----	----	----	----
dissolved mercury filtration location	----	EP509	-	-		Field	----	----	----	----
dissolved metals filtration location	----	EP421	-	-		Field	----	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **CG2212924**	Page	: 1 of 9
Amendment	: 4		
Client	: **Golder Associates Ltd.**	Laboratory	: Calgary - Environmental
Contact	: Elaine Irving	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary, Alberta Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: WO# 20449674/9000	Date Samples Received	: 21-Sep-2022 14:35
PO	: WO#20449674/9000	Issue Date	: 12-Oct-2022 17:07
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid)										
Columbia River + Rock - DA Initiation (A)	E298	21-Sep-2022	22-Sep-2022	----	----		22-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE										
Columbia River + Rock - DA Initiation (A)	E235.Cl	21-Sep-2022	21-Sep-2022	----	----		21-Sep-2022	28 days	1 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE										
Columbia River + Rock - DA Initiation (A)	E235.F	21-Sep-2022	21-Sep-2022	----	----		21-Sep-2022	28 days	1 days	✓
Anions and Nutrients : Nitrate in Water by IC										
HDPE										
Columbia River + Rock - DA Initiation (A)	E235.NO3	21-Sep-2022	21-Sep-2022	----	----		21-Sep-2022	3 days	1 days	✓
Anions and Nutrients : Nitrite in Water by IC										
HDPE										
Columbia River + Rock - DA Initiation (A)	E235.NO2	21-Sep-2022	21-Sep-2022	----	----		21-Sep-2022	3 days	1 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE										
Columbia River + Rock - DA Initiation (A)	E235.SO4	21-Sep-2022	21-Sep-2022	----	----		21-Sep-2022	28 days	1 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid)										
Columbia River + Rock - DA Initiation (A)	E509	21-Sep-2022	26-Sep-2022	----	----		26-Sep-2022	28 days	5 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid)										
Columbia River + Rock - DA Initiation (A)	E421	21-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	180 days	5 days	✓
Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)										
Amber glass dissolved (sulfuric acid)										
Columbia River + Rock - DA Initiation (A)	E358-L	21-Sep-2022	21-Sep-2022	----	----		22-Sep-2022	28 days	2 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE										
Columbia River + Rock - DA Initiation (A)	E290	21-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	14 days	4 days	✓
Physical Tests : Conductivity in Water										
HDPE										
Columbia River + Rock - DA Initiation (A)	E100	21-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	4 days	✓
Physical Tests : pH by Meter										
HDPE										
Columbia River + Rock - DA Initiation (A)	E108	21-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	0.25 hrs	0.26 hrs	× EHTR-FM
Physical Tests : TSS by Gravimetry (Low Level)										
HDPE [TSS-WB]										
Columbia River + Rock - DA Initiation (A)	E160-L	21-Sep-2022	----	----	----		23-Sep-2022	7 days	3 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid)										
Columbia River + Rock - DA Initiation (A)	E508	21-Sep-2022	27-Sep-2022	----	----		27-Sep-2022	28 days	6 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
Columbia River + Rock - DA Initiation (A)	E420	21-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	180 days	4 days	✓

Legend & Qualifier Definitions

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Alkalinity Species by Titration	E290	664627	1	17	5.8	5.0	✓
Ammonia by Fluorescence	E298	660629	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	659036	1	15	6.6	5.0	✓
Conductivity in Water	E100	664626	1	15	6.6	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	665824	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	664934	1	18	5.5	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	658750	1	6	16.6	5.0	✓
Fluoride in Water by IC	E235.F	659033	1	15	6.6	5.0	✓
Nitrate in Water by IC	E235.NO3	659034	1	16	6.2	5.0	✓
Nitrite in Water by IC	E235.NO2	659037	1	14	7.1	5.0	✓
pH by Meter	E108	664625	1	17	5.8	5.0	✓
Sulfate in Water by IC	E235.SO4	659035	1	15	6.6	5.0	✓
Total Mercury in Water by CVAAS	E508	667516	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	664428	1	20	5.0	5.0	✓
Laboratory Control Samples (LCS)							
Alkalinity Species by Titration	E290	664627	1	17	5.8	5.0	✓
Ammonia by Fluorescence	E298	660629	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	659036	1	15	6.6	5.0	✓
Conductivity in Water	E100	664626	1	15	6.6	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	665824	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	664934	1	18	5.5	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	658750	1	6	16.6	5.0	✓
Fluoride in Water by IC	E235.F	659033	1	15	6.6	5.0	✓
Nitrate in Water by IC	E235.NO3	659034	1	16	6.2	5.0	✓
Nitrite in Water by IC	E235.NO2	659037	1	14	7.1	5.0	✓
pH by Meter	E108	664625	1	17	5.8	5.0	✓
Sulfate in Water by IC	E235.SO4	659035	1	15	6.6	5.0	✓
Total Mercury in Water by CVAAS	E508	667516	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	664428	1	20	5.0	5.0	✓
TSS by Gravimetry (Low Level)	E160-L	661513	1	20	5.0	5.0	✓
Method Blanks (MB)							
Alkalinity Species by Titration	E290	664627	1	17	5.8	5.0	✓
Ammonia by Fluorescence	E298	660629	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	659036	1	15	6.6	5.0	✓
Conductivity in Water	E100	664626	1	15	6.6	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	665824	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	664934	1	18	5.5	5.0	✓

Matrix: **Water**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Method Blanks (MB) - Continued							
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	658750	1	6	16.6	5.0	✓
Fluoride in Water by IC	E235.F	659033	1	15	6.6	5.0	✓
Nitrate in Water by IC	E235.NO3	659034	1	16	6.2	5.0	✓
Nitrite in Water by IC	E235.NO2	659037	1	14	7.1	5.0	✓
Sulfate in Water by IC	E235.SO4	659035	1	15	6.6	5.0	✓
Total Mercury in Water by CVAAS	E508	667516	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	664428	1	20	5.0	5.0	✓
TSS by Gravimetry (Low Level)	E160-L	661513	1	20	5.0	5.0	✓
Matrix Spikes (MS)							
Ammonia by Fluorescence	E298	660629	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	659036	1	15	6.6	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	665824	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	664934	1	18	5.5	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	658750	1	6	16.6	5.0	✓
Fluoride in Water by IC	E235.F	659033	1	15	6.6	5.0	✓
Nitrate in Water by IC	E235.NO3	659034	1	16	6.2	5.0	✓
Nitrite in Water by IC	E235.NO2	659037	1	14	7.1	5.0	✓
Sulfate in Water by IC	E235.SO4	659035	1	15	6.6	5.0	✓
Total Mercury in Water by CVAAS	E508	667516	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	664428	1	20	5.0	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Water	E100 Calgary - Environmental	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 Calgary - Environmental	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
TSS by Gravimetry (Low Level)	E160-L Calgary - Environmental	Water	APHA 2540 D (mod)	Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, following by drying of the filter at 104 ± 1°C, with gravimetric measurement of the filtered solids. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.
Chloride in Water by IC	E235.Cl Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Fluoride in Water by IC	E235.F Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrite in Water by IC	E235.NO2 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC	E235.NO3 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration	E290 Calgary - Environmental	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
Ammonia by Fluorescence	E298 Calgary - Environmental	Water	Method Fialab 100, 2018	Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021)
Dissolved Organic Carbon by Combustion (Low Level)	E358-L Calgary - Environmental	Water	APHA 5310 B (mod)	Dissolved Organic Carbon (Non-Purgeable), also known as NPOC (dissolved), is a direct measurement of DOC after a filtered (0.45 micron) sample has been acidified and purged to remove inorganic carbon (IC). Analysis is by high temperature combustion with infrared detection of CO2. NPOC does not include volatile organic species that are purged off with IC. For samples where the majority of DC (dissolved carbon) is comprised of IC (which is common), this method is more accurate and more reliable than the DOC by subtraction method (i.e. DC minus DIC).

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Total metals in Water by CRC ICPMS	E420 Calgary - Environmental	Water	EPA 200.2/6020B (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Dissolved Metals in Water by CRC ICPMS	E421 Calgary - Environmental	Water	APHA 3030B/EPA 6020B (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Total Mercury in Water by CVAAS	E508 Calgary - Environmental	Water	EPA 1631E (mod)	Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS
Dissolved Mercury in Water by CVAAS	E509 Calgary - Environmental	Water	APHA 3030B/EPA 1631E (mod)	Water samples are filtered (0.45 um), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.
Dissolved Hardness (Calculated)	EC100 Calgary - Environmental	Water	APHA 2340B	“Hardness (as CaCO3), dissolved” is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. “Total Hardness” refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations.
Hardness (Calculated) from Total Ca/Mg	EC100A Calgary - Environmental	Water	APHA 2340B	“Hardness (as CaCO3), from total Ca/Mg” is calculated from the sum of total Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. “Total Hardness” refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. Hardness from total Ca/Mg is normally comparable to Dissolved Hardness in non-turbid waters.
Ion Balance using Dissolved Metals	EC101 Calgary - Environmental	Water	APHA 1030E	Cation Sum, Anion Sum, and Ion Balance are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present. Ion Balance cannot be calculated accurately for waters with very low electrical conductivity (EC).
TDS in Water (Calculation)	EC103 Calgary - Environmental	Water	APHA 1030E (mod)	Total Dissolved Solids is calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present.
Nitrate and Nitrite (as N) (Calculation)	EC235.N+N Calgary - Environmental	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Ammonia	EP298 Calgary - Environmental	Water		Sample preparation for Preserved Nutrients Water Quality Analysis.
Preparation for Dissolved Organic Carbon for Combustion	EP358 Calgary - Environmental	Water	APHA 5310 B (mod)	Preparation for Dissolved Organic Carbon

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Dissolved Metals Water Filtration	EP421 Calgary - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO3.
Dissolved Mercury Water Filtration	EP509 Calgary - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HCl.

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **CG2212924**	Page	: 1 of 18
Amendment	: **4**		
Client	: Golder Associates Ltd.	Laboratory	: Calgary - Environmental
Contact	: Elaine Irving	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary, Alberta Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: WO# 20449674/9000	Date Samples Received	: 21-Sep-2022 14:35
PO	: WO#20449674/9000	Date Analysis Commenced	: 21-Sep-2022
C-O-C number	: ----	Issue Date	: 12-Oct-2022 17:07
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Anthony Calero	Supervisor - Inorganic	Calgary Metals, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Calgary Inorganics, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Calgary Metals, Calgary, Alberta
Elke Tabora		Calgary Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Calgary Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Calgary Metals, Calgary, Alberta
Naeun Kim	Analyst	Calgary Metals, Calgary, Alberta
Parker Sgarbossa	Laboratory Analyst	Calgary Inorganics, Calgary, Alberta
Sara Niroomand		Calgary Inorganics, Calgary, Alberta
Sara Niroomand		Calgary Metals, Calgary, Alberta
Vladka Stamenova	Analyst	Calgary Inorganics, Calgary, Alberta

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include 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 predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 664625)											
CG2212902-002	Anonymous	pH	----	E108	0.10	pH units	7.49	7.50	0.133%	4%	----
Physical Tests (QC Lot: 664626)											
CG2212902-003	Anonymous	conductivity	----	E100	2.0	µS/cm	354	355	0.282%	10%	----
Physical Tests (QC Lot: 664627)											
CG2212902-003	Anonymous	alkalinity, total (as CaCO3)	----	E290	2.0	mg/L	201	193	3.81%	20%	----
Anions and Nutrients (QC Lot: 659033)											
CG2212863-001	Anonymous	fluoride	16984-48-8	E235.F	0.100	mg/L	0.229	0.224	0.004	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 659034)											
CG2212863-001	Anonymous	nitrate (as N)	14797-55-8	E235.NO3	0.100	mg/L	<0.100	<0.100	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 659035)											
CG2212863-001	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	1.50	mg/L	906	900	0.778%	20%	----
Anions and Nutrients (QC Lot: 659036)											
CG2212863-001	Anonymous	chloride	16887-00-6	E235.Cl	2.50	mg/L	63.5	62.9	1.03%	20%	----
Anions and Nutrients (QC Lot: 659037)											
CG2212863-001	Anonymous	nitrite (as N)	14797-65-0	E235.NO2	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 660629)											
CG2212921-001	Anonymous	ammonia, total (as N)	7664-41-7	E298	0.125	mg/L	3.31	3.15	4.84%	20%	----
Organic / Inorganic Carbon (QC Lot: 658750)											
CG2212913-012	Anonymous	carbon, dissolved organic [DOC]	----	E358-L	0.50	mg/L	0.76	0.64	0.12	Diff <2x LOR	----
Total Metals (QC Lot: 664428)											
CG2212941-001	Anonymous	aluminum, total	7429-90-5	E420	0.0030	mg/L	0.0567	0.0595	4.88%	20%	----
		antimony, total	7440-36-0	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		arsenic, total	7440-38-2	E420	0.00010	mg/L	0.00043	0.00044	0.000006	Diff <2x LOR	----
		barium, total	7440-39-3	E420	0.00010	mg/L	0.0797	0.0803	0.744%	20%	----
		beryllium, total	7440-41-7	E420	0.000020	mg/L	<0.020 µg/L	<0.000020	0	Diff <2x LOR	----
		bismuth, total	7440-69-9	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		boron, total	7440-42-8	E420	0.010	mg/L	0.032	0.034	0.002	Diff <2x LOR	----
		cadmium, total	7440-43-9	E420	0.0000050	mg/L	0.0265 µg/L	0.0000281	0.0000016	Diff <2x LOR	----
		calcium, total	7440-70-2	E420	0.050	mg/L	201	205	2.25%	20%	----
		cesium, total	7440-46-2	E420	0.000010	mg/L	0.000013	0.000015	0.000002	Diff <2x LOR	----
		chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Total Metals (QC Lot: 664428) - continued											
CG2212941-001	Anonymous	cobalt, total	7440-48-4	E420	0.00010	mg/L	0.60 µg/L	0.00057	0.00003	Diff <2x LOR	----
		copper, total	7440-50-8	E420	0.00050	mg/L	0.00072	0.00076	0.00004	Diff <2x LOR	----
		iron, total	7439-89-6	E420	0.010	mg/L	0.100	0.107	7.29%	20%	----
		lead, total	7439-92-1	E420	0.000050	mg/L	0.000076	0.000081	0.000004	Diff <2x LOR	----
		lithium, total	7439-93-2	E420	0.0010	mg/L	0.0346	0.0358	3.21%	20%	----
		magnesium, total	7439-95-4	E420	0.0050	mg/L	125	122	2.19%	20%	----
		manganese, total	7439-96-5	E420	0.00010	mg/L	0.101	0.100	1.19%	20%	----
		molybdenum, total	7439-98-7	E420	0.000050	mg/L	0.00269	0.00290	7.48%	20%	----
		nickel, total	7440-02-0	E420	0.00050	mg/L	0.00546	0.00552	1.06%	20%	----
		phosphorus, total	7723-14-0	E420	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
		potassium, total	7440-09-7	E420	0.050	mg/L	3.34	3.31	0.920%	20%	----
		rubidium, total	7440-17-7	E420	0.00020	mg/L	0.00092	0.00083	0.00009	Diff <2x LOR	----
		selenium, total	7782-49-2	E420	0.000050	mg/L	0.458 µg/L	0.000411	0.000046	Diff <2x LOR	----
		silicon, total	7440-21-3	E420	0.10	mg/L	6.46	6.45	0.287%	20%	----
		silver, total	7440-22-4	E420	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		sodium, total	7440-23-5	E420	0.050	mg/L	10.1	9.63	5.10%	20%	----
		strontium, total	7440-24-6	E420	0.00020	mg/L	0.583	0.618	5.72%	20%	----
		sulfur, total	7704-34-9	E420	0.50	mg/L	206	208	0.772%	20%	----
		tellurium, total	13494-80-9	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		thallium, total	7440-28-0	E420	0.000010	mg/L	0.000013	0.000012	0.0000006	Diff <2x LOR	----
		thorium, total	7440-29-1	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		tin, total	7440-31-5	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		titanium, total	7440-32-6	E420	0.00030	mg/L	0.00067	0.00053	0.00014	Diff <2x LOR	----
		tungsten, total	7440-33-7	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		uranium, total	7440-61-1	E420	0.000010	mg/L	0.00249	0.00252	1.04%	20%	----
		vanadium, total	7440-62-2	E420	0.00050	mg/L	0.00057	0.00062	0.00005	Diff <2x LOR	----
		zinc, total	7440-66-6	E420	0.0030	mg/L	<0.0030	<0.0030	0	Diff <2x LOR	----
		zirconium, total	7440-67-7	E420	0.00020	mg/L	0.00024	0.00022	0.00003	Diff <2x LOR	----
Total Metals (QC Lot: 667516)											
CG2212924-001	Columbia River + Rock - DA Initiation (A)	mercury, total	7439-97-6	E508	0.0000050	mg/L	0.0000217	0.0000223	0.0000006	Diff <2x LOR	----
Dissolved Metals (QC Lot: 664934)											
CG2213021-001	Anonymous	aluminum, dissolved	7429-90-5	E421	0.0020	mg/L	0.0804	0.0852	5.74%	20%	----
		antimony, dissolved	7440-36-0	E421	0.00010	mg/L	0.00065	0.00067	0.00002	Diff <2x LOR	----
		arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.00091	0.00085	0.00006	Diff <2x LOR	----
		barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.135	0.127	6.44%	20%	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Dissolved Metals (QC Lot: 664934) - continued											
CG2213021-001	Anonymous	beryllium, dissolved	7440-41-7	E421	0.000020	mg/L	<0.040 µg/L	<0.000020	0.000020	Diff <2x LOR	----
		bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000100	<0.000050	0.000050	Diff <2x LOR	----
		boron, dissolved	7440-42-8	E421	0.010	mg/L	<0.020	<0.010	0.010	Diff <2x LOR	----
		cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	0.0612 µg/L	0.0000600	0.0000012	Diff <2x LOR	----
		calcium, dissolved	7440-70-2	E421	0.050	mg/L	30.0	28.3	6.05%	20%	----
		cesium, dissolved	7440-46-2	E421	0.000010	mg/L	<0.000020	<0.000010	0.000010	Diff <2x LOR	----
		chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	<0.20 µg/L	0.00010	0.00010	Diff <2x LOR	----
		copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.00481	0.00450	6.70%	20%	----
		iron, dissolved	7439-89-6	E421	0.020	mg/L	0.142	0.139	0.003	Diff <2x LOR	----
		lead, dissolved	7439-92-1	E421	0.000050	mg/L	0.000133	<0.000050	0.000083	Diff <2x LOR	----
		lithium, dissolved	7439-93-2	E421	0.0010	mg/L	<0.0020	0.0010	0.0010	Diff <2x LOR	----
		magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	15.2	15.0	1.17%	20%	----
		manganese, dissolved	7439-96-5	E421	0.00020	mg/L	0.00145	0.00139	0.00006	Diff <2x LOR	----
		molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.00987	0.0102	3.29%	20%	----
		nickel, dissolved	7440-02-0	E421	0.00050	mg/L	0.00644	0.00628	0.00016	Diff <2x LOR	----
		phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	<0.100	<0.050	0.050	Diff <2x LOR	----
		potassium, dissolved	7440-09-7	E421	0.050	mg/L	1.52	1.55	2.28%	20%	----
		rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	0.00130	0.00148	0.00017	Diff <2x LOR	----
		selenium, dissolved	7782-49-2	E421	0.000050	mg/L	0.874 µg/L	0.00101	14.2%	20%	----
		silicon, dissolved	7440-21-3	E421	0.050	mg/L	2.42	2.32	4.57%	20%	----
		silver, dissolved	7440-22-4	E421	0.000010	mg/L	0.000023	0.000011	0.000012	Diff <2x LOR	----
		sodium, dissolved	7440-23-5	E421	0.050	mg/L	1.50	1.41	6.70%	20%	----
		strontium, dissolved	7440-24-6	E421	0.00020	mg/L	0.0510	0.0491	3.84%	20%	----
		sulfur, dissolved	7704-34-9	E421	0.50	mg/L	<1.00	1.74	0.74	Diff <2x LOR	----
		tellurium, dissolved	13494-80-9	E421	0.00020	mg/L	<0.00040	<0.00020	0.00020	Diff <2x LOR	----
		thallium, dissolved	7440-28-0	E421	0.000010	mg/L	0.000039	0.000036	0.000004	Diff <2x LOR	----
		thorium, dissolved	7440-29-1	E421	0.00010	mg/L	<0.00020	<0.00010	0.00010	Diff <2x LOR	----
		tin, dissolved	7440-31-5	E421	0.00010	mg/L	<0.00020	<0.00010	0.00010	Diff <2x LOR	----
		titanium, dissolved	7440-32-6	E421	0.00060	mg/L	0.0167	0.0163	2.49%	20%	----
		tungsten, dissolved	7440-33-7	E421	0.00010	mg/L	<0.00020	<0.00010	0.00010	Diff <2x LOR	----
		uranium, dissolved	7440-61-1	E421	0.000010	mg/L	0.00122	0.00112	9.33%	20%	----
		vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	0.00213	0.00144	0.00069	Diff <2x LOR	----
		zinc, dissolved	7440-66-6	E421	0.0010	mg/L	0.0024	0.0016	0.0008	Diff <2x LOR	----
		zirconium, dissolved	7440-67-7	E421	0.00040	mg/L	0.00142	0.00139	0.00003	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Dissolved Metals (QC Lot: 665824)											
CG2212894-006	Anonymous	mercury, dissolved	7439-97-6	E509	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 661513)						
solids, total suspended [TSS]	----	E160-L	1	mg/L	<1.0	----
Physical Tests (QCLot: 664626)						
conductivity	----	E100	1	µS/cm	<1.0	----
Physical Tests (QCLot: 664627)						
alkalinity, total (as CaCO3)	----	E290	1	mg/L	<1.0	----
Anions and Nutrients (QCLot: 659033)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 659034)						
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 659035)						
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 659036)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 659037)						
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	<0.010	----
Anions and Nutrients (QCLot: 660629)						
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	<0.0050	----
Organic / Inorganic Carbon (QCLot: 658750)						
carbon, dissolved organic [DOC]	----	E358-L	0.5	mg/L	<0.50	----
Total Metals (QCLot: 664428)						
aluminum, total	7429-90-5	E420	0.003	mg/L	<0.0030	----
antimony, total	7440-36-0	E420	0.0001	mg/L	<0.00010	----
arsenic, total	7440-38-2	E420	0.0001	mg/L	<0.00010	----
barium, total	7440-39-3	E420	0.0001	mg/L	<0.00010	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	<0.000020	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	<0.000050	----
boron, total	7440-42-8	E420	0.01	mg/L	<0.010	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	<0.0000050	----
calcium, total	7440-70-2	E420	0.05	mg/L	<0.050	----
cesium, total	7440-46-2	E420	0.00001	mg/L	<0.000010	----
chromium, total	7440-47-3	E420	0.0005	mg/L	<0.00050	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	<0.00010	----
copper, total	7440-50-8	E420	0.0005	mg/L	<0.00050	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 664428) - continued						
iron, total	7439-89-6	E420	0.01	mg/L	<0.010	----
lead, total	7439-92-1	E420	0.00005	mg/L	<0.000050	----
lithium, total	7439-93-2	E420	0.001	mg/L	<0.0010	----
magnesium, total	7439-95-4	E420	0.005	mg/L	<0.0050	----
manganese, total	7439-96-5	E420	0.0001	mg/L	<0.00010	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	<0.000050	----
nickel, total	7440-02-0	E420	0.0005	mg/L	<0.00050	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	<0.050	----
potassium, total	7440-09-7	E420	0.05	mg/L	<0.050	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	<0.00020	----
selenium, total	7782-49-2	E420	0.00005	mg/L	<0.000050	----
silicon, total	7440-21-3	E420	0.1	mg/L	<0.10	----
silver, total	7440-22-4	E420	0.00001	mg/L	<0.000010	----
sodium, total	7440-23-5	E420	0.05	mg/L	<0.050	----
strontium, total	7440-24-6	E420	0.0002	mg/L	<0.00020	----
sulfur, total	7704-34-9	E420	0.5	mg/L	<0.50	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	<0.00020	----
thallium, total	7440-28-0	E420	0.00001	mg/L	<0.000010	----
thorium, total	7440-29-1	E420	0.0001	mg/L	<0.00010	----
tin, total	7440-31-5	E420	0.0001	mg/L	<0.00010	----
titanium, total	7440-32-6	E420	0.0003	mg/L	<0.00030	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	<0.00010	----
uranium, total	7440-61-1	E420	0.00001	mg/L	<0.000010	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	<0.00050	----
zinc, total	7440-66-6	E420	0.003	mg/L	<0.0030	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	<0.00020	----
Total Metals (QCLot: 667516)						
mercury, total	7439-97-6	E508	0.000005	mg/L	<0.0000050	----
Dissolved Metals (QCLot: 664934)						
aluminum, dissolved	7429-90-5	E421	0.001	mg/L	<0.0010	----
antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	----
arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	----
barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	----
beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	<0.000020	----
bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	<0.000050	----
boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals (QCLot: 664934) - continued						
cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	----
calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	----
cesium, dissolved	7440-46-2	E421	0.00001	mg/L	<0.000010	----
chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	----
cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	<0.00010	----
copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	----
lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----
lithium, dissolved	7439-93-2	E421	0.001	mg/L	<0.0010	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	<0.000050	----
nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----
phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	<0.050	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	<0.00020	----
selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
silicon, dissolved	7440-21-3	E421	0.05	mg/L	<0.050	----
silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
strontium, dissolved	7440-24-6	E421	0.0002	mg/L	<0.00020	----
sulfur, dissolved	7704-34-9	E421	0.5	mg/L	<0.50	----
tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	<0.00020	----
thallium, dissolved	7440-28-0	E421	0.00001	mg/L	<0.000010	----
thorium, dissolved	7440-29-1	E421	0.0001	mg/L	<0.00010	----
tin, dissolved	7440-31-5	E421	0.0001	mg/L	<0.00010	----
titanium, dissolved	7440-32-6	E421	0.0003	mg/L	<0.00030	----
tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	<0.00010	----
uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	----
vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	<0.00050	----
zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	----
zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	<0.00020	----
Dissolved Metals (QCLot: 665824)						
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	<0.0000050	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 661513)									
solids, total suspended [TSS]	----	E160-L	1	mg/L	150 mg/L	93.0	85.0	115	----
Physical Tests (QCLot: 664625)									
pH	----	E108	----	pH units	7 pH units	100	98.6	101	----
Physical Tests (QCLot: 664626)									
conductivity	----	E100	1	µS/cm	146.9 µS/cm	99.7	90.0	110	----
Physical Tests (QCLot: 664627)									
alkalinity, total (as CaCO3)	----	E290	1	mg/L	500 mg/L	102	85.0	115	----
Anions and Nutrients (QCLot: 659033)									
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 659034)									
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	2.5 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 659035)									
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	102	90.0	110	----
Anions and Nutrients (QCLot: 659036)									
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	99.6	90.0	110	----
Anions and Nutrients (QCLot: 659037)									
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	0.5 mg/L	95.7	90.0	110	----
Anions and Nutrients (QCLot: 660629)									
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	0.2 mg/L	92.0	85.0	115	----
Organic / Inorganic Carbon (QCLot: 658750)									
carbon, dissolved organic [DOC]	----	E358-L	0.5	mg/L	8.57 mg/L	88.6	80.0	120	----
Total Metals (QCLot: 664428)									
aluminum, total	7429-90-5	E420	0.003	mg/L	2 mg/L	106	80.0	120	----
antimony, total	7440-36-0	E420	0.0001	mg/L	1 mg/L	110	80.0	120	----
arsenic, total	7440-38-2	E420	0.0001	mg/L	1 mg/L	102	80.0	120	----
barium, total	7440-39-3	E420	0.0001	mg/L	0.25 mg/L	104	80.0	120	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	0.1 mg/L	98.9	80.0	120	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	1 mg/L	98.4	80.0	120	----
boron, total	7440-42-8	E420	0.01	mg/L	1 mg/L	94.2	80.0	120	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	0.1 mg/L	98.5	80.0	120	----
calcium, total	7440-70-2	E420	0.05	mg/L	50 mg/L	106	80.0	120	----

