Memo

To:	Francis Dube, Project Manager, Government of Nunavut
From:	Harrison Roberts, Project Manager, Dillon Consulting Limited
cc:	Paul Clow, Government of Nunavut
	Elan Chalmers, Government of Nunavut
	Gord Marinic, Government of Nunavut
	Amy Jackson, Dillon Consulting Limited
	Kevin Jackman, Dillon Consulting Limited
	Vania Chivers, Dillon Consulting Limited
	Ron Kent, Senior Wetland Specialist, Independent Consultant
Date:	October 6, 2023
Subject:	Arviat WWTF – Wetland Field Assessment
Our File:	22-4921

Dillon Consulting Limited (Dillon) has been retained by The Government of Nunavut (GN) to provide engineering services for the design and construction of a new Waste Water Treatment Facility (WWTF) to meet Arviat's current and future waste water requirements for the next 20 years.

Upon project initiation, the GN provided Dillon with the *Nunami, Stantec Limited – Business Case for Arviat Wastewater – Final Report Rev 01* completed April 23, 2021. Dillon's wetland expert, Ron Kent, led a review of the business case and any relevant documents listed in the RFP. Following the review, Dillon completed a desktop wetland assessment of the existing natural wetland treatment area (WTA) according to the design guidelines suggested in CSA W203.19; the results of this assessment were included in Dillon's *Arviat Wastewater Treatment Facility - 75% Design Development Report* provided to the GN on April 23, 2023.

Upon completion of the Design Development Report, Dillon recommended a wetland field assessment in support of the design calculations. While a wetland field assessment would commonly be completed prior to design calculations, the project commenced after the annual operation period of the existing system (Fall 2022) and therefore a wetland field assessment was recommended in support of the design calculations to assist with timely project delivery. This memo outlines the objectives and results of the wetland field assessment.

1.0 Field Assessment

Dillon field staff visited the current lagoon and wetland treatment area in Arviat, Nunavut between August 8 and 11, 2023. The field team visually assessed the site focusing on flow patterns, erosion areas, external hydrological contributions, and background sources of contamination, such as landfill leachate. Dillon collected discrete water samples from four (4) locations, strategically representing distinct points within the study area. Prior to attending the site, the field crew visited the Hamlet Office to inform them of the activity on site and to learn history, operational considerations, and trouble spots. Further, Dillon hired a local wildlife monitor to accompany the field team while on site during the field visit. Georeferenced photos, notes, points of interest, sample locations, and the delineated wetland area were documented by the field team using ArcGIS Field Maps; the key site features are shown on the Study Area map included as Appendix A.

1.1 Wetland Assessment & Delineation

As part of the wetland assessment, the Dillon field team walked the perimeter and delineated the wetland treatment area according to vegetation type and patterns, and substrate/sediment. A total wetland area of 18 ha was delineated, as shown in Appendix A. Various flow paths, areas of ponded water, and sandy berms were observed throughout the delineated wetland area. These physical characteristics presented challenges when delineating the effective treatment area without the use of a tracer study. However, based upon the observed flow paths, the effective WTA was estimated to range between 8 and 18 ha. Further, an average slope of approximately 1.2% was observed between the lagoon discharge channel and the WTA outlet; this slope falls within the range (1-10%) for desired WTA site conditions, as suggested in CSA W203.19.

Taller grasses and other graminoids[1] were identified along the eastern portion of the WTA and closer to Hudson's Bay. The vegetation observed to the north and west was sparser and lower to the ground, including but not limited to, cloudberry (Figure 1, left), common cottongrass (Figure 1, right), and marsh cinquefoil. Willow shrubs were observed surrounding the ponded water throughout the WTA, and fireweed/dwarf fireweed were observed along the ATV trail that crossed through the southern portion of the wetland. A list of the vegetation observed throughout the WTA has been included in Table 1.

[1] Herbaceous plant with a grass-like morphology

Figure 1: Cloudberry (left), common cottongrass and other bog vegetation (right)

Table 1: List of plant species observed

Scientific Name	Common Name
Salix spp.	Willow
Chamaenerion angustifolium	Fireweed
Rubus chamaemorus	Cloudberry
Betula glandulosa	Dwarf birch
Empetrum nigrum	Black crowberry
Vaccinium vitis-idaea	Lingonberry
Eriophorum angustifolium	Common cottongrass
Hippuris vulgaris	Common Mare's Tail
Comarum palustre	Marsh cinquefoil
Oxyria digyna	Mountain Sorrel
Chamarion latifolium	Dwarf fireweed
Juncus triglumis subsp. Albescens	Bog rush

The substrate predominantly consisted of saturated sand, specifically throughout the eastern portion of the WTA in the vicinity of the lagoon and landfill. Depressed drainage channels that contained deeper organic soils were observed to the west, and webbed through the sandy substrate. Deeper organic soils were also observed along the southern portion of the WTA, closer to Hudson's Bay and particularly in the vicinity of the outlet channels (WC1 and WC2). A sandy upland area (Figure 2), and a sandy elevated all-terrain vehicle pathway were observed along the western and southeastern portions of the site respectively; the locations of these features are included on the map included as Appendix B.

Five (5) watercourses were observed throughout the WTA, as shown on the study area map included in Appendix A. The watercourses included two (2) flow paths discharging from the WTA into Hudson's Bay (WC1 and WC2), two (2) flow paths that appeared to be ephemeral drainage channels (WC3 and WC5), and one (1) inlet to the WTA that discharged from the pond adjacent to the lagoon (WC4). The field team noted that WC5 was a dry channel at the time of the field assessment, however, it was appeared as a mapped watercourse along the western portion of the WTA; the observed dry channel did not appear to extend as far south as the mapped watercourse. Watercourse data (wetted width, pH, depth, etc.) collected at the time of the field assessment had been included in Table 2.

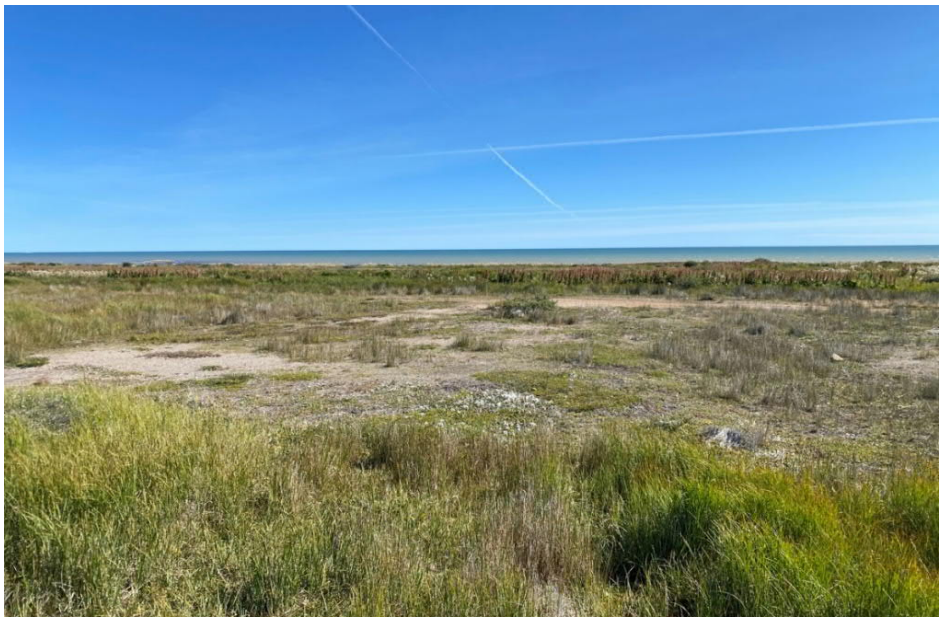


Figure 2: Sandy upland along the western side of the WTA

Table 2: Watercourse Information (August 8-11, 2023)

ID	Wetted Width (m)	Channel Width (m)	Depth (m)	Water Temp. (°C)	Conductivity (µS/cm)	pH	Substrate
WC1	0.40	0.50	0.05	8	953	6.45	Organic
WC2	0.75	1.0	0.05	15	960	6.83	Organic
WC3	0.75	1.00	0.05	-	-	-	Organic
WC4	2.00	2.50	0.15	-	-	-	Fines
WC5	0.50	0.75	0.10	-	-	-	Organic

A wetland area was further observed to the northwest of the WTA across a gravel roadway, as shown in Figure 3. At the time of the field assessment, no roadway culverts or surface flow connections between this wetland area and the delineated WTA were reported. Based on ponded water observed to the northwest of the gravel roadway (Figure 4), it is anticipated that water would overtop the roadway during periods of increased water, such as spring freshet. As the proposed lagoon decant would begin after spring freshet, this area has not been considered to provide external hydrological contributions to the WTA in the design calculations.

