

Wetland 06 Water Monitoring Report Southwest Calgary Ring Road Project, Calgary, Alberta

Prepared for:

KGL Constructors
18 Seven Chiefs Road SW
Calgary, Alberta T2W 3C4

Project No. 102604-01

March 31, 2021

Prepared by:

Hemmera Envirochem Inc.
322 11th Avenue SW, Suite 804
Calgary, AB T2R 0C5
T: 403.264.0671
F: 403.264.0670
hemmera.com

TABLE OF CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS.....	III
LIST OF SYMBOLS AND UNITS OF MEASURE.....	III
1.0 BACKGROUND.....	1
2.0 INTRODUCTION.....	2
3.0 SITE DESCRIPTION.....	3
4.0 METHODS	5
4.1 Sample Locations.....	5
4.1.1 Water Quality Monitoring	5
4.1.2 Sediment Sampling	6
4.1.3 Water Flow Monitoring	9
4.2 Water Quality Monitoring	10
4.3 Sediment Sampling.....	12
4.4 Water Flow Monitoring	13
5.0 RESULTS	14
5.1 Water Quality Monitoring	14
5.1.1 2020 Water Quality Results	14
5.1.2 Comparison with Year 1 and Year 2 Results	25
5.1.3 Comparison with Historic Measurements	25
5.2 Water Flow Monitoring	29
6.0 SUMMARY.....	32
7.0 RECOMMENDATIONS.....	33
8.0 CLOSURE.....	34
9.0 REFERENCES.....	35

LIST OF TABLES (WITHIN TEXT)

Table 4-a	Year 3 (i.e., 2020) Sample Locations.....	9
Table 4-b	Surface Water Flow Sample Locations.....	10
Table 4-c	Water Quality Monitoring Parameters.....	11
Table 4-d	Sediment Monitoring Parameters	12
Table 5-a	Summary of 2018 to 2020 Water Quality Sampling Results.....	16
Table 5-b	Summary of 2020 Water Quality Sampling Results at WQ-06 and WQ-07.....	18

Table 5-c	Summary of Supplemental Water Quality Sampling Results from Supplemental Fall Sampling in November 2020.....	22
Table 5-d	Summary of Supplemental Sediment Sampling Results from Supplemental Fall Sampling in November 2020.....	24
Table 5-e	Surface Water Quality Parameters Collected from Wetland 06 Sites from 2016 to 2020	28
Table 5-f	Summary of Water Flow Monitoring Site Channel Width and Depth.....	29
Table 5-g	Summary of Water Flow Monitoring Site Velocity and Discharge	30
Table 5-h	Summary of Wetted Width Measurements from 2018 to 2020.....	32

LIST OF FIGURES (WITHIN TEXT)

Figure 1	Wetland Locations.....	4
Figure 2	Water Flow and Quality Sampling Locations	7
Figure 3	Water Flow and Quality Sampling Location Details	8

LIST OF APPENDICES

Appendix A	Monitoring Plan
Appendix B	Raw Water Quality Data
Appendix C	Raw Sediment Sampling Data
Appendix D	Photo Log

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
the Approval	Water Act Approval No.: 00388473-00-00
Ausenco	Ausenco Engineering Canada Inc.
BOD	Biochemical Oxygen Demand
CALA	Canadian Association for Laboratory Accreditation
CCME	Canadian Council of Ministers of the Environment
DO	Dissolved Oxygen
ESC	Erosion and Sediment Control
GOA	Government of Alberta
GPS	Global Positioning System
Hemmera	Hemmera Envirochem Inc.
KGL	KGL Constructors
Monitoring Plan	Long-Term Monitoring Plan
the Order	Ministerial Order 06/2018
the Project	Southwest Calgary Ring Road Project
QEP	Qualified Environmental Professional
SWCRR	Southwest Calgary Ring Road
TUC	Transportation Utility Corridor
TSS	Total Suspended Solids

LIST OF SYMBOLS AND UNITS OF MEASURE

Symbol / Unit of Measure	Definition
km	Kilometre
m	Metre
mg/L	Milligrams per liter
µg/L	Microgram per liter
m/sec	Meters per second
m ³ /sec	Meters cubed per second

1.0 BACKGROUND

Wetland 06 is located in the Weaselhead Natural Area, a natural environmental park that borders the west end of Glenmore Reservoir (**Figure 1**) within the City of Calgary. A small portion of Wetland 06 is located within the Transportation Utility Corridor (TUC) running north to south through the Weaselhead Natural Area. Wetland 06 is an historical oxbow channel to the Elbow River that is over 500 metres (m) in length with wetted widths that are generally less than 30 m. Wetland 06 collects surface water from several other wetlands (Wetland 07, 08, and 09, **Figure 1**) located upslope. Wetland 06 drains generally east through the Weaselhead Natural Area and eventually discharges into the Glenmore Reservoir, which provides approximately half of the city of Calgary's drinking water supply.

The TUC containing the western portion of Wetland 06 was incorporated into the proposed design of the Southwest Calgary Ring Road (SWCRR) Project (the Project). The SWCRR Project was awarded by Alberta Transportation to Mountain View Partnership, which in turn engaged KGL Constructors (KGL) to develop the Project. The scope of the Project encompasses the design and construction of approximately 31 kilometers (km) of new six and eight lane divided freeway, 14 interchanges, as well as three watercourse realignments and associated crossing structures. The Project corridor is located along the western limit of the City of Calgary south of Highway 8 and includes sections of Highways 8 and 22.

On August 11, 2017, the Project received *Water Act* Approval No.: 00388473-00-00 (the Approval) to impact twenty-four wetlands, including Wetland 06. Subsequently, an Environmental Appeal was filed (*Brockman and Tulick v. Director, South Saskatchewan Region, AEP*; Appeal No.: 17-047 and 17-050-R. 2017) affecting KGL's ability to impact the wetlands, as described in the Approval.

As a result of the Environmental Appeal, the Minister of Environment and Parks issued a Ministerial Order 06/2018 (the Order), on January 29, 2018, that amended the previously received Approval to include additional conditions to address water quality and quantity impacts to Wetland 06. In June 2018 a Long-Term Monitoring Plan (Monitoring Plan) developed by Hemmera Envirochem (Hemmera) on behalf of on behalf of KGL to fulfil requirements of the Order (see conditions 6.2 and 6.6) was approved by the Director of Alberta Environment and Parks.

The Monitoring Plan outlined the following obligations:

- The Monitoring Plan will come into effect as soon as approved by the Director and shall remain in effect for a period of five years after the road is officially opened to the public.
- Monitoring of the flow of water into Wetland 06 shall occur in the spring and fall of each year that the plan is in effect.
- Monitoring of water quality in Wetland 06 shall occur in the spring and fall of each year that the plan is in effect, including total dissolved solids, salts, dissolved metals, and other parameters consistent with a stormwater sampling program.
- The monitoring data shall be provided to the Director within one month from the date the data were collected.
- The results of the monitoring and analysis of the monitoring shall be provided to the Director in an annual report by March 31 of the year following the calendar year in which the data were collected.

2.0 INTRODUCTION

This monitoring report has been prepared by Hemmera on behalf of KGL. Monitoring of surface water flow and surface water quality in 2020 occurred with reference to the Project's Monitoring Plan (Hemmera 2018). Monitoring in 2020 represented Year 3 of the Monitoring Plan, which will remain in effect throughout construction, and for the first five years of operation of the SWCRR. The construction phase was completed in October 2020 initiating the operational phase. The Monitoring Plan is presented in **Appendix A**.

The objective of Year 3 of monitoring was to follow monitoring protocols established during Year 1, collect surface water quality and surface water flow measurements from sample sites located within Wetland 06, and other waterbodies/drainages providing surface flow to Wetland 06. Consistent with Year 1 and Year 2 monitoring, surface water quality and surface water flow were monitored in a nearby reference wetland, located outside of the potential impact area of construction, to determine naturally occurring variation affecting wetlands in the Weaselhead Natural Area.

Additional sampling locations and events were added to the Wetland 06 scope in 2020:

- Following an Enforcement Order and recommendations provided in the Wetland 06 Sediment Release Remediation (Hemmera 2019) in response to two sediment releases from the SWCRR Project area into Wetland 06 in August of 2019, sampling of total dissolved sediment levels and turbidity was conducted at two additional locations within the west end of Wetland 06 near the location of the sediment releases¹.
- Supplemental water quality sampling and sediment sampling along Pathway 1 was conducted in late fall following the occurrence of high zinc values exceeding the regulatory guidelines during the fall 2020 sampling event.

Information collected during Year 3 monitoring will facilitate comparative analysis with data collected during previous monitoring years regarding potential influences or lack thereof of the Project on surface water quality and flow in Wetland 06. Additionally, Year 3 information will contribute to future data collected by Hemmera facilitating long term analysis of potential Project influences on surface water quality and flow in Wetland 06.

¹ Monitoring requirements under the Enforcement Order include water quality monitoring as well as the local amphibian population, vegetation regeneration and weed growth. Monitoring will be implemented in 2021 with results provided under separate cover in a Monitoring Report following two years of growing seasons, and a Verification Report following three years of growing seasons as conditioned in the Order. Water quality results collected under the Enforcement Order will be included in this report to supplement the surface water quality results collected annually in wetland 06.

3.0 SITE DESCRIPTION

Several adjacent wetlands within the Weaselhead Natural Area contribute surface flow to Wetland 06 (see **Figure 1**). The Monitoring Plan identified two pathways in which Project-influenced water could potentially flow into Wetland 06.

Pathway 1 - conveys flow from Wetland 08 and Wetland 07 which are located to the southwest of Wetland 06. This pathway is an undefined channel that diagonally bisects the Project footprint. From the west side of the TUC boundary, a bypass drainage culvert installed as part of the Project carries water from Wetland 08 and Wetland 07 northeast through the Project area. Water then flows past the east side of the TUC boundary and into a defined channel (approximately 400 m) which ultimately drains into Wetland 6.

Pathway 2 - conveys flow from Wetland 09, located to the south of Wetland 06. This pathway originates as an undefined channel that flows east through Wetland 09 and through a bypass drainage system installed as part of the Project to maintain flow from Wetland 09 to Wetland 06. The drainage system outlets to a constructed riprap lined drainage ditch which flows north towards the eastern TUC boundary. Previously, a constructed drainage ditch channeled water west where it converged with flows from the aforementioned constructed riprap lined drainage ditch. It was noted during 2019 (i.e. Year 2) monitoring visits this constructed drainage ditch had been encompassed by the Project's active construction area and no longer facilitated flow to the west. From the northern edge of the TUC, water meanders north through a defined channel (approximately 1,000 m) eventually draining into Wetland 06.

Throughout the construction phase of the Project, surface run-off from the work area was managed through temporary erosion and sediment control (ESC) measures and redirected away from Wetland 06. During the operational phase of the Project, the natural flow of surface water (i.e., from the west side of the TUC) into Wetland 06 will be maintained via the bypass drainage systems described above. Further, during the operational phase, Project-impacted water will not be discharged into Wetland 06. All Project-impacted water in the vicinity of wetland 06 has been designed to flow northwest into a stormwater pond. The construction phase was completed in October 2020 initiating the operational phase.

Wetland 06 Supplemental Sampling Stations
November 2020

Legend

Water Flow Sample Location (Hemmera, 2020)

Water Quality Sample Location (Hemmera, 2020)

Decommissioned Water Quality Location (Hemmera, 2019)

Bypass Culvert

Pathway #1 Approximate Direction of Flow

Pathway #2 Approximate Direction of Flow

Pathway #2 Approximate Direction of Flow (Decommissioned)

Stormwater Drainage Line

City of Calgary Boundary

Natural Area

Transportation and Utility Corridor (TUC)

Watercourse

Wetland

Notes

1. All mapped features are approximate and should be used for discussion purposes only.

2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

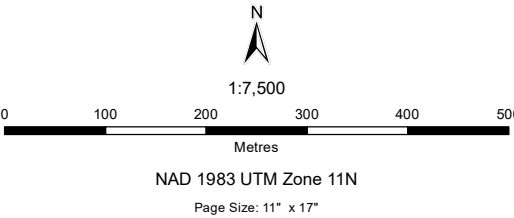
3. Sample site WQ-02 was frozen to bottom and could not be sampled.

4. WQ-04A was not sampled as permission to access Weaselhead Road was not received prior to sampling visit.

Sources

- Contains information licensed under the Open Government Licence: Alberta

- Aerial Image: City of Calgary, 2020



Path: S:\Geomatics\Projects\102604\01\mxd\fig_1_102604_01.mxd, 2020, 201217.mxd

4.0 METHODS

Site visits of Wetland 06 and surrounding wetlands during Year 3 were conducted by a crew of two, led by a Qualified Environmental Professional (QEP) from Hemmera. Site visits were conducted during the spring and the fall in order to capture seasonal variability of the wetlands. During 2020 three site visits were conducted; follow up sampling was conducted in late fall to facilitate additional data collection. The timing of each site visit was influenced by environmental conditions, including ambient air temperatures, snow/ice cover, and precipitation events. In order to reduce temporal variation no sampling was conducted within 72 hours of a substantial precipitation event. Site visits followed the schedule outlined by the Monitoring plan. Site visits were completed on the following dates:

- Spring –May 28, 2020;
- Fall – October 15, 2020; and
- Late Fall (supplemental sampling) – November 27, 2020.

4.1 Sample Locations

The original locations for surface water quality and flow monitoring are provided in **Figure 2**. Sites were originally selected during Year 1 (i.e., 2018) monitoring strategically to provide appropriate reference and comparison site considerations, in order to facilitate comparative analysis. The suitability of sample locations was field verified during spring 2019; it was noted that a sample site (WQ-05c) located in Pathway 2 had been encompassed by active construction and surface water was no longer accessible for sampling. This sampling point was eliminated from the monitoring plan, it was determined no additional sampling points were required as sample site WQ-05b located downstream of sample site WQ-05c would reflect water quality and flow changes associated with Pathway 2.

An additional four sample sites were added to the Monitoring Plan in 2020 to facilitate additional data collection. Two sites were established at the west end of Wetland 06 (i.e., WQ-06 and WQ-07 sampled during spring and fall), with another two sites established along Pathway 1 (i.e., WQ-04c and WQ-04d sampled during supplemental fall sampling only). Sampling sites in and near Wetland 06 are provided in an enhanced view in **Figure 3**.

4.1.1 Water Quality Monitoring

Eleven surface water quality monitoring sites were sampled during Year 3 monitoring (**Table 4-a**). Seven surface water quality monitoring sites were previously established during Year 1 (i.e., 2018), four additional surface water quality monitoring sites were established during Year 3 (i.e., 2020).

One surface water quality reference site (WQ-01) is located north of Wetland 06, in an adjacent wetland outside the TUC. This location serves as a reference site as there are no identified or known pathways from the Project that could direct Project-affected water into the adjacent wetland.

Three surface water quality reference sites are located within the pathway of flow from Wetland 08 and Wetland 07 into Wetland 06 (i.e. Pathway 1). The three sample sites along this pathway are WQ-04a, WQ-04b, and WQ-02. Site WQ-04a is located upstream of any potential influences from the Project and was selected to serve as a background site for this pathway.

Three surface water quality reference sites are located along the pathway of flow from Wetland 09 to Wetland 06 (i.e. Pathway 2). The sample sites along this pathway during Year 2 monitoring are WQ-05a, WQ-05b, and WQ-03. Site WQ-05a was located upstream of any potential influences from the Project and was selected to serve as a background site for this pathway. Water quality reference site WQ-05c was no longer accessible for sampling and eliminated from the monitoring plan.

Following the monitoring recommendations of the 2019 Wetland 06 Sediment Release Remediation Memorandum (Hemmera 2020), two new water sampling sites (i.e., WQ-06 and WQ-07) were added along a manually vegetated bank (i.e., the green wall) on the west side of Wetland 06. The WQ-06 sample point is located at 11U 699028, 5652251 UTM and the WQ-07 sample point is located at 11U 699027, 5652284 UTM. As these areas were first sampled in spring 2020, they are not described in the original monitoring plan.

Two additional supplementary surface water quality sampling sites were added along Pathway 1 in late fall of 2020, following the results of fall sampling. The WQ-04d sample point is located at 11U 699123, 5652000 UTM and the WQ-04c sample point is located at 11U 699129, 5652100 UTM. These sites were only sampled once during Year 3 monitoring.

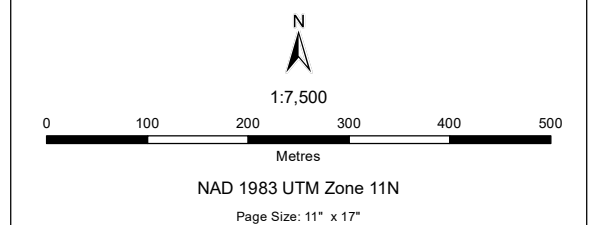
4.1.2 Sediment Sampling

Co-located sediment sampling was conducted at seven monitoring sites during Year 3 monitoring as a component of supplemental fall sampling (**Table 4-a**). Five of the sites were located at previously established surface water quality monitoring sites (i.e., WQ-02, WQ-03, WQ-04a, WQ-04b, and WQ-06), with two additional sites established along Pathway 1 (i.e., WQ-04c and WQ-04d; **Figure 3**). Sediment samples were only collected once during Year 3 monitoring.

- Water Flow Sample Location (Hemmera, 2020)
- Water Quality Sample Location (Hemmera, 2020)
- Decommissioned Water Quality Location (Hemmera, 2019)
- Bypass Culvert
- Pathway #1 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow (Decommissioned)
- Stormwater Drainage Line
- City of Calgary Boundary
- Natural Area
- Transportation and Utility Corridor (TUC)
- Watercourse
- Wetland

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

- Contains information licensed under the Open Government Licence:
Alberta
- Aerial Image: City of Calgary, 2020



102604-01	Production Date: Mar 3, 2021	Figure 2
-----------	------------------------------	----------

Water Flow and Quality
Sampling Location Details

Legend

- Water Flow Sample Location (Hemmera, 2020)
- Water Quality Sample Location (Hemmera, 2020)
- Transect Location (Hemmera, 2019)
- Bypass Culvert
- Pathway #1 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow
- City of Calgary Boundary
- Natural Area
- Transportation and Utility Corridor (TUC)
- Wetland

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: ESRI World Imagery, 2016

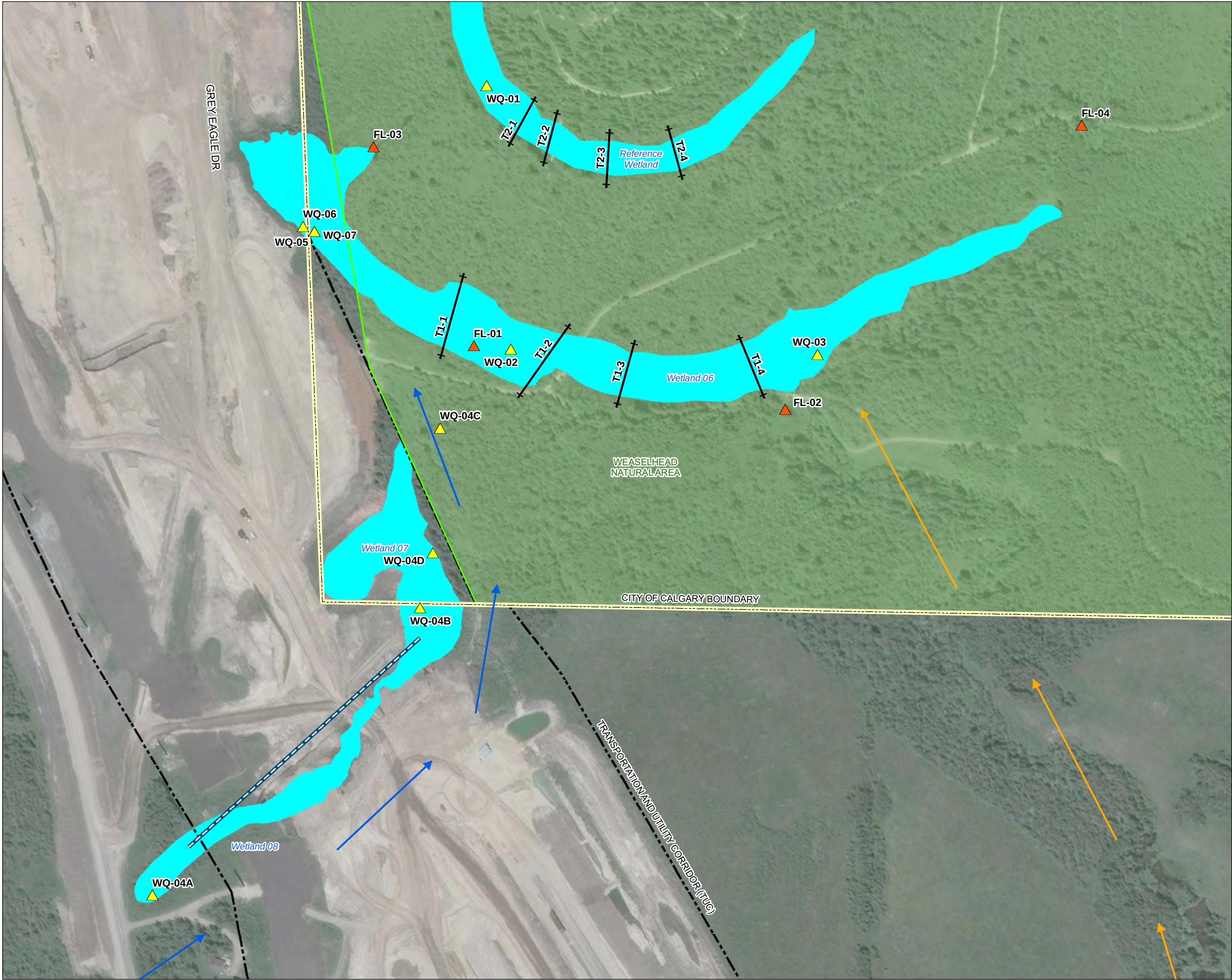
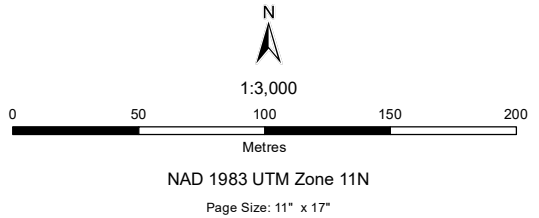


Table 4-a Year 3 (i.e., 2020) Sample Locations

Site Name	Universal Transverse Mercator (Zone 11U)		Site Description	Site Type ¹	Sampling Component	
	Easting	Northing			In-situ and Analytical Water Quality	Sediment Sampling
WQ-01	699168	5652375	Reference wetland to the north of Wetland 06	Reference	X	-
WQ-02	699186	5652164	West (upslope) side of Wetland 06	Comparison	X	X
WQ-03	699432	5652159	East (downslope) side of Wetland 06	Comparison	X	X
WQ-04a	698898	5651725	Wetland 08, upslope of SWCRR Project	Background	X	X
WQ-04b	699113	5651956	Wetland 07, downslope of SWCRR Project and Wetland 08	Comparison	X	X
WQ-04c ³	699129	5652100	Wetland 07, downslope of SWCRR Project and WQ-04b	Comparison	X	X
WQ-04d ³	699123	5652000	Wetland 07, downslope of SWCRR Project and WQ-04b	Comparison	X	X
WQ-05a	699060	5650929	Upslope of Wetland 09 and SWCRR Project	Background	X	-
WQ-05b	699788	5651289	Watercourse 01 downslope of Wetland 09 and SWCRR Project	Comparison	X	-
WQ-06 ³	699028	5652251	Northwest (upslope) side of Wetland 06 down gradient of the Green Wall	Comparison	X	X
WQ-07 ³	699027	5652284	Northwest (upslope) side of Wetland 06 down gradient of the Green Wall	Comparison	X	X
WQ-05c	700061	5651274	WQ-05c was no longer accessible for sampling and eliminated from the monitoring plan in 2019	Comparison	N/A	N/A

Notes:

¹ The reference site is an adjacent wetland outside the TUC with no identified or known pathways that could direct Project-affected water into the wetland. Background sites are located upstream of potential Project-affected. Comparison sites are located downstream of potential Project affected water.