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Total Metals (QCLot: 664428) - continued									
cesium, total	7440-46-2	E420	0.00001	mg/L	0.05 mg/L	99.4	80.0	120	----
chromium, total	7440-47-3	E420	0.0005	mg/L	0.25 mg/L	102	80.0	120	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	0.25 mg/L	102	80.0	120	----
copper, total	7440-50-8	E420	0.0005	mg/L	0.25 mg/L	104	80.0	120	----
iron, total	7439-89-6	E420	0.01	mg/L	1 mg/L	99.2	80.0	120	----
lead, total	7439-92-1	E420	0.00005	mg/L	0.5 mg/L	99.0	80.0	120	----
lithium, total	7439-93-2	E420	0.001	mg/L	0.25 mg/L	99.8	80.0	120	----
magnesium, total	7439-95-4	E420	0.005	mg/L	50 mg/L	108	80.0	120	----
manganese, total	7439-96-5	E420	0.0001	mg/L	0.25 mg/L	104	80.0	120	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.25 mg/L	105	80.0	120	----
nickel, total	7440-02-0	E420	0.0005	mg/L	0.5 mg/L	108	80.0	120	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	10 mg/L	97.6	70.0	130	----
potassium, total	7440-09-7	E420	0.05	mg/L	50 mg/L	102	80.0	120	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	0.1 mg/L	91.6	80.0	120	----
selenium, total	7782-49-2	E420	0.00005	mg/L	1 mg/L	99.5	80.0	120	----
silicon, total	7440-21-3	E420	0.1	mg/L	10 mg/L	95.4	60.0	140	----
silver, total	7440-22-4	E420	0.00001	mg/L	0.1 mg/L	97.0	80.0	120	----
sodium, total	7440-23-5	E420	0.05	mg/L	50 mg/L	102	80.0	120	----
strontium, total	7440-24-6	E420	0.0002	mg/L	0.25 mg/L	109	80.0	120	----
sulfur, total	7704-34-9	E420	0.5	mg/L	50 mg/L	108	80.0	120	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	0.1 mg/L	93.2	80.0	120	----
thallium, total	7440-28-0	E420	0.00001	mg/L	1 mg/L	96.8	80.0	120	----
thorium, total	7440-29-1	E420	0.0001	mg/L	0.1 mg/L	98.1	80.0	120	----
tin, total	7440-31-5	E420	0.0001	mg/L	0.5 mg/L	104	80.0	120	----
titanium, total	7440-32-6	E420	0.0003	mg/L	0.25 mg/L	96.0	80.0	120	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	0.1 mg/L	98.0	80.0	120	----
uranium, total	7440-61-1	E420	0.00001	mg/L	0.005 mg/L	96.6	80.0	120	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	0.5 mg/L	103	80.0	120	----
zinc, total	7440-66-6	E420	0.003	mg/L	0.5 mg/L	90.0	80.0	120	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	0.1 mg/L	93.5	80.0	120	----
Total Metals (QCLot: 667516)									
mercury, total	7439-97-6	E508	0.000005	mg/L	0.0001 mg/L	106	80.0	120	----
Dissolved Metals (QCLot: 664934)									
aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	97.1	80.0	120	----
antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	103	80.0	120	----
arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	95.4	80.0	120	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	Qualifier
Dissolved Metals (QCLot: 664934) - continued									
barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	96.6	80.0	120	----
beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.1 mg/L	95.2	80.0	120	----
bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	1 mg/L	96.3	80.0	120	----
boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	89.8	80.0	120	----
cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	95.5	80.0	120	----
calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	94.8	80.0	120	----
cesium, dissolved	7440-46-2	E421	0.00001	mg/L	0.05 mg/L	92.4	80.0	120	----
chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	93.1	80.0	120	----
cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.25 mg/L	92.5	80.0	120	----
copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	89.2	80.0	120	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	106	80.0	120	----
lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	96.0	80.0	120	----
lithium, dissolved	7439-93-2	E421	0.001	mg/L	0.25 mg/L	96.0	80.0	120	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	92.3	80.0	120	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	93.4	80.0	120	----
molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.25 mg/L	100	80.0	120	----
nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	92.6	80.0	120	----
phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	10 mg/L	96.2	70.0	130	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	93.9	80.0	120	----
rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	0.1 mg/L	102	80.0	120	----
selenium, dissolved	7782-49-2	E421	0.00005	mg/L	1 mg/L	91.0	80.0	120	----
silicon, dissolved	7440-21-3	E421	0.05	mg/L	10 mg/L	98.2	60.0	140	----
silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	91.7	80.0	120	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	92.4	80.0	120	----
strontium, dissolved	7440-24-6	E421	0.0002	mg/L	0.25 mg/L	96.9	80.0	120	----
sulfur, dissolved	7704-34-9	E421	0.5	mg/L	50 mg/L	101	80.0	120	----
tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	0.1 mg/L	92.8	80.0	120	----
thallium, dissolved	7440-28-0	E421	0.00001	mg/L	1 mg/L	96.4	80.0	120	----
thorium, dissolved	7440-29-1	E421	0.0001	mg/L	0.1 mg/L	90.3	80.0	120	----
tin, dissolved	7440-31-5	E421	0.0001	mg/L	0.5 mg/L	99.1	80.0	120	----
titanium, dissolved	7440-32-6	E421	0.0003	mg/L	0.25 mg/L	87.6	80.0	120	----
tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	0.1 mg/L	99.7	80.0	120	----
uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	93.1	80.0	120	----
vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.5 mg/L	96.8	80.0	120	----
zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	86.8	80.0	120	----
zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	0.1 mg/L	98.9	80.0	120	----
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	0.0001 mg/L	96.6	80.0	120	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Anions and Nutrients (QCLot: 659033)										
CG2212863-002	Anonymous	fluoride	16984-48-8	E235.F	0.903 mg/L	1 mg/L	90.3	75.0	125	----
Anions and Nutrients (QCLot: 659034)										
CG2212863-002	Anonymous	nitrate (as N)	14797-55-8	E235.NO3	2.41 mg/L	2.5 mg/L	96.4	75.0	125	----
Anions and Nutrients (QCLot: 659035)										
CG2212863-002	Anonymous	sulfate (as SO4)	14808-79-8	E235.SO4	ND mg/L	100 mg/L	ND	75.0	125	----
Anions and Nutrients (QCLot: 659036)										
CG2212863-002	Anonymous	chloride	16887-00-6	E235.Cl	95.0 mg/L	100 mg/L	95.0	75.0	125	----
Anions and Nutrients (QCLot: 659037)										
CG2212863-002	Anonymous	nitrite (as N)	14797-65-0	E235.NO2	0.486 mg/L	0.5 mg/L	97.3	75.0	125	----
Anions and Nutrients (QCLot: 660629)										
CG2212924-001	Columbia River + Rock - DA Initiation (A)	ammonia, total (as N)	7664-41-7	E298	0.0974 mg/L	0.1 mg/L	97.4	75.0	125	----
Organic / Inorganic Carbon (QCLot: 658750)										
CG2212913-012	Anonymous	carbon, dissolved organic [DOC]	----	E358-L	5.25 mg/L	5 mg/L	105	70.0	130	----
Total Metals (QCLot: 664428)										
CG2212941-002	Anonymous	aluminum, total	7429-90-5	E420	2.07 mg/L	2 mg/L	104	70.0	130	----
		antimony, total	7440-36-0	E420	0.207 mg/L	0.2 mg/L	103	70.0	130	----
		arsenic, total	7440-38-2	E420	0.205 mg/L	0.2 mg/L	103	70.0	130	----
		barium, total	7440-39-3	E420	0.212 mg/L	0.2 mg/L	106	70.0	130	----
		beryllium, total	7440-41-7	E420	0.404 mg/L	0.4 mg/L	101	70.0	130	----
		bismuth, total	7440-69-9	E420	0.0949 mg/L	0.1 mg/L	94.9	70.0	130	----
		boron, total	7440-42-8	E420	0.980 mg/L	1 mg/L	98.0	70.0	130	----
		cadmium, total	7440-43-9	E420	0.0401 mg/L	0.04 mg/L	100	70.0	130	----
		calcium, total	7440-70-2	E420	ND mg/L	40 mg/L	ND	70.0	130	----
		cesium, total	7440-46-2	E420	0.102 mg/L	0.1 mg/L	102	70.0	130	----
		chromium, total	7440-47-3	E420	0.410 mg/L	0.4 mg/L	102	70.0	130	----
		cobalt, total	7440-48-4	E420	0.201 mg/L	0.2 mg/L	101	70.0	130	----
		copper, total	7440-50-8	E420	0.207 mg/L	0.2 mg/L	104	70.0	130	----
		iron, total	7439-89-6	E420	20.2 mg/L	20 mg/L	101	70.0	130	----
		lead, total	7439-92-1	E420	0.195 mg/L	0.2 mg/L	97.3	70.0	130	----
		lithium, total	7439-93-2	E420	1.01 mg/L	1 mg/L	101	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Total Metals (QCLot: 664428) - continued										
CG2212941-002	Anonymous	magnesium, total	7439-95-4	E420	ND mg/L	10 mg/L	ND	70.0	130	----
		manganese, total	7439-96-5	E420	0.207 mg/L	0.2 mg/L	104	70.0	130	----
		molybdenum, total	7439-98-7	E420	0.216 mg/L	0.2 mg/L	108	70.0	130	----
		nickel, total	7440-02-0	E420	0.430 mg/L	0.4 mg/L	108	70.0	130	----
		phosphorus, total	7723-14-0	E420	85.2 mg/L	100 mg/L	85.2	70.0	130	----
		potassium, total	7440-09-7	E420	38.7 mg/L	40 mg/L	96.8	70.0	130	----
		rubidium, total	7440-17-7	E420	0.188 mg/L	0.2 mg/L	93.9	70.0	130	----
		selenium, total	7782-49-2	E420	0.426 mg/L	0.4 mg/L	106	70.0	130	----
		silicon, total	7440-21-3	E420	87.3 mg/L	100 mg/L	87.3	70.0	130	----
		silver, total	7440-22-4	E420	0.0432 mg/L	0.04 mg/L	108	70.0	130	----
		sodium, total	7440-23-5	E420	18.2 mg/L	20 mg/L	91.2	70.0	130	----
		strontium, total	7440-24-6	E420	ND mg/L	0.2 mg/L	ND	70.0	130	----
		sulfur, total	7704-34-9	E420	ND mg/L	200 mg/L	ND	70.0	130	----
		tellurium, total	13494-80-9	E420	0.380 mg/L	0.4 mg/L	95.0	70.0	130	----
		thallium, total	7440-28-0	E420	0.0384 mg/L	0.04 mg/L	96.0	70.0	130	----
		thorium, total	7440-29-1	E420	0.207 mg/L	0.2 mg/L	103	70.0	130	----
		tin, total	7440-31-5	E420	0.203 mg/L	0.2 mg/L	102	70.0	130	----
		titanium, total	7440-32-6	E420	0.377 mg/L	0.4 mg/L	94.2	70.0	130	----
		tungsten, total	7440-33-7	E420	0.192 mg/L	0.2 mg/L	95.8	70.0	130	----
		uranium, total	7440-61-1	E420	0.0389 mg/L	0.04 mg/L	97.3	70.0	130	----
		vanadium, total	7440-62-2	E420	0.991 mg/L	1 mg/L	99.1	70.0	130	----
		zinc, total	7440-66-6	E420	3.70 mg/L	4 mg/L	92.5	70.0	130	----
		zirconium, total	7440-67-7	E420	0.434 mg/L	0.4 mg/L	108	70.0	130	----
Total Metals (QCLot: 667516)										
CG2212941-001	Anonymous	mercury, total	7439-97-6	E508	0.000102 mg/L	0.0001 mg/L	102	70.0	130	----
Dissolved Metals (QCLot: 664934)										
CG2213021-002	Anonymous	aluminum, dissolved	7429-90-5	E421	1.99 mg/L	2 mg/L	99.4	70.0	130	----
		antimony, dissolved	7440-36-0	E421	0.191 mg/L	0.2 mg/L	95.5	70.0	130	----
		arsenic, dissolved	7440-38-2	E421	0.186 mg/L	0.2 mg/L	92.8	70.0	130	----
		barium, dissolved	7440-39-3	E421	ND mg/L	0.2 mg/L	ND	70.0	130	----
		beryllium, dissolved	7440-41-7	E421	0.366 mg/L	0.4 mg/L	91.5	70.0	130	----
		bismuth, dissolved	7440-69-9	E421	0.0858 mg/L	0.1 mg/L	85.8	70.0	130	----
		boron, dissolved	7440-42-8	E421	0.918 mg/L	1 mg/L	91.8	70.0	130	----
		cadmium, dissolved	7440-43-9	E421	0.0374 mg/L	0.04 mg/L	93.4	70.0	130	----
		calcium, dissolved	7440-70-2	E421	35.0 mg/L	40 mg/L	87.5	70.0	130	----
		cesium, dissolved	7440-46-2	E421	0.0880 mg/L	0.1 mg/L	88.0	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Dissolved Metals (QCLot: 664934) - continued										
CG2213021-002	Anonymous	chromium, dissolved	7440-47-3	E421	0.366 mg/L	0.4 mg/L	91.5	70.0	130	----
		cobalt, dissolved	7440-48-4	E421	0.187 mg/L	0.2 mg/L	93.3	70.0	130	----
		copper, dissolved	7440-50-8	E421	0.180 mg/L	0.2 mg/L	90.2	70.0	130	----
		iron, dissolved	7439-89-6	E421	18.2 mg/L	20 mg/L	90.9	70.0	130	----
		lead, dissolved	7439-92-1	E421	0.178 mg/L	0.2 mg/L	88.9	70.0	130	----
		lithium, dissolved	7439-93-2	E421	0.906 mg/L	1 mg/L	90.6	70.0	130	----
		magnesium, dissolved	7439-95-4	E421	ND mg/L	10 mg/L	ND	70.0	130	----
		manganese, dissolved	7439-96-5	E421	0.188 mg/L	0.2 mg/L	94.1	70.0	130	----
		molybdenum, dissolved	7439-98-7	E421	0.188 mg/L	0.2 mg/L	93.8	70.0	130	----
		nickel, dissolved	7440-02-0	E421	0.377 mg/L	0.4 mg/L	94.2	70.0	130	----
		phosphorus, dissolved	7723-14-0	E421	92.9 mg/L	100 mg/L	92.9	70.0	130	----
		potassium, dissolved	7440-09-7	E421	36.8 mg/L	40 mg/L	91.9	70.0	130	----
		rubidium, dissolved	7440-17-7	E421	0.194 mg/L	0.2 mg/L	97.3	70.0	130	----
		selenium, dissolved	7782-49-2	E421	0.359 mg/L	0.4 mg/L	89.7	70.0	130	----
		silicon, dissolved	7440-21-3	E421	75.0 mg/L	100 mg/L	75.0	70.0	130	----
		silver, dissolved	7440-22-4	E421	0.0395 mg/L	0.04 mg/L	98.8	70.0	130	----
		sodium, dissolved	7440-23-5	E421	17.6 mg/L	20 mg/L	88.1	70.0	130	----
		strontium, dissolved	7440-24-6	E421	0.168 mg/L	0.2 mg/L	84.3	70.0	130	----
		sulfur, dissolved	7704-34-9	E421	189 mg/L	200 mg/L	94.3	70.0	130	----
		tellurium, dissolved	13494-80-9	E421	0.378 mg/L	0.4 mg/L	94.4	70.0	130	----
		thallium, dissolved	7440-28-0	E421	0.0340 mg/L	0.04 mg/L	85.1	70.0	130	----
		thorium, dissolved	7440-29-1	E421	0.190 mg/L	0.2 mg/L	95.2	70.0	130	----
		tin, dissolved	7440-31-5	E421	0.188 mg/L	0.2 mg/L	94.1	70.0	130	----
		titanium, dissolved	7440-32-6	E421	0.388 mg/L	0.4 mg/L	97.1	70.0	130	----
		tungsten, dissolved	7440-33-7	E421	0.190 mg/L	0.2 mg/L	95.1	70.0	130	----
		uranium, dissolved	7440-61-1	E421	0.0350 mg/L	0.04 mg/L	87.6	70.0	130	----
		vanadium, dissolved	7440-62-2	E421	0.924 mg/L	1 mg/L	92.4	70.0	130	----
		zinc, dissolved	7440-66-6	E421	3.50 mg/L	4 mg/L	87.6	70.0	130	----
		zirconium, dissolved	7440-67-7	E421	0.377 mg/L	0.4 mg/L	94.2	70.0	130	----
Dissolved Metals (QCLot: 665824)										
CG2212894-007	Anonymous	mercury, dissolved	7439-97-6	E509	0.000106 mg/L	0.0001 mg/L	106	70.0	130	----

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here
(lab use only)

COC Number: 17 -

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	Elaine Irving
Phone:	Elaine_Irving@golder.com
	Company address below will appear on the final report
Street:	2920 Virtual Way, Suite 200
City/Province:	Vancouver, BC
Postal Code:	
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Golder Associates
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: Elaine_Irving@golder.com
Email 2: Mikayla_Donovan@golder.com
Email 3: emilie@nautilusenvironmental.ca

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: ap_customerservice@golder.com
Email 2: Elaine_Irving@golder.com

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☐ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☑ ; 3 day [P3-25%] ☐ ; 2 day [P2-50%] ☐
EMERGENCY: 1 Business day [E - 100%] ☐ ; Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:	CG22-GOLD100-0012 BC Hydro
Job #:	WO# 20449674/9000
PO / AFE:	WO# 20449674/9000
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#:
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only): | **ALS Contact:** | **Sampler:**

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Routine (PR01)	DOC (E358-L)	Total Metals + Hg (BC11)	Dissolved Metals + Hg (BC10)	TSS (E160-L)	Ammonia (E298)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Columbia River + Rock - DA Initiation (A)	21-Sep-22	12:10	Water	7	P4	P4	P4	P4	P4	P4		

Environmental Division
Calgary
Work Order Reference
CG2212924

Telephone : +1 403 407 1800

Environmental Division
Calgary
Work Order Reference
CG2212924

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO
Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
			9.6				

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date: 9/24	Time:	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

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**.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 -

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	Elaine Irving
Phone:	Elaine_Irving@golder.com
	Company address below will appear on the final report
Street:	2920 Virtual Way, Suite 200
City/Province:	Vancouver, BC
Postal Code:	
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Golder Associates
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	Elaine_Irving@golder.com
Email 2	Mikayla_Donovan@golder.com
Email 3	emilie@nautilusenvironmental.ca

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap_customerservice@golder.com
Email 2	Elaine_Irving@golder.com

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☐ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☑ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information	
ALS Account # / Quote #:	CG22-GOLD100-0012 BC Hydro
Job #:	WO# 20449674/9000
PO / AFE:	WO# 20449674/9000
LSD:	
ALS Lab Work Order # (lab use only):	
ALS Contact:	Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Routine (PR01)	DOC (E358-L)	Total Metals + Hg (BC11)	Dissolved Metals + Hg (BC10)	TSS (E160-L)	Ammonia (E298)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Columbia River + Rock - DA Initiation (A)	21-Sep-22	12:10	Water	7	P4	P4	P4	P4	P4	P4		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
10							

SHIPMENT RELEASE (client use)		
Released by:	Date:	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: 9/21	Time: 12:24

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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**.