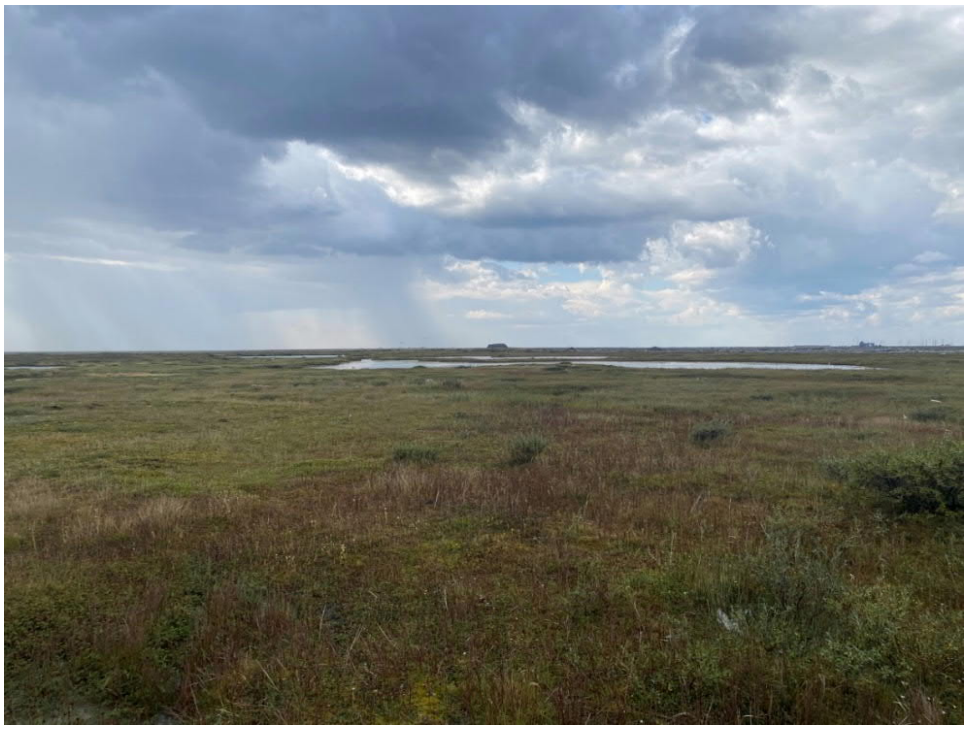


Figure 3: Wetland (not-delineated) northwest of the study area

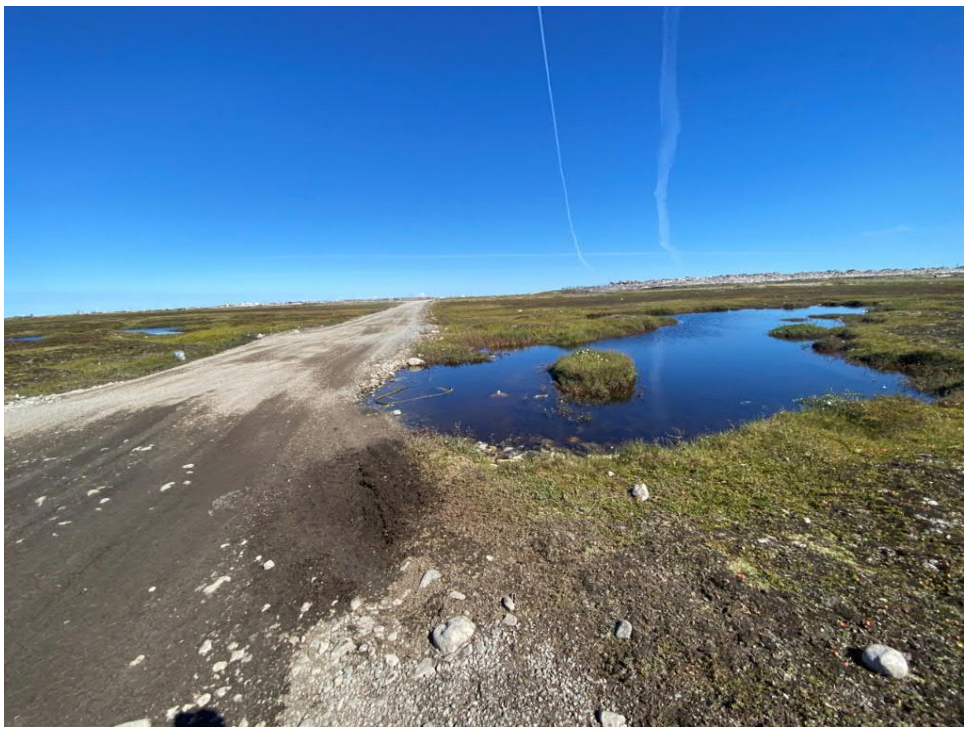


Figure 4: Gravel roadway and pooled water northwest of the WTA

No significant areas of erosion, external hydrological contributions, or background sources of contamination were identified during the wetland field assessment.

1.2 Points of Interest

Additional points of interested were documented by the field team using ArcGIS Field Maps and are shown on the map included as Appendix B; the corresponding identifiers and associated comments have been included in Appendix C.

1.3 Water Quality Results

In order to characterize the performance of the current wastewater treatment area, discrete water samples were collected from four (4) locations strategically representing distinct points within the study area. Water quality samples were analyzed for the following suite of parameters, commonly found in municipal wastewater effluent: carbonaceous biological oxygen demand (CBOD5), total suspended solids (TSS), *E. coli*, ammonia nitrogen (NH3), and heavy metals, including but not limited to arsenic, iron, copper, zinc, and nickel.

All sample analysis was completed by an accredited laboratory, with samples collected by Dillon field staff on August 9, 2023, and submitted to ALS Global Laboratories (ALS) in Winnipeg, Manitoba. Sample containers were received from ALS and were preloaded with preservatives specific to the requested suite of parameters. Samples were stored on ice at approximately 5°C until the time of analysis and were submitted to ALS within 48 hours of collection. The water quality sample locations are shown in Appendix A, and are described as follows:

- Lagoon effluent (LAGOON): Collected from the lagoon outlet channel to represent water concentrations entering the WTA;
- WTA effluent (WC2 OUTLET, WC1 OUTLET): Two samples collected, one from each watercourse discharging from the WTA to Hudson's Bay, to represent the concentrations entering the receiving environment; and,
- Reference (WL POND): Collected from a pond situated within the western sector of the delineated wetland, positioned at a considerable distance from the lagoon and landfill areas to represent freshwater in the surrounding area that had not been impacted by wastewater. It is noteworthy that the pond, while chosen for its location, exhibited the presence of refuse material, as did the entirety of the delineated wetland area.

The results of the water quality analyses are included in Table 3 below, and detailed lab reports have been included in Appendix D.