² WQ-4c and WQ4d are two supplemental sampling sites added in fall 2020 following the results of fall sampling.

³ WQ-06 and WQ-07 are new sampling sites added in spring 2020 following the monitoring recommendations of the 2019 Wetland 06 Sediment Release Remediation Report (Hemmera 2019).

4.1.3 Water Flow Monitoring

Surface water flow monitoring sampling sites were established at four locations within Wetland 06 (**Table 4-b**) during Year 1 (i.e., 2018). Sampling locations were selected based on the expectation they would provide conveyance of surface flow (inflow or outflow) year-round during normal surface flow conditions. Locations with defined channels were selected for monitoring sites, as monitoring the flow of undefined channels could result in reduced accuracy.

Three sampling locations were identified to measure surface water inflows into Wetland 06. Site FL-01 was located at the inflow of surface water from Wetland 07 and 08 along drainage Pathway 1. Site FL-02 was located where the surface water inflow was conveyed from Wetland 09 along drainage Pathway 2. Site FL-03 was located where the surface water inflow from the reference wetland drained into Wetland 06. One site was established to monitor surface water outflow from Wetland 06; site FL-04 was located 75 m downstream of Wetland 06 at the Glenmore Pathway bridge crossing.

No supplementary surface water monitoring sites were required throughout Year 3 monitoring, as no additional inflow or outflow locations were identified during field sampling visits.

Table 4-b Surface Water Flow Sample Locations

Site Name	Universal Transverse Mercator (Zone 11U)		Inflow or Outflow
	Easting	Northing	
FL-01	699156	5652166	Inflow
FL-02	699406	5652115	Inflow
FL-03	699075	5652326	Inflow
FL-04	699644	5652343	Outflow

4.2 Water Quality Monitoring

Surface water quality sampling was conducted from the banks of the sample sites provided in **Table 4-a** and described in **section 4.1.1**. Site conditions (e.g. weather) were recorded, and photos documenting current conditions were taken at each location.

Sampling was conducted following the shore sampling protocol provided by Canadian Council of Ministers of Environment (CCME) (2011). The crew wore unpowdered latex disposable gloves during sample collection. At each sampling site, the crew collected water samples using an extension pole to avoid site disturbance. The extension pole and clamp were rinsed upon arrival at each site, before samples were collected, in order to reduce contamination between sites. Laboratory protocols for sample bottle rinsing were followed by the crew; all rinsing of bottles or collection equipment was conducted slightly downslope of the sample site to prevent cross contamination.

Water samples were collected at approximately 60% depth and facing upstream if flow was present. Algae, sediment, organic matter, scum and film were avoided in order to ensure the sample was representative. All water samples were collected one at a time, capped immediately to prevent contamination and labelled with a water-proof marker to facilitate accurate future identification. After collection, samples were kept at approximately 4°C within a cooler using ice packs. Before transport from site, all samples were packed and sealed as to prevent spillage and breakage. Samples were collected and delivered to a laboratory within the same day to allow sample analysis within appropriate holding times.

Bureau Veritas, a laboratory certified by the Canadian Association for Laboratory Accreditation (CALA) completed the analysis of water samples. A chain of custody form was completed, indicating the transfer of custody from the authorized crew member to the CALA laboratory.

Water quality parameters with a holding time of less than 7-days (i.e. biological oxygen demand, nitrate, nitrite, sulfate, total dissolved solids, and total suspended solids) were immediately analyzed in all samples. Samples collected from the reference wetland (WQ-01) and Wetland 06 (WQ-02 and WQ-03) were immediately analysed for the parameters listed in **Table 4-c**. These parameters are reflective of the City of Calgary Stormwater Management and Design Manual (2011) and likely to facilitate the detection of any potential impacts of the construction and operation phases of the Project. The remaining samples (WQ-04a, WQ-04b, WQ-05a, and WQ-05b) were held by the CALA Laboratory and tested if exceedances in Wetland 06 samples were detected in water quality parameters under the Environmental Quality Guidelines for Alberta Surface Water (GOA) (Government of Alberta 2018). This testing protocol facilitated the potential determination of source pathway of water quality exceedances in Wetland 06.

Table 4-c Water Quality Monitoring Parameters

Sediment and Physical			
• Total Suspended Solids (TSS)	• Conductivity (EC)		
• Total Dissolved Solids (TDS)	• pH		
• Turbidity	• Dissolved Oxygen (DO)		
Nutrients and Others (mg/L)			
• Biochemical Oxygen Demand (BOD)	• Total Kjeldahl Nitrogen (TKN)		
• Chemical Oxygen Demand (COD)	• Ammonia-Nitrogen (NH ₃ -N)		
• Nitrate (NO ₃)	• Total Phosphorus (TP)		
• Nitrite (NO ₂)	• Dissolved Reactive Phosphorus (DRP)		
	• Ortho-Phosphate		
Metals (mg/L)			
• Silver (Ag)	• Cobalt (Co)	• Molybdenum (Mo)	• Tin (Sn)
• Aluminum (Al)	• Chromium (Cr)	• Nickel (Ni)	• Strontium (Sr)
• Arsenic (As)	• Copper (Cu)	• Lead (Pb)	• Sodium (Na)
• Boron (B)	• Iron (Fe)	• Sulfur (S)	• Titanium (Ti)
• Barium (Ba)	• Potassium (K)	• Antimony (Sb)	• Thallium (Tl)
• Beryllium (Be)	• Lithium (Li)	• Selenium (Se)	• Uranium (U)
• Calcium (Ca)	• Magnesium (Mg)	• Silicon (Si)	• Vanadium (V)
• Cadmium (Cd)	• Manganese (Mn)		• Zinc (Zn)
Major Ions and Salts			
• Sodium (Na ²⁺)	• Calcium (Ca ²⁺)		
• Potassium (K ⁺)	• Chloride (Cl ⁻)		
• Potassium (K ⁺)	• Sulfate (SO ⁴⁻)		

In-situ measurements were also collected at all water quality sampling sites; sediment and physical parameters were recorded (i.e. Turbidity, conductivity, dissolved oxygen, pH and water temperature). Measurements were taken at approximately 60% water depth using an Aquatroll 600 as per the manufacturer's instructions, following calibration.

Year 3 water quality parameters were compared to previous monitoring years (i.e., Year 1 and Year 2) surface water data. Additionally, select water quality parameters were compared to surface water quality parameters collected from proximate sites in Wetland 06 in 2016 and 2017 by the Weaselhead / Glenmore Preservation Society and presented in their 2017 Environmental Monitoring Report (Porto 2018).

4.3 Sediment Sampling

During the follow up fall sampling visit, sediment samples were collected from eight co-located sites along Pathway 1 and within Wetland 06. Samples were collected from the water-sediment interface at non-frozen sites provided in **Table 4-a** and described in **Section 4.1.1**. Site conditions (e.g., ice cover and thickness) were recorded, and photos documenting current conditions were taken at each location. Sediment monitoring parameters are presented in **Table 4-d**.

Sampling was conducted in alignment with contaminated soil sampling guidance provided by CCME (1993). Sediment samples were collected from downstream to upstream sites where flow was present to reduce alteration of site conditions prior to sample collection. The crew wore unpowdered latex disposable gloves during sample collection. At each sampling site, the crew collected sediment samples using a stainless steel trowel and bowl. The trowel and bowl were cleaned withalconox and rinsed with metal free deionized water between each site in order to reduce contamination between sites; all rinsing of collection equipment was conducted downslope and away from the shoreline of the sample site to prevent cross contamination.

The collected sediment was mixed until homogenous; algae, woody debris, organic matter, and rocks were removed from the sample to ensure the sample was representative. All sediment samples were collected one at a time, capped immediately to prevent contamination, and were labelled with a water-proof marker to facilitate accurate future identification. After collection, samples were kept at approximately 4°C within a cooler using ice packs. Before transport from site, all samples were packed and sealed to prevent spillage and breakage. Samples were collected and delivered to a laboratory within the same day to allow sample analysis within appropriate holding times.

Bureau Veritas, a laboratory certified by the Canadian Association for Laboratory Accreditation (CALA) completed the analysis of sediment samples. A chain of custody form was completed, indicating the transfer of custody from the authorized crew member to the CALA laboratory.

Table 4-d Sediment Monitoring Parameters

Field Parameter			
• Percent saturation			
Inorganics			
• Boron Sat Paste (mg/L)		• Moisture (%)	
Metals (mg/kg)			
• Arsenic (As)	• Chromium (Cr)	• Lead (Pb)	• Vanadium (V)
• Boron (B)	• Chromium, hexavalent	• Antimony (Sb)	• Zinc (Zn)
• Barium (Ba)	• Copper (Cu)	• Selenium (Se)	
• Beryllium (Be)	• Molybdenum (Mo)	• Silver Tin (Sn)	
• Cadmium (Cd)	• Mercury (Mg)	• Thallium (Tl)	
• Cobalt (Co)	• Nickel (Ni)	• Uranium (U)	

4.4 Water Flow Monitoring

Surface flow monitoring was conducted by the crew at the sample sites provided in **Table 4-b** and described in **Section 4.1.2**. Surface flow was determined using the velocity-area method (Government of Alberta 2009) and a HACH® velocity flow meter. During spring monitoring the inflow channel from the reference wetland (FL-03) as well as the outflow channel (FL-04) were dry at the time of survey, preventing the measurement of water flow for these sampling sites. The inflow channel from the reference wetland (FL-03) and the outflow channel (FL-04) remained dry during the fall monitoring visit. Following each seasonal monitoring visit, the inflows and outflow of Wetland 06 were used to calculate a modified water balance within the wetland.

Water level measurements were taken at staff gauges located within Wetland 06 and the reference wetland during spring and fall monitoring visits. The water level staff gauges were originally deployed during spring 2018, during Year 1 monitoring.

Four transects were completed by the crew in both Wetland 06 and the reference wetland respectively (**Figure 3**). Transect locations to measure wetted width during both field visits were established during Year 1 (i.e., 2018) monitoring. The location of each transect was recorded in reference to distinct local landmarks and using a global positioning system (GPS) device. Transect measurements of wetted widths of Wetland 06 were replicated by the crew during the fall sampling visit. There was no surface water present in the reference wetland during fall sampling, as a result the wetted width was not measured.

Water level and wetted width of Wetland 06 and the reference wetland were compared and used to assess if the wetted perimeter of Wetland 06 was impacted by Project activities, by accounting for seasonal variability resulting from natural fluctuations.

5.0 RESULTS

5.1 Water Quality Monitoring

5.1.1 2020 Water Quality Results

Water quality parameters outlined in **Table 4-c** were collected from sampling sites located within Wetland 06, the inflow pathways from Wetlands 07 and 08, and Wetland 09, as well as the reference wetland. Water quality sampling results from WQ-01, WQ-02 and WQ-03 are summarized in **Table 5-a** and demonstrate the natural variability within Wetland 06 and the reference wetland during both spring and fall. Raw water quality data from all viable sampling sites are provided in **Appendix B**. Water quality samples could not be collected from sampling site WQ-05c as the proposed location was within the footprint of active construction and no longer contributed to the surface water flow along Pathway 2. During fall monitoring, water quality samples could also not be collected from WQ-01, WQ-05a, and WQ-06 as they were dry during the monitoring visit. Photographs taken at each sampling site are provided in **Appendix D**.

Water quality results from Year 3 sampling were compared to the Environmental Quality Guidelines for Alberta Surface Water (GOA 2018) and the Canadian Council of Ministers of the Environment (CCME) Guidelines for the Protection of Fresh Water Organisms (CCME 1999). Three water quality parameters (pH, Dissolved Oxygen [DO] and zinc) exceeded the Environmental Quality Guidelines at WQ-01 and WQ-02, respectively. No water quality exceedances were found for Nutrients or Major Ions or Salts in any of the samples analyzed.

pH: In-situ pH measured during spring at sampling sites WQ-02 and WQ-06 were recorded as 9.01 and 9.09, respectively, which exceeds the pH range provided by the AB SW Freshwater Aquatic Life (Long-term) of 6.5 to 9.0 (GOA 2014). During the same sampling period, the pH concentration measured at the other Wetland 06 sample sites (i.e., WQ-03 and WQ-07) were 8.89 and 8.65, respectively. During fall sampling, the pH had been reduced at site WQ-02 to 8.53 and at site WQ-06 to 8.42, which is within the acceptable range of Freshwater Aquatic Life (Long-term). The pH measured at site WQ-02 during fall remained within the range of pH provided by the Freshwater Aquatic Life guidelines (WQ-07 was dry during fall sampling).

Although in-situ measurements recorded pH values above 9.0 at Wetland 06 sample sites, lab analysis of water samples did not result in any elevated pH during spring or fall sampling of Wetland 06 in 2020.

Previously during summer 2018 sampling, in-situ pH at site WQ-03 was recorded as 9.01. No exceedances in pH were documented at any of the sample sites in 2019.

Dissolved Oxygen: DO measured during 2020 fall water quality sampling at the Wetland 06 site WQ-03 was recorded as 4.86 mg/L during in-situ measurements. The minimum acceptable DO concentration for freshwater biota under the Environmental Quality Guidelines (GOA 2018) is 5.0 mg/L. Lab measured DO results for the same site showed DO concentrations of 8.00 mg/L, which is within the acceptable Freshwater Aquatic Life standards range.

The low DO recorded at site WQ-03 during fall sampling was not observed at either of the other sample sites located within Wetland 06 (i.e., WQ-02 and WQ-06), where all measurements of DO were within the Environmental Quality Guidelines for DO concentration criteria. The low DO concentration recorded at

WQ-03 during fall sampling is likely related to the decomposition of algae or submerged plants consuming dissolved oxygen. The higher Biochemical Oxygen Demand (BOD) levels recorded at this location during fall sampling supports this assumption.

Previously, during Year 1 (i.e., 2018) fall sampling, in-situ DO at site WQ-03 was recorded as 4.3 mg/L. In fall 2019, DO was measured at site WQ-01 (i.e., the reference wetland) of 3.70 mg/L. Both these DO measurements were below the Environmental Quality Guidelines (i.e., 5.0 mg/L). These low DO measurements were attributed to the same decomposition conditions present in 2020 and correlated with higher BOD measurements at each respective sample location.

Zinc: Analytical results of water quality sampling collected during fall from site WQ-02 (i.e., Wetland 06) indicated a dissolved zinc concentration of 0.007 mg/L, equivalent to the CCME (GOA 2018) Freshwater Aquatic Life guidelines for long-term exposure (i.e., 0.007 mg/L). The WQ-02 sample was within the Freshwater Aquatic Life guidelines for short-term exposure (i.e., 0.037 mg/L). Fall samples collected from the other sample sites located within Wetland 06 (i.e., WQ-03 and WQ-06) were within the CCME zinc guideline criteria (GOA 2014). No zinc exceedances were observed within Wetland 06 sample sites (i.e., WQ-02, WQ-03, WQ-06, and WQ-07) during the earlier 2020 spring sampling visit.

Following the exceedance documented at WQ-02 during fall 2020, water quality samples collected at sites upstream of Wetland 06 were analysed for zinc concentrations. Samples collected at WQ-04b (i.e., upslope from WQ-02 along Pathway 1, downslope of the SWCRR Project influences) were found to have a dissolved zinc concentration of 0.054 mg/L, exceeding the CCME guidelines for long-term and short-term exposure. Dissolved zinc levels at WQ-04a (i.e., the background site for Pathway 1, upslope of SWCRR Project influences) had zinc levels below 0.003 mg/L (i.e., detectable limits) during fall sampling. Zinc exceedances at WQ-02 and WQ-04b, but not at WQ-04a (i.e., upslope of the SWCRR Project influences) suggests that project activities may be contributing to elevated levels of dissolved zinc present along Pathway 1. Following recommendations from the Year 2 (2019) Monitoring Report, supplemental sampling was conducted to verify results and attempt to identify potential project-related sources of elevated levels.

Table 5-a Summary of 2018 to 2020 Water Quality Sampling Results

	CCME Guidelines (1999)		WQ-01						WQ-02						WQ-03					
			Summer	Spring		Fall			Summer	Spring		Fall			Summer	Spring		Fall		
	AB SW Freshwater Aquatic Life (Long-term)	AB SW Freshwater Aquatic Life (Short-term)	05/06/2018	29/05/2019	28/05/2020	11/10/2018*	16/10/2019	15/10/2020*	05/06/2018	29/05/2019	28/05/2020	11/10/2018	16/10/2019	15/10/2020	05/06/2018	29/05/2019	28/05/2020	11/10/2018	16/10/2019	15/10/2020
Sediment and Physical																				
Total Suspended Solids (TSS) (mg/L)	Narr.	Narr.	18	3.1	1.0	-	8	-	17	2.1	2.5	9.7	17	23	3.5	14	7.1	25	8.4	26
Total Dissolved Solids (TDS) (mg/L)	N/A	N/A	530	520 - 570	560	-	490 - 510	-	470	430 - 450	380	490	450 - 460	490	270	370 - 390	340	390	440 - 450	460
Turbidity (NTU)	Narr.	Narr.	6.5	3.3	1.1	-	1.8	-	7	2	1.7	5.4	8.9	7.7	2.6	1.8	7.4	17	6.5	11
Conductivity (EC) (µS/cm)	N/A	N/A	950	970	1000	-	900	-	850	780	680	850	810	780	500	690	620	710	800	750
pH	6.50 – 9.00	N/A	8.13	7.97	7.91	-	8.12	-	8.25	8.26	8.34	8.25	8.22	8.30	9.1	8.33	8.29	8.09	8.29	7.96
Dissolved Oxygen (mg/L)	Narr.	5	2.2	5.1	3.2	-	3.7	-	10	7.7	11	11	10	10	14	7.9	9.4	4.3	8	8.2
Nutrients and Others (mg/L)																				
Biochemical Oxygen Demand (BOD)	N/A	N/A	3.2	<2	<2.0	-	3.3	-	<2.0	<2	2.2	<2.0	<2	<2.0	<2.0	<2	2.3	3.5	2.5	4.3
Chemical Oxygen Demand (COD)	N/A	N/A	36	30	28	-	34	-	35	30	27	15	18	<10	27	40	42	37	44	41
Nitrate (NO3)	3	124	<0.044	<0.044	<0.044	-	<0.044	-	<0.044	<0.044	<0.044	0.6	0.079	0.71	0.072	<0.044	8.0	<0.044	<0.044	<0.22
Nitrite (NO2)	N/A	N/A	<0.033	<0.033	<0.033	-	<0.033	-	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	<0.033	0.35	<0.033	<0.033	<0.033
Total Kjelaahl Nitrogen (TKN)	N/A	N/A	1.5	0.58	0.58	-	0.72	-	0.81	0.55	0.90	0.44	0.37	0.31	0.86	0.64	1.6	0.9	1	1.9
Ammonia-Nitrogen (NH3-N)	N/A	N/A	0.043	0.03	0.066	-	0.058	-	0.045	0.027	0.075	<0.015	0.065	0.063	0.024	<0.015	0.093	0.039	0.11	0.48
Ortho-Phosphate	N/A	N/A	0.008	0.013	0.0036	-	0.03	-	0.0068	0.0037	0.0033	0.0034	<0.003	0.0053	0.0085	0.0039	0.0040	<0.003	<0.003	0.0053
Dissolved Metals and Metals (mg/L)																				
Silver (Ag)	N/A	0.0075 mg/L	<0.0001	<0.0001	<0.00010	-	<0.0001	-	<0.0001	<0.0001	<0.00010	<0.0001	<0.0001	<0.00010	<0.0001	<0.0001	<0.00010	<0.0001	<0.0001	<0.00010
Aluminum (Al)	0.100 mg/L	N/A	<0.003	<0.003	<0.0030	-	0.0037	-	<0.003	<0.003	<0.0030	0.0034	0.0034	<0.0030	<0.003	0.005	<0.0030	0.0034	0.0051	0.0043
Arsenic (As)	0.005 mg/L	N/A	0.0013	0.00063	0.00095	-	0.0035	-	0.0021	0.0008	0.0011	0.00061	0.00046	0.00040	0.0016	0.0011	0.0012	0.0012	0.0011	0.0023
Boron (B)	1.500 mg/L	29.000mg/L	0.032	0.032	0.036	-	0.025	-	0.032	0.046	0.041	0.04	0.033	0.030	0.028	0.031	0.033	0.041	0.035	0.051
Berium (Ba)	N/A	N/A	0.23	0.15	0.17	-	0.13	-	0.13	0.14	0.12	0.11	0.1	0.083	0.069	0.15	0.14	0.21	0.18	0.23
Beryllium (Be)	N/A	N/A	<0.001	<0.001	<0.0010	-	<0.001	-	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010
Calcium (Ca)	N/A	N/A	97	93	98	-	83	-	80	58	55	73	67	68	30	57	54	52	67	60
Cadmium (Cd)	N/A	N/A	<0.00002	<0.001	<0.000020	-	<0.001	-	<0.00002	<0.001	<0.000020	<0.00002	<0.001	<0.000020	<0.00002	<0.001	<0.000020	<0.00002	<0.001	<0.000020
Colbalt (Co)	N/A	N/A	0.00074	<0.0003	<0.00030	-	0.00058	-	0.00041	<0.0003	<0.00030	<0.0003	<0.0003	<0.00030	<0.0003	<0.0003	<0.00030	<0.0003	<0.0003	<0.00030
Chromium (Cr)	N/A	N/A	<0.001	<0.001	<0.0010	-	<0.001	-	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010
Copper (Cu)	N/A	N/A	0.00021	0.00085	0.030	-	0.0016	-	0.00025	0.00071	0.00067	0.00036	<0.0002	0.00054	0.0004	0.00047	0.0012	<0.0002	0.00045	<0.00020