NOV 2016 FRONT

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **CG2213108**	Page	: 1 of 6
Amendment	: **3**		
Client	: **Golder Associates Ltd.**	Laboratory	: Calgary - Environmental
Contact	: Elaine Irving	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary AB Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: WO# 20449674/9000	Date Samples Received	: 23-Sep-2022 13:00
PO	: WO#20449674/9000	Date Analysis Commenced	: 24-Sep-2022
C-O-C number	: ----	Issue Date	: 12-Oct-2022 17:11
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Anthony Calero	Supervisor - Inorganic	Metals, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Inorganics, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Metals, Calgary, Alberta
Elke Tabora		Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Inorganics, Calgary, Alberta
Mackenzie Lamoureux	Laboratory Analyst	Metals, Calgary, Alberta
Sara Niroomand		Inorganics, Calgary, Alberta
Vladka Stamenova	Analyst	Inorganics, Calgary, Alberta
Zakieh Lalonde		Metals, Calgary, Alberta

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit
%	percent
µS/cm	Microsiemens per centimetre
meq/L	milliequivalents per litre
mg/L	milligrams per litre
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior 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.

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

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

Qualifier	*Description*
RRV	*Reported result verified by repeat analysis.*

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	Columbia River + Rock-DA Termination (A)	Columbia River + Rock-TR Termination (A)	Columbia River + Rock-TR Termination (A) - Duplicate	----	----
					Client sampling date / time	24-Sep-2022 11:30	24-Sep-2022 12:00	24-Sep-2022 12:10	----	----
						CG2213108-001	CG2213108-002	CG2213108-003	--------	--------
						Result	Result	Result	----	----
Physical Tests										
hardness (as CaCO3), dissolved	----	EC100	0.50	mg/L		50.8	50.9	50.6	----	----
hardness (as CaCO3), from total Ca/Mg	----	EC100A	0.60	mg/L		50.1	51.3	51.4	----	----
solids, total suspended [TSS]	----	E160-L	1.0	mg/L		2.5	1.4	1.2	----	----
conductivity	----	E100	2.0	µS/cm		107	110	110	----	----
pH	----	E108	0.10	pH units		7.70	7.70	7.69	----	----
alkalinity, bicarbonate (as HCO3)	71-52-3	E290	1.0	mg/L		57.3	57.3	58.3	----	----
alkalinity, carbonate (as CO3)	3812-32-6	E290	1.0	mg/L		<1.0	<1.0	<1.0	----	----
alkalinity, hydroxide (as OH)	14280-30-9	E290	1.0	mg/L		<1.0	<1.0	<1.0	----	----
alkalinity, total (as CaCO3)	----	E290	2.0	mg/L		47.0	47.0	47.8	----	----
solids, total dissolved [TDS], calculated	----	EC103	1.0	mg/L		65.2	64.7	65.1	----	----
Anions and Nutrients										
ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L		0.101	0.377	0.377	----	----
chloride	16887-00-6	E235.Cl	0.50	mg/L		0.54	0.89	1.05	----	----
fluoride	16984-48-8	E235.F	0.020	mg/L		0.070	0.062	0.061	----	----
nitrate (as N)	14797-55-8	E235.NO3	0.020	mg/L		0.173	0.110	0.114	----	----
nitrite (as N)	14797-65-0	E235.NO2	0.010	mg/L		0.019	0.012	0.012	----	----
sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L		8.68	8.82	8.84	----	----
nitrate + nitrite (as N)	----	EC235.N+N	0.0500	mg/L		0.192	0.122	0.126	----	----
Organic / Inorganic Carbon										
carbon, dissolved organic [DOC]	----	E358-L	0.50	mg/L		2.38	0.91	0.82	----	----
Ion Balance										
anion sum	----	EC101	0.10	meq/L		1.15	1.16	1.18	----	----
cation sum	----	EC101	0.10	meq/L		1.08	1.12	1.11	----	----
ion balance (APHA)	----	EC101	0.010	%		3.14	1.75	3.06	----	----
ion balance (cations/anions)	----	EC101	0.010	%		93.9	96.6	94.1	----	----
Total Metals										
aluminum, total	7429-90-5	E420	0.0030	mg/L		0.0257	0.0354	0.0349	----	----
antimony, total	7440-36-0	E420	0.00010	mg/L		0.00050	0.00022	0.00023	----	----
arsenic, total	7440-38-2	E420	0.00010	mg/L		0.00029	0.00018	0.00021	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	Columbia River + Rock-DA Termination (A)	Columbia River + Rock-TR Termination (A)	Columbia River + Rock-TR Termination (A) - Duplicate	----	----
					Client sampling date / time	24-Sep-2022 11:30	24-Sep-2022 12:00	24-Sep-2022 12:10	----	----
						CG2213108-001	CG2213108-002	CG2213108-003	--------	--------
						Result	Result	Result	----	----
Total Metals										
barium, total	7440-39-3	E420	0.00010	mg/L		0.0189	0.0212	0.0217	----	----
beryllium, total	7440-41-7	E420	0.000100	mg/L		<0.000100	<0.000100	<0.000100	----	----
bismuth, total	7440-69-9	E420	0.000050	mg/L		<0.000050	<0.000050	<0.000050	----	----
boron, total	7440-42-8	E420	0.010	mg/L		0.038	0.026	0.026	----	----
cadmium, total	7440-43-9	E420	0.0000050	mg/L		0.0000154	0.0000113	0.0000123	----	----
calcium, total	7440-70-2	E420	0.050	mg/L		15.1	15.8	15.7	----	----
cesium, total	7440-46-2	E420	0.000010	mg/L		0.000011	0.000011	0.000012	----	----
chromium, total	7440-47-3	E420	0.00050	mg/L		<0.00050	<0.00050	<0.00050	----	----
cobalt, total	7440-48-4	E420	0.00010	mg/L		<0.00010	<0.00010	<0.00010	----	----
copper, total	7440-50-8	E420	0.00050	mg/L		0.00083	0.00091	0.00101	----	----
iron, total	7439-89-6	E420	0.010	mg/L		0.028	0.022	0.029	----	----
lead, total	7439-92-1	E420	0.000050	mg/L		0.000051	0.000054	0.000056	----	----
lithium, total	7439-93-2	E420	0.0010	mg/L		0.0014	0.0014	0.0013	----	----
magnesium, total	7439-95-4	E420	0.0050	mg/L		3.02	2.87	2.95	----	----
manganese, total	7439-96-5	E420	0.00010	mg/L		0.0128	0.00653	0.00722	----	----
mercury, total	7439-97-6	E508	0.0000050	mg/L		0.0000148 RRV	0.0000095 RRV	0.0000088 RRV	----	----
molybdenum, total	7439-98-7	E420	0.000050	mg/L		0.000932	0.00102	0.000985	----	----
nickel, total	7440-02-0	E420	0.00050	mg/L		0.00056	0.00073	0.00085	----	----
phosphorus, total	7723-14-0	E420	0.050	mg/L		<0.050	0.059	0.104	----	----
potassium, total	7440-09-7	E420	0.050	mg/L		0.703	0.977	0.955	----	----
rubidium, total	7440-17-7	E420	0.00020	mg/L		0.00101	0.00148	0.00139	----	----
selenium, total	7782-49-2	E420	0.000050	mg/L		0.000128	0.000093	0.000118	----	----
silicon, total	7440-21-3	E420	0.10	mg/L		1.67	1.52	1.56	----	----
silver, total	7440-22-4	E420	0.000010	mg/L		<0.000010	<0.000010	<0.000010	----	----
sodium, total	7440-23-5	E420	0.050	mg/L		0.866	1.08	1.14	----	----
strontium, total	7440-24-6	E420	0.00020	mg/L		0.0977	0.0974	0.0973	----	----
sulfur, total	7704-34-9	E420	0.50	mg/L		3.48	3.54	3.67	----	----
tellurium, total	13494-80-9	E420	0.00020	mg/L		<0.00020	<0.00020	<0.00020	----	----
thallium, total	7440-28-0	E420	0.000010	mg/L		0.000011	<0.000010	<0.000010	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	Columbia River + Rock-DA Termination (A)	Columbia River + Rock-TR Termination (A)	Columbia River + Rock-TR Termination (A) - Duplicate	----	----
					Client sampling date / time	24-Sep-2022 11:30	24-Sep-2022 12:00	24-Sep-2022 12:10	----	----
						CG2213108-001	CG2213108-002	CG2213108-003	--------	--------
						Result	Result	Result	----	----
Total Metals										
thorium, total	7440-29-1	E420	0.00010	mg/L		<0.00010	<0.00010	<0.00010	----	----
tin, total	7440-31-5	E420	0.00010	mg/L		0.00046	0.00946	0.00962	----	----
titanium, total	7440-32-6	E420	0.00030	mg/L		0.00127	<0.00030	0.00174	----	----
tungsten, total	7440-33-7	E420	0.00010	mg/L		<0.00010	<0.00010	<0.00010	----	----
uranium, total	7440-61-1	E420	0.000010	mg/L		0.000788	0.000775	0.000778	----	----
vanadium, total	7440-62-2	E420	0.00050	mg/L		0.00059	0.00124	0.00131	----	----
zinc, total	7440-66-6	E420	0.0030	mg/L		0.0057	0.0062	0.0059	----	----
zirconium, total	7440-67-7	E420	0.00020	mg/L		<0.00020	<0.00020	<0.00020	----	----
Dissolved Metals										
aluminum, dissolved	7429-90-5	E421	0.0010	mg/L		0.0037	0.0147	0.0148	----	----
antimony, dissolved	7440-36-0	E421	0.00010	mg/L		0.00043	0.00014	0.00014	----	----
arsenic, dissolved	7440-38-2	E421	0.00010	mg/L		0.00019	0.00014	0.00011	----	----
barium, dissolved	7440-39-3	E421	0.00010	mg/L		0.0195	0.0210	0.0211	----	----
beryllium, dissolved	7440-41-7	E421	0.000020	mg/L		<0.000020	<0.000020	<0.000020	----	----
bismuth, dissolved	7440-69-9	E421	0.000050	mg/L		<0.000050	<0.000050	<0.000050	----	----
boron, dissolved	7440-42-8	E421	0.010	mg/L		0.037	0.025	0.025	----	----
cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L		0.0000138	0.0000058	0.0000105	----	----
calcium, dissolved	7440-70-2	E421	0.050	mg/L		15.8	16.0	15.9	----	----
cesium, dissolved	7440-46-2	E421	0.000010	mg/L		<0.000010	<0.000010	<0.000010	----	----
chromium, dissolved	7440-47-3	E421	0.00050	mg/L		<0.00050	<0.00050	<0.00050	----	----
cobalt, dissolved	7440-48-4	E421	0.00010	mg/L		<0.00010	<0.00010	<0.00010	----	----
copper, dissolved	7440-50-8	E421	0.00020	mg/L		0.00067	0.00079	0.00075	----	----
iron, dissolved	7439-89-6	E421	0.010	mg/L		<0.010	<0.010	<0.010	----	----
lead, dissolved	7439-92-1	E421	0.000050	mg/L		<0.000050	<0.000050	<0.000050	----	----
lithium, dissolved	7439-93-2	E421	0.0010	mg/L		0.0013	0.0013	0.0013	----	----
magnesium, dissolved	7439-95-4	E421	0.0050	mg/L		2.76	2.65	2.64	----	----
manganese, dissolved	7439-96-5	E421	0.00010	mg/L		0.00973	0.00054	0.00029	----	----
mercury, dissolved	7439-97-6	E509	0.0000050	mg/L		0.0000080 RRV	<0.0000050	<0.0000050	----	----
molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L		0.000851	0.000987	0.000898	----	----

Analytical Results

Sub-Matrix: **Water**
(Matrix: **Water**)

Analyte	CAS Number	Method	LOR	Unit	Client sample ID	Columbia River + Rock-DA Termination (A)	Columbia River + Rock-TR Termination (A)	Columbia River + Rock-TR Termination (A) - Duplicate	----	----
					Client sampling date / time	24-Sep-2022 11:30	24-Sep-2022 12:00	24-Sep-2022 12:10	----	----
						CG2213108-001	CG2213108-002	CG2213108-003	--------	--------
						Result	Result	Result	----	----
Dissolved Metals										
nickel, dissolved	7440-02-0	E421	0.00050	mg/L		<0.00050	0.00054	0.00060	----	----
phosphorus, dissolved	7723-14-0	E421	0.050	mg/L		<0.050	<0.050	<0.050	----	----
potassium, dissolved	7440-09-7	E421	0.050	mg/L		0.750	0.996	1.00	----	----
rubidium, dissolved	7440-17-7	E421	0.00020	mg/L		0.00091	0.00119	0.00137	----	----
selenium, dissolved	7782-49-2	E421	0.000050	mg/L		0.000120	0.000084	0.000098	----	----
silicon, dissolved	7440-21-3	E421	0.050	mg/L		1.53	1.46	1.45	----	----
silver, dissolved	7440-22-4	E421	0.000010	mg/L		<0.000010	<0.000010	<0.000010	----	----
sodium, dissolved	7440-23-5	E421	0.050	mg/L		0.923	1.21	1.15	----	----
strontium, dissolved	7440-24-6	E421	0.00020	mg/L		0.101	0.0991	0.0979	----	----
sulfur, dissolved	7704-34-9	E421	0.50	mg/L		3.04	3.16	3.20	----	----
tellurium, dissolved	13494-80-9	E421	0.00020	mg/L		<0.00020	<0.00020	<0.00020	----	----
thallium, dissolved	7440-28-0	E421	0.000010	mg/L		<0.000010	<0.000010	<0.000010	----	----
thorium, dissolved	7440-29-1	E421	0.00010	mg/L		<0.00010	<0.00010	<0.00010	----	----
tin, dissolved	7440-31-5	E421	0.00010	mg/L		0.00042	0.00872	0.00885	----	----
titanium, dissolved	7440-32-6	E421	0.00030	mg/L		<0.00030	<0.00030	<0.00030	----	----
tungsten, dissolved	7440-33-7	E421	0.00010	mg/L		<0.00010	<0.00010	<0.00010	----	----
uranium, dissolved	7440-61-1	E421	0.000010	mg/L		0.000780	0.000785	0.000774	----	----
vanadium, dissolved	7440-62-2	E421	0.00050	mg/L		<0.00050	<0.00050	<0.00050	----	----
zinc, dissolved	7440-66-6	E421	0.0010	mg/L		0.0058	0.0047	0.0041	----	----
zirconium, dissolved	7440-67-7	E421	0.00020	mg/L		<0.00020	<0.00020	<0.00020	----	----
dissolved mercury filtration location	----	EP509	-	-		Field	Field	Field	----	----
dissolved metals filtration location	----	EP421	-	-		Field	Field	Field	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **CG2213108**	Page	: 1 of 13
Amendment	: 3		
Client	: **Golder Associates Ltd.**	Laboratory	: Calgary - Environmental
Contact	: Elaine Irving	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary, Alberta Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: WO# 20449674/9000	Date Samples Received	: 23-Sep-2022 13:00
PO	: WO#20449674/9000	Issue Date	: 12-Oct-2022 17:11
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) Columbia River + Rock-DA Termination (A)	E298	24-Sep-2022	24-Sep-2022	----	----		24-Sep-2022	28 days	1 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) Columbia River + Rock-TR Termination (A)	E298	24-Sep-2022	24-Sep-2022	----	----		24-Sep-2022	28 days	1 days	✓
Anions and Nutrients : Ammonia by Fluorescence										
Amber glass total (sulfuric acid) Columbia River + Rock-TR Termination (A) - Duplicate	E298	24-Sep-2022	24-Sep-2022	----	----		24-Sep-2022	28 days	1 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE Columbia River + Rock-DA Termination (A)	E235.Cl	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE Columbia River + Rock-TR Termination (A)	E235.Cl	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE Columbia River + Rock-TR Termination (A) - Duplicate	E235.Cl	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE Columbia River + Rock-DA Termination (A)	E235.F	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Fluoride in Water by IC										
HDPE Columbia River + Rock-TR Termination (A)	E235.F	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE Columbia River + Rock-TR Termination (A) - Duplicate	E235.F	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Nitrate in Water by IC										
HDPE Columbia River + Rock-DA Termination (A)	E235.NO3	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	3 days	2 days	✓
Anions and Nutrients : Nitrate in Water by IC										
HDPE Columbia River + Rock-TR Termination (A)	E235.NO3	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	3 days	2 days	✓
Anions and Nutrients : Nitrate in Water by IC										
HDPE Columbia River + Rock-TR Termination (A) - Duplicate	E235.NO3	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	3 days	2 days	✓
Anions and Nutrients : Nitrite in Water by IC										
HDPE Columbia River + Rock-DA Termination (A)	E235.NO2	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	3 days	2 days	✓
Anions and Nutrients : Nitrite in Water by IC										
HDPE Columbia River + Rock-TR Termination (A)	E235.NO2	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	3 days	2 days	✓
Anions and Nutrients : Nitrite in Water by IC										
HDPE Columbia River + Rock-TR Termination (A) - Duplicate	E235.NO2	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	3 days	2 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE Columbia River + Rock-DA Termination (A)	E235.SO4	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Sulfate in Water by IC										
HDPE										
Columbia River + Rock-TR Termination (A)	E235.SO4	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE										
Columbia River + Rock-TR Termination (A) - Duplicate	E235.SO4	24-Sep-2022	25-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid)										
Columbia River + Rock-DA Termination (A)	E509	24-Sep-2022	28-Sep-2022	----	----		28-Sep-2022	28 days	5 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid)										
Columbia River + Rock-TR Termination (A)	E509	24-Sep-2022	28-Sep-2022	----	----		28-Sep-2022	28 days	5 days	✓
Dissolved Metals : Dissolved Mercury in Water by CVAAS										
Glass vial dissolved (hydrochloric acid)										
Columbia River + Rock-TR Termination (A) - Duplicate	E509	24-Sep-2022	28-Sep-2022	----	----		28-Sep-2022	28 days	5 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid)										
Columbia River + Rock-DA Termination (A)	E421	24-Sep-2022	28-Sep-2022	----	----		28-Sep-2022	180 days	5 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid)										
Columbia River + Rock-TR Termination (A)	E421	24-Sep-2022	28-Sep-2022	----	----		28-Sep-2022	180 days	5 days	✓
Dissolved Metals : Dissolved Metals in Water by CRC ICPMS										
HDPE dissolved (nitric acid)										
Columbia River + Rock-TR Termination (A) - Duplicate	E421	24-Sep-2022	28-Sep-2022	----	----		28-Sep-2022	180 days	5 days	✓
Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)										
Amber glass dissolved (sulfuric acid)										
Columbia River + Rock-DA Termination (A)	E358-L	24-Sep-2022	24-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)										
Amber glass dissolved (sulfuric acid)										
Columbia River + Rock-TR Termination (A)	E358-L	24-Sep-2022	24-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓
Organic / Inorganic Carbon : Dissolved Organic Carbon by Combustion (Low Level)										
Amber glass dissolved (sulfuric acid)										
Columbia River + Rock-TR Termination (A) - Duplicate	E358-L	24-Sep-2022	24-Sep-2022	----	----		25-Sep-2022	28 days	2 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE										
Columbia River + Rock-DA Termination (A)	E290	24-Sep-2022	26-Sep-2022	----	----		26-Sep-2022	14 days	3 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE										
Columbia River + Rock-TR Termination (A)	E290	24-Sep-2022	26-Sep-2022	----	----		26-Sep-2022	14 days	3 days	✓
Physical Tests : Alkalinity Species by Titration										
HDPE										
Columbia River + Rock-TR Termination (A) - Duplicate	E290	24-Sep-2022	26-Sep-2022	----	----		26-Sep-2022	14 days	3 days	✓
Physical Tests : Conductivity in Water										
HDPE										
Columbia River + Rock-DA Termination (A)	E100	24-Sep-2022	26-Sep-2022	----	----		26-Sep-2022	28 days	3 days	✓
Physical Tests : Conductivity in Water										
HDPE										
Columbia River + Rock-TR Termination (A)	E100	24-Sep-2022	26-Sep-2022	----	----		26-Sep-2022	28 days	3 days	✓
Physical Tests : Conductivity in Water										
HDPE										
Columbia River + Rock-TR Termination (A) - Duplicate	E100	24-Sep-2022	26-Sep-2022	----	----		26-Sep-2022	28 days	3 days	✓
Physical Tests : pH by Meter										
HDPE										
Columbia River + Rock-DA Termination (A)	E108	24-Sep-2022	26-Sep-2022	----	----		26-Sep-2022	0.25 hrs	0.25 hrs	× EHTL

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : pH by Meter										
HDPE										
Columbia River + Rock-TR Termination (A)	E108	24-Sep-2022	26-Sep-2022	----	----		26-Sep-2022	0.25 hrs	0.25 hrs	× EHTL
Physical Tests : pH by Meter										
HDPE										
Columbia River + Rock-TR Termination (A) - Duplicate	E108	24-Sep-2022	26-Sep-2022	----	----		26-Sep-2022	0.25 hrs	0.25 hrs	× EHTL
Physical Tests : TSS by Gravimetry (Low Level)										
HDPE										
Columbia River + Rock-DA Termination (A)	E160-L	24-Sep-2022	----	----	----		27-Sep-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry (Low Level)										
HDPE										
Columbia River + Rock-TR Termination (A)	E160-L	24-Sep-2022	----	----	----		27-Sep-2022	7 days	3 days	✓
Physical Tests : TSS by Gravimetry (Low Level)										
HDPE										
Columbia River + Rock-TR Termination (A) - Duplicate	E160-L	24-Sep-2022	----	----	----		27-Sep-2022	7 days	3 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid)										
Columbia River + Rock-DA Termination (A)	E508	24-Sep-2022	29-Sep-2022	----	----		29-Sep-2022	28 days	6 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid)										
Columbia River + Rock-TR Termination (A)	E508	24-Sep-2022	29-Sep-2022	----	----		29-Sep-2022	28 days	6 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid)										
Columbia River + Rock-TR Termination (A) - Duplicate	E508	24-Sep-2022	29-Sep-2022	----	----		29-Sep-2022	28 days	6 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
Columbia River + Rock-DA Termination (A)	E420	24-Sep-2022	28-Sep-2022	----	----		28-Sep-2022	180 days	5 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
Columbia River + Rock-TR Termination (A)	E420	24-Sep-2022	28-Sep-2022	----	----		28-Sep-2022	180 days	5 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
Columbia River + Rock-TR Termination (A) - Duplicate	E420	24-Sep-2022	28-Sep-2022	----	----		28-Sep-2022	180 days	5 days	✓