Table 3: Water Quality Results (August 10, 2023)

Parameter	Units	LAGOON	WC1 OUTLET	WC2 OUTLET	WL POND
BOD5	mg/L	252	225	70.9	<6.0
cBOD5	mg/L	238	116	70.4	<6.0
E. coli	MPN/100mL	>24200	80	1220	<10
TSS	mg/L	284	294	3500	6.2
Ammonia, total (as N)	mg/L	19.1	2.66	<0.100	<0.100

The results of the water quality analyses showed varying treatment performance results throughout the WTA. BOD5 reductions ranged from 11% to 70% between the lagoon discharge channel and the outlets at WC1 and WC2, respectively. Similarly, cBOD5 reductions ranged from approximately 51% to 71% between the lagoon discharge channel and the outlets at WC1 and WC2, respectively. This variation in treatment performance, may indicate that external factors are influencing BOD5 and cBOD5 concentrations in the vicinity of WC1.

TSS levels also varied significantly between the lagoon and outlet locations, with TSS increases reported at both WTA outlets. While TSS is a common water quality parameter used to evaluate the treatment performance of conventional systems, it has proved to be challenging when considering natural wetland environments as disturbances to vegetation and natural water inputs within a wetland can cause significant variability within TSS values[2].

The reported *E. coli* reductions varied between both WTA outlet locations, with both concentrations meeting the existing (1×10^4 CFU/100 mL) and proposed water license criteria (1×10^6 CFU/100 mL). Ammonia reductions throughout the wetland ranged from 86% to 99%. Based upon the reported ammonia concentrations, the water temperature, and pH measured in WC1 and WC2 at the time of the study, the calculated un-ionized ammonia concentrations (ranging up to 0.001 mg/L) would be below the water license criteria (1.25 mg/L) at both of the WTA outlet locations.

2.0 Conclusion and Recommendations

Dillon conducted the aforementioned wetland field assessment to support assumptions made regarding the physical characteristics of the WTA outlined in the *Arviat Wastewater Treatment Facility - 75% Design Development Report*. In this report, the design calculations assumed an effective WTA of 4.5 ha. According to the observations made by the field team during the field assessment, the study area hosts an effective WTA estimated at upwards of 8 ha.

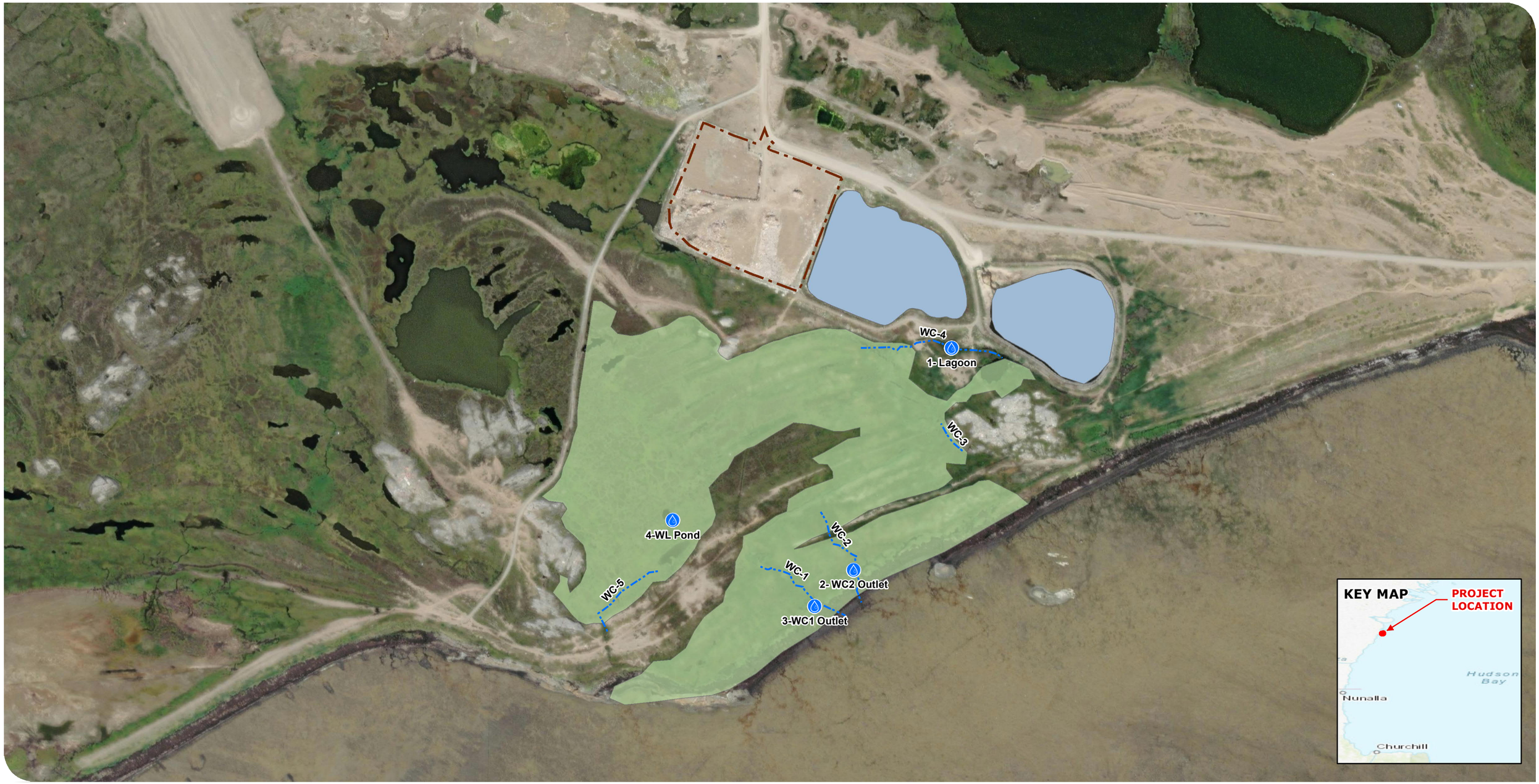
The visual assessment of the wetland confirmed that the treatment area hosts established wetland vegetation and substrate material capable of supporting wetland vegetation. Further, no significant areas of erosion, external hydrological contributions, or background sources of contamination were identified during the wetland field assessment.

Overall, the wetland field assessment supports the assumptions made the Design Development Report regarding the physical characteristics of the WTA treatment area.

[2] Balch, G., Hayward, J., Jamieson, R., Wootton, B., & Yates, C. N. (2018). Recommendations for the Use of Tundra Wetlands for Treatment of Municipal Wastewater in Canada's Far North. Multifunctional Wetlands: Pollution Abatement and Other Ecological Services from Natural and Constructed Wetlands (pp. 83–120). Springer International Publishing. https://doi.org/10.1007/978-3-319-67416-2_3

Appendix A

Study Area Map



GOVERNMENT OF NUNAVUT
Arviat Wastewater Treatment Facility

Surface Water Sample Location
Field Delineated Watercourse
Field Delineated Wetland
Solid Waste Site
Lagoon

STUDY AREA
FIGURE 1

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Dillon Consulting Limited, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: AJ
MAP PROJECTION: NAD 1983 CSRS UTM Zone 15N