	CCME Guidelines (1999)		WQ-01						WQ-02						WQ-03					
			Summer	Spring		Fall			Summer	Spring		Fall			Summer	Spring		Fall		
	AB SW Freshwater Aquatic Life (Long-term)	AB SW Freshwater Aquatic Life (Short-term)	05/06/2018	29/05/2019	28/05/2020	11/10/2018*	16/10/2019	15/10/2020*	05/06/2018	29/05/2019	28/05/2020	11/10/2018	16/10/2019	15/10/2020	05/06/2018	29/05/2019	28/05/2020	11/10/2018	16/10/2019	15/10/2020
Iron (Fe)	0.30 mg/L	N/A	1	0.2	<0.060	-	0.09	-	<0.06	0.083	0.090	0.1	<0.06	0.083	<0.06	0.076	<0.060	0.064	<0.06	0.10
Potassium (K)	N/A	N/A	1.7	3.7	4.7	-	13	-	4.1	4.7	4.2	2.3	3.6	4.3	3.6	5.8	5.7	6.8	5.5	8.6
Lithium (Li)	N/A	N/A	<0.02	<0.02	<0.020	-	<0.02	-	0.024	<0.02	<0.020	0.026	0.023	0.022	<0.02	<0.02	<0.020	<0.02	<0.02	0.021
Magnesium (Mg)	N/A	N/A	49	48	49	-	44	-	49	47	41	53	49	46	35	42	33	43	52	43
Manganese (Mn)	N/A	N/A	0.44	0.063	0.089	-	0.53	-	0.12	0.016	0.0063	0.065	0.02	0.022	0.0083	0.0098	0.0053	0.025	0.012	0.12
Molybdenum (Mo)	0.073 mg/L	N/A	0.00036	0.001	0.00082	-	0.0013	-	0.0038	0.0025	0.0021	0.0019	0.0017	0.0016	0.0028	0.0025	0.0029	0.0057	0.0027	0.0064
Nickel (Ni)	N/A	N/A	0.0011	0.00079	0.0017	-	0.0016	-	0.0014	0.0008	0.0011	0.00066	0.00063	<0.00050	0.00098	0.0011	0.0021	0.0014	0.0027	0.0010
Lead (P)	N/A	N/A	<0.0002	<0.0002	<0.00020	-	<0.0002	-	<0.0002	<0.0002	<0.00020	<0.0002	<0.0002	<0.00020	<0.0002	<0.0002	<0.00020	<0.0002	<0.0002	<0.00020
Sulfur (S)	N/A	N/A	3	6.9	14	-	14	-	7.7	17	15	20	21	18	10	8.1	18	14	6.4	13
Antimony (Sb)	N/A	N/A	<0.0006	<0.0006	<0.00060	-	<0.0006	-	<0.0006	<0.0006	<0.00060	<0.0006	<0.0006	<0.00060	<0.0006	<0.0006	<0.00060	<0.0006	<0.0006	<0.00060
Selenium (Se)	0.001 mg/L	N/A	<0.0002	<0.0002	<0.00020	-	<0.0002	-	0.0011	0.0006	0.00088	0.0014	0.0011	0.0013	0.0006	0.00033	0.00073	0.0004	0.00036	0.00049
Silicon (Si)	N/A	N/A	4.4	8.1	12	-	5.6	-	6	0.92	1.5	5.2	4.4	4.7	1.2	1.3	3.1	1.4	4	3.1
Tin (Sn)	N/A	N/A	<0.001	0.0013	<0.0010	-	<0.001	-	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010
Strontium (Sr)	N/A	N/A	0.63	0.58	0.61	-	0.53	-	0.85	0.64	0.55	0.74	0.72	0.68	0.37	0.51	0.40	0.52	0.62	0.55
Sodium (Na)	N/A	N/A	49	45	45	-	39	-	34	38	33	44	45	41	23	26	26	34	34	37
Titanium (Ti)	N/A	N/A	<0.001	<0.001	<0.0010	-	<0.001	-	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010
Thallium (Tl)	0.0008 mg/L	N/A	<0.0002	<0.0002	<0.00020	-	<0.0002	-	<0.0002	<0.0002	<0.00020	<0.0002	<0.0002	<0.00020	<0.0002	<0.0002	<0.00020	<0.0002	<0.0002	<0.00020
Uranium (U)	0.015mg/L	0.033 mg/L	0.00044	0.0018	0.0011	-	0.0022	-	0.0031	0.0059	0.0035	0.0048	0.0043	0.0032	0.0023	0.0052	0.0030	0.0083	0.0056	0.0071
Vanadium (V)	N/A	N/A	<0.001	<0.001	<0.0010	-	<0.001	-	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010	<0.001	<0.001	<0.0010
Zinc (Zn)	0.007 mg/L	0.037mg/L	<0.003	<0.003	0.0062	-	0.0051	-	<0.003	<0.003	<0.0030	0.013	0.018	0.0071	<0.003	<0.003	<0.0030	<0.003	<0.003	<0.0030
Major Ions and Salts																				
Chloride (Cl-)	120	640	12	17	16	-	27	-	41	13	12	12	7.3	11	51	12	18	29	12	15
Sulfate (SO4-)	N/A	N/A	6.6	21	44	-	40	-	24	56	50	59	65	62	34	24	55	40	20	49

Note: * WQ01 was dry during fall sampling visit.
 Bold = Indicates exceedance of CCME water quality guidelines
 (-) = null result.
 Narr = Narrative guidelines.
 N/A = CCME data regarding water quality limits for specified parameter is unavailable.

Additional Wetland 06 Sampling Following Sediment Release

During Year 3 monitoring, two additional water quality sample sites (i.e., WQ-06 and WQ-07) were added along a manually vegetated bank (i.e., the green wall) on the west side of Wetland 06. Additional sampling of Turbidity and Total Dissolved Solids (TDS) was proposed as part of recommendations developed following two sediment release events which occurred in 2019. Additional water quality parameters consistent with the other Wetland 06 sampling sites were also collected. Site locations are shown on **Figure 3**; surface and sediment analytical results are presented in provided in **Table 5-b**. During fall sampling water quality samples could not be collected from WQ-07 as it was dry. The certificate of analysis for surface water and sediment results are provided in **Appendix C**. Photographs taken during monitoring visits are provided in **Appendix D**.

In-situ pH measured during spring at sample site WQ-06 was recorded as 9.09, which exceeds the pH range provided by the AB SW Freshwater Aquatic Life (Long-term) of 6.5 to 9.0 (GOA 2014). During the same sampling period, the pH concentration measured at WQ-07) was 8.65. During fall sampling, the pH had been reduced at site WQ-06 to 8.42, which is within the acceptable range of Freshwater Aquatic Life (Long-term).

In-situ turbidity sampling at WQ-06 and WQ-07 resulted in lower turbidity measures than the other Wetland 06 sample sites; all Wetland 06 sample sites followed similar trends with higher turbidity present during the fall sampling season. Lab analysed results from 2020 for TDS from WQ-06 and WQ-07 sites had lower concentrations than the reference wetland (i.e., WQ-01) during spring sampling, and had equivalent or lower TDS concentrations to the other Wetland 06 sample sites (i.e., WQ-02 and WQ-03) throughout Year 3 monitoring. As WQ-06 and WQ-07 sample sites were established in 2020, the results of Year 3 sampling cannot be compared to previous year results. All other parameters from in-situ and analytical water sampling conducted in Year 3 (i.e., 2020) were consistent with AB SW Freshwater Aquatic Life guidelines.

Table 5-b Summary of 2020 Water Quality Sampling Results at WQ-06 and WQ-07

	Site		WQ-06		WQ-07	
	CCME Guidelines (1999)		Spring	Fall	Spring	Fall
	AB SW Freshwater Aquatic Life (Long-term)	AB SW Freshwater Aquatic Life (Short-term)	28/05/2020	15/10/2020	28/05/2020	15/10/2020
Sediment and Physical						
Total Suspended Solids (TSS) (mg/L)	Narr.	Narr.	6	28	6.8	-
Total Dissolved Solids (TDS) (mg/L)	N/A	N/A	330 - 380	380	350 - 380	-
Turbidity (NTU)	Narr.	Narr.	1.9	4.5	2	-
Conductivity (EC) (µS/cm)	N/A	N/A	680	750	710	-
pH (In-situ)	N/A	N/A	9.09	8.42	8.65	
pH (Lab)	6.50 – 9.00	N/A	8.29	8.26	8.18	-
Dissolved Oxygen (mg/L)	Narr.	5	11.00	9.40	7.00	-

	Site		WQ-06		WQ-07	
	CCME Guidelines (1999)		Spring	Fall	Spring	Fall
	AB SW Freshwater Aquatic Life (Long-term)	AB SW Freshwater Aquatic Life (Short-term)	28/05/2020	15/10/2020	28/05/2020	15/10/2020
Nutrients and Others (mg/L)						
Biochemical Oxygen Demand (BOD)	N/A	N/A	2.80	<2.00	3.20	-
Chemical Oxygen Demand (COD)	N/A	N/A	32.00	12.00	33.00	-
Nitrate (NO ₃)	3	124	<0.04	<0.22	<0.04	-
Nitrite (NO ₂)	N/A	N/A	<0.03	<0.03	<0.03	-
Total Kjeldahl Nitrogen (TKN)	N/A	N/A	0.77	0.50	0.98	-
Ammonia-Nitrogen (NH ₃ -N)	N/A	N/A	0.058	<0.015	0.068	-
Ortho-Phosphate	N/A	N/A	<0.003	<0.003	0.007	-
Dissolved Metals and Metals (mg/L)						
Silver (Ag)	N/A	0.0075 mg/L	<0.0001	<0.0001	<0.0001	-
Aluminum (Al)	0.100 mg/L	N/A	<0.003	0.003	<0.003	-
Arsenic (As)	0.005 mg/L	N/A	0.0011	0.0012	0.0012	-
Boron (B)	1.500 mg/L	29.000mg/L	0.034	0.044	0.035	-
Berium (Ba)	N/A	N/A	0.11	0.15	0.12	-
Beryllium (Be)	N/A	N/A	<0.001	<0.001	<0.001	-
Calcium (Ca)	N/A	N/A	49	48	51	-
Cadmium (Cd)	N/A	N/A	<0.00002	<0.00002	<0.00002	-
Colbalt (Co)	N/A	N/A	<0.0003	<0.0003	<0.0003	-
Chromium (Cr)	N/A	N/A	<0.001	<0.001	<0.001	-
Copper (Cu)	N/A	N/A	0.0006	0.004	0.0005	-
Iron (Fe)	0.30 mg/L	N/A	<0.06	0.11	0.083	-
Potassium (K)	N/A	N/A	4.8	4.5	5.7	-
Lithium (Li)	N/A	N/A	<0.020	0.024	<0.020	-
Magnesium (Mg)	N/A	N/A	40	50	42	-
Manganese (Mn)	N/A	N/A	0.0082	0.0099	0.021	-
Molybdenum (Mo)	0.073 mg/L	N/A	0.0019	0.0020	0.0021	-
Nickel (Ni)	N/A	N/A	0.001	<0.0005	0.0012	-
Lead (P)	N/A	N/A	<0.0002	<0.0002	<0.0002	-
Sulfur (S)	N/A	N/A	15.00	15.00	17.00	-
Antimony (Sb)	N/A	N/A	<0.0006	<0.0006	<0.0006	-
Selenium (Se)	0.001 mg/L	N/A	0.0007	0.00032	0.00057	-
Silicon (Si)	N/A	N/A	0.67	1.60	1.40	-

	Site		WQ-06		WQ-07	
	CCME Guidelines (1999)		Spring	Fall	Spring	Fall
	AB SW Freshwater Aquatic Life (Long-term)	AB SW Freshwater Aquatic Life (Short-term)	28/05/2020	15/10/2020	28/05/2020	15/10/2020
Tin (Sn)	N/A	N/A	<0.001	<0.001	<0.001	-
Strontium (Sr)	N/A	N/A	0.510	0.650	0.510	-
Sodium (Na)	N/A	N/A	34	46	35	-
Titanium (Ti)	N/A	N/A	<0.001	<0.001	<0.001	-
Thallium (Tl)	0.0008 mg/L	N/A	<0.0002	<0.0002	<0.0002	-
Uranium (U)	0.015mg/L	0.033 mg/L	0.0035	0.0032	0.0034	-
Vanadium (V)	N/A	N/A	<0.001	<0.001	<0.001	-
Zinc (Zn)	0.007 mg/L	0.037mg/L	<0.003	0.004	<0.003	-
Major Ions and Salts (mg/L)						
Chloride (Cl-)	120	640	13	9.5	13	-
Sulfate (SO4-)	N/A	N/A	52	54	57	-

Supplemental Fall Sampling

Additional sampling was conducted on November 27, 2020 following evaluation of fall water quality analytical results by a qualified Engineering Hydrogeologist. Co-located sediment and surface water sampling was conducted within Wetland 06 and along Pathway 1 to identify potential project-related sources of elevated zinc concentrations. Surface water samples were collected and tested for dissolved metals. Sediment samples were collected and tested for total metals (**Table 4-d**). Site locations during follow up sampling are shown on **Figure 3**; surface and sediment analytical results are presented in provided in **Table 4-a**. Sediment and water quality samples could not be collected from WQ-02, WQ-04a and WQ-07 as thick ice and frozen ground conditions prevented the collection of samples. The certificate of analysis for surface water results is provided in **Appendix C**. The certificate of analysis for sediment results is provided in **Appendix C**. Photographs taken during the supplemental fall monitoring visit are provided in **Appendix D**.

Analytical results indicated zinc exceedances in surface water samples at sites WQ-4b, and WQ-4d with zinc concentrations of 0.078 mg/L and 0.058 mg/L, respectively. Analytical results also indicated that samples collected from site WQ-4c, which is located downstream of sites WQ-4b and WQ-4d had zinc concentrations less than guidelines (i.e., 0.033 mg/L). Site WQ-02 (i.e., the Wetland 06 sample site directly down-gradient of Pathway 1) could not be sampled during the supplemental visit as the sample site was frozen to bottom. Analytical results from water quality samples collected from the other Wetland 06 sample sites (i.e., WQ-03 and WQ-06) also indicated zinc concentrations less than guidelines. The results of supplemental water quality sampling are provided in **Table 5-e**.

Sediment analytical results indicated zinc exceedances at sites WQ-4b and WQ-4c compared to the Alberta Tier 1 Soil Remediation Guidelines value of 250 mg/kg (GOA 2019) with zinc concentrations of 340 mg/kg and 330 mg/kg, respectively. Sediment sampling analytical results from the other Wetland 06 sample sites (i.e., WQ-03 and WQ-06) indicated zinc concentrations less than guidelines. The results of supplemental sediment sampling are provided in **Table 5-f**.

The supplemental sampling analytical results indicated generally decreasing zinc concentrations in surface water along the flow path of Pathway 1 (i.e., concentration decreased from upstream to downstream), while sediment sampling results showed elevated total zinc concentrations along the flow path. The decreasing concentration of dissolved zinc in water samples in combination with the elevated total zinc concentrations in the sediment along the flow path support the interpretation that zinc is attenuating into the sediment from the surface water as it flows downstream. Water quality and sediment analytical results at Wetland 06 sites (i.e., WQ-03 and WQ-06) indicated zinc concentrations less than applicable guidelines also supporting the interpretation that the area of impact of elevated zinc is of limited spatial extent.

The release of zinc from sediments can naturally occur when conditions become reducing with respect to iron, which is more likely to occur when oxygen concentrations are depleted (e.g. during the low DO concentrations measured during the fall sampling event). However, measured values for pH and DO at sampling locations where zinc exceedances occurred (i.e., WQ-04b, WQ-04c, WQ-04d) indicate an oxidizing environment (iron was also less than detection limit for all samples). This suggests zinc is not being released by naturally occurring geochemical changes, but is being added to the Pathway 1 from an external source.

A galvanized culvert, under Tsuut'ina Trail, which conveys Pathway 1 flow from the background sample site WQ-04a to the upstream most comparison site WQ-04b has been identified as a possible source of zinc. Zinc is a common component of galvanized coatings which are used to inhibit corrosion. The results of water quality sampling from 2018, 2019, and 2020 all show zinc concentrations are highest at WQ-04a, immediately downstream of the culvert; this was also observed in sediment samples collected in 2020. Other common adsorbents (arsenic, cadmium, cobalt, copper, nickel and lead) which may indicate more diverse sources of contamination were all less than detection limit or present in very low concentrations less than their applicable guideline, further supporting the interpretation that the culvert is the source of zinc.

Table 5-c Summary of Supplemental Water Quality Sampling Results from Supplemental Fall Sampling in November 2020.

	AB SW Freshwater Aquatic Life (Long-term)	AB SW Freshwater Aquatic Life (Short-term)	Unit	November 2020				
				WQ4B	WQ4D	WQ4C	WQ6	WQ3
Dissolved Metals and Metals								
Aluminium (Filtered)	N/A	0.0075 mg/L	µg/L	<3	<3	<3	36	<3
Antimony (Filtered)	100 mg/L	N/A	µg/L	<0.6	<0.6	<0.6	<0.6	<0.6
Arsenic (Filtered)	5.0 µg/L	N/A	µg/L	0.28	0.34	0.26	1.7	4.8
Barium (Filtered)	N/A	N/A	µg/L	68	74	75	190	290
Beryllium (Filtered)	N/A	N/A	µg/L	<1	<1	<1	<1	<1
Boron (Filtered)	1500 mg/L	29,000 mg/L	µg/L	47	44	43	51	51
Cadmium (Filtered)	N/A	N/A	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Calcium (Filtered)	N/A	N/A	µg/L	73	75	74	95	96
Chromium (Filtered)	N/A	N/A	mg/L	<1	<1	<1	<1	<1
Cobalt (Filtered)	N/A	N/A	µg/L	<0.3	<0.3	<0.3	0.35	0.52
Copper (Filtered)	N/A	N/A	µg/L	1.7	1.8	0.59	0.89	1.7
Iron (Filtered)	0.30 mg/L	N/A	mg/L	<0.06	<0.06	<0.06	0.49	5.8
Lead (Filtered)	N/A	N/A	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Lithium (Filtered)	N/A	N/A	µg/L	<20	<20	22	22	<20
Magnesium (Filtered)	N/A	N/A	µg/L	43	45	46	66	63
Manganese (Filtered)	N/A	N/A	mg/L	15	13	6.8	280	490
Mercury (Filtered)	N/A	N/A	µg/L	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019
Molybdenum (Filtered)	73.0 µg/L	N/A	µg/L	2.2	2.2	2.1	1.4	2.1
Nickel (Filtered)	N/A	N/A	µg/L	<0.5	<0.5	<0.5	0.98	1.5
Potassium (Filtered)	N/A	N/A	µg/L	4.2	4.1	4.1	6.6	9.2
Selenium (Filtered)	1.0 µg/L	N/A	µg/L	2.0	1.9	1.8	0.56	0.22
Silicon (Filtered)	N/A	N/A	µg/L	4600	4500	4500	5500	5200
Silver (Filtered)	N/A	N/A	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1

	AB SW Freshwater Aquatic Life (Long-term)	AB SW Freshwater Aquatic Life (Short-term)	Unit	November 2020				
				WQ4B	WQ4D	WQ4C	WQ6	WQ3
Sodium (Filtered)	N/A	N/A	µg/L	43	43	43	62	50
Strontium (Filtered)	N/A	N/A	mg/L	710	720	720	980	820
Sulfur, elemental (Filtered)	N/A	N/A	µg/L	19,000	19,000	19,000	23,000	20,000
Thallium (Filtered)	0.8 µg/L	N/A	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Tin (Filtered)	N/A	N/A	µg/L	<1	<1	<1	<1	<1
Titanium (Filtered)	N/A	N/A	µg/L	<1	<1	<1	<1	<1
Uranium (Filtered)	0.015 mg/L	0.033 mg/L	mg/L	0.0034	0.0037	0.004	0.0032	0.0039
Vanadium (Filtered)	N/A	N/A	µg/L	<1	<1	<1	<1	<1
Zinc (Filtered)	0.007 mg/L	0.037 mg/L	mg/L	0.078	0.058	0.033	0.0039	0.0065

Note: **Bold** = Indicates exceedance of CCME water quality guidelines
N/A = CCME data regarding water quality limits for specified parameter is unavailable

Table 5-d Summary of Supplemental Sediment Sampling Results from Supplemental Fall Sampling in November 2020

		AB Sediment Interim Guidelines	AB Sediment Probable Effects Level	AB Sediment Lowest Effects Level	Units	November 2020				
						WQ4B	WQ4D	WQ4C	WQ6	WQ3
Regulated Metals - Soils										
Field Parameter	Percent Saturation	N/A	N/A	N/A	%	62	60	65	66	91
Inorganics	Boron Sat Paste	N/A	N/A	N/A	mg/L	0.18	<0.1	0.18	<0.1	0.14
	Moisture	N/A	N/A	N/A	%	40	48	48	42	50
Metals	Antimony	N/A	N/A	N/A	mg/kg	<0.5	<0.5	<0.5	0.51	<0.5
	Arsenic	5.9	17.0	N/A	mg/kg	5.9	2.9	4.6	6.2	4.2
	Barium	N/A	N/A	N/A	mg/kg	290	170	290	290	280
	Beryllium	N/A	N/A	N/A	mg/kg	0.57	0.41	0.45	0.67	0.55
	Boron	N/A	N/A	N/A	mg/kg	0.11	<0.06	0.12	<0.066	0.13
	Cadmium	N/A	N/A	N/A	mg/kg	0.43	0.35	0.4	0.49	0.6
	Chromium	37.3	90.0	N/A	mg/kg	16	11	19	17	15
	Chromium, hexavalent	N/A	N/A	N/A	mg/kg	<0.08	<0.08	<0.08	<0.08	<0.08
	Cobalt	N/A	N/A	N/A	mg/kg	7	4.5	5.8	7.2	6.3
	Copper	35.7	197.0	N/A	mg/kg	16	11	13	19	18
	Lead	35.0	91.3	N/A	mg/kg	9.6	6.7	7.9	11	12
	Mercury	0.170	0.486	N/A	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
	Molybdenum	N/A	N/A	N/A	mg/kg	0.86	0.48	0.86	0.95	0.69
	Nickel	N/A	N/A	16.0	mg/kg	21	14	19	23	20
	Selenium	2.0	N/A	N/A	mg/kg	1.4	2.5	2.6	0.62	2.1
	Silver	N/A	N/A	N/A	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
	Thallium	N/A	N/A	N/A	mg/kg	0.16	0.11	0.13	0.2	0.15
	Tin	N/A	N/A	N/A	mg/kg	<1	<1	<1	<1	<1
	Uranium	N/A	N/A	N/A	mg/kg	1	0.91	1.1	1.2	1.5
	Vanadium	N/A	N/A	N/A	mg/kg	25	15	20	29	24
	Zinc	123	315	N/A	mg/kg	340	230	330	78	88

Note: **Bold** = Indicates exceedance of Alberta Tier 1 (AT1) Criteria for Contaminated Soil Assessment and Remediation
N/A = AT1 data regarding soil quality limits for specified parameter is unavailable

5.1.2 Comparison with Year 1 and Year 2 Results

After three years of spring and fall water quality monitoring, the following observations have been made:

- In all three years water quality sampling, pH and DO have both been measured slightly outside of the CCME detection limits at single locations within Wetland 06. These exceedances were limited in duration (i.e., were observed during a single season within the monitoring year) and are often associated with biological processes.
- Iron was previously identified in exceedance of Environmental Quality Guidelines during Year 1 (i.e., 2018); high levels of iron were identified at the reference wetland site (i.e., WQ-01) in summer. All subsequent sampling within wetland 06 and the reference wetland has resulted in iron levels within Environmental Quality Guidelines.
- Following elevated zinc concentrations documented at WQ-02 during Fall 2020 sampling and recommendations from the Year 2 (2019) Monitoring Report, supplemental sampling was conducted to verify results and attempt to identify potential project-related sources of elevated levels. Co-located sediment and surface water sampling was conducted within Wetland 06 and along Pathway 1. Elevated zinc concentrations observed at sample sites along Pathway 1 suggests a Project related input source of the zinc exceedances observed in Fall 2020 and 2019. Sampling results from Wetland 06 sites (i.e., WQ-03 and WQ-06) did not show zinc exceedances; indicating the area of impact of elevated zinc is limited.
- All other Wetland 06 parameters remain within the CCME guidelines.