Legend & Qualifier Definitions

EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Alkalinity Species by Titration	E290	665936	1	18	5.5	5.0	✓
Ammonia by Fluorescence	E298	664405	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	664761	1	17	5.8	5.0	✓
Conductivity in Water	E100	665934	1	18	5.5	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	669574	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	668781	1	8	12.5	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	664517	1	20	5.0	5.0	✓
Fluoride in Water by IC	E235.F	664758	1	20	5.0	5.0	✓
Nitrate in Water by IC	E235.NO3	664759	1	17	5.8	5.0	✓
Nitrite in Water by IC	E235.NO2	664762	1	17	5.8	5.0	✓
pH by Meter	E108	665935	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	664760	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	669568	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	668923	1	14	7.1	5.0	✓
Laboratory Control Samples (LCS)							
Alkalinity Species by Titration	E290	665936	1	18	5.5	5.0	✓
Ammonia by Fluorescence	E298	664405	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	664761	1	17	5.8	5.0	✓
Conductivity in Water	E100	665934	1	18	5.5	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	669574	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	668781	1	8	12.5	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	664517	1	20	5.0	5.0	✓
Fluoride in Water by IC	E235.F	664758	1	20	5.0	5.0	✓
Nitrate in Water by IC	E235.NO3	664759	1	17	5.8	5.0	✓
Nitrite in Water by IC	E235.NO2	664762	1	17	5.8	5.0	✓
pH by Meter	E108	665935	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	664760	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	669568	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	668923	1	14	7.1	5.0	✓
TSS by Gravimetry (Low Level)	E160-L	665122	1	20	5.0	5.0	✓
Method Blanks (MB)							
Alkalinity Species by Titration	E290	665936	1	18	5.5	5.0	✓
Ammonia by Fluorescence	E298	664405	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	664761	1	17	5.8	5.0	✓
Conductivity in Water	E100	665934	1	18	5.5	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	669574	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	668781	1	8	12.5	5.0	✓

Matrix: **Water**

Evaluation: × = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Method Blanks (MB) - Continued							
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	664517	1	20	5.0	5.0	✓
Fluoride in Water by IC	E235.F	664758	1	20	5.0	5.0	✓
Nitrate in Water by IC	E235.NO3	664759	1	17	5.8	5.0	✓
Nitrite in Water by IC	E235.NO2	664762	1	17	5.8	5.0	✓
Sulfate in Water by IC	E235.SO4	664760	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	669568	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	668923	1	14	7.1	5.0	✓
TSS by Gravimetry (Low Level)	E160-L	665122	1	20	5.0	5.0	✓
Matrix Spikes (MS)							
Ammonia by Fluorescence	E298	664405	1	18	5.5	5.0	✓
Chloride in Water by IC	E235.Cl	664761	1	17	5.8	5.0	✓
Dissolved Mercury in Water by CVAAS	E509	669574	1	20	5.0	5.0	✓
Dissolved Metals in Water by CRC ICPMS	E421	668781	1	8	12.5	5.0	✓
Dissolved Organic Carbon by Combustion (Low Level)	E358-L	664517	1	20	5.0	5.0	✓
Fluoride in Water by IC	E235.F	664758	1	20	5.0	5.0	✓
Nitrate in Water by IC	E235.NO3	664759	1	17	5.8	5.0	✓
Nitrite in Water by IC	E235.NO2	664762	1	17	5.8	5.0	✓
Sulfate in Water by IC	E235.SO4	664760	1	20	5.0	5.0	✓
Total Mercury in Water by CVAAS	E508	669568	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	668923	1	14	7.1	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Water	E100 Calgary - Environmental	Water	APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a water sample. Conductivity measurements are temperature-compensated to 25°C.
pH by Meter	E108 Calgary - Environmental	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
TSS by Gravimetry (Low Level)	E160-L Calgary - Environmental	Water	APHA 2540 D (mod)	Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, following by drying of the filter at 104 ± 1°C, with gravimetric measurement of the filtered solids. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.
Chloride in Water by IC	E235.Cl Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Fluoride in Water by IC	E235.F Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrite in Water by IC	E235.NO2 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Nitrate in Water by IC	E235.NO3 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 Calgary - Environmental	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Alkalinity Species by Titration	E290 Calgary - Environmental	Water	APHA 2320 B (mod)	Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.
Ammonia by Fluorescence	E298 Calgary - Environmental	Water	Method Fialab 100, 2018	Ammonia in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021)
Dissolved Organic Carbon by Combustion (Low Level)	E358-L Calgary - Environmental	Water	APHA 5310 B (mod)	Dissolved Organic Carbon (Non-Purgeable), also known as NPOC (dissolved), is a direct measurement of DOC after a filtered (0.45 micron) sample has been acidified and purged to remove inorganic carbon (IC). Analysis is by high temperature combustion with infrared detection of CO2. NPOC does not include volatile organic species that are purged off with IC. For samples where the majority of DC (dissolved carbon) is comprised of IC (which is common), this method is more accurate and more reliable than the DOC by subtraction method (i.e. DC minus DIC).

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Total metals in Water by CRC ICPMS	E420 Calgary - Environmental	Water	EPA 200.2/6020B (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Dissolved Metals in Water by CRC ICPMS	E421 Calgary - Environmental	Water	APHA 3030B/EPA 6020B (mod)	Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Total Mercury in Water by CVAAS	E508 Calgary - Environmental	Water	EPA 1631E (mod)	Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS
Dissolved Mercury in Water by CVAAS	E509 Calgary - Environmental	Water	APHA 3030B/EPA 1631E (mod)	Water samples are filtered (0.45 um), preserved with HCl, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.
Dissolved Hardness (Calculated)	EC100 Calgary - Environmental	Water	APHA 2340B	“Hardness (as CaCO3), dissolved” is calculated from the sum of dissolved Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. “Total Hardness” refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations.
Hardness (Calculated) from Total Ca/Mg	EC100A Calgary - Environmental	Water	APHA 2340B	“Hardness (as CaCO3), from total Ca/Mg” is calculated from the sum of total Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. “Total Hardness” refers to the sum of Calcium and Magnesium Hardness. Hardness is normally or preferentially calculated from dissolved Calcium and Magnesium concentrations, because it is a property of water due to dissolved divalent cations. Hardness from total Ca/Mg is normally comparable to Dissolved Hardness in non-turbid waters.
Ion Balance using Dissolved Metals	EC101 Calgary - Environmental	Water	APHA 1030E	Cation Sum, Anion Sum, and Ion Balance are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present. Ion Balance cannot be calculated accurately for waters with very low electrical conductivity (EC).
TDS in Water (Calculation)	EC103 Calgary - Environmental	Water	APHA 1030E (mod)	Total Dissolved Solids is calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Dissolved species are used where available. Minor ions are included where data is present.
Nitrate and Nitrite (as N) (Calculation)	EC235.N+N Calgary - Environmental	Water	EPA 300.0	Nitrate and Nitrite (as N) is a calculated parameter. Nitrate and Nitrite (as N) = Nitrite (as N) + Nitrate (as N).

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Ammonia	EP298 Calgary - Environmental	Water		Sample preparation for Preserved Nutrients Water Quality Analysis.
Preparation for Dissolved Organic Carbon for Combustion	EP358 Calgary - Environmental	Water	APHA 5310 B (mod)	Preparation for Dissolved Organic Carbon

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Dissolved Metals Water Filtration	EP421 Calgary - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HNO3.
Dissolved Mercury Water Filtration	EP509 Calgary - Environmental	Water	APHA 3030B	Water samples are filtered (0.45 um), and preserved with HCl.

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **CG2213108**	Page	: 1 of 18
Amendment	: **3**		
Client	: Golder Associates Ltd.	Laboratory	: Calgary - Environmental
Contact	: Elaine Irving	Account Manager	: Patryk Wojciak
Address	: 2800, 700 - 2nd Street SW Calgary AB Canada T2P 2W2	Address	: 2559 29th Street NE Calgary, Alberta Canada T1Y 7B5
Telephone	: ----	Telephone	: +1 403 407 1800
Project	: WO# 20449674/9000	Date Samples Received	: 23-Sep-2022 13:00
PO	: WO#20449674/9000	Date Analysis Commenced	: 24-Sep-2022
C-O-C number	: ----	Issue Date	: 12-Oct-2022 17:11
Sampler	: ----		
Site	: ----		
Quote number	: CG22-GOLD100-0012 BC Hydro		
No. of samples received	: 3		
No. of samples analysed	: 3		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Anthony Calero	Supervisor - Inorganic	Calgary Metals, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Calgary Inorganics, Calgary, Alberta
Dwayne Bennett	Technical Specialist	Calgary Metals, Calgary, Alberta
Elke Tabora		Calgary Inorganics, Calgary, Alberta
Harpreet Chawla	Team Leader - Inorganics	Calgary Inorganics, Calgary, Alberta
Mackenzie Lamoureux	Laboratory Analyst	Calgary Metals, Calgary, Alberta
Sara Niroomand		Calgary Inorganics, Calgary, Alberta
Vladka Stamenova	Analyst	Calgary Inorganics, Calgary, Alberta
Zakieh Lalonde		Calgary Metals, Calgary, Alberta

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include 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 predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 665934)											
CG2213036-002	Anonymous	conductivity	----	E100	2.0	µS/cm	262	257	1.93%	10%	----
Physical Tests (QC Lot: 665935)											
CG2213036-002	Anonymous	pH	----	E108	0.10	pH units	8.18	8.24	0.731%	4%	----
Physical Tests (QC Lot: 665936)											
CG2213036-002	Anonymous	alkalinity, total (as CaCO3)	----	E290	1.0	mg/L	127	129	1.48%	20%	----
Anions and Nutrients (QC Lot: 664405)											
CG2213099-001	Anonymous	ammonia, total (as N)	7664-41-7	E298	0.0050	mg/L	0.457	0.458	0.218%	20%	----
Anions and Nutrients (QC Lot: 664758)											
CG2213108-001	Columbia River + Rock-DA Termination (A)	fluoride	16984-48-8	E235.F	0.020	mg/L	0.070	0.070	0.0005	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 664759)											
CG2213108-001	Columbia River + Rock-DA Termination (A)	nitrate (as N)	14797-55-8	E235.NO3	0.020	mg/L	0.173	0.173	0.0005	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 664760)											
CG2213108-001	Columbia River + Rock-DA Termination (A)	sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	8.68	8.87	2.19%	20%	----
Anions and Nutrients (QC Lot: 664761)											
CG2213108-001	Columbia River + Rock-DA Termination (A)	chloride	16887-00-6	E235.Cl	0.50	mg/L	0.54	0.56	0.02	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 664762)											
CG2213108-001	Columbia River + Rock-DA Termination (A)	nitrite (as N)	14797-65-0	E235.NO2	0.010	mg/L	0.019	0.020	0.0003	Diff <2x LOR	----
Organic / Inorganic Carbon (QC Lot: 664517)											
CG2213108-001	Columbia River + Rock-DA Termination (A)	carbon, dissolved organic [DOC]	----	E358-L	0.50	mg/L	2.38	2.11	0.28	Diff <2x LOR	----
Total Metals (QC Lot: 668923)											
CG2213108-001	Columbia River + Rock-DA Termination (A)	aluminum, total	7429-90-5	E420	0.0030	mg/L	0.0257	0.0264	0.0006	Diff <2x LOR	----
		antimony, total	7440-36-0	E420	0.00010	mg/L	0.00050	0.00051	0.000010	Diff <2x LOR	----
		arsenic, total	7440-38-2	E420	0.00010	mg/L	0.00029	0.00018	0.00011	Diff <2x LOR	----
		barium, total	7440-39-3	E420	0.00010	mg/L	0.0189	0.0184	2.29%	20%	----
		beryllium, total	7440-41-7	E420	0.000100	mg/L	<0.000100	<0.000100	0	Diff <2x LOR	----
		bismuth, total	7440-69-9	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		boron, total	7440-42-8	E420	0.010	mg/L	0.038	0.038	0.0003	Diff <2x LOR	----
		cadmium, total	7440-43-9	E420	0.0000050	mg/L	0.0000154	0.0000138	0.0000016	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Total Metals (QC Lot: 668923) - continued											
CG2213108-001	Columbia River + Rock-DA Termination (A)	calcium, total	7440-70-2	E420	0.050	mg/L	15.1	15.1	0.196%	20%	----
		cesium, total	7440-46-2	E420	0.000010	mg/L	0.000011	0.000011	0.0000007	Diff <2x LOR	----
		chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		cobalt, total	7440-48-4	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		copper, total	7440-50-8	E420	0.00050	mg/L	0.00083	0.00072	0.00011	Diff <2x LOR	----
		iron, total	7439-89-6	E420	0.010	mg/L	0.028	0.027	0.0009	Diff <2x LOR	----
		lead, total	7439-92-1	E420	0.000050	mg/L	0.000051	0.000050	0.000001	Diff <2x LOR	----
		lithium, total	7439-93-2	E420	0.0010	mg/L	0.0014	0.0014	0.00005	Diff <2x LOR	----
		magnesium, total	7439-95-4	E420	0.0050	mg/L	3.02	2.88	4.95%	20%	----
		manganese, total	7439-96-5	E420	0.00010	mg/L	0.0128	0.0118	7.78%	20%	----
		molybdenum, total	7439-98-7	E420	0.000050	mg/L	0.000932	0.000907	2.71%	20%	----
		nickel, total	7440-02-0	E420	0.00050	mg/L	0.00056	<0.00050	0.00006	Diff <2x LOR	----
		phosphorus, total	7723-14-0	E420	0.050	mg/L	<0.050	<0.050	0	Diff <2x LOR	----
		potassium, total	7440-09-7	E420	0.050	mg/L	0.703	0.702	0.185%	20%	----
		rubidium, total	7440-17-7	E420	0.00020	mg/L	0.00101	0.00136	0.00035	Diff <2x LOR	----
		selenium, total	7782-49-2	E420	0.000050	mg/L	0.000128	0.000109	0.000018	Diff <2x LOR	----
		silicon, total	7440-21-3	E420	0.10	mg/L	1.67	1.65	1.14%	20%	----
		silver, total	7440-22-4	E420	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		sodium, total	7440-23-5	E420	0.050	mg/L	0.866	0.800	7.97%	20%	----
		strontium, total	7440-24-6	E420	0.00020	mg/L	0.0977	0.0976	0.0944%	20%	----
		sulfur, total	7704-34-9	E420	0.50	mg/L	3.48	3.45	0.03	Diff <2x LOR	----
		tellurium, total	13494-80-9	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		thallium, total	7440-28-0	E420	0.000010	mg/L	0.000011	<0.000010	0.0000008	Diff <2x LOR	----
		thorium, total	7440-29-1	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		tin, total	7440-31-5	E420	0.00010	mg/L	0.00046	0.00046	0.0000010	Diff <2x LOR	----
		titanium, total	7440-32-6	E420	0.00030	mg/L	0.00127	0.00107	0.00020	Diff <2x LOR	----
		tungsten, total	7440-33-7	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		uranium, total	7440-61-1	E420	0.000010	mg/L	0.000788	0.000795	0.912%	20%	----
		vanadium, total	7440-62-2	E420	0.00050	mg/L	0.00059	<0.00050	0.00009	Diff <2x LOR	----
		zinc, total	7440-66-6	E420	0.0030	mg/L	0.0057	0.0059	0.0003	Diff <2x LOR	----
		zirconium, total	7440-67-7	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
Total Metals (QC Lot: 669568)											
CG2213099-003	Anonymous	mercury, total	7439-97-6	E508	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
Dissolved Metals (QC Lot: 668781)											
CG2213106-001	Anonymous	aluminum, dissolved	7429-90-5	E421	0.0010	mg/L	0.0015	0.0017	0.0002	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Dissolved Metals (QC Lot: 668781) - continued											
CG2213106-001	Anonymous	antimony, dissolved	7440-36-0	E421	0.00010	mg/L	0.00016	0.00016	0.000007	Diff <2x LOR	----
		arsenic, dissolved	7440-38-2	E421	0.00010	mg/L	0.00030	0.00031	0.000006	Diff <2x LOR	----
		barium, dissolved	7440-39-3	E421	0.00010	mg/L	0.0940	0.0910	3.26%	20%	----
		beryllium, dissolved	7440-41-7	E421	0.000020	mg/L	<0.020 µg/L	<0.000020	0	Diff <2x LOR	----
		bismuth, dissolved	7440-69-9	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		boron, dissolved	7440-42-8	E421	0.010	mg/L	0.016	0.015	0.0001	Diff <2x LOR	----
		cadmium, dissolved	7440-43-9	E421	0.0000050	mg/L	0.204 µg/L	0.000183	10.9%	20%	----
		calcium, dissolved	7440-70-2	E421	0.050	mg/L	89.9	89.1	0.807%	20%	----
		cesium, dissolved	7440-46-2	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		chromium, dissolved	7440-47-3	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		cobalt, dissolved	7440-48-4	E421	0.00010	mg/L	0.37 µg/L	0.00034	0.00003	Diff <2x LOR	----
		copper, dissolved	7440-50-8	E421	0.00020	mg/L	0.00033	0.00034	0.00001	Diff <2x LOR	----
		iron, dissolved	7439-89-6	E421	0.010	mg/L	<0.010	<0.010	0	Diff <2x LOR	----
		lead, dissolved	7439-92-1	E421	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		lithium, dissolved	7439-93-2	E421	0.0010	mg/L	0.0164	0.0162	1.48%	20%	----
		magnesium, dissolved	7439-95-4	E421	0.0050	mg/L	34.8	33.8	2.60%	20%	----
		manganese, dissolved	7439-96-5	E421	0.00010	mg/L	0.00600	0.00585	2.57%	20%	----
		molybdenum, dissolved	7439-98-7	E421	0.000050	mg/L	0.000605	0.000618	2.28%	20%	----
		nickel, dissolved	7440-02-0	E421	0.00050	mg/L	0.00443	0.00434	0.00008	Diff <2x LOR	----
		phosphorus, dissolved	7723-14-0	E421	0.050	mg/L	0.053	0.111	0.058	Diff <2x LOR	----
		potassium, dissolved	7440-09-7	E421	0.050	mg/L	1.88	1.86	1.12%	20%	----
		rubidium, dissolved	7440-17-7	E421	0.00020	mg/L	0.00122	0.00118	0.00004	Diff <2x LOR	----
		selenium, dissolved	7782-49-2	E421	0.000050	mg/L	3.02 µg/L	0.00293	2.98%	20%	----
		silicon, dissolved	7440-21-3	E421	0.050	mg/L	3.68	3.61	2.13%	20%	----
		silver, dissolved	7440-22-4	E421	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		sodium, dissolved	7440-23-5	E421	0.050	mg/L	5.20	5.05	2.89%	20%	----
		strontium, dissolved	7440-24-6	E421	0.00020	mg/L	0.194	0.193	0.330%	20%	----
		sulfur, dissolved	7704-34-9	E421	0.50	mg/L	68.2	67.5	0.952%	20%	----
		tellurium, dissolved	13494-80-9	E421	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
		thallium, dissolved	7440-28-0	E421	0.000010	mg/L	0.000016	0.000017	0.0000009	Diff <2x LOR	----
		thorium, dissolved	7440-29-1	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		tin, dissolved	7440-31-5	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		titanium, dissolved	7440-32-6	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
		tungsten, dissolved	7440-33-7	E421	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		uranium, dissolved	7440-61-1	E421	0.000010	mg/L	0.000633	0.000642	1.38%	20%	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Dissolved Metals (QC Lot: 668781) - continued											
CG2213106-001	Anonymous	vanadium, dissolved	7440-62-2	E421	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		zinc, dissolved	7440-66-6	E421	0.0010	mg/L	0.0057	0.0062	0.0005	Diff <2x LOR	----
		zirconium, dissolved	7440-67-7	E421	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
Dissolved Metals (QC Lot: 669574)											
CG2213099-002	Anonymous	mercury, dissolved	7439-97-6	E509	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 665122)						
solids, total suspended [TSS]	----	E160-L	1	mg/L	<1.0	----
Physical Tests (QCLot: 665934)						
conductivity	----	E100	1	µS/cm	1.0	----
Physical Tests (QCLot: 665936)						
alkalinity, total (as CaCO3)	----	E290	1	mg/L	<1.0	----
Anions and Nutrients (QCLot: 664405)						
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	<0.0050	----
Anions and Nutrients (QCLot: 664758)						
fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 664759)						
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 664760)						
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Anions and Nutrients (QCLot: 664761)						
chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 664762)						
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	<0.010	----
Organic / Inorganic Carbon (QCLot: 664517)						
carbon, dissolved organic [DOC]	----	E358-L	0.5	mg/L	<0.50	----
Total Metals (QCLot: 668923)						
aluminum, total	7429-90-5	E420	0.003	mg/L	<0.0030	----
antimony, total	7440-36-0	E420	0.0001	mg/L	<0.00010	----
arsenic, total	7440-38-2	E420	0.0001	mg/L	<0.00010	----
barium, total	7440-39-3	E420	0.0001	mg/L	<0.00010	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	<0.000020	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	<0.000050	----
boron, total	7440-42-8	E420	0.01	mg/L	<0.010	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	<0.0000050	----
calcium, total	7440-70-2	E420	0.05	mg/L	<0.050	----
cesium, total	7440-46-2	E420	0.00001	mg/L	<0.000010	----
chromium, total	7440-47-3	E420	0.0005	mg/L	<0.00050	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	<0.00010	----
copper, total	7440-50-8	E420	0.0005	mg/L	<0.00050	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 668923) - continued						
iron, total	7439-89-6	E420	0.01	mg/L	<0.010	----
lead, total	7439-92-1	E420	0.00005	mg/L	<0.000050	----
lithium, total	7439-93-2	E420	0.001	mg/L	<0.0010	----
magnesium, total	7439-95-4	E420	0.005	mg/L	<0.0050	----
manganese, total	7439-96-5	E420	0.0001	mg/L	<0.00010	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	<0.000050	----
nickel, total	7440-02-0	E420	0.0005	mg/L	<0.00050	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	<0.050	----
potassium, total	7440-09-7	E420	0.05	mg/L	<0.050	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	<0.00020	----
selenium, total	7782-49-2	E420	0.00005	mg/L	<0.000050	----
silicon, total	7440-21-3	E420	0.1	mg/L	<0.10	----
silver, total	7440-22-4	E420	0.00001	mg/L	<0.000010	----
sodium, total	7440-23-5	E420	0.05	mg/L	<0.050	----
strontium, total	7440-24-6	E420	0.0002	mg/L	<0.00020	----
sulfur, total	7704-34-9	E420	0.5	mg/L	<0.50	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	<0.00020	----
thallium, total	7440-28-0	E420	0.00001	mg/L	<0.000010	----
thorium, total	7440-29-1	E420	0.0001	mg/L	<0.00010	----
tin, total	7440-31-5	E420	0.0001	mg/L	<0.00010	----
titanium, total	7440-32-6	E420	0.0003	mg/L	<0.00030	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	<0.00010	----
uranium, total	7440-61-1	E420	0.00001	mg/L	<0.000010	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	<0.00050	----
zinc, total	7440-66-6	E420	0.003	mg/L	<0.0030	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	<0.00020	----
Total Metals (QCLot: 669568)						
mercury, total	7439-97-6	E508	0.000005	mg/L	<0.0000050	----
Dissolved Metals (QCLot: 668781)						
aluminum, dissolved	7429-90-5	E421	0.001	mg/L	<0.0010	----
antimony, dissolved	7440-36-0	E421	0.0001	mg/L	<0.00010	----
arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	<0.00010	----
barium, dissolved	7440-39-3	E421	0.0001	mg/L	<0.00010	----
beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	<0.000020	----
bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	<0.000050	----
boron, dissolved	7440-42-8	E421	0.01	mg/L	<0.010	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Dissolved Metals (QCLot: 668781) - continued						
cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	<0.0000050	----
calcium, dissolved	7440-70-2	E421	0.05	mg/L	<0.050	----
cesium, dissolved	7440-46-2	E421	0.00001	mg/L	<0.000010	----
chromium, dissolved	7440-47-3	E421	0.0005	mg/L	<0.00050	----
cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	<0.00010	----
copper, dissolved	7440-50-8	E421	0.0002	mg/L	<0.00020	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	<0.010	----
lead, dissolved	7439-92-1	E421	0.00005	mg/L	<0.000050	----
lithium, dissolved	7439-93-2	E421	0.001	mg/L	<0.0010	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	<0.0050	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	<0.00010	----
molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	<0.000050	----
nickel, dissolved	7440-02-0	E421	0.0005	mg/L	<0.00050	----
phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	<0.050	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	<0.050	----
rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	<0.00020	----
selenium, dissolved	7782-49-2	E421	0.00005	mg/L	<0.000050	----
silicon, dissolved	7440-21-3	E421	0.05	mg/L	<0.050	----
silver, dissolved	7440-22-4	E421	0.00001	mg/L	<0.000010	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	<0.050	----
strontium, dissolved	7440-24-6	E421	0.0002	mg/L	<0.00020	----
sulfur, dissolved	7704-34-9	E421	0.5	mg/L	<0.50	----
tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	<0.00020	----
thallium, dissolved	7440-28-0	E421	0.00001	mg/L	<0.000010	----
thorium, dissolved	7440-29-1	E421	0.0001	mg/L	<0.00010	----
tin, dissolved	7440-31-5	E421	0.0001	mg/L	<0.00010	----
titanium, dissolved	7440-32-6	E421	0.0003	mg/L	<0.00030	----
tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	<0.00010	----
uranium, dissolved	7440-61-1	E421	0.00001	mg/L	<0.000010	----
vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	<0.00050	----
zinc, dissolved	7440-66-6	E421	0.001	mg/L	<0.0010	----
zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	<0.00020	----
Dissolved Metals (QCLot: 669574)						
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	<0.0000050	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 665122)									
solids, total suspended [TSS]	----	E160-L	1	mg/L	150 mg/L	103	85.0	115	----
Physical Tests (QCLot: 665934)									
conductivity	----	E100	1	µS/cm	146.9 µS/cm	100	90.0	110	----
Physical Tests (QCLot: 665935)									
pH	----	E108	----	pH units	7 pH units	101	98.6	101	----
Physical Tests (QCLot: 665936)									
alkalinity, total (as CaCO3)	----	E290	1	mg/L	500 mg/L	103	85.0	115	----
Anions and Nutrients (QCLot: 664405)									
ammonia, total (as N)	7664-41-7	E298	0.005	mg/L	0.2 mg/L	110	85.0	115	----
Anions and Nutrients (QCLot: 664758)									
fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 664759)									
nitrate (as N)	14797-55-8	E235.NO3	0.02	mg/L	2.5 mg/L	99.8	90.0	110	----
Anions and Nutrients (QCLot: 664760)									
sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 664761)									
chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	99.5	90.0	110	----
Anions and Nutrients (QCLot: 664762)									
nitrite (as N)	14797-65-0	E235.NO2	0.01	mg/L	0.5 mg/L	99.7	90.0	110	----
Organic / Inorganic Carbon (QCLot: 664517)									
carbon, dissolved organic [DOC]	----	E358-L	0.5	mg/L	8.57 mg/L	84.3	80.0	120	----
Total Metals (QCLot: 668923)									
aluminum, total	7429-90-5	E420	0.003	mg/L	2 mg/L	96.8	80.0	120	----
antimony, total	7440-36-0	E420	0.0001	mg/L	1 mg/L	102	80.0	120	----
arsenic, total	7440-38-2	E420	0.0001	mg/L	1 mg/L	96.6	80.0	120	----
barium, total	7440-39-3	E420	0.0001	mg/L	0.25 mg/L	97.8	80.0	120	----
beryllium, total	7440-41-7	E420	0.00002	mg/L	0.1 mg/L	95.5	80.0	120	----
bismuth, total	7440-69-9	E420	0.00005	mg/L	1 mg/L	95.9	80.0	120	----
boron, total	7440-42-8	E420	0.01	mg/L	1 mg/L	97.3	80.0	120	----
cadmium, total	7440-43-9	E420	0.000005	mg/L	0.1 mg/L	92.7	80.0	120	----
calcium, total	7440-70-2	E420	0.05	mg/L	50 mg/L	96.2	80.0	120	----