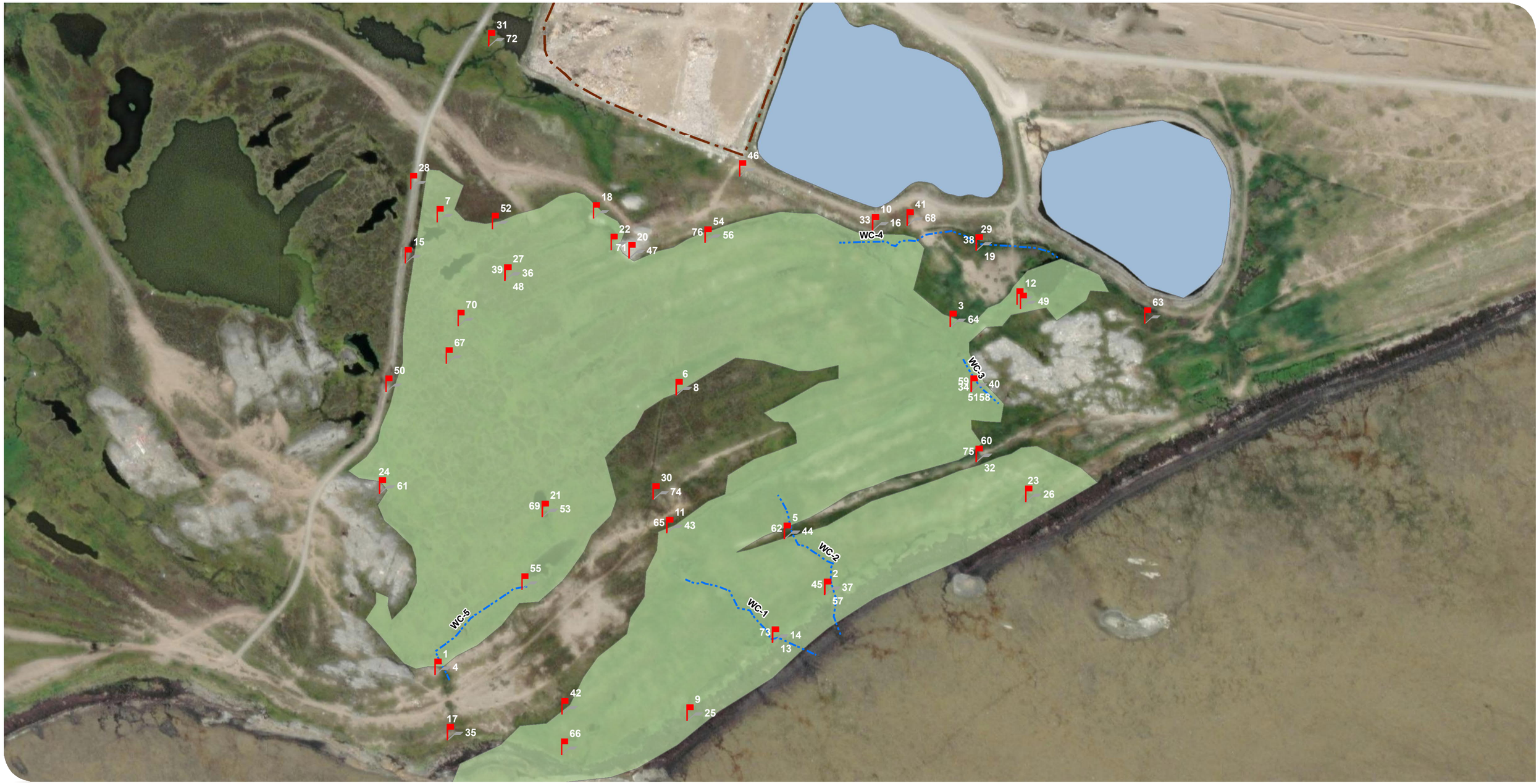
SCALE 1:5,000
0 0.05 0.1 0.2 km
N W E S

PROJECT: 224921 STATUS: DRAFT DATE: 2023-10-04

FILE LOCATION: K:\2022\224921\Product\Client\Report Figures_Oct 2023\F1_StudyArea.mxd

Appendix B

Points of Interest Map



GOVERNMENT OF NUNAVUT
Arviat Wastewater Treatment Facility

Arviat Point of Interest
Field Delineated Watercourse
Field Delineated Wetland
Solid Waste Site
Lagoon

POINT OF INTEREST
FIGURE 2

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY Dillon Consulting Limited, ESRI

MAP CREATED BY: SCM
MAP CHECKED BY: AJ
MAP PROJECTION: NAD 1983 CSRS UTM Zone 15N

SCALE 1:3,249

0 0.035 0.07 0.14 km

N W E S

PROJECT: 224921 STATUS: DRAFT DATE: 2023-10-05

FILE LOCATION: K:\2022\224921\Product\Client\Report Figures_Oct 2023\F2_PointsofInterest.mxd

Appendix C

Points of Interest Table

Table A-1: Points of Interest

Point of Interest	Comment	Type
1		Photo
2	Mapped wetland outlet channel.	Photo
3		Photo
4		Photo
5		Photo
6		Photo
7		Photo
8		Photo
9		Photo
10		Photo
11		Photo
12	Water likely flows out of pond over quad road during high water events.	Outlet
13		Photo
14		Photo
15		Photo
16		Photo
17	Mapped outlet, no flow or channel observed.	Other
18		Photo
19		Photo
20		Photo
21	Wetland water sample location. Some garbage.	Photo
22		Photo
23	Near water the land becomes extremely saturated	Photo
24	Cottongrass and other bog species on this end of wetland	Photo
25		Photo
26	Near water the land becomes extremely saturated	Photo
27	Barren sandy land with drainage channels throughout. Sand is saturated.	Other
28	Area to northwest is all wetland	Photo
29		Photo
30	Sandy upland.	Photo
31	Area to the west is all wetland	Photo
32	Sandy, elevated ATV trail	Other
33		Photo
34		Photo
35	Mapped outlet, no flow or channel observed.	Other
36	Barren sandy land with drainage channels throughout. Sand is saturated.	Other
37	Mapped wetland outlet channel.	Photo
38		Photo
39	Barren sandy land with drainage channels throughout. Sand is saturated.	Other
40		Photo

Point of Interest	Comment	Type
41	~3-4m berm along boundary of lagoons and dump.	Other
42		Photo
43		Photo
44		Photo
45	Mapped wetland outlet channel.	Photo
46		Photo
47		Photo
48	Barren sandy land with drainage channels throughout. Sand is saturated.	Other
49		Photo
50	Several flow channels weaving through area.	Photo
51		Photo
52		Photo
53	Wetland water sample location. Some garbage.	Photo
54	Wet strip like a ravine. Flow is east to west.	Other
55		Photo
56	Wet strip like a ravine. Flow is east to west.	Other
57	Mapped wetland outlet channel.	Photo
58		Photo
59		Photo
60	Sandy, elevated ATV trail	Other
61	Cottongrass and other bog species on this end of wetland	Photo
62		Photo
63	Drainage ditch outside lagoon fence.	Other
64		Photo
65		Photo
66		Photo
67		Photo
68	~3-4m berm along boundary of lagoons and dump.	Other
69	Wetland water sample location. Some garbage.	Photo
70		Photo
71		Photo
72	Area to the west is all wetland	Photo
73		Photo
74	Sandy upland.	Photo
75	Sandy, elevated ATV trail	Other
76	Wet strip like a ravine. Flow is east to west.	Other

Appendix D

Water Quality Analytical Results

CERTIFICATE OF ANALYSIS

Work Order	: **WP2319096**	Page	: 1 of 4
Amendment	: **1**		
Client	: **Dillon Consulting Limited**	Laboratory	: ALS Environmental - Winnipeg
Contact	: Amy Jackson	Account Manager	: Judy Dalmaijer
Address	: 1558 Willson Place Winnipeg MB Canada R3T 0Y4	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg MB Canada R2J 3T4
Telephone	: 204 453 2301	Telephone	: +1 204 255 9720
Project	: 22-4921-2060-00	Date Samples Received	: 12-Aug-2023 07:30
PO	: ----	Date Analysis Commenced	: 12-Aug-2023
C-O-C number	: ----	Issue Date	: 21-Aug-2023 09:42
Sampler	: ----		
Site	: ----		
Quote number	: Analytical Testing - Watermain		
No. of samples received	: 4		
No. of samples analysed	: 4		

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*
Lee McTavish		Inorganics, Winnipeg, Manitoba
Lee McTavish		Metals, Winnipeg, Manitoba
William Lake	Analyst	Microbiology, Winnipeg, Manitoba