5.1.3 Comparison with Historic Measurements

Select surface water quality parameters (i.e. turbidity, temperature, pH, conductivity, DO, phosphate and chloride) collected at WQ-02 and WQ-03 during Years 3 post construction monitoring were compared to data collected in 2016 and 2017 by the Weaselhead / Glenmore Preservation Society (Porto 2018) at two sampling sites in close proximity to WQ-02 and WQ-03. Water quality data collected by the Weaselhead / Glenmore Preservation Society in 2016 was collected prior to the initiation of construction activities on the Project. A comparison of surface water quality parameters is presented in **Table 5-e** and demonstrates the natural variability in water quality between sites and season in Wetland 06.

Turbidity: In-situ water quality sampling of WQ-02 and WQ-03 in 2020 measured higher turbidity compared to water quality data collected by the Weaselhead / Glenmore Preservation Society in 2016 and 2017 (i.e., prior to construction); documented turbidity ranged from 0.8 NTU to 19.6 NTU (Porto 2018). Fall 2020 samples measured in-situ turbidity of 60.4 NTU and 33.2 NTU at the WQ-02 and WQ-03 sample locations, respectively. Lab analysed water samples collected concurrently with in-situ measurements resulted in 7.1 NTU and 11.0 NTU at the WQ-02 and WQ-03 sample locations, respectively.

Turbidity measures the amount of particulate matter (e.g., sediment, organic matter, algae, etc.) suspended in the water. Turbidity is a point measurement specific to conditions at the time of sampling; as such, it is difficult to compare point measurements from year to year. There are a number of potential causes of increased turbidity including, but not limited to, site conditions, precipitation preceding the sampling event, localized animal activity in the vicinity of the sample location, and sampling procedures.

During fall sample collection, both Wetland 06 sample sites (i.e., WQ-02 and WQ-03) were covered with a layer of ice approximately 2 mm thick which had to be removed to facilitate water quality sampling; 2020 was the first year ice was encountered at these sites. The water disturbance caused by the removal of the surface ice, in combination with shallow water depths, fine sediments and organic matter may have resulted in temporarily elevated turbidity at the sample sites.

During fall 2020 sampling limited surface flow into Wetland 06 along input Pathway 1 and Pathway 2 was encountered; the results of flow monitoring are provided in **Section 5.2**. Surface water was detectable in Pathway 1 at the FL-01 monitoring site (upstream of WQ-02), but velocities were too low to calculate a discharge. Surface flow was impeded along Pathway 2 by a beaver dam (constructed between spring and fall 2020 monitoring visits), which blocked outflow into Wetland 06 immediately upstream of WQ-03. The limited surface connectivity observed during fall 2020 suggest that high turbidity recorded within Wetland 06 is unlikely to be the result of particulate inputs related to the SWCRR Project.

pH: In-situ water quality sampling of WQ-02 in 2020 measured higher pH compared to water quality data collected by the Weaselhead / Glenmore Preservation Society in 2016 and 2017 (i.e., prior to construction). Samples collected during the 2020 measured a pH of 9.01mg/L and 8.53 mg/L during the spring and summer site visits, respectively. The pH of 9.01mg/L measured during spring exceeds the pH range provided by the AB SW Freshwater Aquatic Life (Long-term) guidelines of 6.5 to 9.0 (GOA 2014). Elevated pH levels in surface water can result from increased photosynthesis rates during a period of higher water temperatures and increased sunlight intensity. Fall sampling documented a reduction in the pH at site WQ-02 to within the acceptable range under the guidelines (GOA 2014). Year 3 (i.e., 2020) is the first year an exceedance in pH has been documented at a Wetland 06 sample site; this parameter will continue to be closely monitored throughout subsequent monitoring years to detect long-term trends.

Chloride: Water quality sampling of Wetland 06 in 2020 measured higher chloride concentrations compared to water quality data collected by the Weaselhead / Glenmore Preservation Society in 2016 and 2017 (i.e., prior to construction). Samples collected during the 2020 spring site visit measured a chloride concentration of 12.0 mg/L and 18.0 mg/L at the WQ-02 and WQ-03 sample locations, respectively. During the 2020 fall site visit measured a chloride concentration of 15.0 mg/L and 7.9 mg/L at the WQ-02 and WQ-03 sample locations, respectively.

Elevated chloride concentrations may result from a variety of sources including road salt runoff and herbicides (Kelly et al. 2012). The increase in chloride levels identified within Wetland 06 may be a result of two sediment releases from the SWCRR construction area into the west side of Wetland 06 which occurred in August of 2019 during a heavy rainfall event.

A comparison between post construction sampling years shows that although chloride remains elevated from pre-construction levels, the chloride concentration at both Wetland 06 sample sites has decreased compared to 2018. As chloride has limited reactivity with the environment and is highly soluble in water, its residence time within a water body is greatly influenced by the rate of water flow; limited flow will result in a longer persistence time. The CCME guidelines for water quality recommend a maximum chloride concentration of 120 mg/L for the long-term protection of aquatic life (CCME 1999); the concentration of chloride identified at Wetland 06 sample sites remained below this limit. Although current concentrations of chloride are below CCME limits and reduced from 2018 concentrations, this parameter will continue to be closely monitored throughout subsequent monitoring years to detect any long-term trends.

Conductivity: In-situ water quality sampling of Wetland 06 in 2020 measured elevated conductivity when compared to previous water quality data collected by the Weaselhead / Glenmore Preservation Society in 2016 and 2017 (i.e., prior to construction). Samples collected during the 2020 spring site visit measured a conductivity of 662.02 $\mu\text{S/cm}$ and 590.97 $\mu\text{S/cm}$ at the WQ-02 and WQ-03 sample locations, respectively. During the 2020 fall site visit measured a conductivity of 759.50 $\mu\text{S/cm}$ and 737.36 $\mu\text{S/cm}$ at the WQ-02 and WQ-03 sample locations, respectively. A comparison between post-construction sampling years shows that although conductivity remains elevated from pre-construction levels, the conductivity sampled from WQ-02 has decreased since 2018. The conductivity sampled from WQ-03 has gradually increased each monitoring year; however, conductivity levels at WQ-03 remain lower than WQ-02.

Conductivity in surface water is affected by the presence of a variety of inorganic cations and anions, including chloride. There are no CCME or Alberta Environmental Quality Guidelines specific to conductivity due to its high natural variability, however natural waters can vary between 50 $\mu\text{S/cm}$ and 1,500 $\mu\text{S/cm}$ (BC Ministry of Environment 2013). Variation in conductivity measured in Wetland 06 falls within this range

Table 5-e Surface Water Quality Parameters Collected from Wetland 06 Sites from 2016 to 2020

Surface Water Quality Parameters of Wetland 06											
		2016 ¹		2017 ¹		2018 ²		2019 ³		2020 ⁴	
		Summer	Fall	Summer	Fall	Summer	Fall	Spring ⁴	Fall	Spring	Fall ⁵
Sampling Site 1 (close proximity to WQ-02)	Turbidity (NTU)	30.8	0.8	20.0	18.7	6.5	5.4	2.0	8.9	6.4	60.4
	Temperature C	11.9	4.0	14.6	4.2	19.1	1.1	12.30	3.25	14.58	3.12
	pH	7.6	7.9	7.53	8.07	7.6	6.5	8.0	8.2	9.0	8.5
	Conductivity (µS/cm)	470	444	589	500	882	833	712	698	662	760
	DO (mg/L)	5.20	10.48	2.03	9.12	10.5	9.8	7.2	10.0	9.67	11.01
	Phosphate (mg/L)	0	0	0.01	0.01	0.0068	0.0034	0.0037	<0.003	0.003	0.004
	Chloride (mg/L)	2.88	5.26	3.68	5.25	41	12	13	7.3	12.0	15.0
Sampling Site 2 (close proximity to WQ-03)	Turbidity (NTU)	3.3	10.0	36.0	19.6	7.0	7.0	1.8	6.5	22.2	33.2
	Temperature C	12.2	4.1	10.7	2.4	20.6	0.5	16.06	3.87	12.68	5.34
	pH	8	8	7.95	8.15	8.9	6.8	8.27	8.19	8.89	7.96
	Conductivity (µS/cm)	469	449	523	491	509	688	575	766	590.97	737.36
	DO (mg/L)	5.3	5.1	2.65	9.99	14.4	5.8	8.68	7.31	9.72	4.86
	Phosphate (mg/L)	0.16	0.01	0	0	0.0085	0.0085	0.0039	<0.003	0.004	0.004
	Chloride (mg/L)	4.18	5.85	7.70	4.68	51	29	12	12	18.0	7.9

Note: ¹ Porto 2018

² Data collected at WQ-02 and WQ-03 in 2018 as part of the Monitoring Plan.

³ Data collected at WQ-02 and WQ-03 in 2019 as part of the Monitoring Plan.

⁴ Data collected at WQ-02 and WQ-03 in 2020 as part of the Monitoring Plan.

⁵ Water samples collected during fall 2020 following the removal of approximately 2 mm of surface ice from sample sites WQ-02 and WQ-03

5.2 Water Flow Monitoring

Surface water flow monitoring was conducted during the spring and fall at three inflow sites and one outflow site located within Wetland 06 (**Table 4-b**). Information on channel width, channel depth, velocity and discharge were collected during each monitoring visit; the results are summarized in **Table 5-f, Table 5-g and Table 5-h**.

Following procedures specified in the Monitoring Plan, and recommendations made following Year 1 surface water flow monitoring, the initial 2020 site visit was conducted earlier in the year (i.e., May) to capture higher periods of flow within the Project area; enabling calculations of velocity and discharge at all inflow and outflow locations. However, during the spring monitoring visit water levels remained low, preventing the collection of flow data at all sites. The inflow channels at site FL-01 and site FL-02 had surface water present, but no measurable velocity within the channel. The inflow channel at site FL-03 and the outflow channel at site FL-04 were dry at the time of monitoring. There was not sufficient surface water or velocity during spring monitoring to calculate discharge at any of the sites. These results were consistent with the results of Year 1 (i.e., 2018) and Year 2 (i.e., 2019) monitoring.

Surface water levels were also low during the fall monitoring visit. Site FL-01 had increased water depth compared to the conditions present during spring monitoring but showed a reduction in channel width and velocity. Site FL-02 had surface water present, but no measurable velocity in the channel. The wetted width and depth of the channel at site FL-02 was consistent when compared to spring measurements. The inflow channel at site FL-03 and the outflow channel at site FL-04 were dry at the time of monitoring. There was not sufficient surface water or velocity during fall monitoring to calculate discharge at any of the sites. These results were consistent with the results of Year 1 (i.e., 2018) and Year 2 (i.e., 2019) monitoring.

Table 5-f Summary of Water Flow Monitoring Site Channel Width and Depth

Site	Inflow or Outflow	Channel Width (m)	Depth*(m)		
			RMID	MID	LMID
Summer 2018					
FL-01	Inflow	0.42	0.30	0.27	0.28
FL-02	Inflow	2.50	0.68	0.58	0.39
FL-03	Inflow	-	-	-	-
FL-04	Outflow	-	-	-	-
Fall 2018					
FL-01	Inflow	0.49	0.07	0.07	0.07
FL-02	Inflow	1.15	0.14	0.23	0.28
FL-03	Inflow	-	-	-	-
FL-04	Outflow	-	-	-	-
Spring 2019					
FL-01	Inflow	0.55	-	0.04	-
FL-02	Inflow	1.58	0.26	0.55	0.66
FL-03	Inflow	-	-	-	-
FL-04	Outflow	-	-	-	-

Site	Inflow or Outflow	Channel Width (m)	Depth*(m)		
			RMID	MID	LMID
Fall 2019					
FL-01	Inflow	0.25	-	0.12	-
FL-02	Inflow	1.30	0.26	0.42	0.66
FL-03	Inflow	5.00	-	0.40	-
FL-04	Outflow	-	-	-	-
Spring 2020					
FL-01	Inflow	0.55	0.03	0.08	0.05
FL-02	Inflow	1.62	0.62	0.65	0.64
FL-03	Inflow	-	-	-	-
FL-04	Outflow	-	-	-	-
Fall 2020					
FL-01	Inflow	0.82	0.01	0.08	0.02
FL-02	Inflow	1.32	0.22	0.32	0.44
FL-03	Inflow	-	-	-	-
FL-04	Outflow	-	-	-	-

Note: * RMID= right mid channel, MID= mid channel, LMID= left mid channel

(-) = null result

Table 5-g Summary of Water Flow Monitoring Site Velocity and Discharge

Site	Inflow or Outflow	Velocity* (m/sec)			Discharge (m3/sec)
		RMID	MID	LMID	
Summer 2018					
FL-01	Inflow	-	-	-	-
FL-02	Inflow	-	-	-	-
FL-03	Inflow	-	-	-	-
FL-04	Outflow	-	-	-	-
Fall 2018					
FL-01	Inflow	0	0.15	0	-
FL-02	Inflow	-	-	-	-
FL-03	Inflow	-	-	-	-
FL-04	Outflow	-	-	-	-
Spring 2019					
FL-01	Inflow	-	0.20	-	-
FL-02	Inflow	0.00	0.00	0.00	-
FL-03	Inflow	-	-	-	-
FL-04	Outflow	-	-	-	-

Site	Inflow or Outflow	Velocity* (m/sec)			Discharge (m3/sec)
		RMID	MID	LMID	
Fall 2019					
FL-01	Inflow	-	0.10	-	-
FL-02	Inflow	0.00	0.00	0.00	-
FL-03	Inflow	0.00	0.00	0.00	-
FL-04	Outflow	-	-	-	-
Spring 2020					
FL-01	Inflow	0.00	0.10	0.00	-
FL-02	Inflow	0.00	0.00	0.00	-
FL-03	Inflow	-	-	-	-
FL-04	Outflow	-	-	-	-
Fall 2020					
FL-01	Inflow	0.00	0.11	0.00	0.00
FL-02	Inflow	0.00	0.00	0.00	0.00
FL-03	Inflow	-	-	-	-
FL-04	Outflow	-	-	-	-

Note: * RMID= right mid channel, MID= mid channel, LMID= left mid channel
 (-) = null result

Wetted widths measured at four transects in Wetland 06 and four transects in the reference wetland are summarized in **Table 5-g**. In Wetland 06, wetted widths were longer in the spring than in the fall, indicating a reduction in the quantity of surface water within the wetland. The transect located at the eastern most extent of Wetland 06 (T1) showed the most significant reduction in wetted width between monitoring visits. The reference wetland was dry during the fall monitoring visit and wetted width transects could not be conducted. These results were consistent with the wetted widths results of Year 1 (i.e., 2018) and Year 2 (i.e., 2019) monitoring.

During Year 3 monitoring, water levels were recorded with the staff gauge installed in Wetland 06. During the spring site visit the water level was recorded as 27.9 cm. During the fall site visit the water level had dropped to 8.0 cm, with a total difference in water levels between seasons of 19.1 cm. The change in seasonal water levels within Wetland 06 is consistent with the changes in wetted width measurements between the spring and fall sampling visits. Water levels were also documented on a staff gauge installed at the reference wetland. During the spring site visit the water level was recorded as 30.5 cm. During the fall site visit the reference wetland was dry; this is consistent with Year 1 (i.e., 2018) and Year 2 (i.e., 2019) monitoring results. As a result, a change water level cannot be accurately obtained from the staff gauge installed to measure water depths at reference wetland. Although a direct water depth comparison between the reference wetland and Wetland 06 cannot be completed, both the reference wetland and Wetland 06 show a reduction in water level during the fall site visit.

Table 5-h Summary of Wetted Width Measurements from 2018 to 2020

Site	Transect	Wetted Width(m)		Percent Change of Wetted Width (%)	Wetted Width(m)		Percent Change of Wetted Width (%)	Wetted Width(m)		Percent Change of Wetted Width (%)
		Summer 2018	Fall 2018		Spring 2019	Fall 2019		Spring 2020	Fall 2020	
Wetland 06	T1-1	28.0	1.0	96.4	*	*	*	34.0	1.8	94.7
	T1-2	26.0	22.0	15.4	45.0	2.0	95.6	14.0	25.0	44.0
	T1-3	52.0	51.0	1.9	35.0	29.0	17.1	24.0	22.0	8.3
	T1-4	37.0	35.0	5.4	40.0	32.0	20.0	28.0	27.0	3.6
Reference Wetland	T2-1	25.0	-	100.0	13.0	-	100.0	19.0	-	100.0
	T2-2	32.0	-	100.0	15.0	-	100.0	22.0	-	100.0
	T2-3	28.0	-	100.0	13.0	-	100.0	22.0	-	100.0
	T2-4	28.0	-	100.0	7.0	-	100.0	13.0	-	100.0

Note: (-) = wetland was dry during monitoring visit, (*) = data not available

6.0 SUMMARY

Monitoring effort conducted in 2020 represents Year 3 of the Wetland 06 monitoring program. This report presents the 2020 results which will add to the sampling record within the Project area and facilitate additional comparison in subsequent monitoring years. Year 3 of the monitoring program was completed according to the criteria specified in the Monitoring Plan, with the addition of supplemental monitoring sites to.

During Year 3 of monitoring, the following key observations were noted:

- Water quality results show variation in water quality parameters among sampling locations within Wetland 06, as well between spring and fall sampling visits.
- The majority of surface water quality parameters measured were consistent with CCME criteria for the protection of aquatic life. Within Wetland 06 pH, zinc, and DO did not meet guidelines for the protection of aquatic life during sampling.
- Following elevated zinc concentrations documented at WQ-02 during Fall 2020 sampling and recommendations from the Year 2 (2019) Monitoring Report, supplemental sampling was conducted to verify results and attempt to identify potential project-related sources of elevated levels. Co-located sediment and surface water sampling was conducted within Wetland 06 and along Pathway 1. Elevated zinc concentrations observed at sample sites along Pathway 1 suggests a Project related input source of the zinc. Sampling results from the available Wetland 06 sites (i.e., WQ-03 and WQ-06) did not show zinc exceedances; indicating the area of impact of elevated zinc is limited.
- Turbidity, pH, chloride and conductivity concentrations measured in Wetland 06 in 2020 were higher than historic measurements taken in 2016 and 2017.
- The spring site visit was conducted earlier in May to capture higher periods of flow within the Project area to enable calculations of velocity and discharge, however inflow and outflow channel

measurements found limited to no surface water flow into or out of Wetland 06 during the two monitoring visits.

- Smaller wetted widths were recorded during the fall site visit at all transects in Wetland 06 indicating a reduction in surface water quantity; this is consistent with all previous years of post-construction monitoring. During the fall site visit the reference wetland was dry.

7.0 RECOMMENDATIONS

Based on the results of the Year 3 (i.e., 2019) monitoring program, the following recommendations are suggested for monitoring in 2021:

- Monitoring of water quality and quantity should be continued in 2021 using similar methods and effort as employed in 2020 and outlined in the Monitoring Plan.
- Water quality monitoring efforts will continue in Year 4 to better facilitate detection of any changes to surface water quality as a result of SWCRR Project impacts.
 - Increased diligence should be taken in regard to water quality parameters (i.e., pH, DO, iron and zinc) which have been measured in exceedance of CCME guidance during post-construction monitoring periods (i.e., Year 1, Year 2 and Year 3). Subsequent years of monitoring will provide greater understanding of trends in water quality parameters following initial exceedances and determine if changes were the result of natural variation within the wetlands or part of an ongoing change in environmental conditions.
 - Analytical results of water quality sampling will continue to be reviewed by a qualified Engineering Hydrogeologist as soon as received. If anomalies or exceedances in results are detected, resampling and additional sampling will be conducted within 45 days of the original date of sample collection to verify results and attempt to identify potential project-related sources of elevated levels.
 - Co-located sediment samples should be collected along Pathway 1 during spring and fall site visits to collect supplemental data should zinc levels in exceedance of CCME Guidelines for the Protection of Fresh Water Organisms occur during the Year 4 monitoring period.
 - Trends in changing water quality parameters noted in Wetland 06 when compared to historical data (i.e. conductivity and chloride) should continue to be investigated throughout subsequent monitoring to confirm potential long-term trends identified during post-construction monitoring.
- Water flow monitoring will continue in Year 4 to determine if surface water quantity within Wetland 06 has been influenced by activities related to the SWCRR Project.