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Total Metals (QCLot: 668923) - continued									
cesium, total	7440-46-2	E420	0.00001	mg/L	0.05 mg/L	92.2	80.0	120	----
chromium, total	7440-47-3	E420	0.0005	mg/L	0.25 mg/L	96.1	80.0	120	----
cobalt, total	7440-48-4	E420	0.0001	mg/L	0.25 mg/L	95.2	80.0	120	----
copper, total	7440-50-8	E420	0.0005	mg/L	0.25 mg/L	91.3	80.0	120	----
iron, total	7439-89-6	E420	0.01	mg/L	1 mg/L	104	80.0	120	----
lead, total	7439-92-1	E420	0.00005	mg/L	0.5 mg/L	92.9	80.0	120	----
lithium, total	7439-93-2	E420	0.001	mg/L	0.25 mg/L	102	80.0	120	----
magnesium, total	7439-95-4	E420	0.005	mg/L	50 mg/L	94.9	80.0	120	----
manganese, total	7439-96-5	E420	0.0001	mg/L	0.25 mg/L	93.0	80.0	120	----
molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.25 mg/L	100	80.0	120	----
nickel, total	7440-02-0	E420	0.0005	mg/L	0.5 mg/L	93.9	80.0	120	----
phosphorus, total	7723-14-0	E420	0.05	mg/L	10 mg/L	98.7	70.0	130	----
potassium, total	7440-09-7	E420	0.05	mg/L	50 mg/L	93.2	80.0	120	----
rubidium, total	7440-17-7	E420	0.0002	mg/L	0.1 mg/L	98.6	80.0	120	----
selenium, total	7782-49-2	E420	0.00005	mg/L	1 mg/L	87.4	80.0	120	----
silicon, total	7440-21-3	E420	0.1	mg/L	10 mg/L	95.4	60.0	140	----
silver, total	7440-22-4	E420	0.00001	mg/L	0.1 mg/L	92.7	80.0	120	----
sodium, total	7440-23-5	E420	0.05	mg/L	50 mg/L	88.3	80.0	120	----
strontium, total	7440-24-6	E420	0.0002	mg/L	0.25 mg/L	94.0	80.0	120	----
sulfur, total	7704-34-9	E420	0.5	mg/L	50 mg/L	103	80.0	120	----
tellurium, total	13494-80-9	E420	0.0002	mg/L	0.1 mg/L	91.3	80.0	120	----
thallium, total	7440-28-0	E420	0.00001	mg/L	1 mg/L	95.8	80.0	120	----
thorium, total	7440-29-1	E420	0.0001	mg/L	0.1 mg/L	90.6	80.0	120	----
tin, total	7440-31-5	E420	0.0001	mg/L	0.5 mg/L	97.7	80.0	120	----
titanium, total	7440-32-6	E420	0.0003	mg/L	0.25 mg/L	86.8	80.0	120	----
tungsten, total	7440-33-7	E420	0.0001	mg/L	0.1 mg/L	98.5	80.0	120	----
uranium, total	7440-61-1	E420	0.00001	mg/L	0.005 mg/L	92.0	80.0	120	----
vanadium, total	7440-62-2	E420	0.0005	mg/L	0.5 mg/L	95.2	80.0	120	----
zinc, total	7440-66-6	E420	0.003	mg/L	0.5 mg/L	86.8	80.0	120	----
zirconium, total	7440-67-7	E420	0.0002	mg/L	0.1 mg/L	98.3	80.0	120	----
Total Metals (QCLot: 669568)									
mercury, total	7439-97-6	E508	0.000005	mg/L	0.0001 mg/L	103	80.0	120	----
Dissolved Metals (QCLot: 668781)									
aluminum, dissolved	7429-90-5	E421	0.001	mg/L	2 mg/L	99.2	80.0	120	----
antimony, dissolved	7440-36-0	E421	0.0001	mg/L	1 mg/L	106	80.0	120	----
arsenic, dissolved	7440-38-2	E421	0.0001	mg/L	1 mg/L	97.6	80.0	120	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	Qualifier
Dissolved Metals (QCLot: 668781) - continued									
barium, dissolved	7440-39-3	E421	0.0001	mg/L	0.25 mg/L	102	80.0	120	----
beryllium, dissolved	7440-41-7	E421	0.00002	mg/L	0.1 mg/L	98.1	80.0	120	----
bismuth, dissolved	7440-69-9	E421	0.00005	mg/L	1 mg/L	97.8	80.0	120	----
boron, dissolved	7440-42-8	E421	0.01	mg/L	1 mg/L	98.2	80.0	120	----
cadmium, dissolved	7440-43-9	E421	0.000005	mg/L	0.1 mg/L	97.5	80.0	120	----
calcium, dissolved	7440-70-2	E421	0.05	mg/L	50 mg/L	100	80.0	120	----
cesium, dissolved	7440-46-2	E421	0.00001	mg/L	0.05 mg/L	95.9	80.0	120	----
chromium, dissolved	7440-47-3	E421	0.0005	mg/L	0.25 mg/L	96.4	80.0	120	----
cobalt, dissolved	7440-48-4	E421	0.0001	mg/L	0.25 mg/L	98.2	80.0	120	----
copper, dissolved	7440-50-8	E421	0.0002	mg/L	0.25 mg/L	96.8	80.0	120	----
iron, dissolved	7439-89-6	E421	0.01	mg/L	1 mg/L	111	80.0	120	----
lead, dissolved	7439-92-1	E421	0.00005	mg/L	0.5 mg/L	99.0	80.0	120	----
lithium, dissolved	7439-93-2	E421	0.001	mg/L	0.25 mg/L	104	80.0	120	----
magnesium, dissolved	7439-95-4	E421	0.005	mg/L	50 mg/L	92.1	80.0	120	----
manganese, dissolved	7439-96-5	E421	0.0001	mg/L	0.25 mg/L	97.7	80.0	120	----
molybdenum, dissolved	7439-98-7	E421	0.00005	mg/L	0.25 mg/L	103	80.0	120	----
nickel, dissolved	7440-02-0	E421	0.0005	mg/L	0.5 mg/L	95.3	80.0	120	----
phosphorus, dissolved	7723-14-0	E421	0.05	mg/L	10 mg/L	101	70.0	130	----
potassium, dissolved	7440-09-7	E421	0.05	mg/L	50 mg/L	102	80.0	120	----
rubidium, dissolved	7440-17-7	E421	0.0002	mg/L	0.1 mg/L	91.9	80.0	120	----
selenium, dissolved	7782-49-2	E421	0.00005	mg/L	1 mg/L	93.4	80.0	120	----
silicon, dissolved	7440-21-3	E421	0.05	mg/L	10 mg/L	98.0	60.0	140	----
silver, dissolved	7440-22-4	E421	0.00001	mg/L	0.1 mg/L	94.8	80.0	120	----
sodium, dissolved	7440-23-5	E421	0.05	mg/L	50 mg/L	97.1	80.0	120	----
strontium, dissolved	7440-24-6	E421	0.0002	mg/L	0.25 mg/L	96.4	80.0	120	----
sulfur, dissolved	7704-34-9	E421	0.5	mg/L	50 mg/L	99.8	80.0	120	----
tellurium, dissolved	13494-80-9	E421	0.0002	mg/L	0.1 mg/L	84.4	80.0	120	----
thallium, dissolved	7440-28-0	E421	0.00001	mg/L	1 mg/L	97.5	80.0	120	----
thorium, dissolved	7440-29-1	E421	0.0001	mg/L	0.1 mg/L	93.6	80.0	120	----
tin, dissolved	7440-31-5	E421	0.0001	mg/L	0.5 mg/L	100.0	80.0	120	----
titanium, dissolved	7440-32-6	E421	0.0003	mg/L	0.25 mg/L	89.6	80.0	120	----
tungsten, dissolved	7440-33-7	E421	0.0001	mg/L	0.1 mg/L	101	80.0	120	----
uranium, dissolved	7440-61-1	E421	0.00001	mg/L	0.005 mg/L	95.7	80.0	120	----
vanadium, dissolved	7440-62-2	E421	0.0005	mg/L	0.5 mg/L	99.5	80.0	120	----
zinc, dissolved	7440-66-6	E421	0.001	mg/L	0.5 mg/L	92.5	80.0	120	----
zirconium, dissolved	7440-67-7	E421	0.0002	mg/L	0.1 mg/L	102	80.0	120	----
mercury, dissolved	7439-97-6	E509	0.000005	mg/L	0.0001 mg/L	107	80.0	120	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Anions and Nutrients (QCLot: 664405)										
CG2213099-002	Anonymous	ammonia, total (as N)	7664-41-7	E298	0.104 mg/L	0.1 mg/L	104	75.0	125	----
Anions and Nutrients (QCLot: 664758)										
CG2213108-002	Columbia River + Rock-TR Termination (A)	fluoride	16984-48-8	E235.F	1.01 mg/L	1 mg/L	101	75.0	125	----
Anions and Nutrients (QCLot: 664759)										
CG2213108-002	Columbia River + Rock-TR Termination (A)	nitrate (as N)	14797-55-8	E235.NO3	2.48 mg/L	2.5 mg/L	99.3	75.0	125	----
Anions and Nutrients (QCLot: 664760)										
CG2213108-002	Columbia River + Rock-TR Termination (A)	sulfate (as SO4)	14808-79-8	E235.SO4	99.5 mg/L	100 mg/L	99.5	75.0	125	----
Anions and Nutrients (QCLot: 664761)										
CG2213108-002	Columbia River + Rock-TR Termination (A)	chloride	16887-00-6	E235.Cl	99.2 mg/L	100 mg/L	99.2	75.0	125	----
Anions and Nutrients (QCLot: 664762)										
CG2213108-002	Columbia River + Rock-TR Termination (A)	nitrite (as N)	14797-65-0	E235.NO2	0.506 mg/L	0.5 mg/L	101	75.0	125	----
Organic / Inorganic Carbon (QCLot: 664517)										
CG2213108-001	Columbia River + Rock-DA Termination (A)	carbon, dissolved organic [DOC]	----	E358-L	4.16 mg/L	5 mg/L	83.3	70.0	130	----
Total Metals (QCLot: 668923)										
CG2213108-002	Columbia River + Rock-TR Termination (A)	aluminum, total	7429-90-5	E420	1.88 mg/L	2 mg/L	93.8	70.0	130	----
		antimony, total	7440-36-0	E420	0.198 mg/L	0.2 mg/L	99.0	70.0	130	----
		arsenic, total	7440-38-2	E420	0.193 mg/L	0.2 mg/L	96.3	70.0	130	----
		barium, total	7440-39-3	E420	0.191 mg/L	0.2 mg/L	95.6	70.0	130	----
		beryllium, total	7440-41-7	E420	0.389 mg/L	0.4 mg/L	97.2	70.0	130	----
		bismuth, total	7440-69-9	E420	0.0907 mg/L	0.1 mg/L	90.7	70.0	130	----
		boron, total	7440-42-8	E420	1.02 mg/L	1 mg/L	102	70.0	130	----
		cadmium, total	7440-43-9	E420	0.0365 mg/L	0.04 mg/L	91.2	70.0	130	----
		calcium, total	7440-70-2	E420	37.3 mg/L	40 mg/L	93.3	70.0	130	----
		cesium, total	7440-46-2	E420	0.0906 mg/L	0.1 mg/L	90.6	70.0	130	----
		chromium, total	7440-47-3	E420	0.393 mg/L	0.4 mg/L	98.3	70.0	130	----
		cobalt, total	7440-48-4	E420	0.193 mg/L	0.2 mg/L	96.6	70.0	130	----
		copper, total	7440-50-8	E420	0.186 mg/L	0.2 mg/L	93.1	70.0	130	----
		iron, total	7439-89-6	E420	18.8 mg/L	20 mg/L	93.8	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Total Metals (QCLot: 668923) - continued										
CG2213108-002	Columbia River + Rock-TR Termination (A)	lead, total	7439-92-1	E420	0.186 mg/L	0.2 mg/L	92.8	70.0	130	----
		lithium, total	7439-93-2	E420	0.938 mg/L	1 mg/L	93.8	70.0	130	----
		magnesium, total	7439-95-4	E420	9.61 mg/L	10 mg/L	96.1	70.0	130	----
		manganese, total	7439-96-5	E420	0.190 mg/L	0.2 mg/L	94.9	70.0	130	----
		molybdenum, total	7439-98-7	E420	0.192 mg/L	0.2 mg/L	95.9	70.0	130	----
		nickel, total	7440-02-0	E420	0.383 mg/L	0.4 mg/L	95.7	70.0	130	----
		phosphorus, total	7723-14-0	E420	102 mg/L	100 mg/L	102	70.0	130	----
		potassium, total	7440-09-7	E420	37.1 mg/L	40 mg/L	92.8	70.0	130	----
		rubidium, total	7440-17-7	E420	0.204 mg/L	0.2 mg/L	102	70.0	130	----
		selenium, total	7782-49-2	E420	0.353 mg/L	0.4 mg/L	88.3	70.0	130	----
		silicon, total	7440-21-3	E420	93.3 mg/L	100 mg/L	93.3	70.0	130	----
		silver, total	7440-22-4	E420	0.0416 mg/L	0.04 mg/L	104	70.0	130	----
		sodium, total	7440-23-5	E420	17.7 mg/L	20 mg/L	88.6	70.0	130	----
		strontium, total	7440-24-6	E420	0.174 mg/L	0.2 mg/L	87.1	70.0	130	----
		sulfur, total	7704-34-9	E420	186 mg/L	200 mg/L	93.0	70.0	130	----
		tellurium, total	13494-80-9	E420	0.353 mg/L	0.4 mg/L	88.2	70.0	130	----
		thallium, total	7440-28-0	E420	0.0353 mg/L	0.04 mg/L	88.3	70.0	130	----
		thorium, total	7440-29-1	E420	0.183 mg/L	0.2 mg/L	91.5	70.0	130	----
		tin, total	7440-31-5	E420	0.192 mg/L	0.2 mg/L	95.9	70.0	130	----
		titanium, total	7440-32-6	E420	0.348 mg/L	0.4 mg/L	87.0	70.0	130	----
		tungsten, total	7440-33-7	E420	0.189 mg/L	0.2 mg/L	94.5	70.0	130	----
		uranium, total	7440-61-1	E420	0.0360 mg/L	0.04 mg/L	90.1	70.0	130	----
		vanadium, total	7440-62-2	E420	0.948 mg/L	1 mg/L	94.8	70.0	130	----
		zinc, total	7440-66-6	E420	3.60 mg/L	4 mg/L	90.0	70.0	130	----
		zirconium, total	7440-67-7	E420	0.382 mg/L	0.4 mg/L	95.6	70.0	130	----
Total Metals (QCLot: 669568)										
CG2213099-004	Anonymous	mercury, total	7439-97-6	E508	0.000118 mg/L	0.0001 mg/L	118	70.0	130	----
Dissolved Metals (QCLot: 668781)										
CG2213106-002	Anonymous	aluminum, dissolved	7429-90-5	E421	1.99 mg/L	2 mg/L	99.6	70.0	130	----
		antimony, dissolved	7440-36-0	E421	0.200 mg/L	0.2 mg/L	99.8	70.0	130	----
		arsenic, dissolved	7440-38-2	E421	0.206 mg/L	0.2 mg/L	103	70.0	130	----
		barium, dissolved	7440-39-3	E421	0.197 mg/L	0.2 mg/L	98.4	70.0	130	----
		beryllium, dissolved	7440-41-7	E421	0.384 mg/L	0.4 mg/L	96.0	70.0	130	----
		bismuth, dissolved	7440-69-9	E421	0.0920 mg/L	0.1 mg/L	92.0	70.0	130	----
		boron, dissolved	7440-42-8	E421	0.940 mg/L	1 mg/L	94.0	70.0	130	----
		cadmium, dissolved	7440-43-9	E421	0.0400 mg/L	0.04 mg/L	99.9	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Dissolved Metals (QCLot: 668781) - continued										
CG2213106-002	Anonymous	calcium, dissolved	7440-70-2	E421	ND mg/L	40 mg/L	ND	70.0	130	----
		cesium, dissolved	7440-46-2	E421	0.0960 mg/L	0.1 mg/L	96.0	70.0	130	----
		chromium, dissolved	7440-47-3	E421	0.398 mg/L	0.4 mg/L	99.5	70.0	130	----
		cobalt, dissolved	7440-48-4	E421	0.197 mg/L	0.2 mg/L	98.6	70.0	130	----
		copper, dissolved	7440-50-8	E421	0.198 mg/L	0.2 mg/L	99.1	70.0	130	----
		iron, dissolved	7439-89-6	E421	20.2 mg/L	20 mg/L	101	70.0	130	----
		lead, dissolved	7439-92-1	E421	0.189 mg/L	0.2 mg/L	94.6	70.0	130	----
		lithium, dissolved	7439-93-2	E421	0.942 mg/L	1 mg/L	94.2	70.0	130	----
		magnesium, dissolved	7439-95-4	E421	ND mg/L	10 mg/L	ND	70.0	130	----
		manganese, dissolved	7439-96-5	E421	0.190 mg/L	0.2 mg/L	95.3	70.0	130	----
		molybdenum, dissolved	7439-98-7	E421	0.201 mg/L	0.2 mg/L	101	70.0	130	----
		nickel, dissolved	7440-02-0	E421	0.382 mg/L	0.4 mg/L	95.6	70.0	130	----
		phosphorus, dissolved	7723-14-0	E421	96.8 mg/L	100 mg/L	96.8	70.0	130	----
		potassium, dissolved	7440-09-7	E421	40.6 mg/L	40 mg/L	101	70.0	130	----
		rubidium, dissolved	7440-17-7	E421	0.182 mg/L	0.2 mg/L	91.3	70.0	130	----
		selenium, dissolved	7782-49-2	E421	0.404 mg/L	0.4 mg/L	101	70.0	130	----
		silicon, dissolved	7440-21-3	E421	94.0 mg/L	100 mg/L	94.0	70.0	130	----
		silver, dissolved	7440-22-4	E421	0.0422 mg/L	0.04 mg/L	106	70.0	130	----
		sodium, dissolved	7440-23-5	E421	19.6 mg/L	20 mg/L	97.9	70.0	130	----
		strontium, dissolved	7440-24-6	E421	ND mg/L	0.2 mg/L	ND	70.0	130	----
		sulfur, dissolved	7704-34-9	E421	ND mg/L	200 mg/L	ND	70.0	130	----
		tellurium, dissolved	13494-80-9	E421	0.355 mg/L	0.4 mg/L	88.7	70.0	130	----
		thallium, dissolved	7440-28-0	E421	0.0363 mg/L	0.04 mg/L	90.7	70.0	130	----
		thorium, dissolved	7440-29-1	E421	0.206 mg/L	0.2 mg/L	103	70.0	130	----
		tin, dissolved	7440-31-5	E421	0.190 mg/L	0.2 mg/L	95.0	70.0	130	----
		titanium, dissolved	7440-32-6	E421	0.368 mg/L	0.4 mg/L	92.1	70.0	130	----
		tungsten, dissolved	7440-33-7	E421	0.197 mg/L	0.2 mg/L	98.3	70.0	130	----
		uranium, dissolved	7440-61-1	E421	0.0385 mg/L	0.04 mg/L	96.2	70.0	130	----
		vanadium, dissolved	7440-62-2	E421	0.990 mg/L	1 mg/L	99.0	70.0	130	----
		zinc, dissolved	7440-66-6	E421	3.80 mg/L	4 mg/L	95.0	70.0	130	----
		zirconium, dissolved	7440-67-7	E421	0.394 mg/L	0.4 mg/L	98.4	70.0	130	----
Dissolved Metals (QCLot: 669574)										
CG2213099-003	Anonymous	mercury, dissolved	7439-97-6	E509	0.000122 mg/L	0.0001 mg/L	122	70.0	130	----

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here
(lab use only)

COC Number: 17 -

Page 1 of 2

Environmental Division Calgary Work Order Reference CG2213108

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	Elaine Irving
Phone:	Elaine_Irving@golder.com
	Company address below will appear on the final report
Street:	2920 Virtual Way, Suite 200
City/Province:	Vancouver, BC
Postal Code:	
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Golder Associates
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: Elaine_Irving@golder.com
Email 2: Mikayla_Donovan@golder.com
Email 3: emilie@nautilusenvironmental.ca

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: ap_customerservice@golder.com
Email 2: Elaine_Irving@golder.com

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#:
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☐ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☑ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)]

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:	CG22-GOLD100-0012 BC Hydro
Job #:	WO# 20449674/9000
PO / AFE:	WO# 20449674/9000
LSD:	

ALS Lab Work Order # (lab use only):

ALS Contact: | **Sampler:**

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Routine (PR01)	DOC (E358-L)	Total Metals + Hg (BC11)	Dissolved Metals + Hg (BC10)	TSS (E160-L)	Ammonia (E298)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Columbia River + Rock - DA Termination (A)	23-Sep-22	11:30	Water	7	P4	P4	P4	P4	P4	P4		

Environmental Division Calgary Work Order Reference CG2213108

Telephone: +1 403 407 1800

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐		SIF Observations	Yes ☐	No	☐
Ice Packs ☐	Ice Cubes ☐	Custody seal intact	Yes ☐	No	☐
Cooling Initiated ☐					

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)		FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by: Amber M	Date: Sept-23	Time: 3:00 pm	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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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**.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 -

Page 2 of 2

Report To	Contact and company name below will appear on the final report
Company:	Golder Associates Ltd.
Contact:	Elaine Irving
Phone:	Elaine_Irving@golder.com
	Company address below will appear on the final report
Street:	2920 Virtual Way, Suite 200
City/Province:	Vancouver, BC
Postal Code:	
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☑ NO
Company:	Golder Associates
Contact:	

Report Format / Distribution	
Select Report Format:	☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report	☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	Elaine_Irving@golder.com
Email 2	Mikayla_Donovan@golder.com
Email 3	emilie@nautilusenvironmental.ca

Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	ap_customerservice@golder.com
Email 2	Elaine_Irving@golder.com

Project Information	
ALS Account # / Quote #:	CG22-GOLD100-0012 BC Hydro
Job #:	WO# 20449674/9000
PO / AFE:	WO# 20449674/9000
LSD:	

Oil and Gas Required Fields (client use)	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only): | **ALS Contact:** | **Sampler:**

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☐ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☑ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Routine (PR01)	DOC (E358-L)	Total Metals + Hg (BC11)	Dissolved Metals + Hg (BC10)	TSS (E160-L)	Ammonia (E298)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Columbia River + Rock - TR Termination (A)	23-Sep-22	12:00	Water	7	P4	P4	P4	P4	P4	P4		
	Columbia River + Rock - TR Termination (A) - Duplicate	23-Sep-22	12:10	Water	7	P4	P4	P4	P4	P4	P4		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☐ NO

Are samples for human consumption/ use? ☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
10							

SHIPMENT RELEASE (client use)		
Released by:	Date:	Time:

INITIAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date: Sept 23/22	Time: 3100

FINAL SHIPMENT RECEPTION (lab use only)		
Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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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.