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*
mg/L	milligrams per litre
MPN/100mL	most probable number per hundred millilitres

<: 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*
DLM	*Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).*

Analytical Results

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

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID: 1-LAGOON	2-WC2 OUTLET	3-WC1 OUTLET	4-WL POND	----
Client sampling date / time					10-Aug-2023 12:34	10-Aug-2023 12:55	10-Aug-2023 13:16	10-Aug-2023 13:35	----
					WP2319096-001	WP2319096-002	WP2319096-003	WP2319096-004	--------
					Result	Result	Result	Result	----
Physical Tests									
Solids, total suspended [TSS]	----	E160/WP	3.0	mg/L	284	3500	294	6.2	----
Anions and Nutrients									
Ammonia, total (as N)	7664-41-7	E303/WP	0.010	mg/L	19.1	<0.100 DLM	2.66	<0.100 DLM	----
Microbiological Tests									
Coliforms, Escherichia coli [E. coli]	----	E010-H/WP	10	MPN/100mL	>24200	1220	80	<10	----
Total Metals									
Aluminum, total	7429-90-5	E420/WP	0.0030	mg/L	0.468	0.498	1.11	0.226	----
Antimony, total	7440-36-0	E420/WP	0.00010	mg/L	0.00052	0.00020	0.00050	0.00010	----
Arsenic, total	7440-38-2	E420/WP	0.00010	mg/L	0.0106	0.00843	0.0122	0.00393	----
Barium, total	7440-39-3	E420/WP	0.00010	mg/L	0.0610	0.0886	0.422	0.00438	----
Beryllium, total	7440-41-7	E420/WP	0.000020	mg/L	0.000030	0.000070	0.000164	0.000033	----
Bismuth, total	7440-69-9	E420/WP	0.000050	mg/L	0.000798	<0.000050	0.000175	<0.000050	----
Boron, total	7440-42-8	E420/WP	0.010	mg/L	0.279	0.156	0.171	0.075	----
Cadmium, total	7440-43-9	E420/WP	0.0000050	mg/L	0.000137	0.000138	0.000312	0.0000526	----
Calcium, total	7440-70-2	E420/WP	0.050	mg/L	21.8	22.6	38.5	3.98	----
Cesium, total	7440-46-2	E420/WP	0.000010	mg/L	0.000113	0.000036	0.000073	0.000033	----
Chromium, total	7440-47-3	E420/WP	0.00050	mg/L	0.00219	0.00379	0.00825	0.00148	----
Cobalt, total	7440-48-4	E420/WP	0.00010	mg/L	0.00309	0.00319	0.00221	0.00046	----
Copper, total	7440-50-8	E420/WP	0.00050	mg/L	0.120	0.00492	0.0285	0.00097	----
Iron, total	7439-89-6	E420/WP	0.010	mg/L	17.2	22.5	93.2	1.59	----
Lead, total	7439-92-1	E420/WP	0.000050	mg/L	0.00326	0.000694	0.00283	0.000692	----
Lithium, total	7439-93-2	E420/WP	0.0010	mg/L	0.0080	0.0067	0.0063	0.0050	----
Magnesium, total	7439-95-4	E420/WP	0.0050	mg/L	22.8	21.3	23.3	3.64	----
Manganese, total	7439-96-5	E420/WP	0.00010	mg/L	0.310	3.52	0.659	0.0102	----
Molybdenum, total	7439-98-7	E420/WP	0.000050	mg/L	0.00162	0.000256	0.000898	0.000135	----
Nickel, total	7440-02-0	E420/WP	0.00050	mg/L	0.00788	0.00449	0.00912	0.00254	----
Phosphorus, total	7723-14-0	E420/WP	0.050	mg/L	14.3	7.81	40.6	0.359	----
Potassium, total	7440-09-7	E420/WP	0.050	mg/L	36.5	11.9	11.7	2.60	----
Rubidium, total	7440-17-7	E420/WP	0.00020	mg/L	0.0344	0.00854	0.0121	0.00336	----

Analytical Results

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

Analyte	CAS Number	Method/Lab	LOR	Unit	Client sample ID	1-LAGOON	2-WC2 OUTLET	3-WC1 OUTLET	4-WL POND	----
					Client sampling date / time	10-Aug-2023 12:34	10-Aug-2023 12:55	10-Aug-2023 13:16	10-Aug-2023 13:35	----
						WP2319096-001	WP2319096-002	WP2319096-003	WP2319096-004	--------
						Result	Result	Result	Result	----
Total Metals										
Selenium, total	7782-49-2	E420/WP	0.000050	mg/L		0.000497	0.000207	0.000449	0.000118	----
Silicon, total	7440-21-3	E420/WP	0.10	mg/L		4.61	1.97	5.17	0.29	----
Silver, total	7440-22-4	E420/WP	0.000010	mg/L		0.000196	0.000030	0.000129	<0.000010	----
Sodium, total	7440-23-5	E420/WP	0.050	mg/L		177	154	149	29.8	----
Strontium, total	7440-24-6	E420/WP	0.00020	mg/L		0.221	0.452	1.60	0.140	----
Sulfur, total	7704-34-9	E420/WP	0.50	mg/L		14.7	4.14	9.72	3.95	----
Tellurium, total	13494-80-9	E420/WP	0.00020	mg/L		<0.00020	<0.00020	<0.00020	<0.00020	----
Thallium, total	7440-28-0	E420/WP	0.000010	mg/L		0.000070	0.000016	0.000049	<0.000010	----
Thorium, total	7440-29-1	E420/WP	0.00010	mg/L		0.00013	0.00036	0.00079	0.00016	----
Tin, total	7440-31-5	E420/WP	0.00010	mg/L		0.00095	0.00015	0.00065	<0.00010	----
Titanium, total	7440-32-6	E420/WP	0.00030	mg/L		0.0316	0.0222	0.0577	0.00578	----
Tungsten, total	7440-33-7	E420/WP	0.00010	mg/L		0.00057	0.00023	0.00032	<0.00010	----
Uranium, total	7440-61-1	E420/WP	0.000010	mg/L		0.000492	0.000420	0.00132	0.000129	----
Vanadium, total	7440-62-2	E420/WP	0.00050	mg/L		0.00832	0.0117	0.0115	0.00233	----
Zinc, total	7440-66-6	E420/WP	0.0030	mg/L		0.0726	0.0092	0.0264	<0.0030	----
Zirconium, total	7440-67-7	E420/WP	0.00020	mg/L		0.00104	0.00214	0.00253	0.00066	----
Aggregate Organics										
Biochemical oxygen demand [BOD]	----	E550/WP	2.0	mg/L		252	70.9	225	<6.0	----
Carbonaceous biochemical oxygen demand [CBOD]	----	E555/WP	2.0	mg/L		238	70.4	116	<6.0	----

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

Please refer to the Accreditation section for an explanation of analyte accreditations.