8.0 CLOSURE

The results of Year 3 monitoring provide an additional year of surface water quality comparison for Wetland 06 following the initiation of construction phase of the SWCRR. In addition, Year 3 monitoring also provides initial results of sediment sampling within Wetland 06 and along Pathway 1 which may be compared against future data in subsequent monitoring years. This report addresses water quality and quantity impacts to Wetland 06, fulfilling the requirements of the Order which amended the initial *Water Act* Approval received by the Project No.: 00388473-00-00.

Report prepared by:
Hemmera Envirochem Inc.



Jessica Eaton, B.Sc. BIT
Biologist

Report reviewed by:
Hemmera Envirochem Inc.



Kirsten Norris, B.Sc., M.Sc., P.Biol.
Senior Fisheries Biologist

9.0 REFERENCES

- British Columbia Ministry of Environment. 2013. Water Quality Assessment and Objects for Coldstream Creek. Available at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/wqgs-wqos/thomp-ok-wqos/technical_coldstream_wqo_jan_2016.pdf.
- Canadian Council of Ministers of the Environment. 2011. Protocols Manual for Water Quality Sampling in Canada. Available at: https://www.ccme.ca/files/Resources/water/water_quality/protocols_document_e_final_101.pdf
- Canadian Council of Ministers of the Environment. 1999. Canadian environmental quality guidelines, 1999. Canadian Council of Ministers of the Environment, Winnipeg, MB.
- Canadian Council of Ministers of the Environment. 1993. Guidance Manual on Sampling, Analysis, and Data Management for Contaminated Sites. Available at: https://www.ccme.ca/en/resources/contaminated_site_management/assessment.html
- City of Calgary. 2011. Stormwater Management and Design Manual. Water Resources Division. Available at: <https://www.calgary.ca/UEP/Water/Documents/Water-Documents/Stormwater%20Source%20Control%20Practices%20Handbook%20-%20November%202007.pdf?noredirect=1>
- Government of Alberta. 2019. Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Land Policy Branch, Alberta Environment and Parks. Edmonton, Alberta. 43 pp.
- Government of Alberta. 2009. Water Measurement Guidebook. Available at: <https://open.alberta.ca/dataset/4abef720-89a2-4040-af1d-c75d31050fda/resource/b890c99d-e51e-4376-9993-7aa01051d396/download/wur-watermeasurementguidebook-2009.pdf>
- Government of Alberta. 2014. Environmental Quality Guidelines for Alberta Surface Waters. Alberta Environment and Sustainable Resource Development, Water Policy Branch, Policy Division. Edmonton, 48 pp.
- Government of Alberta. 2018. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Alberta Environment and Parks. Edmonton, Alberta. 58 pp.
- Hemmera. 2018. Wetland 06 Water Monitoring Plan, Southwest Calgary Ring Road Project, Calgary, Alberta. Prepared for KGL Constructors.
- Hemmera. 2019. Wetland 06 Water Monitoring Plan, Southwest Calgary Ring Road Project, Calgary, Alberta. Prepared for KGL Constructors.
- Kelly, W.R., Panno, S.V., Hackley, K. 2012. The Sources, Distribution, and Trends of Chloride in the Waters of Illinois. Prairie Research Institute, University of Illinois. Champaign, USA.
- Porto, Cassiano. 2018. Weaselhead/Glenmore Park SWCRR Impact Study 2016-2023 Environmental Monitoring Report 2017: Part 1 – Noise, birds, vegetation, water quality and aquatic invertebrates.

APPENDIX A

Monitoring Plan

Wetland 06 Water Monitoring Plan Southwest Calgary Ring Road Project Calgary, Alberta

Prepared for:

KGL Constructors
18 Steven Chiefs Road SW
Calgary, Alberta T2W 3C4

Project No. 102604-01

Prepared by:

Hemmera Envirochem Inc.
322 11th Avenue SW, Suite 804
Calgary, AB T2R 0C5
T: 403.264.0671
F: 403.264.0670
hemmera.com

June 2018

TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
1.1	Monitoring Objectives.....	1
2.0	DESCRIPTION OF WETLAND 06	2
3.0	MONITORING SCHEDULE	3
4.0	METHODOLOGY	4
4.1	Sample locations.....	4
4.1.1	Surface Water Quality	4
4.1.2	Surface Water Flow	5
4.2	Frequency of sampling.....	6
4.3	Water Quality Monitoring	6
4.4	Water Flow Monitoring	8
4.5	Reporting.....	9
5.0	CLOSURE.....	9
6.0	REFERENCES.....	10

LIST OF TABLES (WITHIN TEXT)

Table 1	Monitoring Schedule	3
Table 2	Surface Water Quality Sample Locations	5
Table 3	Surface Water Flow Sample Locations.....	5
Table 4	Water Quality Parameters Monitored During the Plan.....	7

LIST OF FIGURES (WITHIN TEXT)

LIST OF APPENDICES

FIGURES (APPENDED)

Figure 1	Wetland Locations
Figure 2	Water Flow and Quality Sampling Locations
Figure 3	Water Flow and Quality Sampling Location Details

1.0 INTRODUCTION

The Southwest Calgary Ring Road (SWCRR) Project (the Project) includes the design and construction of approximately 31 kilometers of new six and eight lane divided freeway, 14 interchanges, as well as three watercourse realignments and associated crossing structures. The Project corridor is located along the western limit of the City of Calgary south of Highway 8 and includes sections of Highways 8 and 22. The Project has been awarded by Alberta Transportation to Mountain View Partnership, which in turn has engaged KGL Constructors (KGL) to develop the Project.

On August 11, 2017, the Project received *Water Act* Approval No.: 00388473-00-00 (the Approval) to impact twenty-four (24) wetlands, including Wetland 06. Subsequently, an Environmental Appeal was filed (*Brockman and Tulick v. Director, South Saskatchewan Region, AEP*; Appeal Nos.: 17-047 and 17-050-R. 2017) affecting KGL's ability to impact the wetlands, as described in the Approval.

As a result of the Environmental Appeal, the Minister of Environment and Parks issued a Ministerial Order 06/2018 (the Order), on January 29, 2018, that amended the previously received Approval to include conditions to address water quality and quantity impacts to Wetland 06 (see conditions 6.2 to 6.6). To address these conditions, KGL Constructors retained Hemmera Envirochem Inc. (Hemmera) to develop a monitoring plan (the Plan) that includes:

- monitoring of the flow of water flow into Wetland 06 in the spring and fall of each year that the plan is in effect;
- monitoring of the water quality in Wetland 06 in the spring and fall of each year that the plan is in effect, including total dissolved solids, salts, dissolved metals, and other parameters consistent with a stormwater sampling program;
- the monitoring data shall be provided to the Director within one month from the date the data were collected;
- the results of the monitoring and an analysis of the monitoring shall be provided to the Director in an annual report by March 31 of the year following the calendar year in which the data were collected; and
- the monitoring plan shall come into effect as soon as the Director approves the plan and shall remain in effect for a period of five years after the road is officially opened to the public.

1.1 Monitoring Objectives

Wetlands consist of land that has been saturated for sufficient time to promote the formation of water altered soils, growth of water tolerant vegetation, and various kinds of biological activity, adapted to wet environments (ESRD 2013). They play an important role on the landscape and are ecologically and economically significant by maintaining water quality and supply in watersheds, providing flood protection and erosion control, as well as providing habitat for various fish and wildlife species. Wetland health is reflective of numerous physical, chemical, and biological components. We acknowledge that there are numerous indicators of wetland health; however, the monitoring plan has been developed specifically to reflect requirements of the Order. As a result, monitoring elements of this Plan were prioritized to surface water quality and flow exclusively.

The objectives of the Plan include:

- monitoring surface water quality in Wetland 06 and flow into Wetland 06,
- monitoring surface water flow out of Wetland 06,
- monitoring surface water quality in waterbodies/drainages that provide surface water flow into Wetland 06, and
- monitoring surface water quality in an adjacent reference wetland.

It is expected that by monitoring Wetland 06 as well as other nearby wetlands and waterbodies, the Plan will result in a suitable comparative analysis about the potential influences or lack thereof of the Project on surface water quality and flow in Wetland 06.

2.0 DESCRIPTION OF WETLAND 06

Wetland 06 is located in the Weaselhead Natural Area, a natural environmental park that borders the west end of Glenmore Reservoir (**Figure 1**) within the City of Calgary. A small portion of Wetland 06 is located within the Transportation Utility Corridor (TUC). Wetland 06 is a historical oxbow channel to the Elbow River that is over 500 m in length with wetted widths that are generally less than 30 m. A pedestrian/bike bridge associated with the Glenmore Reservoir Regional Pathway network crosses Wetland 06. Wetland 06 drains generally east through the Weaselhead Natural Area and eventually discharges into the Glenmore Reservoir, which provides approximately half of the City of Calgary's drinking water supply.

Wetlands 07, 08, and 09 are located upslope of Wetland 06 and are the source of surface water flow into Wetland 06 (**Figure 1**). Wetland 08 and 07 are located to the southwest of Wetland 06. Surface flow from Wetland 08 and 07 are conveyed into Wetland 06 by an undefined channel that becomes defined downstream of the TUC near Wetland 06 as the slope gradient increases. A bypass drainage culvert will be installed during the construction phase of the Project to convey water from Wetland 07 and 08 through the Project area. Wetland 09 is located south of Wetland 06. Surface flow from Wetland 09 is conveyed by an undefined channel first flowing easterly through the Project and then northerly from the TUC boundary through a defined channel to Wetland 06. A bypass drainage system has been installed as part of the Project to maintain flow from Wetland 09 to Wetland 06.

During the construction phase of the Project, surface run-off from the work area will be managed through temporary erosion and sediment control (ESC) measures and will be redirected away from Wetland 06. During the operational phase of the Project, the natural flow of surface water (i.e., from the west side of the TUC) into Wetland 06 will be maintained via the bypass drainage systems described above. Further, during the operational phase, Project-impacted water will not be discharged into Wetland 06. All Project-impacted water in the vicinity of Wetland 06 has been designed to flow north into a stormwater pond.

3.0 MONITORING SCHEDULE

The monitoring schedule, including field sampling visits, seasonal data summaries, and annual reports is provided in **Table 1**. Field sampling visits to monitor surface water quality and flow will occur during the spring and fall of each year of the Plan. Additional details on sampling frequency are provided in **Section 4.2**.

Following each season of monitoring, data summaries (i.e., surface water quality and flow) will be made publicly available by KGL within one month of the seasonal field sampling visits. The annual report will be made publicly available by March 31 of the year following the field sampling visits.

Table 1 Monitoring Schedule

Task	Monitoring Year ^a											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1. Water Quality Monitoring ^b												
2. Water Flow Monitoring ^b												
3. Seasonal Data Summary ^c												
4. Annual Report ^d												

^a Plan year includes construction phase and first five years of the operational phase.

^b Surface water quality and flow field sampling visits are proposed in May and October of each year of the Plan; however, annual variability in ambient air temperature, snow/ice cover, and precipitation events may impact the exact date of sampling.

^c Surface water quality and flow data summaries will be made publicly available within one month of each seasonal monitoring visit.

^dThe Annual Report will be made publicly available by March 31 of the year following the field sampling visits (e.g., the 2018 Annual Report will be posted by March 30, 2019).

4.0 METHODOLOGY

4.1 Sample locations

The locations for surface water quality and flow monitoring are provided in **Figure 2**. The sites have been selected strategically for appropriate reference and comparison site considerations, in order to allow for a comparative analysis. An enhanced view of the sampling sites in and near Wetland 06 is provided in **Figure 3**. Suitability of these locations has been field verified during a reconnaissance survey in early spring 2018, however, the locations of these sites are subject to change pending potential subsequent annual and seasonal variability in site conditions.

4.1.1 Surface Water Quality

Surface water quality will be monitored at eight site locations (**Table 2**).

One surface water quality reference site (WQ-01) is identified for the Plan. The reference site is located north of Wetland 06 in an adjacent wetland that is outside the TUC. This site was selected as there are no identified or known pathways from the Project that could potentially direct Project-effected water into the adjacent wetland.

Based on a desktop assessment and a field reconnaissance, Hemmera identified two pathways in which Project-influenced water could potentially flow into Wetland 06 (see **Figure 1**). The two identified pathways are described below. For each of the respective pathways, comparison samples will be collected from a series of sample sites (i.e., background vs. comparison) (see **Figure 2**).

- Pathway 1 is an undefined channel that diagonally bisects the Project footprint. From the west side of the TUC boundary, water flows northeast through Wetland 08 into Wetland 07 where it then flows past the east side of the TUC boundary and then into a defined channel (approximately 400 m) that ultimately drains into Wetland 06 (see **Figure 1**). The sample sites associated with Pathway 1 are; WQ-04a, WQ-04b, and WQ-02 (see **Figure 2**). WQ-04a has been selected as a background site, as it is located upstream of potential influences from the Project.
- Pathway 2 is an undefined channel that flows east through Wetland 09 where it then enters a recently construction stormwater drainage system (see **Figure 1**). The drainage system outlets into a constructed riprap lined drainage ditch that flows north towards the eastern TUC boundary. In addition, a constructed drainage ditches channels water west where it converges with flows in the aforementioned constructed riprap lined drainage ditch. From the eastern TUC water meanders north through a defined channel (approximately 1,000 m) that eventually drains into Wetland 06 (see **Figure 1**). The samples sites associated with Pathway 2 are; WQ-05a, WQ-05b, WQ-05c, and WQ-03 (see **Figure 2**).

Surface water quality monitoring sites are subject to change due to seasonality and site conditions. Additional or alternative surface water quality monitoring sites may be identified if field crews observe abnormal site conditions or contaminant indicators, more information is provided in **Section 4.3**.

Table 2 Surface Water Quality Sample Locations

Site Name	Universal Transverse Mercator (Zone 11U)		Site Description	Reference or Comparison Site
	Easting	Northing		
WQ-01	699168	5652375	Reference wetland to the north of Wetland 06	Reference
WQ-02	699186	5652164	West (upslope) side of Wetland 06	Comparison
WQ-03	699432	5652159	East (downslope) side of Wetland 06	Comparison
WQ-04a	698898	5651725	Wetland 08, upslope of SWCRR Project	Background
WQ-04b	699113	5651956	Wetland 07, downslope of SWCRR Project and Wetland 08	Comparison
WQ-05a	699060	5650929	Upslope of Wetland 09 and SWCRR Project	Background
WQ-5b	699788	5651289	Watercourse 01 downslope of Wetland 09 and SWCRR Project	Comparison
WQ-05c	700061	5651274	Catchment basin to the east of SWCRR Project and upslope of the confluence with Watercourse 01	Comparison

4.1.2 Surface Water Flow

Surface water flow will be monitored at four locations around Wetland 06 (**Table 3**). Each of these locations are expected to provide conveyance of surface flow (inflow or outflow) year-round during normal surface flow conditions. Given the higher than average snowfall and later than normal lowland melt in 2018, sampling locations for surface water flow may need to be reconsidered in subsequent sampling visits.

Surface water inflows have been identified at FL-01, FL-02, and FL-03. The sampling location FL-01 occurs where surface water inflow is associated with drainage from Wetland 07 and 08. Site FL-02 is where the surface water inflow is conveyed from Wetland 09. Site FL-03 is where the surface water inflow associated with drainage from the reference wetland to the north of Wetland 06. Surface water outflow monitoring will occur at FL-04 at the Glenmore Pathway bridge crossing approximately 75 m downslope from Wetland 06.

Table 3 Surface Water Flow Sample Locations

Site Name	Universal Transverse Mercator (Zone 11U)		Inflow or Outflow
	Easting	Northing	
FL-01	699156	5652166	Inflow
FL-02	699406	5652115	Inflow
FL-03	699075	5652326	Inflow
FL-04	699644	5652343	Outflow

Surface flow in undefined channels (i.e., lacking defined bed and banks) may be present at the surface water flow monitoring locations pending flow conditions during each field sampling visit and are expected to be influenced by natural events (e.g., precipitation levels) within and between monitoring years. Monitoring flow in waterbodies lacking defined bed and banks can also have reduced accuracy as compared to a defined channel. Therefore, field crews may be required to adjust the surface water flow monitoring sites

during each field sampling visit to a location where channel characteristics are most appropriate for flow measurements. If additional surface water inflow or outflow locations are identified during the field sampling visits due to variability in hydrological connectivity, contingency surface water flow monitoring sites will be added.

4.2 Frequency of sampling

Surface water quality and flow monitoring will occur twice annually, once in the spring and once in the fall. The spring field sampling visit is proposed to occur in May and the fall field sampling visit is proposed to occur in October of each year of the Plan. The exact timing of the spring and fall field sampling visits are dependent on environmental conditions including ambient air temperatures, snow/ice cover, and precipitation events. Sampling will not occur during or within 72 hours of a substantial precipitation event to reduce any temporal variation (short-term pulse response) associated with extreme disturbances resulting in water and flow sampling that is more representative of the wetland conditions.

4.3 Water Quality Monitoring

Surface water quality samples will be taken from the banks of at the sample sites provided in **Tables 2** and discussed in **Section 4.1.1**. Site conditions (e.g., weather) will be recorded by the field crew. At each sampling site, five photos will be taken in a north, south, east, west, and ground direction.

Discrete profile lake water sampling and composite integrated water sampling methodologies (Alberta Environment 2006) have been determined to be inappropriate sampling methodologies for this Plan as water depths at the sampling sites are not deep enough to require spatial characterization over a horizontal or depth profile. The protocol provided by Canadian Council of Ministers of the Environment (CCME) (2011) for shore sampling will be followed and is summarized below. A certified Canadian Association for Laboratory Accreditation (CALA) laboratory will complete the laboratory analysis of water samples.

Samples will be labeled using a water-proof marker for accurate identification by the field crews and the laboratory. A chain of custody form will be completed, and any transfers of custody will be noted on the form by the authorized personnel including transfer to the CALA laboratory. Field crews will wear unpowdered latex or polyethylene disposable gloves and refrain from smoking or eating while collecting water samples (Alberta Government 2006).

An extension pole will be used to collect a “grab sample” from each sampling site and to avoid disturbing the site during collection of the water samples (CCME 2011). At each sampling location, the extension pole and clamp will be rinsed prior to collecting the water samples to reduce possible contamination between sites. Laboratory protocols for sample bottle rinsing will be followed and any rinsing of sample bottles or collection equipment will be completed slightly downslope of the sampling location to prevent cross contamination.

Water samples will be collected facing upstream if flow is present (CCME 2011). Water bottles will be uncapped immediately prior to filling. Water samples will be collected one at a time ensuring the lid is immediately capped once the bottle is filled. Water samples will be collected at approximately 60% water depth to avoid surface scum and film, and to collect a representative water sample. Algae, sediment, and organic matter will be avoided in the water sample.

Laboratory protocols for preservatives, storage, and transportation of water samples will be followed. Water samples will be kept in coolers containing enough ice packs or warm water bottles to keep the samples at approximately 4°C. All water samples will be sealed and packed in the coolers as to prevent spillage or breakage. Water samples will be delivered to the laboratory as soon as possible after collection, preferably the same day and hold times will be followed so analysis will occur within the appropriate hold periods.

Water sample parameters to be monitored during the Plan include those identified as potential sources or indicators of sources of pollutants or contaminants that may result from the construction and operations phases of the Project. Previous studies have shown sediment transport and deposition pose the greatest risk to the construction phase of highway projects, resulting from excavation and earthworks (Barrett et. al., 1995). Eroded soil can also transport nutrients, ions, and metals (Barrett et. al., 1995). During the operations phase of highway projects, sedimentation remains a concern along with transportation of pollutants from vehicles operating on the highway through run-off (Barrett et. al., 1995).

Water samples will be collected at all eight sampling (**Table 2**) for the parameters provided in **Table 4**. All samples collected from Wetland 06 and the reference wetland (i.e., WQ-01, WQ-02, and WQ-03) will be submitted for analysis for all parameters immediately after collection, with regular turn around time of 7-days requested. For remaining sample locations (i.e., WQ-04a,b; WQ-05a,b,c), all samples will be submitted, however, only those samples which have a holding time of less than 7 days will be immediately analysed (i.e., biological oxygen demand, nitrate, nitrite, sulfate, total dissolved solids, and total suspended solids). Samples not immediately analysed will be kept at the laboratory, pending the results from WQ-01 to WQ-03, and will be stored at the laboratory in accordance with CALA standards. If an exceedance value is identified at WQ- 01, WQ-02, or WQ-03, additional laboratory analysis for the exceedance parameter(s) will be conducted for the remaining sample sites (i.e., WQ-04a,b; WQ-05a,b,c), to determine if the exceedance is Project related or generated offsite.

The parameters provided in **Table 4** are reflective of those included in the City of Calgary Stormwater Management and Design Manual (2011). Project activities associated with the construction and operations phase of the Project are unlikely to have effects on microbiological indicators; as such they have been excluded from the Plan.

Table 4 Water Quality Parameters Monitored During the Plan

Sediment & Physical	
• Total Suspended Solids (TSS) • Total Dissolved Solids (TDS) • Turbidity	• Conductivity (EC) • pH • Dissolved Oxygen (DO)
Nutrients and Others (mg/L)	
• Biochemical Oxygen Demand (BOD) • Chemical Oxygen Demand (COD) • Nitrate (NO₃) • Nitrite (NO₂)	• Total Kjeldahl Nitrogen (TKN) • Ammonia-Nitrogen (NH₃-N) • Total Phosphorus (TP) • Dissolved Reactive Phosphorus (TDP) • Ortho-Phosphate

Dissolved Metals & Metals (mg/L)			
• Silver (Ag)	• Cobalt (Co)	• Molybdenum (Mo)	• Tin (Sn)
• Aluminum (Al)	• Chromium (Cr)	• Nickel (Ni)	• Strontium (Sr)
• Arsenic (As)	• Copper (Cu)	• Lead (P)	• Sodium (Na)
• Boron (B)	• Iron (Fe)	• Lead (Pb)	• Titanium (Ti)
• Barium (Ba)	• Potassium (K)	• Sulfur (S)	• Thallium (Tl)
• Beryllium (Be)	• Lithium (Li)	• Antimony (Sb)	• Uranium (U)
• Calcium (Ca)	• Magnesium (Mg)	• Selenium (Se)	• Vanadium (V)
• Cadmium (Cd)	• Manganese (Mn)	• Silicon (Si)	• Zinc (Zn)
Major Ions & Salts			
• Sodium (Na ²⁺)	• Calcium (Ca ²⁺)		
• Potassium (K ⁺)	• Chloride (Cl ⁻)		
• Potassium (K ⁺)	• Sulfate (SO ⁴⁻)		

Sediment and physical parameters provided in the first section of **Table 4** (i.e., TSS, TDS, turbidity, conductivity, dissolved oxygen, and pH) will be measured at all water quality monitoring sites listed in **Table 2**. In addition, water temperature, conductivity, pH, and dissolved oxygen which will be measured in-situ at all water quality monitoring sites provided in **Table 2**. These measurements will be taken below the water surface at approximately 60% water depth. Manufacturers instructions for calibration and measuring parameters will be followed.