ATTACHMENT 4

Water Quality Data and Guideline Comparison

ATTACHMENT 4
Water Quality Data and Guideline Comparison

Parameter	Unit	BC Water Quality Guideline		D/S HKD
				17-Sep-22
		Long-Term Chronic	Short-Term Acute	CG2212738-001
Field Measured				
pH	-	6.5 - 9.0	6.5 - 9.0	7.9
Specific conductivity	µS/cm	-	-	92
Temperature	°C	-	-	16
Dissolved oxygen	mg/L	8.0	5.0	9.9
Dissolved oxygen	%	-	-	100
Turbidity	NTU	-	-	0.61
Redox potential	mV	-	-	174
Conventional Parameters				
pH	-	6.5 - 9.0	6.5 - 9.0	7.8
Specific conductivity	µS/cm	-	-	98
Hardness, as $CaCO_3$	mg/L	-	-	46
Hardness, as $CaCO_3$ (Total)	mg/L	-	-	44
Total alkalinity, as $CaCO_3$	mg/L	20[(a)]	-	45
Total dissolved solids	mg/L	-	-	73
Total dissolved solids (calculated)	mg/L	-	-	58
Total suspended solids	mg/L	-	-	<1.0
Total organic carbon	mg/L	-	-	0.77
Dissolved organic carbon	mg/L	-	-	0.73
Turbidity	NTU	-	-	0.74
Major Ions				
Bicarbonate	mg/L	-	-	55
Calcium	mg/L	-	-	14
Carbonate	mg/L	-	-	<1.0
Chloride	mg/L	150	600	<0.5
Fluoride	mg/L	-	1.0[(b)]	0.040
Hydroxide	mg/L	-	-	<1.0
Magnesium	mg/L	-	-	2.7
Potassium	mg/L	-	-	0.60
Sodium	mg/L	-	-	0.63
Sulphate	mg/L	218[(b)]	-	8.0
Nutrients				
Nitrate	mg-N/L	3.0	33	0.089
Nitrite	mg-N/L	0.020[(c)]	0.060[(c)]	<0.01
Nitrate + nitrite	mg-N/L	-	-	0.089
Total ammonia	mg-N/L	1.2[(d)]	6.7[(d)]	0.0056
Total phosphorus	mg-P/L	-	-	0.0023
Dissolved phosphorus	mg-P/L	-	-	<0.002
Nitrogen, Kjeldahl	mg-N/L	-	-	<0.2
Total Metals				
Aluminum	mg/L	-	-	0.017
Antimony	mg/L	0.0090	-	<0.0001
Arsenic	mg/L	-	0.0050	0.00014
Barium	mg/L	1.0	-	0.012
Beryllium	mg/L	0.00013	-	<0.0001
Bismuth	mg/L	-	-	<0.00005
Boron	mg/L	1.2	-	<0.01
Cadmium	mg/L	-	-	0.0000086
Calcium	mg/L	-	-	13
Cesium	mg/L	-	-	0.000014
Chromium	mg/L	0.0010[(e)]	-	<0.0005
Cobalt	mg/L	0.0040	0.11	<0.0001
Copper	mg/L	-	-	<0.0005
Iron	mg/L	-	1.0	<0.01
Lead	mg/L	0.0045[(b)]	0.030[(b)]	<0.00005
Lithium	mg/L	-	-	0.0010
Magnesium	mg/L	-	-	2.6
Manganese	mg/L	-	-	0.00053
Mercury	mg/L	0.000020[(f)]	-	<0.000005
Molybdenum	mg/L	1.0	2.0	0.00050
Nickel	mg/L	0.025[(b)]	-	<0.0005
Potassium	mg/L	-	-	0.54
Rubidium	mg/L	-	-	0.0012
Selenium	mg/L	0.0020	-	0.000061
Silicon	mg/L	-	-	1.3
Silver	mg/L	0.000050[(b)]	0.00010[(b)]	<0.00001
Sodium	mg/L	-	-	0.67
Strontium	mg/L	-	-	0.087
Sulphur	mg/L	-	-	2.6
Tellurium	mg/L	-	-	<0.0002
Thallium	mg/L	0.00080	-	<0.00001
Thorium	mg/L	-	-	<0.0001
Tin	mg/L	-	-	<0.0001
Titanium	mg/L	-	-	<0.0003
Tungsten	mg/L	-	-	<0.0001
Uranium	mg/L	0.0085	-	0.00030
Vanadium	mg/L	-	-	0.00074
Zinc	mg/L	0.0075	0.033	<0.003
Zirconium	mg/L	-	-	<0.0002

Parameter	Unit	BC Water Quality Guideline		D/S HKD
				17-Sep-22
		Long-Term Chronic	Short-Term Acute	CG2212738-001
Dissolved Metals				
Aluminum	mg/L	0.050[(g)]	0.10[(g)]	0.0099
Antimony	mg/L	-	-	<0.0001
Arsenic	mg/L	-	-	0.00010
Barium	mg/L	-	-	0.013
Beryllium	mg/L	-	-	<0.00002
Bismuth	mg/L	-	-	<0.00005
Boron	mg/L	-	-	<0.01
Cadmium	mg/L	0.00012[(b)]	0.00026[(b)]	<0.000005
Cesium	mg/L	-	-	<0.00001
Chromium	mg/L	-	-	<0.0005
Cobalt	mg/L	-	-	<0.0001
Copper	mg/L	0.0003[(h)]	0.0019[(h)]	<0.0002
Iron	mg/L	-	0.35	<0.03
Lead	mg/L	-	-	<0.00005
Lithium	mg/L	-	-	0.0012
Manganese	mg/L	-	-	<0.005
Mercury	mg/L	-	-	<0.000005
Molybdenum	mg/L	-	-	0.00070
Nickel	mg/L	-	-	<0.0005
Rubidium	mg/L	-	-	0.0013
Selenium	mg/L	-	-	0.000079
Silicon	mg/L	-	-	1.3
Silver	mg/L	-	-	<0.00001
Strontium	mg/L	-	-	0.088
Sulphur	mg/L	-	-	3.1
Tellurium	mg/L	-	-	<0.0002
Thallium	mg/L	-	-	<0.00001
Thorium	mg/L	-	-	<0.0001
Tin	mg/L	-	-	<0.0001
Titanium	mg/L	-	-	<0.0003
Tungsten	mg/L	-	-	<0.0001
Uranium	mg/L	-	-	0.00018
Vanadium	mg/L	-	-	<0.0005
Zinc	mg/L	-	-	<0.001
Zirconium	mg/L	-	-	<0.0002

Note: No results were greater than the applicable BC water quality guideline.
a) Guideline is a minimum value, unless the background concentration or value is lower.
b) Guideline is hardness dependent. The guideline range shown is based on the hardness observed in the dataset (46 mg/L).
c) Guideline is chloride dependent. The guideline range shown is based on the chloride concentration observed in the dataset (<0.5 mg/L).
d) The ammonia guideline is pH and temperature dependent. The guideline is based on the combination of field pH (7.9) and water temperature (16°C).
e) Guideline is for chromium VI.
e e me e 0 o o e o o r ver e e v ro me e o e e
g) Guideline is pH dependent. The guideline range shown is based on the pH in the dataset (7.9).
h) The copper guideline is pH, DOC, and hardness dependent. The guideline is based on the combination of field pH (7.9), DOC (0.73 mg/L), and hardness (46 mg/L).
°C = degrees Celsius; $CaCO_3$ = calcium carbonate; DOC = dissolved organic carbon; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; mV = millivolts; µS/cm = microsiemens per centimetre; NTU = nephelometric turbidity units; < = less than; - = not applicable.

Parameter	Unit	BC Water Quality Guideline		*Daphnia magna*		Rainbow Trout *(Oncorhynchus mykiss)*	
				Initiation	Termination	Initiation	Termination
				21-Sep-22	24-Sep-22	19-Sep-22	24-Sep-22
		Long-Term Chronic	Short-Term Acute	CG2212924-001	CG2213108-001	CG2212837-001	CG2213108-002
Field Measured							
Temperature	-	-	-	20	20	15	15
Conventional Parameters							
pH	-	6.5 - 9.0	6.5 - 9.0	7.6	7.7	7.7	7.7
Specific conductivity	µS/cm	-	-	101	107	102	110
Hardness, as $CaCO_3$	mg/L	-	-	47	51	49	51
Hardness, as $CaCO_3$ (Total)	mg/L	-	-	53	50	48	51
Total alkalinity, as $CaCO_3$	mg/L	20[(a)]	-	46	47	46	47
Total dissolved solids (calculated)	mg/L	-	-	61	65	59	65
Total suspended solids	mg/L	-	-	9.0	2.5	3.7	1.4
Dissolved organic carbon	mg/L	-	-	2.4	2.4	<0.5	0.91
Major Ions							
Bicarbonate	mg/L	-	-	56	57	57	57
Calcium	mg/L	-	-	14	16	14	16
Carbonate	mg/L	-	-	<1.0	<1.0	<1.0	<1.0
Chloride	mg/L	150	600	<0.5	0.54	<0.5	0.89
Fluoride	mg/L	-	1.0 - 1.1[(b)]	0.065	0.070	0.044	0.062
Hydroxide	mg/L	-	-	<1.0	<1.0	<1.0	<1.0
Magnesium	mg/L	-	-	2.7	2.8	3.2	2.7
Potassium	mg/L	-	-	0.65	0.75	0.67	1.00
Sodium	mg/L	-	-	0.78	0.92	0.91	1.2
Sulphate	mg/L	218[(b)]	-	8.1	8.7	8.2	8.8
Nutrients							
Nitrate	mg-N/L	3.0	33	0.16	0.17	0.096	0.11
Nitrite	mg-N/L	0.020[(c)]	0.060[(c)]	0.014	0.019	<0.01	0.012
Nitrate + nitrite	mg-N/L	-	-	0.17	0.19	0.096	0.12
Total ammonia	mg-N/L	1.2 - 1.8[(d)]	9.1 - 11[(d)]	0.034	0.10	0.012	0.38
Total phosphorus	mg-P/L	-	-	<0.05	<0.05	<0.05	0.059
Dissolved phosphorus	mg-P/L	-	-	<0.05	<0.05	<0.05	<0.05
Total Metals							
Aluminum	mg/L	-	-	0.093	0.026	0.034	0.035
Antimony	mg/L	0.0090	-	0.00037	0.00050	<0.0001	0.00022
Arsenic	mg/L	-	0.0050	0.00018	0.00029	0.00024	0.00018
Barium	mg/L	1.0	-	0.022	0.019	0.015	0.021
Beryllium	mg/L	0.00013	-	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth	mg/L	-	-	<0.00005	<0.00005	<0.00005	<0.00005
Boron	mg/L	1.2	-	0.035	0.038	<0.01	0.026
Cadmium	mg/L	-	-	0.000025	0.000015	0.000010	0.000011
Calcium	mg/L	-	-	16	15	14	16
Cesium	mg/L	-	-	0.000031	0.000011	0.000018	0.000011
Chromium	mg/L	0.0010[(e)]	-	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt	mg/L	0.0040	0.11	0.00011	<0.0001	<0.0001	<0.0001
Copper	mg/L	-	-	0.0011	0.00083	<0.0005	0.00091
Iron	mg/L	-	1.0	0.11	0.028	0.026	0.022
Lead	mg/L	0.0045 - 0.0047[(b)]	0.031 - 0.035[(b)]	0.00021	0.000051	<0.00005	0.000054
Lithium	mg/L	-	-	0.0010	0.0014	<0.001	0.0014
Magnesium	mg/L	-	-	3.2	3.0	3.0	2.9
Manganese	mg/L	-	-	0.023	0.013	0.0022	0.0065
Mercury	mg/L	0.000020[(f)]	-	**0.000022**	0.000015	0.0000079	0.0000095
Molybdenum	mg/L	1.0	2.0	0.00089	0.00093	0.00058	0.0010
Nickel	mg/L	0.025[(b)]	-	0.00083	0.00056	0.00052	0.00073
Potassium	mg/L	-	-	0.71	0.70	0.62	0.98
Rubidium	mg/L	-	-	0.0013	0.0010	0.0014	0.0015
Selenium	mg/L	0.0020	-	0.000097	0.00013	0.000077	0.000093
Silicon	mg/L	-	-	1.5	1.7	1.5	1.5
Silver	mg/L	0.000050[(b)]	0.00010[(b)]	<0.00001	<0.00001	<0.00001	<0.00001
Sodium	mg/L	-	-	0.84	0.87	0.82	1.1
Strontium	mg/L	-	-	0.10	0.098	0.088	0.097
Sulphur	mg/L	-	-	3.2	3.5	3.1	3.5
Tellurium	mg/L	-	-	<0.0002	<0.0002	<0.0002	<0.0002
Thallium	mg/L	0.00080	-	<0.00001	0.000011	<0.00001	<0.00001
Thorium	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Tin	mg/L	-	-	0.00045	0.00046	0.00047	0.0095
Titanium	mg/L	-	-	0.0069	0.0013	0.0017	<0.0003
Tungsten	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Uranium	mg/L	0.0085	-	0.00082	0.00079	0.00034	0.00078
Vanadium	mg/L	-	-	0.00053	0.00059	0.0014	0.0012
Zinc	mg/L	0.0075	0.033	**0.0080**	0.0057	<0.003	0.0062
Zirconium	mg/L	-	-	<0.0002	<0.0002	<0.0002	<0.0002

Parameter	Unit	BC Water Quality Guideline		*Daphnia magna*		Rainbow Trout *(Oncorhynchus mykiss)*	
				Initiation	Termination	Initiation	Termination
				21-Sep-22	24-Sep-22	19-Sep-22	24-Sep-22
		Long-Term Chronic	Short-Term Acute	CG2212924-001	CG2213108-001	CG2212837-001	CG2213108-002
Dissolved Metals							
Aluminum	mg/L	0.050[(g)]	0.10[(g)]	0.0080	0.0037	0.012	0.015
Antimony	mg/L	-	-	0.00036	0.00043	<0.0001	0.00014
Arsenic	mg/L	-	-	0.00016	0.00019	0.00013	0.00014
Barium	mg/L	-	-	0.018	0.020	0.017	0.021
Beryllium	mg/L	-	-	<0.00002	<0.00002	<0.00002	<0.00002
Bismuth	mg/L	-	-	<0.00005	<0.00005	<0.00005	<0.00005
Boron	mg/L	-	-	0.034	0.037	<0.01	0.025
Cadmium	mg/L	0.00012 - 0.00013[(b)]	0.00027 - 0.00029[(b)]	0.000016	0.000014	<0.000005	0.0000058
Cesium	mg/L	-	-	<0.00001	<0.00001	0.000012	<0.00001
Chromium	mg/L	-	-	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Copper	mg/L	0.0002 - 0.0009[(h)]	0.0005 - 0.0054[(h)]	0.00063	0.00067	**0.00045**	**0.00079**
Iron	mg/L	-	0.35	<0.03	<0.03	<0.03	<0.03
Lead	mg/L	-	-	<0.00005	<0.00005	<0.00005	<0.00005
Lithium	mg/L	-	-	<0.001	0.0013	<0.001	0.0013
Manganese	mg/L	-	-	0.010	0.0097	<0.005	<0.005
Mercury	mg/L	-	-	0.0000098	0.0000080	0.0000062	<0.000005
Molybdenum	mg/L	-	-	0.00085	0.00085	0.00051	0.00099
Nickel	mg/L	-	-	<0.0005	<0.0005	0.00054	0.00054
Rubidium	mg/L	-	-	0.00091	0.00091	0.0013	0.0012
Selenium	mg/L	-	-	0.00015	0.00012	0.000084	0.000084
Silicon	mg/L	-	-	1.5	1.5	1.3	1.5
Silver	mg/L	-	-	<0.00001	<0.00001	<0.00001	<0.00001
Strontium	mg/L	-	-	0.093	0.10	0.092	0.099
Sulphur	mg/L	-	-	3.0	3.0	4.0	3.2
Tellurium	mg/L	-	-	<0.0002	<0.0002	<0.0002	<0.0002
Thallium	mg/L	-	-	<0.00001	<0.00001	<0.00001	<0.00001
Thorium	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Tin	mg/L	-	-	0.00042	0.00042	0.00043	0.0087
Titanium	mg/L	-	-	<0.0003	<0.0003	<0.0003	<0.0003
Tungsten	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Uranium	mg/L	-	-	0.00076	0.00078	0.00035	0.00079
Vanadium	mg/L	-	-	<0.0005	<0.0005	<0.0005	<0.0005
Zinc	mg/L	-	-	0.0065	0.0058	0.0035	0.0047
Zirconium	mg/L	-	-	<0.0002	<0.0002	<0.0002	<0.0002

Note: **Bolded** concentrations are higher than water quality guidelines.
a) Guideline is a minimum value, unless the background concentration or value is lower.
b) Guideline is hardness dependent. The guideline range shown is based on the hardness range observed in the dataset (47 to 51 mg/L). The guideline is calculated based on the individual hardness value for each sample.
c) Guideline is chloride dependent. The guideline range shown is based on the chloride concentration range observed in the dataset (<0.5 to 0.89 mg/L). The guideline is calculated based on the individual chloride concentration in each sample.
d) The ammonia guideline is pH and temperature dependent. The guidelines are based on the combination of lab pH (7.6 to 7.7) and water temperature (15 to 20°C).
e) Guideline is for chromium VI.
e e me e 0 o o e o o r ver e e v ro me e o e e
g) Guideline is pH dependent. The guideline range shown is based on the pH range observed in the dataset (7.6 to 7.7). The guideline is calculated based on the individual pH for each sample.
h) The copper guideline is pH, DOC, and hardness dependent. The guideline is based on the combination of lab pH (7.6 to 7.7), DOC (<0.5 to 2.4 mg/L), and hardness (47 to 51 mg/L).
°C = degrees Celsius; $CaCO_3$ = calcium carbonate; DOC = dissolved organic carbon; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; µS/cm = microsiemens per centimetre; NTU = nephelometric turbidity units; < = less than; - = not applicable.