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QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WP2319096**	Page	: 1 of 7
Amendment	: 1		
Client	: **Dillon Consulting Limited**	Laboratory	: ALS Environmental - Winnipeg
Contact	: Amy Jackson	Account Manager	: Judy Dalmaijer
Address	: 1558 Willson Place Winnipeg MB Canada R3T 0Y4	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg, Manitoba Canada R2J 3T4
Telephone	: 204 453 2301	Telephone	: +1 204 255 9720
Project	: 22-4921-2060-00	Date Samples Received	: 12-Aug-2023 07:30
PO	: ----	Issue Date	: 21-Aug-2023 09:43
C-O-C number	: ----		
Sampler	: ----		
Site	: ----		
Quote number	: Analytical Testing - Watermain		
No. of samples received	: 4		
No. of samples analysed	: 4		

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
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d]										
1-LAGOON	E550	10-Aug-2023	----	----	----		12-Aug-2023	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d]										
2-WC2 OUTLET	E550	10-Aug-2023	----	----	----		12-Aug-2023	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d]										
3-WC1 OUTLET	E550	10-Aug-2023	----	----	----		12-Aug-2023	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand - 5 day										
HDPE [BOD HT 3d]										
4-WL POND	E550	10-Aug-2023	----	----	----		12-Aug-2023	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand (Carbonaceous) - 5 day										
HDPE [BOD HT 3d]										
1-LAGOON	E555	10-Aug-2023	----	----	----		12-Aug-2023	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand (Carbonaceous) - 5 day										
HDPE [BOD HT 3d]										
2-WC2 OUTLET	E555	10-Aug-2023	----	----	----		12-Aug-2023	3 days	2 days	✓
Aggregate Organics : Biochemical Oxygen Demand (Carbonaceous) - 5 day										
HDPE [BOD HT 3d]										
3-WC1 OUTLET	E555	10-Aug-2023	----	----	----		12-Aug-2023	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
Aggregate Organics : Biochemical Oxygen Demand (Carbonaceous) - 5 day										
HDPE [BOD HT 3d] 4-WL POND	E555	10-Aug-2023	----	----	----		12-Aug-2023	3 days	2 days	✓
Anions and Nutrients : Ammonia in Water by Colour										
Amber glass total (sulfuric acid) 1-LAGOON	E303	10-Aug-2023	14-Aug-2023	28 days	4 days	✓	14-Aug-2023	28 days	4 days	✓
Anions and Nutrients : Ammonia in Water by Colour										
Amber glass total (sulfuric acid) 2-WC2 OUTLET	E303	10-Aug-2023	14-Aug-2023	28 days	4 days	✓	14-Aug-2023	28 days	4 days	✓
Anions and Nutrients : Ammonia in Water by Colour										
Amber glass total (sulfuric acid) 3-WC1 OUTLET	E303	10-Aug-2023	14-Aug-2023	28 days	4 days	✓	14-Aug-2023	28 days	4 days	✓
Anions and Nutrients : Ammonia in Water by Colour										
Amber glass total (sulfuric acid) 4-WL POND	E303	10-Aug-2023	14-Aug-2023	28 days	4 days	✓	14-Aug-2023	28 days	4 days	✓
Microbiological Tests : Total Coliforms and E. coli (Enzyme Substrate)- 1:10										
Sterile HDPE (Sodium thiosulphate) 4-WL POND	E010-H	10-Aug-2023	----	----	----		12-Aug-2023	30 hrs	45 hrs	× EHTR
Microbiological Tests : Total Coliforms and E. coli (Enzyme Substrate)- 1:10										
Sterile HDPE (Sodium thiosulphate) 1-LAGOON	E010-H	10-Aug-2023	----	----	----		12-Aug-2023	30 hrs	46 hrs	× EHTR
Microbiological Tests : Total Coliforms and E. coli (Enzyme Substrate)- 1:10										
Sterile HDPE (Sodium thiosulphate) 2-WC2 OUTLET	E010-H	10-Aug-2023	----	----	----		12-Aug-2023	30 hrs	46 hrs	× EHTR
Microbiological Tests : Total Coliforms and E. coli (Enzyme Substrate)- 1:10										
Sterile HDPE (Sodium thiosulphate) 3-WC1 OUTLET	E010-H	10-Aug-2023	----	----	----		12-Aug-2023	30 hrs	46 hrs	× EHTR

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										
HDPE 1-LAGOON	E160	10-Aug-2023	----	----	----		15-Aug-2023	7 days	5 days	✓
Physical Tests : TSS by Gravimetry										
HDPE 2-WC2 OUTLET	E160	10-Aug-2023	----	----	----		15-Aug-2023	7 days	5 days	✓
Physical Tests : TSS by Gravimetry										
HDPE 3-WC1 OUTLET	E160	10-Aug-2023	----	----	----		15-Aug-2023	7 days	5 days	✓
Physical Tests : TSS by Gravimetry										
HDPE 4-WL POND	E160	10-Aug-2023	----	----	----		15-Aug-2023	7 days	5 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid) 1-LAGOON	E420	10-Aug-2023	15-Aug-2023	180 days	5 days	✓	15-Aug-2023	180 days	5 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid) 2-WC2 OUTLET	E420	10-Aug-2023	15-Aug-2023	180 days	5 days	✓	15-Aug-2023	180 days	5 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid) 3-WC1 OUTLET	E420	10-Aug-2023	15-Aug-2023	180 days	5 days	✓	15-Aug-2023	180 days	5 days	✓
Total Metals : Total metals in Water by CRC ICPMS										
HDPE total (nitric acid) 4-WL POND	E420	10-Aug-2023	15-Aug-2023	180 days	5 days	✓	15-Aug-2023	180 days	5 days	✓

Legend & Qualifier Definitions

EHTR: Exceeded ALS recommended hold time prior to sample receipt.

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)							
Ammonia in Water by Colour	E303	1083900	1	20	5.0	5.0	✓
Biochemical Oxygen Demand - 5 day	E550	1083828	1	4	25.0	5.0	✓
Biochemical Oxygen Demand (Carbonaceous) - 5 day	E555	1083829	1	4	25.0	5.0	✓
Total Coliforms and E. coli (Enzyme Substrate)- 1:10	E010-H	1083884	1	4	25.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	1085295	1	20	5.0	5.0	✓
TSS by Gravimetry	E160	1084299	1	19	5.2	5.0	✓
Laboratory Control Samples (LCS)							
Ammonia in Water by Colour	E303	1083900	1	20	5.0	5.0	✓
Biochemical Oxygen Demand - 5 day	E550	1083828	1	4	25.0	5.0	✓
Biochemical Oxygen Demand (Carbonaceous) - 5 day	E555	1083829	1	4	25.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	1085295	1	20	5.0	5.0	✓
TSS by Gravimetry	E160	1084299	1	19	5.2	5.0	✓
Method Blanks (MB)							
Ammonia in Water by Colour	E303	1083900	1	20	5.0	5.0	✓
Biochemical Oxygen Demand - 5 day	E550	1083828	1	4	25.0	5.0	✓
Biochemical Oxygen Demand (Carbonaceous) - 5 day	E555	1083829	1	4	25.0	5.0	✓
Total Coliforms and E. coli (Enzyme Substrate)- 1:10	E010-H	1083884	1	4	25.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	1085295	1	20	5.0	5.0	✓
TSS by Gravimetry	E160	1084299	1	19	5.2	5.0	✓
Matrix Spikes (MS)							
Ammonia in Water by Colour	E303	1083900	1	20	5.0	5.0	✓
Total metals in Water by CRC ICPMS	E420	1085295	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
Total Coliforms and E. coli (Enzyme Substrate) - 1:10	E010-H ALS Environmental - Winnipeg	Water	APHA 9223 (mod)	The enzyme substrate test simultaneously detects Total Coliforms and E. coli in a 100 mL sample after incubation at 35.0 ±0.5°C for either 18 or 24 hours (dependent on reagent used). Sample dilution performed.
TSS by Gravimetry	E160 ALS Environmental - Winnipeg	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.
Ammonia in Water by Colour	E303 ALS Environmental - Winnipeg	Water	APHA 4500 NH3-NITROGEN (AMMONIA)	This analysis is carried out using procedures adapted from APHA Method 4500 NH3 "NITROGEN (AMMONIA)". Ammonia is determined using the automated phenate colourimetric method.
Total metals in Water by CRC ICPMS	E420 ALS Environmental - Winnipeg	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.
Biochemical Oxygen Demand - 5 day	E550 ALS Environmental - Winnipeg	Water	APHA 5210 B (mod)	Samples are diluted and incubated for a specified time period, after which the oxygen depletion is measured using a dissolved oxygen meter. Free chlorine is a negative interference in the BOD method; please advise ALS when free chlorine is present in samples.
Biochemical Oxygen Demand (Carbonaceous) - 5 day	E555 ALS Environmental - Winnipeg	Water	APHA 5210 B (mod)	Samples are diluted and incubated for a specified time period, after which the oxygen depletion is measured using a dissolved oxygen meter. Nitrification inhibitor is added to samples to prevent nitrogenous compounds from consuming oxygen resulting in only carbonaceous oxygen demand being reported by this method. Free chlorine is a negative interference in the BOD method; please advise ALS when free chlorine is present in samples.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Preparation for Ammonia	EP298 ALS Environmental - Winnipeg	Water		Sample preparation for Preserved Nutrients Water Quality Analysis.