In-situ measurements will be used as field indicators for any supplemental water quality sampling, if required. Field crews may collect additional water samples for analysis at the existing water sampling locations or at additional locations not included in **Table 2** if abnormal site conditions are observed or in-situ measurements indicate potential water quality abnormalities. Field indicators of potential hydrocarbons (e.g., oil sheen, odor) will be noted by field crews and a potential observation will trigger further water quality analysis for hydrocarbons.

4.4 Water Flow Monitoring

The proposed locations for surface water flow monitoring have been discussed in **Section 4.1**. Surface flow will be measured at each monitoring site using a HACH® velocity flow meter (or comparable model) and using the velocity-area method (Government of Alberta 2009). Using the surface water inflows and outflows of Wetland 06, a modified water balance will be completed. The sum of all surface water inflow and sum of all outflows will be compared for each seasonal sampling visit and between years of the Plan.

In addition to flow monitoring, field crews will deploy a water level staff gauge in both Wetland 06 and the reference wetland. Water depths will be recorded during each field sampling visit. Wetted widths will also be measured at four transects across Wetland 06 and the reference wetland. Transect locations will be recorded using a global positioning system (GPS) device and natural landmarks will be recorded for replicability in the transect location from each seasonal field sampling visit during the Plan.

A comparison of the wetted widths and water depths of Wetland 06 and the reference wetland will be used to assess if the wetted perimeter of Wetland 06 is being reduced while accounting for natural fluctuations resulting in annual variability through comparison to the reference wetland.

4.5 Reporting

Surface water quality and flow results for each monitoring field visit will be made publicly available by KGL within one month of the seasonal field sampling event. The annual report, incorporating both seasonal field sampling visits will be made publicly available by KGL by March 31 of the year following the seasonal field sampling visits.

The annual report will include analysis of the surface water quality and flow results for both seasonal field visits. Surface water quality results will be compared relative the Environmental Quality Guidelines for Alberta Surface Waters (Government of Alberta 2014). Select surface water quality parameters (i.e., turbidity, temperature, pH, conductivity, dissolved oxygen, phosphate, and chloride) will also be compared to water quality parameters collected by the Weaselhead /Glenmore Park Preservation Society in 2016 within Wetland 06 as part of a baseline conditions environmental monitoring study (Porto 2017). This study will provide baseline conditions (i.e., prior to construction activities on the Project) in Wetland 06 with the limitation that not all water quality parameters measured in this Plan were included in the 2016 baseline study.

The annual report will also compare wetted width measurements and water depths in Wetland 06 versus the reference wetland to the north. Any change in wetted width or water depth recorded during prescribed sampling times (i.e., May and October) will be compared in the reference wetland to identify if changes in the wetland are due to Project effects or natural environmental conditions (e.g., drought). Following the first annual report, subsequent annual reports will also include a trend analysis through comparison of surface water quality and flow between years of the Plan.

5.0 CLOSURE

This Monitoring Plan has been developed to meet the monitoring requirements described in Condition 6.2 and other additional monitoring components that will enable identification of potential impacts to the surface water quality and flow of Wetland 06. Alternatively, the Plan may also identify and inform on other potential impacts that are not related to the Project.

In developing this Plan, Hemmera has relied in good faith on information provided by others and has assumed that the information provided by those individuals is both complete and accurate. This Plan was developed to current industry standard practice for similar environmental work, within the relevant jurisdiction and same locale, but with specific reference to the Order. The Plan presented herein should be considered within the context of the scope of work and project terms of reference; further, the Plan is time sensitive and should be considered valid only during the timeline included in this Plan. This Plan is based upon the applicable guidelines, regulations, and legislation existing at the time the Plan was produced.

Prepared by:
Hemmera Envirochem Inc.



per: Caitlin Gifford B.Sc., P.Biol.
Aquatic Biologist



Greg Eisler, B.Sc., P.Biol., R.P.Bio.
Senior Aquatic Biologist

6.0 REFERENCES

Environment and Sustainable Resource Development (ESRD) 2013. Alberta Wetland Policy. Prepared by ESRD, September 2013. ISBN: 978-4601-1286-1.

Barrett, Michael E., Joseph F. Malina, Randall J. Harbeneau, and George H. Ward. 1995. Effects of Highway Construction and Operation on Water Quality and Quantity in an Ephemeral Stream in the Austin, Texas Area. Available at:
https://repositories.lib.utexas.edu/bitstream/handle/2152/6739/crwr_onlinereport95-7.pdf.

Canadian Council of Ministers of the Environment. 2011. Protocols Manual for Water Quality Sampling in Canada. Available at:
https://www.ccme.ca/files/Resources/water/water_quality/protocols_document_e_final_101.pdf

City of Calgary. 2011. Stormwater Management and Design Manual. Water Resources Division. Available at:
www.calgary.ca/_layouts/cocis/DirectDownload.aspx?target=http%3a%2f%2fwww.calgary.ca%2fPDA%2fpd%2fDocuments%2furban_development%2fbulletins%2f2011-stormwater-management-and-Design.pdf&noredirect=1&sf=1

Government of Alberta. 2009. Water Measurement Guidebook. Available at:
<http://aep.alberta.ca/water/reports-data/water-use-reporting-system/documents/WUR-WaterMeasurementGuidebook-2009.pdf>

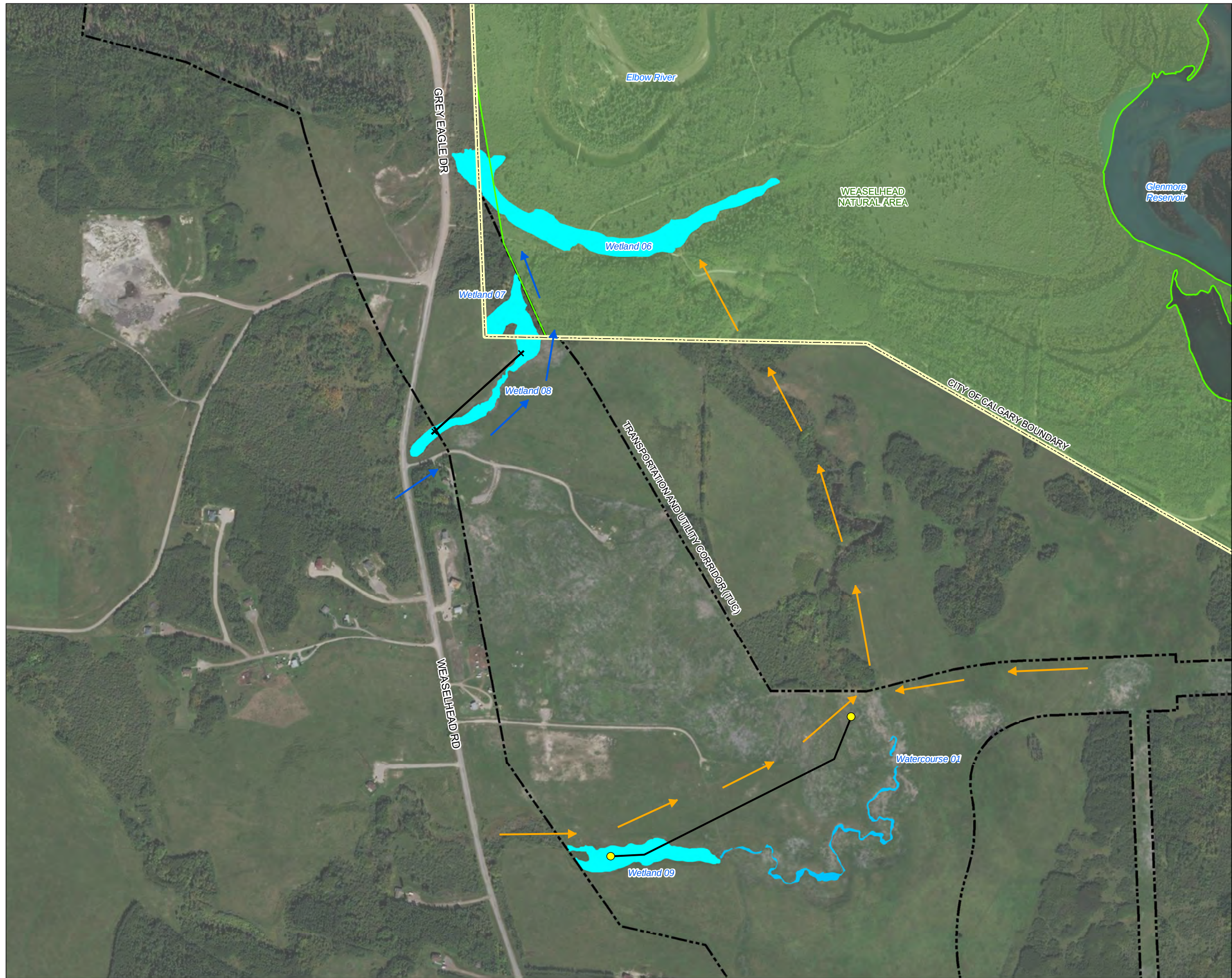
Government of Alberta. 2014. Environmental Quality Guidelines for Alberta Surface Waters. Alberta Environment and Sustainable Resource Development, Water Policy Branch, Policy Division. Edmonton, 48 pp.

Porto, Cassiano. 2017. Weaselhead/Glenmore Park SWCRR Impact Study Environmental Monitoring Report 2016: baseline conditions. Wetland Monitoring Component.

FIGURES

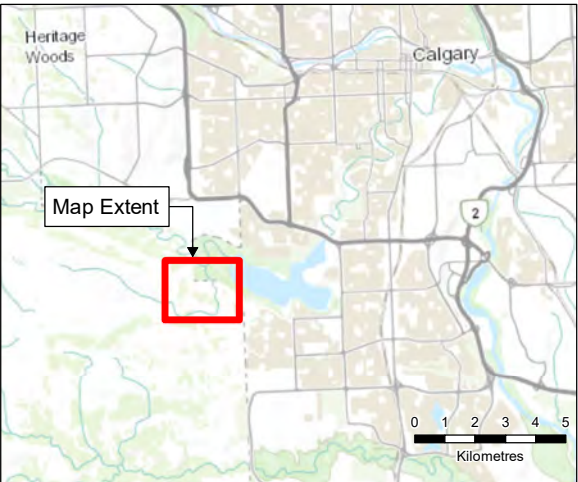
- | | |
|----------|--|
| Figure 1 | Wetland Locations |
| Figure 2 | Water Flow and Quality Sampling Locations |
| Figure 3 | Water Flow and Quality Sampling Location Details |

Path: S:\Geomatics\Projects\102604\01\mxd\fig_1\102604_01_Wetland_Location_180517.mxd



2018 Wetland Monitoring Program
Weaselhead Rd, Calgary AB

Wetland Locations



Legend

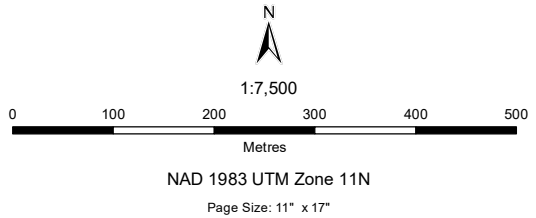
- Bypass Culvert
- Pathway #1 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow
- Stormwater Drainage Line
- City of Calgary Boundary
- Natural Area
- Transportation and Utility Corridor (TUC)
- Watercourse
- Wetland

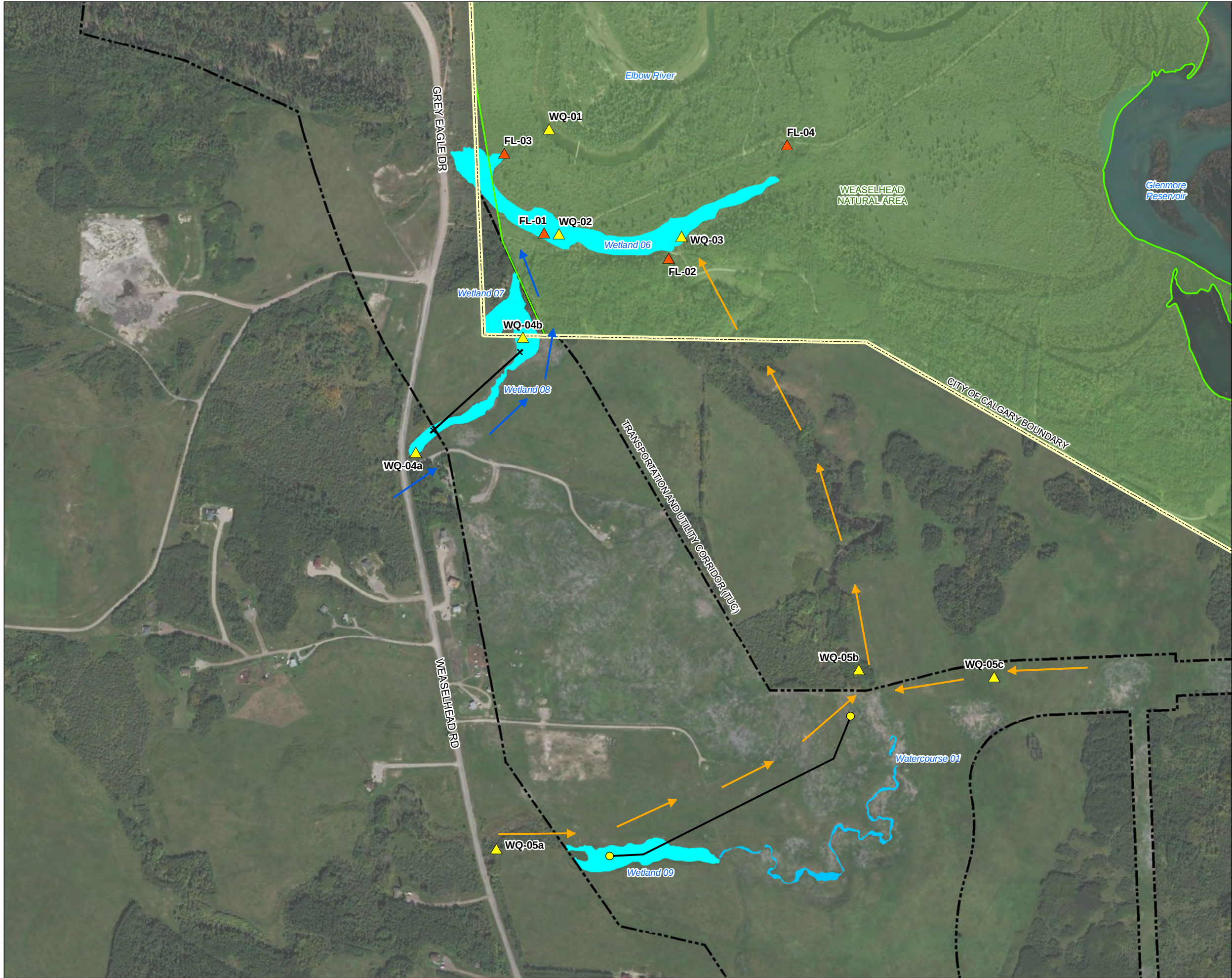
Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: ESRI World Imagery, 2016
- Inset Basemap: ESRI World Topographic Map





Water Flow and Quality
Sampling Locations

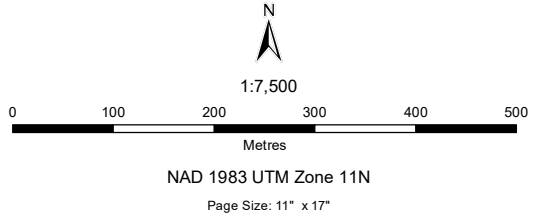
- Legend
- Water Flow Sample Location (Hemmera, 2018)
 - Water Quality Sample Location (Hemmera, 2018)
 - Bypass Culvert
 - Pathway #1 Approximate Direction of Flow
 - Pathway #2 Approximate Direction of Flow
 - Stormwater Drainage Line
 - City of Calgary Boundary
 - Natural Area
 - Transportation and Utility Corridor (TUC)
 - Watercourse
 - Wetland

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: ESRI World Imagery, 2016





2018 Wetland Monitoring Program
Weaselhead Rd, Calgary AB

Water Flow and Quality
Sampling Location Details

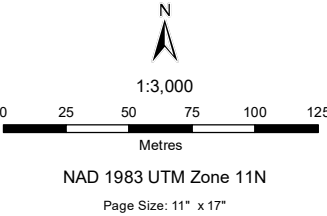
- Legend
- Water Flow Sample Location (Hemmera, 2018)
 - Water Quality Sample Location (Hemmera, 2018)
 - Bypass Culvert
 - Pathway #1 Approximate Direction of Flow
 - Pathway #2 Approximate Direction of Flow
 - City of Calgary Boundary
 - Natural Area
 - Transportation and Utility Corridor (TUC)
 - Wetland

Notes

1. All mapped features are approximate and should be used for discussion purposes only.
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: ESRI World Imagery, 2016



APPENDIX B

Raw Water Quality Data



Your Project #: 102604-01
Your C.O.C. #: 609351-01-01

Attention: CGY SAR LAB REPORTS

HEMMERA ENVIROCHEM INC.
SUITE 804, 322-11TH AVENUE SW
CALGARY, AB
CANADA T2R 0C5

Report Date: 2020/06/05
Report #: R2886922
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C036129

Received: 2020/05/29, 06:00

Sample Matrix: Water
Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO ₃ ,HCO ₃ ,OH	9	N/A	2020/05/30	AB SOP-00005	SM 23 2320 B m
Biochemical Oxygen Demand	1	2020/05/29	2020/06/03	AB SOP-00017	SM 23 5210B m
Biochemical Oxygen Demand	4	2020/05/30	2020/06/04	AB SOP-00017	SM 23 5210B m
Biochemical Oxygen Demand	4	2020/06/01	2020/06/04	AB SOP-00017	SM 23 5210B m
Cadmium - low level CCME - Dissolved	9	N/A	2020/06/02		Auto Calc
Chloride/Sulphate by Auto Colourimetry	6	N/A	2020/06/02	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO ₄ -E m
Chloride/Sulphate by Auto Colourimetry	3	N/A	2020/06/03	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO ₄ -E m
COD by Colorimeter	9	N/A	2020/06/03	AB SOP-00016	SM 23 5220D m
Oxygen (Dissolved) (1)	9	N/A	2020/05/30	AB SOP-00058	SM 23 4500-O C m
Conductivity @25C	9	N/A	2020/05/30	AB SOP-00005	SM 23 2510 B m
Hardness	2	N/A	2020/05/31		Auto Calc
Hardness	5	N/A	2020/06/02		Auto Calc
Hardness	2	N/A	2020/06/03		Auto Calc
Elements by ICP - Dissolved (2)	3	N/A	2020/05/31	AB SOP-00042	EPA 6010d R5 m
Elements by ICP - Dissolved (2)	4	N/A	2020/06/02	AB SOP-00042	EPA 6010d R5 m
Elements by ICP - Dissolved (2)	2	N/A	2020/06/03	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (2)	9	N/A	2020/05/31	AB SOP-00043	EPA 6020b R2 m
Ion Balance	6	N/A	2020/06/03		Auto Calc
Ion Balance	3	N/A	2020/06/04		Auto Calc
Sum of cations, anions	2	N/A	2020/05/31		Auto Calc
Sum of cations, anions	5	N/A	2020/06/02		Auto Calc
Sum of cations, anions	2	N/A	2020/06/03		Auto Calc
Ammonia-N (Total)	9	N/A	2020/06/05	AB SOP-00007	SM 23 4500 NH ₃ A G m
Nitrate and Nitrite	9	N/A	2020/06/01		Auto Calc
Nitrate + Nitrite-N (calculated)	9	N/A	2020/06/01		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	2	N/A	2020/05/31	AB SOP-00023	SM 23 4110 B m
Nitrogen (Nitrite - Nitrate) by IC	7	N/A	2020/06/01	AB SOP-00023	SM 23 4110 B m
pH @25°C (3)	9	N/A	2020/05/30	AB SOP-00005	SM 23 4500-H+B m
Orthophosphate by Konelab (4)	8	N/A	2020/05/30	AB SOP-00025	SM 23 4500-P A,F m
Orthophosphate by Konelab (4)	1	N/A	2020/06/02	AB SOP-00025	SM 23 4500-P A,F m



Your Project #: 102604-01
Your C.O.C. #: 609351-01-01

Attention: CGY SAR LAB REPORTS

HEMMERA ENVIROCHEM INC.
SUITE 804, 322-11TH AVENUE SW
CALGARY, AB
CANADA T2R 0C5

Report Date: 2020/06/05

Report #: R2886922

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C036129

Received: 2020/05/29, 06:00

Sample Matrix: Water
Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Total Dissolved Solids (Filt. Residue)	5	2020/06/03	2020/06/03	AB SOP-00065	SM 23 2540 C m
Total Dissolved Solids (Filt. Residue)	4	2020/06/04	2020/06/04	AB SOP-00065	SM 23 2540 C m
Total Dissolved Solids (Calculated)	6	N/A	2020/06/03		Auto Calc
Total Dissolved Solids (Calculated)	3	N/A	2020/06/04		Auto Calc
Total Kjeldahl Nitrogen	9	2020/06/03	2020/06/04	AB SOP-00008	EPA 351.1 R1978 m
Phosphorus -P (Total, Dissolved) (5)	9	2020/06/03	2020/06/03	AB SOP-00024	SM 23 4500-P A,B,F m
Total Phosphorus	9	2020/06/03	2020/06/03	AB SOP-00024	SM 23 4500-P A,B,F m
Total Suspended Solids (NFR)	9	2020/06/03	2020/06/03	AB SOP-00061	SM 23 2540 D m
Turbidity	9	N/A	2020/05/31	CAL SOP-00081	SM 23 2130 B m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) The APHA Standard Method requires dissolved oxygen to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory dissolved oxygen analyses in this report are reported past the APHA Standard Method holding time. Bureau Veritas Laboratories endeavors to analyze samples as soon as possible after receipt.