ATTACHMENT 5

Quality Assurance and Quality Control Data

Table 5-1: Quality Control Assessment Results from the Rainbow Trout Toxicity Test Termination Water Quality Duplicate Sample, Sept 2022

Parameter	Unit	MDL	Sample	Duplicate	RPD
			24-Sep-22		
Conventional Parameters					
pH	-	0.1	7.7	7.69	2%
Specific conductivity	µS/cm	2	110	110	0%
Hardness, as $CaCO_3$	mg/L	0.5	50.9	50.6	1%
Hardness, as $CaCO_3$ (Total)	mg/L	0.6	51.3	51.4	0%
Total alkalinity, as $CaCO_3$	mg/L	2	47	47.8	2%
Total dissolved solids (calculated)	mg/L	1	64.7	65.1	1%
Total suspended solids	mg/L	1	1.4	1.2	-
Dissolved organic carbon	mg/L	0.5	0.91	0.82	-
Major Ions					
Bicarbonate	mg/L	1	57.3	58.3	2%
Calcium	mg/L	0.05	16	15.9	1%
Carbonate	mg/L	1	<1	<1	-
Chloride	mg/L	0.5	0.89	1.05	-
Fluoride	mg/L	0.02	0.062	0.061	-
Hydroxide	mg/L	1	<1	<1	-
Magnesium	mg/L	0.005	2.65	2.64	0%
Potassium	mg/L	0.05	0.996	1	0%
Sodium	mg/L	0.05	1.21	1.15	5%
Sulphate	mg/L	0.3	8.82	8.84	0%
Nutrients and Chlorophyll a					
Nitrate as N	mg-N/L	0.02	0.11	0.114	4%
Nitrite as N	mg-N/L	0.01	0.012	0.012	-
Nitrate + nitrite	mg-N/L	0.05	0.122	0.126	-
Total ammonia	mg-N/L	0.005	0.377	0.377	0%
Total phosphorus	mg-P/L	0.05	0.059	0.104	-
Dissolved phosphorus	mg-P/L	0.05	<0.05	<0.05	-
Total Metals					
Aluminum	mg/L	0.003	0.0354	0.0349	1%
Antimony	mg/L	0.0001	0.00022	0.00023	-
Arsenic	mg/L	0.0001	0.00018	0.00021	-
Barium	mg/L	0.0001	0.0212	0.0217	2%
Beryllium	mg/L	0.0001	<0.0001	<0.0001	-
Bismuth	mg/L	0.00005	<0.00005	<0.00005	-
Boron	mg/L	0.01	0.026	0.026	-
Cadmium	mg/L	0.000005	0.0000113	0.0000123	-
Calcium	mg/L	0.05	15.8	15.7	1%
Cesium	mg/L	0.00001	0.000011	0.000012	-
Chromium	mg/L	0.0005	<0.0005	<0.0005	-
Cobalt	mg/L	0.0001	<0.0001	<0.0001	-
Copper	mg/L	0.0005	0.00091	0.00101	-
Iron	mg/L	0.01	0.022	0.029	-
Lead	mg/L	0.00005	0.000054	0.000056	-
Lithium	mg/L	0.001	0.0014	0.0013	-
Magnesium	mg/L	0.005	2.87	2.95	3%
Manganese	mg/L	0.0001	0.00653	0.00722	10%
Mercury	mg/L	0.000005	0.0000095	0.0000088	-
Molybdenum	mg/L	0.00005	0.00102	0.000985	3%
Nickel	mg/L	0.0005	0.00073	0.00085	-
Potassium	mg/L	0.05	0.977	0.955	2%
Rubidium	mg/L	0.0002	0.00148	0.00139	6%
Selenium	mg/L	0.00005	0.000093	0.000118	-
Silicon	mg/L	0.1	1.52	1.56	3%
Silver	mg/L	0.00001	<0.00001	<0.00001	-
Sodium	mg/L	0.05	1.08	1.14	5%
Strontium	mg/L	0.0002	0.0974	0.0973	0%
Sulphur	mg/L	0.5	3.54	3.67	4%
Tellurium	mg/L	0.0002	<0.0002	<0.0002	-
Thallium	mg/L	0.00001	<0.00001	<0.00001	-
Thorium	mg/L	0.0001	<0.0001	<0.0001	-
Tin	mg/L	0.0001	0.00946	0.00962	2%
Titanium	mg/L	0.0003	<0.0003	0.0017[(a)]	**141%**
Tungsten	mg/L	0.0001	<0.0001	<0.0001	-
Uranium	mg/L	0.00001	0.000775	0.000778	0%
Vanadium	mg/L	0.0005	0.00124	0.00131	-
Zinc	mg/L	0.003	0.0062	0.0059	-
Zirconium	mg/L	0.0002	<0.0002	<0.0002	-

Table 5-1: Quality Control Assessment Results from the Rainbow Trout Toxicity Test Termination Water Quality Duplicate Sample, Sept 2022

Parameter	Unit	MDL	Sample	Duplicate	RPD
			24-Sep-22		
Dissolved Metals					
Aluminum	mg/L	0.001	0.0147	0.0148	1%
Antimony	mg/L	0.0001	0.00014	0.00014	-
Arsenic	mg/L	0.0001	0.00014	0.00011	-
Barium	mg/L	0.0001	0.021	0.0211	0%
Beryllium	mg/L	0.00002	<0.00002	<0.00002	-
Bismuth	mg/L	0.00005	<0.00005	<0.00005	-
Boron	mg/L	0.01	0.025	0.025	-
Cadmium	mg/L	0.000005	0.0000058	0.0000105	-
Cesium	mg/L	0.00001	<0.00001	<0.00001	-
Chromium	mg/L	0.0005	<0.0005	<0.0005	-
Cobalt	mg/L	0.0001	<0.0001	<0.0001	-
Copper	mg/L	0.0002	0.00079	0.00075	-
Iron	mg/L	0.03	<0.03	<0.03	-
Lead	mg/L	0.00005	<0.00005	<0.00005	-
Lithium	mg/L	0.001	0.0013	0.0013	-
Manganese	mg/L	0.005	<0.005	<0.005	-
Mercury	mg/L	0.000005	<0.000005	<0.000005	-
Molybdenum	mg/L	0.00005	0.000987	0.000898	9%
Nickel	mg/L	0.0005	0.00054	0.0006	-
Rubidium	mg/L	0.0002	0.00119	0.00137	14%
Selenium	mg/L	0.00005	0.000084	0.000098	-
Silicon	mg/L	0.05	1.46	1.45	1%
Silver	mg/L	0.00001	<0.00001	<0.00001	-
Strontium	mg/L	0.0002	0.0991	0.0979	1%
Sulphur	mg/L	0.5	3.16	3.2	1%
Tellurium	mg/L	0.0002	<0.0002	<0.0002	-
Thallium	mg/L	0.00001	<0.00001	<0.00001	-
Thorium	mg/L	0.0001	<0.0001	<0.0001	-
Tin	mg/L	0.0001	0.00872	0.00885	1%
Titanium	mg/L	0.0003	<0.0003	<0.0003	-
Tungsten	mg/L	0.0001	<0.0001	<0.0001	-
Uranium	mg/L	0.00001	0.000785	0.000774	1%
Vanadium	mg/L	0.0005	<0.0005	<0.0005	-
Zinc	mg/L	0.001	0.0047	0.0041	-
Zirconium	mg/L	0.0002	<0.0002	<0.0002	-

Note: **Bolded** values represent notable relative percent differences (i.e., exceeding 20%).

a) Value is greater than five times the method detection limit and is paired with a duplicate value below the method detection limit.

$CaCO_3$ = calcium carbonate; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; RPD = relative percent difference; µS/cm = microsiemens per centimetre; < = less than; - = not applicable.

Table 5-2: Quality Control Assessment Results from the Hugh Keenleyside Dam Field Blank, Sept 2022

Parameter	Unit	Detection Limit	Field Blank
			17-Sep-22
Conventional Parameters			
pH	-	0.1	5.3
Specific conductivity	µS/cm	2	<2
Hardness, as $CaCO_3$	mg/L	0.5	<0.5
Hardness, as $CaCO_3$ (Total)	mg/L	0.6	<0.6
Total alkalinity, as $CaCO_3$	mg/L	2	<2
Total dissolved solids	mg/L	10	<10
Total dissolved solids (calculated)	mg/L	1	<1
Total suspended solids	mg/L	1	<1
Total organic carbon	mg/L	0.5	<0.5
Dissolved organic carbon	mg/L	0.5	<0.5
Turbidity	NTU	0.1	<0.1
Major Ions			
Bicarbonate	mg/L	1	<1
Calcium	mg/L	0.05	<0.05
Carbonate	mg/L	1	<1
Chloride	mg/L	0.5	<0.5
Fluoride	mg/L	0.02	<0.02
Hydroxide	mg/L	1	<1
Magnesium	mg/L	0.005	<0.005
Potassium	mg/L	0.05	<0.05
Sodium	mg/L	0.05	<0.05
Sulphate	mg/L	0.3	<0.3
Nutrients and Biological Indicators			
Nitrate as N	mg-N/L	0.02	<0.02
Nitrite as N	mg-N/L	0.01	<0.01
Nitrate + nitrite	mg-N/L	0.05	<0.05
Total ammonia	mg-N/L	0.005	0.0051
Total phosphorus	mg-P/L	0.002	<0.002
Dissolved phosphorus	mg-P/L	0.002	<0.002
Nitrogen, Kjeldahl	mg/L	0.2	<0.2
Total Metals			
Aluminum	mg/L	0.003	<0.003
Antimony	mg/L	0.0001	<0.0001
Arsenic	mg/L	0.0001	<0.0001
Barium	mg/L	0.0001	<0.0001
Beryllium	mg/L	0.0001	<0.0001
Bismuth	mg/L	0.00005	<0.00005
Boron	mg/L	0.01	<0.01
Cadmium	mg/L	0.000005	<0.000005
Calcium	mg/L	0.05	<0.05
Cesium	mg/L	0.00001	<0.00001
Chromium	mg/L	0.0005	<0.0005
Cobalt	mg/L	0.0001	<0.0001
Copper	mg/L	0.0005	<0.0005
Iron	mg/L	0.01	<0.01
Lead	mg/L	0.00005	<0.00005
Lithium	mg/L	0.001	<0.001
Magnesium	mg/L	0.005	<0.005
Manganese	mg/L	0.0001	<0.0001
Mercury	mg/L	0.000005	<0.000005
Molybdenum	mg/L	0.00005	<0.00005
Nickel	mg/L	0.0005	<0.0005
Potassium	mg/L	0.05	<0.05
Rubidium	mg/L	0.0002	<0.0002
Selenium	mg/L	0.00005	<0.00005
Silicon	mg/L	0.1	<0.1
Silver	mg/L	0.00001	<0.00001
Sodium	mg/L	0.05	<0.05
Strontium	mg/L	0.0002	<0.0002
Sulphur	mg/L	0.5	<0.5
Tellurium	mg/L	0.0002	<0.0002
Thallium	mg/L	0.00001	<0.00001
Thorium	mg/L	0.0001	<0.0001
Tin	mg/L	0.0001	<0.0001
Titanium	mg/L	0.0003	<0.0003
Tungsten	mg/L	0.0001	<0.0001
Uranium	mg/L	0.00001	<0.00001
Vanadium	mg/L	0.0005	<0.0005

Table 5-2: Quality Control Assessment Results from the Hugh Keenleyside Dam Field Blank, Sept 2022

Parameter	Unit	Detection Limit	Field Blank
			17-Sep-22
Zinc	mg/L	0.003	<0.003
Zirconium	mg/L	0.0002	<0.0002

Table 5-2: Quality Control Assessment Results from the Hugh Keenleyside Dam Field Blank, Sept 2022

Parameter	Unit	Detection Limit	Field Blank
			17-Sep-22
Dissolved Metals			
Aluminum	mg/L	0.001	<0.001
Antimony	mg/L	0.0001	<0.0001
Arsenic	mg/L	0.0001	<0.0001
Barium	mg/L	0.0001	<0.0001
Beryllium	mg/L	0.00002	<0.00002
Bismuth	mg/L	0.00005	<0.00005
Boron	mg/L	0.01	<0.01
Cadmium	mg/L	0.000005	<0.000005
Cesium	mg/L	0.00001	<0.00001
Chromium	mg/L	0.0005	<0.0005
Cobalt	mg/L	0.0001	<0.0001
Copper	mg/L	0.0002	<0.0002
Iron	mg/L	0.03	<0.03
Lead	mg/L	0.00005	<0.00005
Lithium	mg/L	0.001	<0.001
Manganese	mg/L	0.005	<0.005
Mercury	mg/L	0.000005	<0.000005
Molybdenum	mg/L	0.00005	<0.00005
Nickel	mg/L	0.0005	<0.0005
Rubidium	mg/L	0.0002	<0.0002
Selenium	mg/L	0.00005	<0.00005
Silicon	mg/L	0.05	<0.05
Silver	mg/L	0.00001	<0.00001
Strontium	mg/L	0.0002	<0.0002
Sulphur	mg/L	0.5	<0.5
Tellurium	mg/L	0.0002	<0.0002
Thallium	mg/L	0.00001	<0.00001
Thorium	mg/L	0.0001	<0.0001
Tin	mg/L	0.0001	<0.0001
Titanium	mg/L	0.0003	<0.0003
Tungsten	mg/L	0.0001	<0.0001
Uranium	mg/L	0.00001	<0.00001
Vanadium	mg/L	0.0005	<0.0005
Zinc	mg/L	0.001	<0.001
Zirconium	mg/L	0.0002	<0.0002

Note: All values were less than five times the method detection limit.

$CaCO_3$ = calcium carbonate; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; µS/cm = microsiemens per centimetre; NTU = nephelometric turbidity units; < = less than; - = not applicable.

APPENDIX E

Post-Construction Survey Surface Assessment and Volume Calculations

TRANSMITTAL

DATE 31 August 2023 **WSP Reference No.** 20449674-018-TR-Rev1

TO Teri Neighbour
BC Hydro

FROM Curtis VanWerkhoven
EMAIL Curtis.VanWerkhoven@wsp.com

BC HYDRO – CLBWORKS 27 FINAL (POST-CONSTRUCTION) SURVEY SURFACE ASSESSMENT AND VOLUME CALCULATIONS

INDEPENDENT VERIFICATION BY WSP

Select one checkbox only

- ☐ **Mail/Express Post**
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- ☐ **Hand Delivered**
- ☐ **Other**

Quantity	Item	Description
1	6 Figures (Appendix A)	Package of Figures and associated volume calculations to provide independent verification of survey data interpretation based on 25 May 2023 survey data
1	Table of Volumes (Appendix B)	Calculated volumes for various scenarios (Table)

Curtis VanWerkhoven, M.A.Sc., P.Eng
Lead Water Resources Engineer

Appendix A: Figures for Independent Verification of Survey Data Interpretation Based on 25 May 2023 Survey
Appendix B: Table of Calculated Volumes

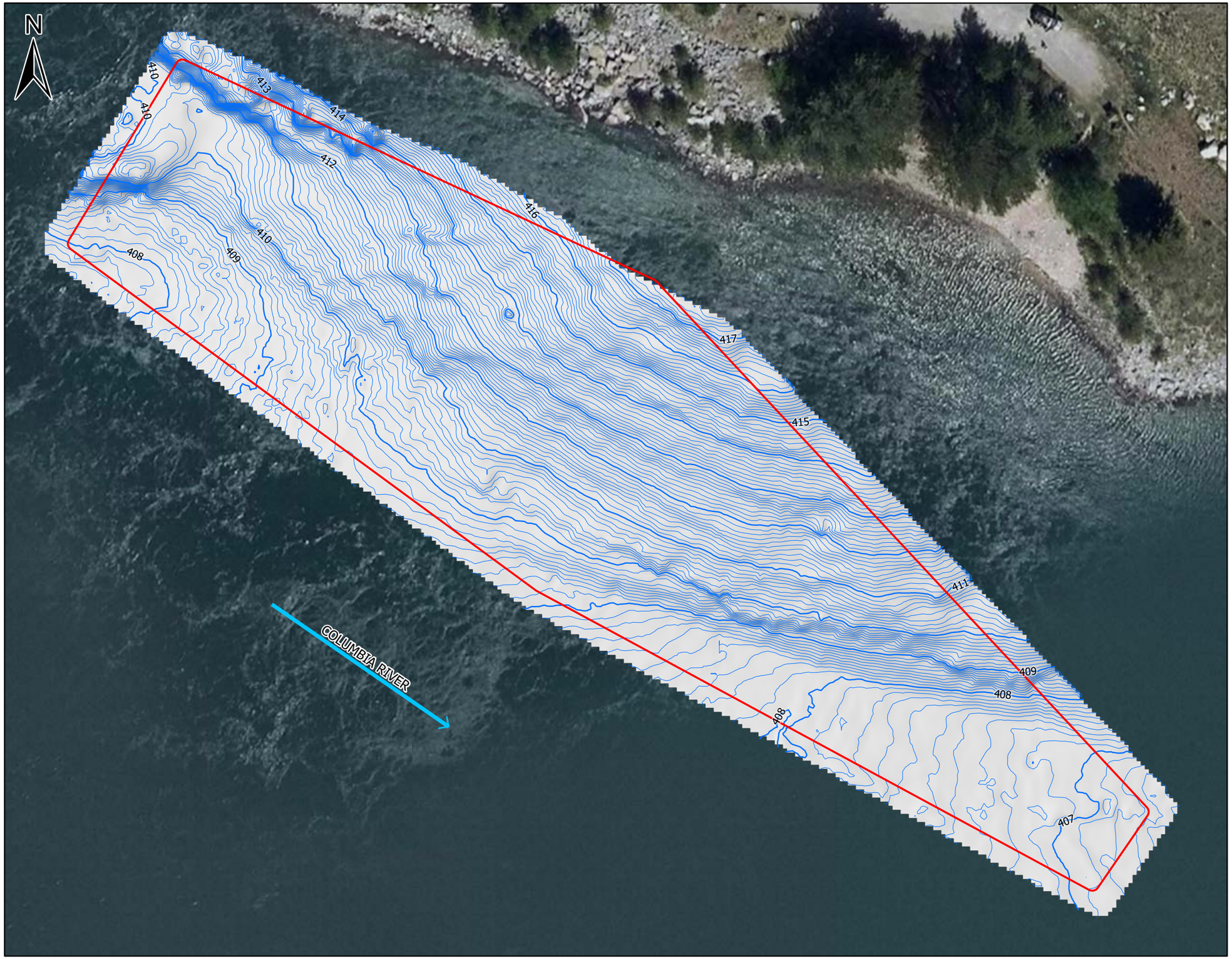
ACKNOWLEDGEMENT REQUIRED:
☑ YES (please email/fax to WSP) ☐ NO

https://golderassociates.sharepoint.com/sites/139832/project files/6 deliverables/issued to client_for wp/20449674-018-tr-rev1/20449674-018-tr-rev1-final post-construction survey figures and volume calculations 31aug_23.docx

WSP Canada Inc.
201 Columbia Avenue Castlegar, British Columbia, V1N 1A8 Canada T: +1 250 365 0344

APPENDIX A

Figures for Independent Verification of Survey Data Interpretation Based on 25 May 2023 Survey



LEGEND

- PROJECT AREA (INCLUDES +1m BUFFER)
- COLUMBIA RIVER FLOW DIRECTION
- PRE-CONSTRUCTION CONTOUR (0.1 m INTERVAL)

DRAFT

1:550 0 5 10 20 Metres

REFERENCES

1. PRE-CONSTRUCTION TOPOGRAPHIC SURVEY, DATED 2022-09-30.
2. IMAGERY: MAXAR, MICROSOFT

SPATIAL REFERENCE: NAD 1983 UTM ZONE 11N

CLIENT
BC HYRDO

PROJECT
BCH CLBWORKS 27 LCR BC

TITLE
PRE-CONSTRUCTION CONTOURS

CONSULTANT
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REVIEWED	RC
APPROVED	CV

PROJECT NO.	CONTROL	REV.	FIGURE
20449674	10000	1	1

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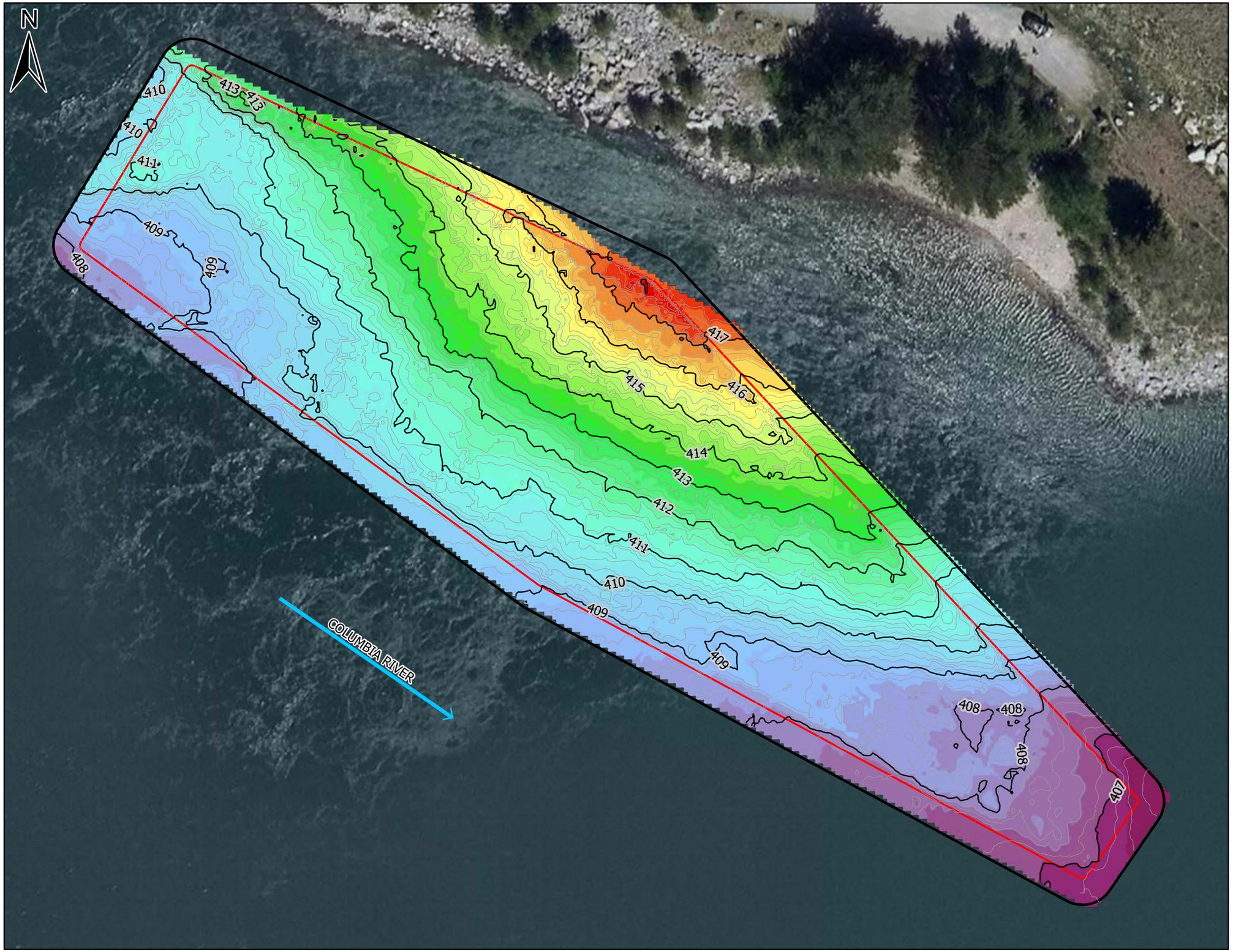

LEGEND

- PROJECT AREA (INCLUDES +1m BUFFER)
- PROJECT AREA (5m BUFFER)
- POST-CONSTRUCTION CONTOUR (0.2 m INTERVAL)
- COLUMBIA RIVER FLOW DIRECTION

POST-CONSTRUCTION GROUND SURFACE (m asl)

- 406.4 - 406.6
- 406.7 - 407
- 407.1 - 407.4
- 407.5 - 407.7
- 407.8 - 408.1
- 408.2 - 408.5
- 408.6 - 408.9
- 409 - 409.2
- 409.3 - 409.6
- 409.7 - 410
- 410.1 - 410.3
- 410.4 - 410.7
- 410.8 - 411.1
- 411.2 - 411.4
- 411.5 - 411.8
- 411.9 - 412.2
- 412.3 - 412.6
- 412.7 - 412.9
- 413 - 413.3
- 413.4 - 413.7
- 413.8 - 414
- 414.1 - 414.4
- 414.5 - 414.8
- 414.9 - 415.1
- 415.2 - 415.5
- 415.6 - 415.9
- 416 - 416.3
- 416.4 - 416.6
- 416.7 - 417
- 417.1 - 417.4
- 417.5 - 417.7
- 417.8 - 418.1

DRAFT

0 5 10 20

1:550 Metres

REFERENCES

1. POST-CONSTRUCTION TOPOGRAPHIC SURVEY COMPLETED USING EDGETECH6205 SWATH BATHYMETRY W/RTK SURVEY, PROCESSING BY DOUG GRIFFIN, P. ENG, DATED 2023-05-25.
2. IMAGERY: MAXAR, MICROSOFT.