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QUALITY CONTROL REPORT

Work Order	: **WP2319096**	Page	: 1 of 10
Amendment	: **1**		
Client	: Dillon Consulting Limited	Laboratory	: ALS Environmental - Winnipeg
Contact	: Amy Jackson	Account Manager	: Judy Dalmaijer
Address	: 1558 Willson Place Winnipeg MB Canada R3T 0Y4	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg, Manitoba Canada R2J 3T4
Telephone	:	Telephone	: +1 204 255 9720
Project	: 22-4921-2060-00	Date Samples Received	: 12-Aug-2023 07:30
PO	: ----	Date Analysis Commenced	: 12-Aug-2023
C-O-C number	: ----	Issue Date	: 21-Aug-2023 09:42
Sampler	: ---- 204 453 2301		
Site	: ----		
Quote number	: Analytical Testing - Watermain		
No. of samples received	: 4		
No. of samples analysed	: 4		

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*
Lee McTavish		Winnipeg Inorganics, Winnipeg, Manitoba
Lee McTavish		Winnipeg Metals, Winnipeg, Manitoba
William Lake	Analyst	Winnipeg Microbiology, Winnipeg, Manitoba

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: 1084299)											
WP2319096-001	1-LAGOON	Solids, total suspended [TSS]	----	E160	7.5	mg/L	284	338	17.4%	20%	----
Anions and Nutrients (QC Lot: 1083900)											
WP2319094-001	Anonymous	Ammonia, total (as N)	7664-41-7	E303	0.100	mg/L	0.838	0.819	0.019	Diff <2x LOR	----
Microbiological Tests (QC Lot: 1083884)											
WP2319096-004	4-WL POND	Coliforms, Escherichia coli [E. coli]	----	E010-H	10	MPN/100mL	<10	<10	0	Diff <2x LOR	----
Total Metals (QC Lot: 1085295)											
WP2319062-001	Anonymous	Aluminum, total	7429-90-5	E420	0.0030	mg/L	0.0047	0.0048	0.00009	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	0.00046	0.00047	0.000008	Diff <2x LOR	----
		Barium, total	7440-39-3	E420	0.00010	mg/L	0.0169	0.0161	4.77%	20%	----
		Beryllium, total	7440-41-7	E420	0.000020	mg/L	<0.000020	<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	0.011	0.010	0.0006	Diff <2x LOR	----
		Cadmium, total	7440-43-9	E420	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
		Calcium, total	7440-70-2	E420	0.050	mg/L	21.3	21.6	1.15%	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	0.00068	0.00067	0.00001	Diff <2x LOR	----
		Copper, total	7440-50-8	E420	0.00050	mg/L	0.0359	0.0356	0.941%	20%	----
		Iron, total	7439-89-6	E420	0.010	mg/L	0.039	0.040	0.0009	Diff <2x LOR	----
		Lead, total	7439-92-1	E420	0.000050	mg/L	0.000064	0.000063	0.0000007	Diff <2x LOR	----
		Lithium, total	7439-93-2	E420	0.0010	mg/L	0.0024	0.0023	0.00003	Diff <2x LOR	----
		Magnesium, total	7439-95-4	E420	0.0050	mg/L	5.99	6.00	0.261%	20%	----
		Manganese, total	7439-96-5	E420	0.00010	mg/L	0.0106	0.0104	1.82%	20%	----
		Molybdenum, total	7439-98-7	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Nickel, total	7440-02-0	E420	0.00050	mg/L	0.00216	0.00206	0.00010	Diff <2x LOR	----
		Phosphorus, total	7723-14-0	E420	0.050	mg/L	0.752	0.743	1.21%	20%	----
		Potassium, total	7440-09-7	E420	0.050	mg/L	1.26	1.25	0.740%	20%	----
		Rubidium, total	7440-17-7	E420	0.00020	mg/L	0.00200	0.00197	0.00003	Diff <2x LOR	----
		Selenium, total	7782-49-2	E420	0.000050	mg/L	<0.000050	<0.000050	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: 1085295) - continued											
WP2319062-001	Anonymous	Silicon, total	7440-21-3	E420	0.10	mg/L	3.18	3.28	2.93%	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	27.4	27.5	0.548%	20%	----
		Strontium, total	7440-24-6	E420	0.00020	mg/L	0.0386	0.0391	1.52%	20%	----
		Sulfur, total	7704-34-9	E420	0.50	mg/L	21.5	22.8	5.87%	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	----
		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	<0.000010	<0.000010	0	Diff <2x LOR	----
		Vanadium, total	7440-62-2	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Zinc, total	7440-66-6	E420	0.0030	mg/L	0.0046	0.0047	0.00004	Diff <2x LOR	----
		Zirconium, total	7440-67-7	E420	0.00020	mg/L	<0.00020	<0.00020	0	Diff <2x LOR	----
Aggregate Organics (QC Lot: 1083828)											
WP2319096-002	2-WC2 OUTLET	Biochemical oxygen demand [BOD]	----	E550	50.0	mg/L	70.9	70.9	0.0%	30%	----
Aggregate Organics (QC Lot: 1083829)											
WP2319096-001	1-LAGOON	Carbonaceous biochemical oxygen demand [CBOD]	----	E555	50.0	mg/L	238	252	6.0%	30%	----

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: 1084299)						
Solids, total suspended [TSS]	----	E160	3	mg/L	<3.0	----
Anions and Nutrients (QCLot: 1083900)						
Ammonia, total (as N)	7664-41-7	E303	0.01	mg/L	<0.010	----
Microbiological Tests (QCLot: 1083884)						
Coliforms, Escherichia coli [E. coli]	----	E010-H	10	MPN/100mL	<10	----
Total Metals (QCLot: 1085295)						
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	----
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	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 1085295) - continued						
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	----
Aggregate Organics (QCLot: 1083828)						
Biochemical oxygen demand [BOD]	----	E550	2	mg/L	<2.0	----
Aggregate Organics (QCLot: 1083829)						
Carbonaceous biochemical oxygen demand [CBOD]	----	E555	2	mg/L	<2.0	----

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: 1084299)									
Solids, total suspended [TSS]	----	E160	3	mg/L	150 mg/L	109	85.0	115	----
Anions and Nutrients (QCLot: 1083900)									
Ammonia, total (as N)	7664-41-7	E303	0.01	mg/L	0.25 mg/L	97.1	85.0	115	----
Total Metals (QCLot: 1085295)									
Aluminum, total	7429-90-5	E420	0.003	mg/L	2 mg/L	108	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	103	80.0	120	----
Barium, total	7440-39-3	E420	0.0001	mg/L	0.25 mg/L	108	80.0	120	----
Beryllium, total	7440-41-7	E420	0.00002	mg/L	0.1 mg/L	102	80.0	120	----
Bismuth, total	7440-69-9	E420	0.00005	mg/L	1 mg/L	107	80.0	120	----
Boron, total	7440-42-8	E420	0.01	mg/L	1 mg/L	96.7	80.0	120	----
Cadmium, total	7440-43-9	E420	0.000005	mg/L	0.1 mg/L	103	80.0	120	----
Calcium, total	7440-70-2	E420	0.05	mg/L	50 mg/L	103	80.0	120	----
Cesium, total	7440-46-2	E420	0.00001	mg/L	0.05 mg/L	98.2	80.0	120	----
Chromium, total	7440-47-3	E420	0.0005	mg/L	0.25 mg/L	105	80.0	120	----
Cobalt, total	7440-48-4	E420	0.0001	mg/L	0.25 mg/L	103	80.0	120	----
Copper, total	7440-50-8	E420	0.0005	mg/L	0.25 mg/L	105	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	103	80.0	120	----
Lithium, total	7439-93-2	E420	0.001	mg/L	0.25 mg/L	103	80.0	120	----
Magnesium, total	7439-95-4	E420	0.005	mg/L	50 mg/L	110	80.0	120	----
Manganese, total	7439-96-5	E420	0.0001	mg/L	0.25 mg/L	103	80.0	120	----
Molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.25 mg/L	103	80.0	120	----
Nickel, total	7440-02-0	E420	0.0005	mg/L	0.5 mg/L	104	80.0	120	----
Phosphorus, total	7723-14-0	E420	0.05	mg/L	10 mg/L	109	80.0	120	----
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	103	80.0	120	----
Selenium, total	7782-49-2	E420	0.00005	mg/L	1 mg/L	100	80.0	120	----
Silicon, total	7440-21-3	E420	0.1	mg/L	10 mg/L	105	80.0	120	----
Silver, total	7440-22-4	E420	0.00001	mg/L	0.1 mg/L	97.1	80.0	120	----
Sodium, total	7440-23-5	E420	0.05	mg/L	50 mg/L	105	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: 1085295) - continued									
Strontium, total	7440-24-6	E420	0.0002	mg/L	0.25 mg/L	98.8	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	97.5	80.0	120	----
Thallium, total	7440-28-0	E420	0.00001	mg/L	1 mg/L	102	80.0	120	----
Thorium, total	7440-29-1	E420	0.0001	mg/L	0.1 mg/L	102	80.0	120	----
Tin, total	7440-31-5	E420	0.0001	mg/L	0.5 mg/L	102	80.0	120	----
Titanium, total	7440-32-6	E420	0.0003	mg/L	0.25 mg/L	104	80.0	120	----
Tungsten, total	7440-33-7	E420	0.0001	mg/L	0.1 mg/L	100	80.0	120	----
Uranium, total	7440-61-1	E420	0.00001	mg/L	0.005 mg/L	105	80.0	120	----
Vanadium, total	7440-62-2	E420	0.0005	mg/L	0.5 mg/L	106	80.0	120	----
Zinc, total	7440-66-6	E420	0.003	mg/L	0.5 mg/L	107	80.0	120	----
Zirconium, total	7440-67-7	E420	0.0002	mg/L	0.1 mg/L	101	80.0	120	----
Aggregate Organics (QCLot: 1083828)									
Biochemical oxygen demand [BOD]	----	E550	2	mg/L	198 mg/L	101	85.0	115	----
Aggregate Organics (QCLot: 1083829)									
Carbonaceous biochemical oxygen demand [CBOD]	----	E555	2	mg/L	198 mg/L	98.3	85.0	115	----

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: 1083900)										
WP2319094-001	Anonymous	Ammonia, total (as N)	7664-41-7	E303	ND mg/L	0.25 mg/L	ND	75.0	125	----
Total Metals (QCLot: 1085295)										
WP2319062-001	Anonymous	Aluminum, total	7429-90-5	E420	0.197 mg/L	0.2 mg/L	98.5	70.0	130	----
		Antimony, total	7440-36-0	E420	0.0201 mg/L	0.02 mg/L	101	70.0	130	----
		Arsenic, total	7440-38-2	E420	0.0198 mg/L	0.02 mg/L	99.2	70.0	130	----
		Barium, total	7440-39-3	E420	0.0189 mg/L	0.02 mg/L	94.4	70.0	130	----
		Beryllium, total	7440-41-7	E420	0.0399 mg/L	0.04 mg/L	99.7	70.0	130	----
		Bismuth, total	7440-69-9	E420	0.0106 mg/L	0.01 mg/L	106	70.0	130	----
		Boron, total	7440-42-8	E420	0.098 mg/L	0.1 mg/L	98.5	70.0	130	----
		Cadmium, total	7440-43-9	E420	0.00399 mg/L	0.004 mg/L	99.8	70.0	130	----
		Calcium, total	7440-70-2	E420	ND mg/L	4 mg/L	ND	70.0	130	----
		Cesium, total	7440-46-2	E420	0.00944 mg/L	0.01 mg/L	94.4	70.0	130	----
		Chromium, total	7440-47-3	E420	0.0402 mg/L	0.04 mg/L	101	70.0	130	----
		Cobalt, total	7440-48-4	E420	0.0201 mg/L	0.02 mg/L	101	70.0	130	----
		Copper, total	7440-50-8	E420	ND mg/L	0.02 mg/L	ND	70.0	130	----
		Iron, total	7439-89-6	E420	1.99 mg/L	2 mg/L	99.4	70.0	130	----
		Lead, total	7439-92-1	E420	0.0211 mg/L	0.02 mg/L	105	70.0	130	----
		Lithium, total	7439-93-2	E420	0.0971 mg/L	0.1 mg/L	97.1	70.0	130	----
		Magnesium, total	7439-95-4	E420	ND mg/L	1 mg/L	ND	70.0	130	----
		Manganese, total	7439-96-5	E420	0.0197 mg/L	0.02 mg/L	98.6	70.0	130	----
		Molybdenum, total	7439-98-7	E420	0.0202 mg/L	0.02 mg/L	101	70.0	130	----
		Nickel, total	7440-02-0	E420	0.0395 mg/L	0.04 mg/L	98.7	70.0	130	----
		Phosphorus, total	7723-14-0	E420	10.2 mg/L	10 mg/L	102	70.0	130	----
		Potassium, total	7440-09-7	E420	4.05 mg/L	4 mg/L	101	70.0	130	----
		Rubidium, total	7440-17-7	E420	0.0200 mg/L	0.02 mg/L	99.8	70.0	130	----
		Selenium, total	7782-49-2	E420	0.0397 mg/L	0.04 mg/L	99.3	70.0	130	----
		Silicon, total	7440-21-3	E420	9.91 mg/L	10 mg/L	99.1	70.0	130	----
		Silver, total	7440-22-4	E420	0.00390 mg/L	0.004 mg/L	97.6	70.0	130	----
		Sodium, total	7440-23-5	E420	ND mg/L	2 mg/L	ND	70.0	130	----
		Strontium, total	7440-24-6	E420	ND mg/L	0.02 mg/L	ND	70.0	130	----
		Sulfur, total	7704-34-9	E420	ND mg/L	20 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: 1085295) - continued										
WP2319062-001	Anonymous	Tellurium, total	13494-80-9	E420	0.0388 mg/L	0.04 mg/L	97.1	70.0	130	----
		Thallium, total	7440-28-0	E420	0.00406 mg/L	0.004 mg/L	101	70.0	130	----
		Thorium, total	7440-29-1	E420	0.0214 mg/L	0.02 mg/L	107	70.0	130	----
		Tin, total	7440-31-5	E420	0.0202 mg/L	0.02 mg/L	101	70.0	130	----
		Titanium, total	7440-32-6	E420	0.0407 mg/L	0.04 mg/L	102	70.0	130	----
		Tungsten, total	7440-33-7	E420	0.0206 mg/L	0.02 mg/L	103	70.0	130	----
		Uranium, total	7440-61-1	E420	0.00416 mg/L	0.004 mg/L	104	70.0	130	----
		Vanadium, total	7440-62-2	E420	0.102 mg/L	0.1 mg/L	102	70.0	130	----
		Zinc, total	7440-66-6	E420	0.392 mg/L	0.4 mg/L	98.0	70.0	130	----
		Zirconium, total	7440-67-7	E420	0.0408 mg/L	0.04 mg/L	102	70.0	130	----