SPATIAL REFERENCE: NAD 1983 UTM ZONE 11N

CLIENT
BC HYDRO

PROJECT
BCH CLBWORKS 27 LCR BC

TITLE
POST-CONSTRUCTION CONTOURS
(DATED 25 MAY 2023)

CONSULTANT

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PROJECT NO.	CONTROL	REV.	FIGURE
20449674	10000	1	2

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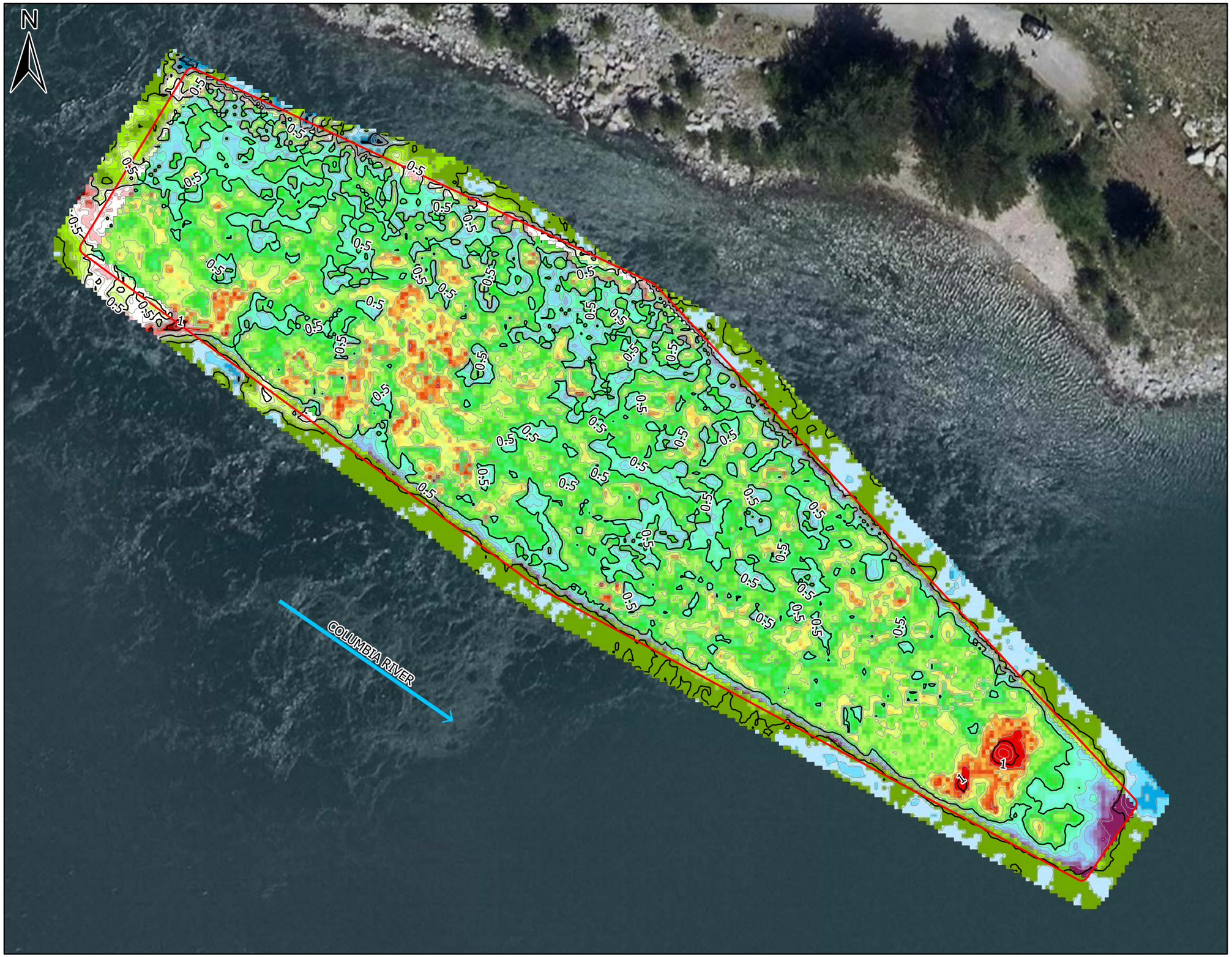

LEGEND

COLUMBIA RIVER FLOW DIRECTION

PROJECT AREA (INCLUDES +1m BUFFER)

DIFFERENCE IN ELEVATION BETWEEN PRE- AND POST-CONSTRUCTION SURVEYS (m)

MAJOR CONTOUR (0.5 m INTERVAL)

MINOR CONTOUR (0.1 m INTERVAL

DIFFERENCE IN ELEVATION BETWEEN PRE- AND POST-CONSTRUCTION SURVEYS (m)

-1.4 - -0.5	(POST CONSTRUCTION SURVEY < PRE-CONSTRUCTION SURVEY)
-0.5 - -0.4	
-0.4 - -0.3	
-0.3 - -0.2	
-0.2 - -0.1	
-0.1 - 0.1	
0.1 - 0.2	(BELOW TOLERANCE)
0.2 - 0.3	
0.3 - 0.4	
0.4 - 0.5	
0.5 - 0.7	(WITHIN TOLERANCE)
0.7 - 0.8	(ABOVE TOLERANCE)
0.8 - 0.9	
0.9 - 1	
1 - 1.6	

DRAFT

0 5 10 20

1:550 Metres

REFERENCES

1. PRE-CONSTRUCTION TOPOGRAPHIC SURVEY, DATED 2022-09-30.
2. POST-CONSTRUCTION TOPOGRAPHIC SURVEY COMPLETED USING EDGETECH6205 SWATH BATHYMETRY W/RTK SURVEY, PROCESSING BY DOUG GRIFFIN, P. ENG. DATED 2023-05-25.
3. IMAGERY: MAXAR, MICROSOFT.

SPATIAL REFERENCE: NAD 1983 UTM ZONE 11N

CLIENT
BC HYDRO

PROJECT
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TITLE
SUBSTRATE DEPTH ABOVE PRE-CONSTRUCTION SURVEY ELEVATION

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PROJECT NO.	CONTROL	REV.	FIGURE
20449674	10000	1	3

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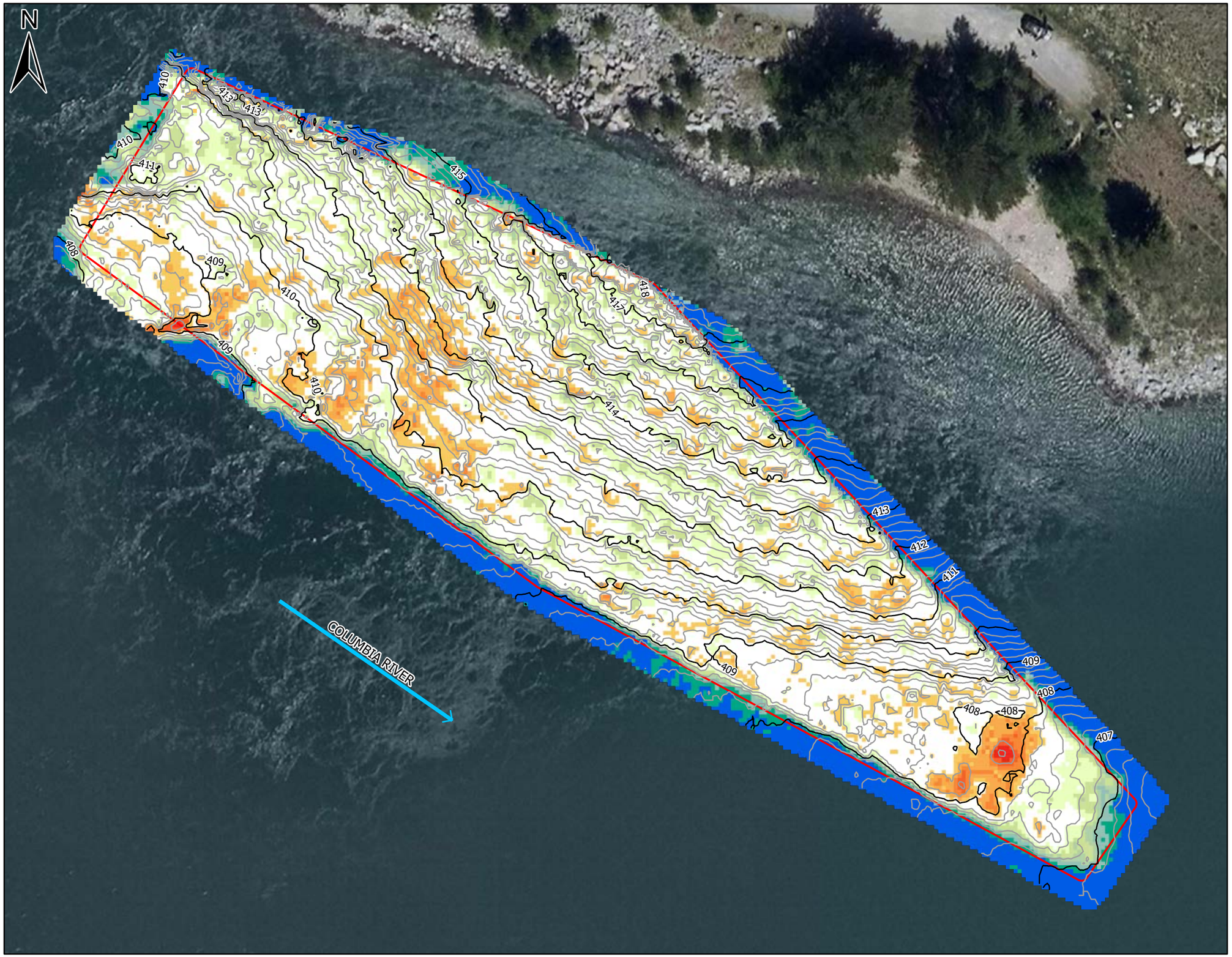

LEGEND

- PROJECT AREA (INCLUDES +1m BUFFER)
- COLUMBIA RIVER FLOW DIRECTION

POST- CONSTRUCTION CONTOUR

- MAJOR (1m INTERVAL)
- MINOR (0.2 m INTERVAL)

DIFFERENCE IN ELEVATION BETWEEN DESIGN SURFACE AND POST-CONSTRUCTION SURFACE (m)

-2 - -0.6	(POST CONSTRUCTION SURVEY < PRE-CONSTRUCTION SURVEY)
-0.6 - -0.5	(BELOW TOLERANCE)
-0.5 - -0.4	
-0.4 - -0.3	
-0.3 - -0.2	
-0.2 - -0.1	
-0.1 - 0.1	(WITHIN TOLERANCE)
0.1 - 0.2	(ABOVE TOLERANCE)
0.2 - 0.3	
0.3 - 0.4	
0.4 - 0.5	
0.5 - 0.7	

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1:550 0 5 10 20 Metres

REFERENCES

1. PRE-CONSTRUCTION TOPOGRAPHIC SURVEY, DATED 2022-09-30.
2. POST-CONSTRUCTION TOPOGRAPHIC SURVEY COMPLETED USING EDGETECH6205 SWATH BATHYMETRY W/RTK SURVEY, PROCESSING BY DOUG GRIFFIN, P. ENG. DATED 2023-05-25.
3. DESIGN SURFACE IS THE PRE-CONSTRUCTION SURFACE PLUS 0.6m.

SPATIAL REFERENCE: NAD 1983 UTM Zone 11N

CLIENT
BC HYDRO

PROJECT
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TITLE
DESIGN SURFACE VS. POST-CONSTRUCTION SURFACE

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PROJECT NO.	CONTROL	REV.	FIGURE
20449674	10000	1	4

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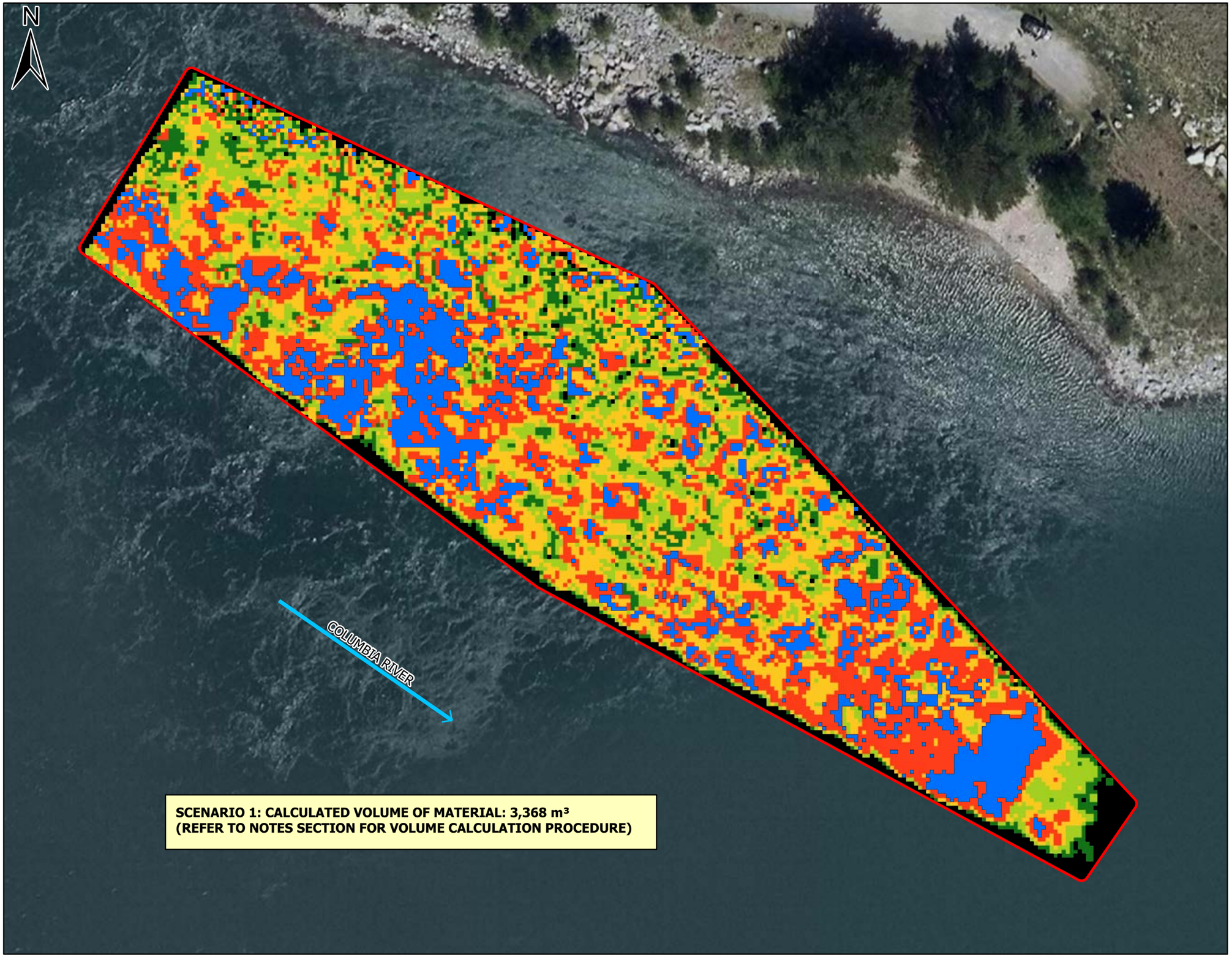

LEGEND

- COLUMBIA RIVER FLOW DIRECTION
- PROJECT AREA (INCLUDES +1m BUFFER)

SCENARIO 1 PLACEMENT THICKNESSES (m)

- 0.3 - 0.4
- 0.5 - 0.6
- 0.6 - 0.6
- 0.7 - 0.7
- AREA WITH PLACED MATERIAL LESS THAN 0.3 m (REFER TO NOTE 1)
- AREA WITH PLACED MATERIAL GREATER THAN 0.7 m (REFER TO NOTE 2)

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1:550 0 5 10 20 Metres

NOTES - PROCEDURE FOR THE CALCULATION OF VOLUME (SCENARIO 1):

1) REMOVED ALL AREAS WHERE CELL (0.6m X 0.6m) THICKNESS IS LESS THAN 0.3 m. THESE AREAS ARE EXCLUDED FROM THE VOLUME CALCULATIONS AS THE CELL DID NOT MEET THE MINIMUM MATERIAL THRESHOLD OF 0.3m.
2) PLACED MATERIAL UP TO A THICKNESS OF 0.7 m IN CELLS MEETING THE 0.3 m MINIMUM THICKNESS CRITERIA ARE INCLUDED IN THE VOLUME CALCULATION. PLACED MATERIAL GREATER THAN 0.7 m IS EXCLUDED FROM THE VOLUME CALCULATION.
3) THE CALCULATED SCENARIO 1 VOLUME WITHIN THE STUDY AREA (INCLUDING +1 m BUFFER) = 3,368 m³

REFERENCES

1. PRE-CONSTRUCTION TOPOGRAPHIC SURVEY, DATED 2022-09-30.
2. POST-CONSTRUCTION TOPOGRAPHIC SURVEY COMPLETED USING EDGETECH6205 SWATH BATHYMETRY W/RTK SURVEY, PROCESSING BY DOUG GRIFFIN, P. ENG. DATED 2023-05-25.
3. IMAGERY: MAXAR, MICROSOFT.

SPATIAL REFERENCE: NAD 1983 UTM ZONE 11N

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TITLE
SCENARIO 1
CALCULATED VOLUME OF PLACED MATERIAL

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PROJECT NO.	CONTROL	REV.	FIGURE
20449674	10000	1	5

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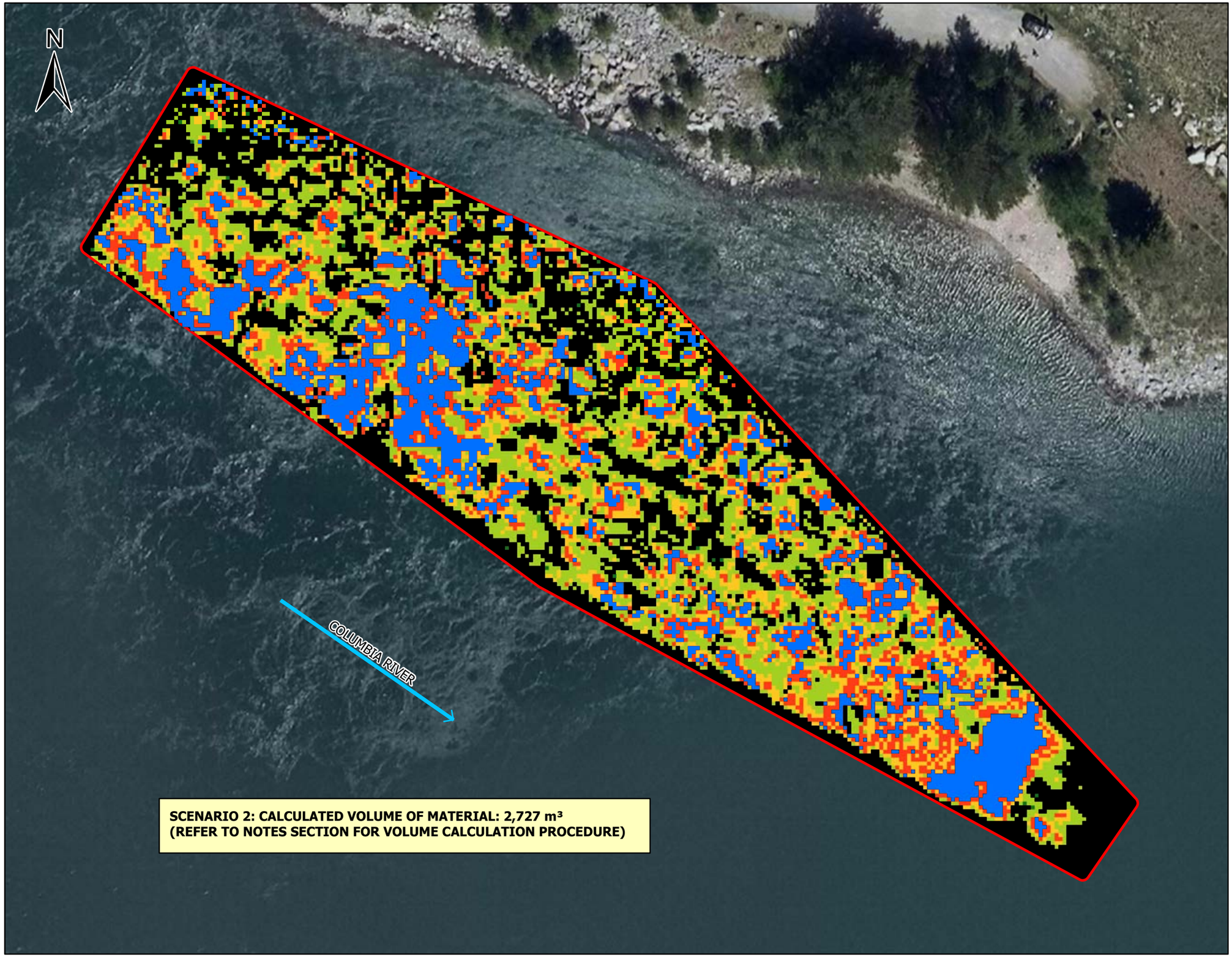

SCENARIO 2: CALCULATED VOLUME OF MATERIAL: 2,727 m³
(REFER TO NOTES SECTION FOR VOLUME CALCULATION PROCEDURE)

LEGEND

- COLUMBIA RIVER FLOW DIRECTION
- PROJECT AREA (INCLUDES +1m BUFFER)

SCENARIO 2 PLACEMENT THICKNESSES (m)

- <0.5 (REMOVED FROM SCENARIO 2)
- 0.5 - 0.6
- 0.6 - 0.6
- 0.7 - 0.7
- AREA WITH PLACED MATERIAL GREATER THAN 0.7 m (REFER TO NOTE 2)
- AREA WITH PLACED MATERIAL LESS THAN 0.5 m (REFER TO NOTE 1)

DRAFT

1:550 0 5 10 20 Metres

NOTES - PROCEDURE FOR THE CALCULATION OF VOLUME (SCENARIO 1):

1) REMOVED ALL AREAS WHERE CELL (0.6m X 0.6m) THICKNESS IS LESS THAN 0.5 m. THESE AREAS ARE EXCLUDED FROM THE VOLUME CALCULATIONS AS THE CELL DID NOT MEET THE MINIMUM MATERIAL THRESHOLD OF 0.3m.
2) PLACED MATERIAL UP TO A THICKNESS OF 0.7 m IN CELLS MEETING THE 0.5 m MINIMUM THICKNESS CRITERIA ARE INCLUDED IN THE VOLUME CALCULATION. PLACED MATERIAL GREATER THAN 0.7 m IS EXCLUDED FROM THE VOLUME CALCULATION.
3) THE CALCULATED SCENARIO 2 VOLUME WITHIN THE STUDY AREA (INCLUDING +1 m BUFFER) = 2,727 m³ .

REFERENCES

1. PRE-CONSTRUCTION TOPOGRAPHIC SURVEY, DATED 2022-09-30.
2. POST-CONSTRUCTION TOPOGRAPHIC SURVEY COMPLETED USING EDGETECH6205 SWATH BATHYMETRY W/RTK SURVEY, PROCESSING BY DOUG GRIFFIN, P. ENG. DATED 2023-05-25.
3. IMAGERY: MAXAR, MICROSOFT.

SPATIAL REFERENCE: NAD 1983 UTM ZONE 11N

CLIENT
BC HYDRO

PROJECT
BCH CLBWORKS 27 LCR BC

TITLE
SCENARIO 2
CALCULATED VOLUME OF PLACED MATERIAL

CONSULTANT
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PREPARED	JG
REVIEWED	RC
APPROVED	CV

PROJECT NO.	CONTROL	REV.	FIGURE
20449674	10000	1	6

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APPENDIX B

Table of Calculated Volumes

Table 1: Table of Calculated Volumes (Final Survey)

Basis of Volume Calculation from 25 May 2023 Final Survey	**Volume (m^3)**
Scenario 1 (See Figure 5)	3,368
Scenario 2 (See Figure 6)	2,727
Total Volume Placed within Placement Area (including 1 m tolerance buffer)	3,509
Total Volume Placed within Placement Area (including 1 m tolerance buffer) for all areas with > 0.3 m thickness	3,470

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