(2) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.



Your Project #: 102604-01
Your C.O.C. #: 609351-01-01

Attention: CGY SAR LAB REPORTS

HEMMERA ENVIROCHEM INC.
SUITE 804, 322-11TH AVENUE SW
CALGARY, AB
CANADA T2R 0C5

Report Date: 2020/06/05
Report #: R2886922
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C036129

Received: 2020/05/29, 06:00

(3) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.
(4) Orthophosphate > Total Phosphorus Imbalance: When applicable, Orthophosphate, Total Phosphorus and dissolved Phosphorus results were reviewed and data quality meets acceptable levels unless otherwise noted.
(5) Dissolved Phosphorus > Total Phosphorus Imbalance: When applicable, Dissolved Phosphorus and Total Phosphorus results were reviewed and data quality meets acceptable levels unless otherwise noted.

Encryption Key



Bureau Veritas Laboratories
05 Jun 2020 14:17:28

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Gail Pedersen, Key Account Specialist
Email: Gail.Pedersen@bvlab.com
Phone# (403) 291-3077

=====

This report has been generated and distributed using a secure automated process.

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		XV3750		XV3751		XV3752		
Sampling Date		2020/05/28 10:40		2020/05/28 14:00		2020/05/28 12:30		
COC Number		609351-01-01		609351-01-01		609351-01-01		
	UNITS	WQ-01	QC Batch	WQ-02	QC Batch	WQ-03	RDL	QC Batch
Calculated Parameters								
Anion Sum	meq/L	11	9865469	7.4	9865469	6.5	N/A	9865469
Cation Sum	meq/L	11	9865469	7.7	9865469	6.6	N/A	9865469
Hardness (CaCO ₃)	mg/L	450	9865887	310	9865887	270	0.50	9865887
Ion Balance (% Difference)	%	1.9	9865346	2.2	9865346	1.1	N/A	9865346
Dissolved Nitrate (NO ₃)	mg/L	<0.044	9865888	<0.044	9865888	8.0	0.044	9866072
Nitrate plus Nitrite (N)	mg/L	<0.014	9865889	<0.014	9865889	1.9	0.014	9866078
Dissolved Nitrite (NO ₂)	mg/L	<0.033	9865888	<0.033	9865888	0.35	0.033	9866072
Calculated Total Dissolved Solids	mg/L	560	9865465	380	9865465	340	10	9865465
Misc. Inorganics								
Conductivity	uS/cm	1000	9866612	680	9866612	620	2.0	9866612
pH	pH	7.91	9866611	8.34	9866611	8.29	N/A	9866611
Low Level Elements								
Dissolved Cadmium (Cd)	mg/L	<0.000020	9865337	<0.000020	9865337	<0.000020	0.000020	9865337
Anions								
Alkalinity (PP as CaCO ₃)	mg/L	<1.0	9866610	2.5	9866610	<1.0	1.0	9866610
Alkalinity (Total as CaCO ₃)	mg/L	510	9866610	300	9866610	240	1.0	9866610
Bicarbonate (HCO ₃)	mg/L	620	9866610	360	9866610	290	1.0	9866610
Carbonate (CO ₃)	mg/L	<1.0	9866610	3.0	9866610	<1.0	1.0	9866610
Hydroxide (OH)	mg/L	<1.0	9866610	<1.0	9866610	<1.0	1.0	9866610
Dissolved Chloride (Cl)	mg/L	16	9866922	12	9866922	18	1.0	9866922
Dissolved Sulphate (SO ₄)	mg/L	44	9866922	50	9866922	55	1.0	9866922
Nutrients								
Dissolved Nitrite (N)	mg/L	<0.010	9867643	<0.010	9867643	0.11	0.010	9867643
Dissolved Nitrate (N)	mg/L	<0.010	9867643	<0.010	9867643	1.8	0.010	9867643
Elements								
Dissolved Aluminum (Al)	mg/L	<0.0030	9867676	<0.0030	9867676	<0.0030	0.0030	9867676
Dissolved Antimony (Sb)	mg/L	<0.00060	9867676	<0.00060	9867676	<0.00060	0.00060	9867676
Dissolved Arsenic (As)	mg/L	0.00095	9867676	0.0011	9867676	0.0012	0.00020	9867676
Dissolved Barium (Ba)	mg/L	0.17	9867707	0.12	9870040	0.14	0.010	9867708
Dissolved Beryllium (Be)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Boron (B)	mg/L	0.036	9867707	0.041	9870040	0.033	0.020	9867708
Dissolved Calcium (Ca)	mg/L	98	9867707	55	9870040	54	0.30	9867708
RDL = Reportable Detection Limit								
N/A = Not Applicable								



ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		XV3750		XV3751		XV3752		
Sampling Date		2020/05/28 10:40		2020/05/28 14:00		2020/05/28 12:30		
COC Number		609351-01-01		609351-01-01		609351-01-01		
	UNITS	WQ-01	QC Batch	WQ-02	QC Batch	WQ-03	RDL	QC Batch
Dissolved Chromium (Cr)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Cobalt (Co)	mg/L	<0.00030	9867676	<0.00030	9867676	<0.00030	0.00030	9867676
Dissolved Copper (Cu)	mg/L	0.030	9867676	0.00067	9867676	0.0012	0.00020	9867676
Dissolved Iron (Fe)	mg/L	<0.060	9867707	0.090	9870040	<0.060	0.060	9867708
Dissolved Lead (Pb)	mg/L	<0.00020	9867676	<0.00020	9867676	<0.00020	0.00020	9867676
Dissolved Lithium (Li)	mg/L	<0.020	9867707	<0.020	9870040	<0.020	0.020	9867708
Dissolved Magnesium (Mg)	mg/L	49	9867707	41	9870040	33	0.20	9867708
Dissolved Manganese (Mn)	mg/L	0.089	9867707	0.0063	9870040	0.0053	0.0040	9867708
Dissolved Molybdenum (Mo)	mg/L	0.00082	9867676	0.0021	9867676	0.0029	0.00020	9867676
Dissolved Nickel (Ni)	mg/L	0.0017	9867676	0.0011	9867676	0.0021	0.00050	9867676
Dissolved Phosphorus (P)	mg/L	<0.10	9867707	<0.10	9870040	<0.10	0.10	9867708
Dissolved Potassium (K)	mg/L	4.7	9867707	4.2	9870040	5.7	0.30	9867708
Dissolved Selenium (Se)	mg/L	<0.00020	9867676	0.00088	9867676	0.00073	0.00020	9867676
Dissolved Silicon (Si)	mg/L	12	9867707	1.5	9870040	3.1	0.10	9867708
Dissolved Silver (Ag)	mg/L	<0.00010	9867676	<0.00010	9867676	<0.00010	0.00010	9867676
Dissolved Sodium (Na)	mg/L	45	9867707	33	9870040	26	0.50	9867708
Dissolved Strontium (Sr)	mg/L	0.61	9867707	0.55	9870040	0.40	0.020	9867708
Dissolved Sulphur (S)	mg/L	14	9867707	15	9870040	18	0.20	9867708
Dissolved Thallium (Tl)	mg/L	<0.00020	9867676	<0.00020	9867676	<0.00020	0.00020	9867676
Dissolved Tin (Sn)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Titanium (Ti)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Uranium (U)	mg/L	0.0011	9867676	0.0035	9867676	0.0030	0.00010	9867676
Dissolved Vanadium (V)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Zinc (Zn)	mg/L	0.0062	9867676	<0.0030	9867676	<0.0030	0.0030	9867676
RDL = Reportable Detection Limit								



ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		XV3753		XV3754		XV3755		
Sampling Date		2020/05/28 17:40		2020/05/28 15:40		2020/05/28 17:15		
COC Number		609351-01-01		609351-01-01		609351-01-01		
	UNITS	WQ-04A	QC Batch	WQ-04B	QC Batch	WQ-05A	RDL	QC Batch
Calculated Parameters								
Anion Sum	meq/L	8.2	9865469	8.4	9865469	9.4	N/A	9865469
Cation Sum	meq/L	8.3	9865469	9.2	9865469	9.4	N/A	9865469
Hardness (CaCO ₃)	mg/L	320	9865887	370	9865887	390	0.50	9865887
Ion Balance (% Difference)	%	0.39	9866062	4.3	9866062	0.0020	N/A	9866062
Dissolved Nitrate (NO ₃)	mg/L	0.086	9866072	0.064	9866072	<0.044	0.044	9866072
Nitrate plus Nitrite (N)	mg/L	0.019	9866078	0.015	9866078	<0.014	0.014	9866078
Dissolved Nitrite (NO ₂)	mg/L	<0.033	9866072	<0.033	9866072	<0.033	0.033	9866072
Calculated Total Dissolved Solids	mg/L	420	9865465	440	9865465	480	10	9865465
Misc. Inorganics								
Conductivity	uS/cm	750	9866609	770	9866612	840	2.0	9866612
pH	pH	8.22	9866608	8.46	9866611	8.15	N/A	9866611
Low Level Elements								
Dissolved Cadmium (Cd)	mg/L	<0.000020	9865337	<0.000020	9865337	<0.000020	0.000020	9865337
Anions								
Alkalinity (PP as CaCO ₃)	mg/L	<1.0	9866607	8.7	9866610	<1.0	1.0	9866610
Alkalinity (Total as CaCO ₃)	mg/L	350	9866607	360	9866610	380	1.0	9866610
Bicarbonate (HCO ₃)	mg/L	420	9866607	420	9866610	460	1.0	9866610
Carbonate (CO ₃)	mg/L	<1.0	9866607	10	9866610	<1.0	1.0	9866610
Hydroxide (OH)	mg/L	<1.0	9866607	<1.0	9866610	<1.0	1.0	9866610
Dissolved Chloride (Cl)	mg/L	7.7	9869387	8.2	9866922	8.1	1.0	9866922
Dissolved Sulphate (SO ₄)	mg/L	52	9869387	50	9866922	76	1.0	9866922
Nutrients								
Dissolved Nitrite (N)	mg/L	<0.010	9867642	<0.010	9867643	<0.010	0.010	9867643
Dissolved Nitrate (N)	mg/L	0.019	9867642	0.015	9867643	<0.010	0.010	9867643
Elements								
Dissolved Aluminum (Al)	mg/L	<0.0030	9867676	<0.0030	9867676	<0.0030	0.0030	9867676
Dissolved Antimony (Sb)	mg/L	<0.00060	9867676	<0.00060	9867676	<0.00060	0.00060	9867676
Dissolved Arsenic (As)	mg/L	0.00036	9867676	0.00056	9867676	0.0018	0.00020	9867676
Dissolved Barium (Ba)	mg/L	0.074	9868722	0.098	9870040	0.12	0.010	9867707
Dissolved Beryllium (Be)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Boron (B)	mg/L	0.049	9868722	0.064	9870040	0.043	0.020	9867707
Dissolved Calcium (Ca)	mg/L	66	9868722	73	9870040	78	0.30	9867707
RDL = Reportable Detection Limit								
N/A = Not Applicable								



ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		XV3753		XV3754		XV3755		
Sampling Date		2020/05/28 17:40		2020/05/28 15:40		2020/05/28 17:15		
COC Number		609351-01-01		609351-01-01		609351-01-01		
	UNITS	WQ-04A	QC Batch	WQ-04B	QC Batch	WQ-05A	RDL	QC Batch
Dissolved Chromium (Cr)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Cobalt (Co)	mg/L	<0.00030	9867676	<0.00030	9867676	<0.00030	0.00030	9867676
Dissolved Copper (Cu)	mg/L	0.00027	9867676	0.00038	9867676	0.00098	0.00020	9867676
Dissolved Iron (Fe)	mg/L	<0.060	9868722	0.092	9870040	<0.060	0.060	9867707
Dissolved Lead (Pb)	mg/L	<0.00020	9867676	<0.00020	9867676	<0.00020	0.00020	9867676
Dissolved Lithium (Li)	mg/L	0.022	9868722	0.022	9870040	<0.020	0.020	9867707
Dissolved Magnesium (Mg)	mg/L	38	9868722	44	9870040	47	0.20	9867707
Dissolved Manganese (Mn)	mg/L	0.0082	9868722	0.023	9870040	0.015	0.0040	9867707
Dissolved Molybdenum (Mo)	mg/L	0.0018	9867676	0.0016	9867676	0.0054	0.00020	9867676
Dissolved Nickel (Ni)	mg/L	<0.00050	9867676	0.00061	9867676	0.0011	0.00050	9867676
Dissolved Phosphorus (P)	mg/L	<0.10	9868722	<0.10	9870040	<0.10	0.10	9867707
Dissolved Potassium (K)	mg/L	4.1	9868722	3.9	9870040	8.7	0.30	9867707
Dissolved Selenium (Se)	mg/L	0.0010	9867676	0.00093	9867676	0.00074	0.00020	9867676
Dissolved Silicon (Si)	mg/L	3.8	9868722	4.3	9870040	6.9	0.10	9867707
Dissolved Silver (Ag)	mg/L	<0.00010	9867676	<0.00010	9867676	<0.00010	0.00010	9867676
Dissolved Sodium (Na)	mg/L	41	9868722	41	9870040	33	0.50	9867707
Dissolved Strontium (Sr)	mg/L	0.64	9868722	0.74	9870040	0.65	0.020	9867707
Dissolved Sulphur (S)	mg/L	16	9868722	16	9870040	26	0.20	9867707
Dissolved Thallium (Tl)	mg/L	<0.00020	9867676	<0.00020	9867676	<0.00020	0.00020	9867676
Dissolved Tin (Sn)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Titanium (Ti)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Uranium (U)	mg/L	0.0025	9867676	0.0025	9867676	0.013	0.00010	9867676
Dissolved Vanadium (V)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Zinc (Zn)	mg/L	<0.0030	9867676	0.084	9867676	0.0031	0.0030	9867676
RDL = Reportable Detection Limit								



ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		XV3756		XV3757		XV3758		
Sampling Date		2020/05/28 16:25		2020/05/28 15:00		2020/05/28 14:30		
COC Number		609351-01-01		609351-01-01		609351-01-01		
	UNITS	WQ-05B	QC Batch	WQ-06	QC Batch	WQ-07	RDL	QC Batch
Calculated Parameters								
Anion Sum	meq/L	9.8	9865469	7.7	9865469	7.6	N/A	9866067
Cation Sum	meq/L	9.7	9865469	7.4	9865469	7.6	N/A	9866067
Hardness (CaCO ₃)	mg/L	410	9865887	290	9865887	300	0.50	9865887
Ion Balance (% Difference)	%	0.61	9866062	2.3	9866062	0.36	N/A	9866062
Dissolved Nitrate (NO ₃)	mg/L	1.6	9866072	<0.044	9866072	<0.044	0.044	9866072
Nitrate plus Nitrite (N)	mg/L	0.36	9866078	<0.014	9866078	<0.014	0.014	9866078
Dissolved Nitrite (NO ₂)	mg/L	<0.033	9866072	<0.033	9866072	<0.033	0.033	9866072
Calculated Total Dissolved Solids	mg/L	500	9865465	380	9865465	380	10	9866084
Misc. Inorganics								
Conductivity	uS/cm	890	9866612	680	9866609	710	2.0	9866612
pH	pH	8.18	9866611	8.29	9866608	8.18	N/A	9866611
Low Level Elements								
Dissolved Cadmium (Cd)	mg/L	<0.000020	9865337	<0.000020	9866059	<0.000020	0.000020	9866059
Anions								
Alkalinity (PP as CaCO ₃)	mg/L	<1.0	9866610	<1.0	9866607	<1.0	1.0	9866610
Alkalinity (Total as CaCO ₃)	mg/L	380	9866610	310	9866607	300	1.0	9866610
Bicarbonate (HCO ₃)	mg/L	460	9866610	380	9866607	370	1.0	9866610
Carbonate (CO ₃)	mg/L	<1.0	9866610	<1.0	9866607	<1.0	1.0	9866610
Hydroxide (OH)	mg/L	<1.0	9866610	<1.0	9866607	<1.0	1.0	9866610
Dissolved Chloride (Cl)	mg/L	11	9869387	13	9869387	13	1.0	9866922
Dissolved Sulphate (SO ₄)	mg/L	96	9869387	52	9869387	57	1.0	9866922
Nutrients								
Dissolved Nitrite (N)	mg/L	<0.010	9867643	<0.010	9867642	<0.010	0.010	9867643
Dissolved Nitrate (N)	mg/L	0.36	9867643	<0.010	9867642	<0.010	0.010	9867643
Elements								
Dissolved Aluminum (Al)	mg/L	<0.0030	9867676	<0.0030	9867676	<0.0030	0.0030	9867676
Dissolved Antimony (Sb)	mg/L	<0.00060	9867676	<0.00060	9867676	<0.00060	0.00060	9867676
Dissolved Arsenic (As)	mg/L	0.00059	9867676	0.0011	9867676	0.0012	0.00020	9867676
Dissolved Barium (Ba)	mg/L	0.15	9868722	0.11	9868722	0.12	0.010	9868722
Dissolved Beryllium (Be)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Boron (B)	mg/L	0.024	9868722	0.034	9868722	0.035	0.020	9868722
Dissolved Calcium (Ca)	mg/L	81	9868722	49	9868722	51	0.30	9868722
RDL = Reportable Detection Limit								
N/A = Not Applicable								



ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		XV3756		XV3757		XV3758		
Sampling Date		2020/05/28 16:25		2020/05/28 15:00		2020/05/28 14:30		
COC Number		609351-01-01		609351-01-01		609351-01-01		
	UNITS	WQ-05B	QC Batch	WQ-06	QC Batch	WQ-07	RDL	QC Batch
Dissolved Chromium (Cr)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Cobalt (Co)	mg/L	<0.00030	9867676	<0.00030	9867676	<0.00030	0.00030	9867676
Dissolved Copper (Cu)	mg/L	0.0019	9867676	0.00055	9867676	0.00052	0.00020	9867676
Dissolved Iron (Fe)	mg/L	<0.060	9868722	<0.060	9868722	0.083	0.060	9868722
Dissolved Lead (Pb)	mg/L	<0.00020	9867676	<0.00020	9867676	<0.00020	0.00020	9867676
Dissolved Lithium (Li)	mg/L	0.022	9868722	<0.020	9868722	<0.020	0.020	9868722
Dissolved Magnesium (Mg)	mg/L	50	9868722	40	9868722	42	0.20	9868722
Dissolved Manganese (Mn)	mg/L	0.0060	9868722	0.0082	9868722	0.021	0.0040	9868722
Dissolved Molybdenum (Mo)	mg/L	0.0030	9867676	0.0019	9867676	0.0021	0.00020	9867676
Dissolved Nickel (Ni)	mg/L	0.0013	9867676	0.0010	9867676	0.0012	0.00050	9867676
Dissolved Phosphorus (P)	mg/L	<0.10	9868722	<0.10	9868722	<0.10	0.10	9868722
Dissolved Potassium (K)	mg/L	5.6	9868722	4.8	9868722	5.7	0.30	9868722
Dissolved Selenium (Se)	mg/L	0.0016	9867676	0.00070	9867676	0.00057	0.00020	9867676
Dissolved Silicon (Si)	mg/L	6.0	9868722	0.67	9868722	1.4	0.10	9868722
Dissolved Silver (Ag)	mg/L	<0.00010	9867676	<0.00010	9867676	<0.00010	0.00010	9867676
Dissolved Sodium (Na)	mg/L	31	9868722	34	9868722	35	0.50	9868722
Dissolved Strontium (Sr)	mg/L	0.61	9868722	0.51	9868722	0.51	0.020	9868722
Dissolved Sulphur (S)	mg/L	28	9868722	15	9868722	17	0.20	9868722
Dissolved Thallium (Tl)	mg/L	<0.00020	9867676	<0.00020	9867676	<0.00020	0.00020	9867676
Dissolved Tin (Sn)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Titanium (Ti)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Uranium (U)	mg/L	0.0089	9867676	0.0035	9867676	0.0034	0.00010	9867676
Dissolved Vanadium (V)	mg/L	<0.0010	9867676	<0.0010	9867676	<0.0010	0.0010	9867676
Dissolved Zinc (Zn)	mg/L	<0.0030	9867676	<0.0030	9867676	<0.0030	0.0030	9867676
RDL = Reportable Detection Limit								



RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		XV3750		XV3751		XV3752	XV3753		
Sampling Date		2020/05/28 10:40		2020/05/28 14:00		2020/05/28 12:30	2020/05/28 17:40		
COC Number		609351-01-01		609351-01-01		609351-01-01	609351-01-01		
	UNITS	WQ-01	QC Batch	WQ-02	QC Batch	WQ-03	WQ-04A	RDL	QC Batch
Demand Parameters									
Biochemical Oxygen Demand	mg/L	<2.0	9865488	2.2	9866790	2.3	<2.0	2.0	9866790
Chemical Oxygen Demand	mg/L	28	9871590	27	9871590	42	22	10	9871590
Misc. Inorganics									
Dissolved Oxygen (O ₂)	mg/L	3.2	9866873	11	9866873	9.4	8.0	0.10	9866873
Total Dissolved Solids	mg/L	540	9873198	360	9871447	360	400	10	9871447
Total Suspended Solids	mg/L	1.0	9870997	2.5	9870997	7.1	2.7	1.0	9870997
Nutrients									
Total Ammonia (N)	mg/L	0.066	9874297	0.075	9874297	0.093	0.047	0.015	9874297
Orthophosphate (P)	mg/L	0.0036	9866554	0.0033 (1)	9869735	0.0040	0.0034	0.0030	9866554
Dissolved Phosphorus (P)	mg/L	0.0032	9871433	0.0052	9871433	0.0095	<0.0030	0.0030	9871433
Total Phosphorus (P)	mg/L	0.011	9871497	0.021	9871485	0.034	0.011	0.0030	9871497
Total Total Kjeldahl Nitrogen	mg/L	0.58	9871942	0.90	9871760	1.6	0.39	0.050	9871760
Physical Properties									
Turbidity	NTU	1.1	9866889	1.7	9866889	7.4	0.20	0.10	9866889
RDL = Reportable Detection Limit									
(1) Sample analyzed past hold time.									



RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		XV3754	XV3755		XV3756	XV3757	XV3758		
Sampling Date		2020/05/28 15:40	2020/05/28 17:15		2020/05/28 16:25	2020/05/28 15:00	2020/05/28 14:30		
COC Number		609351-01-01	609351-01-01		609351-01-01	609351-01-01	609351-01-01		
	UNITS	WQ-04B	WQ-05A	QC Batch	WQ-05B	WQ-06	WQ-07	RDL	QC Batch
Demand Parameters									
Biochemical Oxygen Demand	mg/L	<2.0	<2.0	9866790	<2.0	2.8	3.2	2.0	9866790
Chemical Oxygen Demand	mg/L	20	34	9871590	23	32	33	10	9871590
Misc. Inorganics									
Dissolved Oxygen (O ₂)	mg/L	9.0	9.8	9866873	11	11	7.0	0.10	9866873
Total Dissolved Solids	mg/L	420	500	9871447	470	330	350	10	9873198
Total Suspended Solids	mg/L	11	1.1	9870997	29	6.0	6.8	1.0	9870997
Nutrients									
Total Ammonia (N)	mg/L	0.069	0.072	9874297	0.059	0.058	0.068	0.015	9874297
Orthophosphate (P)	mg/L	<0.0030	0.041	9866554	0.0054	<0.0030	0.0072	0.0030	9866554
Dissolved Phosphorus (P)	mg/L	<0.0030	0.047	9871433	0.0058	0.0051	0.013	0.0030	9871433
Total Phosphorus (P)	mg/L	0.0090	0.060	9871497	0.0092	0.020	0.046	0.0030	9871497
Total Total Kjeldahl Nitrogen	mg/L	0.45	0.90	9871760	0.70	0.77	0.98	0.050	9871760
Physical Properties									
Turbidity	NTU	5.9	0.41	9866889	0.87	1.9	2.0	0.10	9866889
RDL = Reportable Detection Limit									

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.3°C
Package 2	4.7°C
Package 3	3.3°C

Sample XV3750 [WQ-01] : Nitrogen (Nitrite - Nitrate) by IC completed within 48h after laboratory receipt to a maximum of five days from sampling. Data are satisfactory for compliance purposes.

Sample XV3751 [WQ-02] : Nitrogen (Nitrite - Nitrate) by IC completed within 48h after laboratory receipt to a maximum of five days from sampling. Data are satisfactory for compliance purposes. Orthophosphate by Konelab completed within 48h after laboratory receipt to a maximum of five days from sampling. Data are satisfactory for compliance purposes.

Sample XV3752 [WQ-03] : Nitrogen (Nitrite - Nitrate) by IC completed within 48h after laboratory receipt to a maximum of five days from sampling. Data are satisfactory for compliance purposes.

Sample XV3753 [WQ-04A] : Sample was analyzed past method specified hold time for Biochemical Oxygen Demand. Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.

Sample XV3754 [WQ-04B] : Sample was analyzed past method specified hold time for Biochemical Oxygen Demand. Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised. Nitrogen (Nitrite - Nitrate) by IC completed within 48h after laboratory receipt to a maximum of five days from sampling. Data are satisfactory for compliance purposes.

Sample XV3755 [WQ-05A] : Sample was analyzed past method specified hold time for Biochemical Oxygen Demand. Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised. Nitrogen (Nitrite - Nitrate) by IC completed within 48h after laboratory receipt to a maximum of five days from sampling. Data are satisfactory for compliance purposes.

Sample XV3756 [WQ-05B] : Sample was analyzed past method specified hold time for Biochemical Oxygen Demand. Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised. Nitrogen (Nitrite - Nitrate) by IC completed within 48h after laboratory receipt to a maximum of five days from sampling. Data are satisfactory for compliance purposes.

Sample XV3758 [WQ-07] : Nitrogen (Nitrite - Nitrate) by IC completed within 48h after laboratory receipt to a maximum of five days from sampling. Data are satisfactory for compliance purposes.

Results relate only to the items tested.



BV Labs Job #: C036129
Report Date: 2020/06/05

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9865488	SLL	Spiked Blank	Biochemical Oxygen Demand	2020/06/03		101	%	85 - 115
9865488	SLL	Method Blank	Biochemical Oxygen Demand	2020/06/03	<2.0		mg/L	
9865488	SLL	RPD	Biochemical Oxygen Demand	2020/06/03	4.5		%	20
9866554	FM0	Matrix Spike	Orthophosphate (P)	2020/05/30		NC	%	80 - 120
9866554	FM0	Spiked Blank	Orthophosphate (P)	2020/05/30		100	%	80 - 120
9866554	FM0	Method Blank	Orthophosphate (P)	2020/05/30	<0.0030		mg/L	
9866554	FM0	RPD	Orthophosphate (P)	2020/05/30	0.49		%	20
9866607	IKO	Spiked Blank	Alkalinity (Total as CaCO3)	2020/05/30		93	%	80 - 120
9866607	IKO	Method Blank	Alkalinity (PP as CaCO3)	2020/05/30	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2020/05/30	<1.0		mg/L	
			Bicarbonate (HCO3)	2020/05/30	<1.0		mg/L	
			Carbonate (CO3)	2020/05/30	<1.0		mg/L	
			Hydroxide (OH)	2020/05/30	<1.0		mg/L	
9866607	IKO	RPD [XV3753-01]	Alkalinity (PP as CaCO3)	2020/05/30	NC		%	20
			Alkalinity (Total as CaCO3)	2020/05/30	6.1		%	20
			Bicarbonate (HCO3)	2020/05/30	6.1		%	20
			Carbonate (CO3)	2020/05/30	NC		%	20
			Hydroxide (OH)	2020/05/30	NC		%	20
9866608	IKO	Spiked Blank	pH	2020/05/30		101	%	97 - 103
9866608	IKO	RPD [XV3753-01]	pH	2020/05/30	0.095		%	N/A
9866609	IKO	Spiked Blank	Conductivity	2020/05/30		102	%	90 - 110
9866609	IKO	Method Blank	Conductivity	2020/05/30	<2.0		uS/cm	
9866609	IKO	RPD [XV3753-01]	Conductivity	2020/05/30	0.14		%	10
9866610	IKO	Spiked Blank	Alkalinity (Total as CaCO3)	2020/05/30		94	%	80 - 120
9866610	IKO	Method Blank	Alkalinity (PP as CaCO3)	2020/05/30	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2020/05/30	<1.0		mg/L	
			Bicarbonate (HCO3)	2020/05/30	<1.0		mg/L	
			Carbonate (CO3)	2020/05/30	<1.0		mg/L	
			Hydroxide (OH)	2020/05/30	<1.0		mg/L	
9866610	IKO	RPD	Alkalinity (PP as CaCO3)	2020/05/30	NC		%	20
			Alkalinity (Total as CaCO3)	2020/05/30	4.6		%	20
			Bicarbonate (HCO3)	2020/05/30	4.6		%	20
			Carbonate (CO3)	2020/05/30	NC		%	20
			Hydroxide (OH)	2020/05/30	NC		%	20
9866611	IKO	Spiked Blank	pH	2020/05/30		101	%	97 - 103
9866611	IKO	RPD	pH	2020/05/30	1.3		%	N/A
9866612	IKO	Spiked Blank	Conductivity	2020/05/30		103	%	90 - 110
9866612	IKO	Method Blank	Conductivity	2020/05/30	<2.0		uS/cm	
9866612	IKO	RPD	Conductivity	2020/05/30	0.66		%	10
9866790	SLL	Spiked Blank	Biochemical Oxygen Demand	2020/06/04		101	%	85 - 115
9866790	SLL	Method Blank	Biochemical Oxygen Demand	2020/06/04	<2.0		mg/L	
9866790	SLL	RPD	Biochemical Oxygen Demand	2020/06/04	2.9		%	20
9866873	PK8	Spiked Blank	Dissolved Oxygen (O2)	2020/05/30		90	%	80 - 120
9866873	PK8	RPD	Dissolved Oxygen (O2)	2020/05/30	0		%	20
9866889	NAP	Spiked Blank	Turbidity	2020/05/31		110	%	80 - 120
9866889	NAP	Method Blank	Turbidity	2020/05/31	<0.10		NTU	
9866889	NAP	RPD	Turbidity	2020/05/31	11		%	20
9866922	CCQ	Matrix Spike	Dissolved Chloride (Cl)	2020/06/03		102	%	80 - 120
			Dissolved Sulphate (SO4)	2020/06/03		126 (1)	%	80 - 120
9866922	CCQ	Spiked Blank	Dissolved Chloride (Cl)	2020/06/02		99	%	80 - 120
			Dissolved Sulphate (SO4)	2020/06/02		108	%	80 - 120
9866922	CCQ	Method Blank	Dissolved Chloride (Cl)	2020/06/02	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2020/06/02	<1.0		mg/L	
9866922	CCQ	RPD	Dissolved Chloride (Cl)	2020/06/03	2.4		%	20
			Dissolved Sulphate (SO4)	2020/06/03	2.8		%	20



BV Labs Job #: C036129
Report Date: 2020/06/05

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9867642	KD9	Matrix Spike	Dissolved Nitrite (N)	2020/05/31		99	%	80 - 120
			Dissolved Nitrate (N)	2020/05/31		101	%	80 - 120
9867642	KD9	Spiked Blank	Dissolved Nitrite (N)	2020/05/31		101	%	80 - 120
			Dissolved Nitrate (N)	2020/05/31		103	%	80 - 120
9867642	KD9	Method Blank	Dissolved Nitrite (N)	2020/05/31	<0.010		mg/L	
			Dissolved Nitrate (N)	2020/05/31	<0.010		mg/L	
9867642	KD9	RPD	Dissolved Nitrite (N)	2020/05/31	NC		%	20
			Dissolved Nitrate (N)	2020/05/31	NC		%	20
9867643	KD9	Matrix Spike [XV3754-01]	Dissolved Nitrite (N)	2020/06/01		101	%	80 - 120
			Dissolved Nitrate (N)	2020/06/01		103	%	80 - 120
9867643	KD9	Spiked Blank	Dissolved Nitrite (N)	2020/06/01		100	%	80 - 120
			Dissolved Nitrate (N)	2020/06/01		101	%	80 - 120
9867643	KD9	Method Blank	Dissolved Nitrite (N)	2020/06/01	<0.010		mg/L	
			Dissolved Nitrate (N)	2020/06/01	<0.010		mg/L	
9867643	KD9	RPD [XV3754-01]	Dissolved Nitrite (N)	2020/06/01	NC		%	20
			Dissolved Nitrate (N)	2020/06/01	4.7		%	20
9867676	LQ1	Matrix Spike	Dissolved Aluminum (Al)	2020/05/31		107	%	80 - 120
			Dissolved Antimony (Sb)	2020/05/31		121 (1)	%	80 - 120
			Dissolved Arsenic (As)	2020/05/31		100	%	80 - 120
			Dissolved Beryllium (Be)	2020/05/31		101	%	80 - 120
			Dissolved Chromium (Cr)	2020/05/31		98	%	80 - 120
			Dissolved Cobalt (Co)	2020/05/31		95	%	80 - 120
			Dissolved Copper (Cu)	2020/05/31		96	%	80 - 120
			Dissolved Lead (Pb)	2020/05/31		94	%	80 - 120
			Dissolved Molybdenum (Mo)	2020/05/31		106	%	80 - 120
			Dissolved Nickel (Ni)	2020/05/31		96	%	80 - 120
			Dissolved Selenium (Se)	2020/05/31		102	%	80 - 120
			Dissolved Silver (Ag)	2020/05/31		101	%	80 - 120
			Dissolved Thallium (Tl)	2020/05/31		95	%	80 - 120
			Dissolved Tin (Sn)	2020/05/31		102	%	80 - 120
			Dissolved Titanium (Ti)	2020/05/31		91	%	80 - 120
			Dissolved Uranium (U)	2020/05/31		94	%	80 - 120
			Dissolved Vanadium (V)	2020/05/31		101	%	80 - 120
			Dissolved Zinc (Zn)	2020/05/31		104	%	80 - 120
9867676	LQ1	Spiked Blank	Dissolved Aluminum (Al)	2020/05/31		108	%	80 - 120
			Dissolved Antimony (Sb)	2020/05/31		119	%	80 - 120
			Dissolved Arsenic (As)	2020/05/31		102	%	80 - 120
			Dissolved Beryllium (Be)	2020/05/31		99	%	80 - 120
			Dissolved Chromium (Cr)	2020/05/31		99	%	80 - 120
			Dissolved Cobalt (Co)	2020/05/31		98	%	80 - 120
			Dissolved Copper (Cu)	2020/05/31		99	%	80 - 120
			Dissolved Lead (Pb)	2020/05/31		95	%	80 - 120
			Dissolved Molybdenum (Mo)	2020/05/31		102	%	80 - 120
			Dissolved Nickel (Ni)	2020/05/31		98	%	80 - 120
			Dissolved Selenium (Se)	2020/05/31		100	%	80 - 120
			Dissolved Silver (Ag)	2020/05/31		100	%	80 - 120
			Dissolved Thallium (Tl)	2020/05/31		94	%	80 - 120
			Dissolved Tin (Sn)	2020/05/31		103	%	80 - 120
			Dissolved Titanium (Ti)	2020/05/31		110	%	80 - 120
			Dissolved Uranium (U)	2020/05/31		92	%	80 - 120
			Dissolved Vanadium (V)	2020/05/31		101	%	80 - 120
			Dissolved Zinc (Zn)	2020/05/31		115	%	80 - 120
9867676	LQ1	Method Blank	Dissolved Aluminum (Al)	2020/05/31	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2020/05/31	<0.00060		mg/L	
			Dissolved Arsenic (As)	2020/05/31	<0.00020		mg/L	



BV Labs Job #: C036129
Report Date: 2020/06/05

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9867676	LQ1	RPD	Dissolved Beryllium (Be)	2020/05/31	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2020/05/31	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2020/05/31	<0.00030		mg/L	
			Dissolved Copper (Cu)	2020/05/31	<0.00020		mg/L	
			Dissolved Lead (Pb)	2020/05/31	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2020/05/31	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2020/05/31	<0.00050		mg/L	
			Dissolved Selenium (Se)	2020/05/31	<0.00020		mg/L	
			Dissolved Silver (Ag)	2020/05/31	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2020/05/31	<0.00020		mg/L	
			Dissolved Tin (Sn)	2020/05/31	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2020/05/31	<0.0010		mg/L	
			Dissolved Uranium (U)	2020/05/31	<0.00010		mg/L	
			Dissolved Vanadium (V)	2020/05/31	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2020/05/31	<0.0030		mg/L	
			Dissolved Aluminum (Al)	2020/05/31	NC		%	20
			Dissolved Antimony (Sb)	2020/05/31	NC		%	20
			Dissolved Arsenic (As)	2020/05/31	6.8		%	20
			Dissolved Beryllium (Be)	2020/05/31	NC		%	20
			Dissolved Chromium (Cr)	2020/05/31	NC		%	20
			Dissolved Cobalt (Co)	2020/05/31	NC		%	20
			Dissolved Copper (Cu)	2020/05/31	NC		%	20
			Dissolved Lead (Pb)	2020/05/31	NC		%	20
			Dissolved Molybdenum (Mo)	2020/05/31	NC		%	20
			Dissolved Nickel (Ni)	2020/05/31	15		%	20
			Dissolved Selenium (Se)	2020/05/31	NC		%	20
			Dissolved Silver (Ag)	2020/05/31	NC		%	20
			Dissolved Thallium (Tl)	2020/05/31	NC		%	20
			Dissolved Tin (Sn)	2020/05/31	NC		%	20
			Dissolved Titanium (Ti)	2020/05/31	6.9		%	20
			Dissolved Uranium (U)	2020/05/31	0.72		%	20
			Dissolved Vanadium (V)	2020/05/31	0.64		%	20
			Dissolved Zinc (Zn)	2020/05/31	3.8		%	20
9867707	JAB	Matrix Spike	Dissolved Barium (Ba)	2020/05/31		95	%	80 - 120
			Dissolved Boron (B)	2020/05/31		104	%	80 - 120
			Dissolved Calcium (Ca)	2020/05/31		NC	%	80 - 120
			Dissolved Iron (Fe)	2020/05/31		105	%	80 - 120
			Dissolved Lithium (Li)	2020/05/31		102	%	80 - 120
			Dissolved Magnesium (Mg)	2020/05/31		95	%	80 - 120
			Dissolved Manganese (Mn)	2020/05/31		104	%	80 - 120
			Dissolved Phosphorus (P)	2020/05/31		102	%	80 - 120
			Dissolved Potassium (K)	2020/05/31		102	%	80 - 120
			Dissolved Silicon (Si)	2020/05/31		95	%	80 - 120
			Dissolved Sodium (Na)	2020/05/31		98	%	80 - 120
			Dissolved Strontium (Sr)	2020/05/31		90	%	80 - 120
			Dissolved Sulphur (S)	2020/05/31		107	%	80 - 120
9867707	JAB	Spiked Blank	Dissolved Barium (Ba)	2020/05/31		100	%	80 - 120
			Dissolved Boron (B)	2020/05/31		103	%	80 - 120
			Dissolved Calcium (Ca)	2020/05/31		98	%	80 - 120
			Dissolved Iron (Fe)	2020/05/31		109	%	80 - 120
			Dissolved Lithium (Li)	2020/05/31		102	%	80 - 120
			Dissolved Magnesium (Mg)	2020/05/31		97	%	80 - 120
			Dissolved Manganese (Mn)	2020/05/31		103	%	80 - 120
			Dissolved Phosphorus (P)	2020/05/31		98	%	80 - 120
			Dissolved Potassium (K)	2020/05/31		102	%	80 - 120



BV Labs Job #: C036129
Report Date: 2020/06/05

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9867707	JAB	Method Blank	Dissolved Silicon (Si)	2020/05/31		99	%	80 - 120
			Dissolved Sodium (Na)	2020/05/31		100	%	80 - 120
			Dissolved Strontium (Sr)	2020/05/31		96	%	80 - 120
			Dissolved Sulphur (S)	2020/05/31		100	%	80 - 120
			Dissolved Barium (Ba)	2020/05/31	<0.010		mg/L	
			Dissolved Boron (B)	2020/05/31	<0.020		mg/L	
			Dissolved Calcium (Ca)	2020/05/31	<0.30		mg/L	
			Dissolved Iron (Fe)	2020/05/31	<0.060		mg/L	
			Dissolved Lithium (Li)	2020/05/31	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2020/05/31	<0.20		mg/L	
			Dissolved Manganese (Mn)	2020/05/31	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2020/05/31	<0.10		mg/L	
			Dissolved Potassium (K)	2020/05/31	<0.30		mg/L	
			Dissolved Silicon (Si)	2020/05/31	<0.10		mg/L	
			Dissolved Sodium (Na)	2020/05/31	<0.50		mg/L	
9867707	JAB	RPD	Dissolved Strontium (Sr)	2020/05/31	<0.020		mg/L	
			Dissolved Sulphur (S)	2020/05/31	<0.20		mg/L	
			Dissolved Calcium (Ca)	2020/05/31	0.046		%	20
			Dissolved Magnesium (Mg)	2020/05/31	0.058		%	20
			Dissolved Potassium (K)	2020/05/31	0.097		%	20
9867708	JAB	Matrix Spike [XV3752-07]	Dissolved Sodium (Na)	2020/05/31	0.24		%	20
			Dissolved Barium (Ba)	2020/05/31		97	%	80 - 120
			Dissolved Boron (B)	2020/05/31		106	%	80 - 120
			Dissolved Calcium (Ca)	2020/05/31		96	%	80 - 120
			Dissolved Iron (Fe)	2020/05/31		106	%	80 - 120
			Dissolved Lithium (Li)	2020/05/31		103	%	80 - 120
			Dissolved Magnesium (Mg)	2020/05/31		94	%	80 - 120
			Dissolved Manganese (Mn)	2020/05/31		105	%	80 - 120
			Dissolved Phosphorus (P)	2020/05/31		100	%	80 - 120
			Dissolved Potassium (K)	2020/05/31		102	%	80 - 120
			Dissolved Silicon (Si)	2020/05/31		97	%	80 - 120
			Dissolved Sodium (Na)	2020/05/31		99	%	80 - 120
			Dissolved Strontium (Sr)	2020/05/31		93	%	80 - 120
			Dissolved Sulphur (S)	2020/05/31		106	%	80 - 120
			Dissolved Barium (Ba)	2020/05/31		102	%	80 - 120
9867708	JAB	Spiked Blank	Dissolved Boron (B)	2020/05/31		105	%	80 - 120
			Dissolved Calcium (Ca)	2020/05/31		100	%	80 - 120
			Dissolved Iron (Fe)	2020/05/31		109	%	80 - 120
			Dissolved Lithium (Li)	2020/05/31		104	%	80 - 120
			Dissolved Magnesium (Mg)	2020/05/31		97	%	80 - 120
			Dissolved Manganese (Mn)	2020/05/31		103	%	80 - 120
			Dissolved Phosphorus (P)	2020/05/31		98	%	80 - 120
			Dissolved Potassium (K)	2020/05/31		103	%	80 - 120
			Dissolved Silicon (Si)	2020/05/31		99	%	80 - 120
			Dissolved Sodium (Na)	2020/05/31		103	%	80 - 120
			Dissolved Strontium (Sr)	2020/05/31		97	%	80 - 120
			Dissolved Sulphur (S)	2020/05/31		100	%	80 - 120
			Dissolved Barium (Ba)	2020/05/31	<0.010		mg/L	
			Dissolved Boron (B)	2020/05/31	<0.020		mg/L	
			Dissolved Calcium (Ca)	2020/05/31	<0.30		mg/L	
9867708	JAB	Method Blank	Dissolved Iron (Fe)	2020/05/31	<0.060		mg/L	
			Dissolved Lithium (Li)	2020/05/31	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2020/05/31	<0.20		mg/L	
			Dissolved Manganese (Mn)	2020/05/31	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2020/05/31	<0.10		mg/L	



BV Labs Job #: C036129
Report Date: 2020/06/05

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9867708	JAB	RPD [XV3752-07]	Dissolved Potassium (K)	2020/05/31	<0.30		mg/L	
			Dissolved Silicon (Si)	2020/05/31	0.11, RDL=0.10		mg/L	
			Dissolved Sodium (Na)	2020/05/31	<0.50		mg/L	
			Dissolved Strontium (Sr)	2020/05/31	<0.020		mg/L	
			Dissolved Sulphur (S)	2020/05/31	<0.20		mg/L	
			Dissolved Barium (Ba)	2020/05/31	0.42		%	20
			Dissolved Boron (B)	2020/05/31	13		%	20
			Dissolved Calcium (Ca)	2020/05/31	1.0		%	20
			Dissolved Iron (Fe)	2020/05/31	NC		%	20
			Dissolved Lithium (Li)	2020/05/31	NC		%	20
			Dissolved Magnesium (Mg)	2020/05/31	1.8		%	20
			Dissolved Manganese (Mn)	2020/05/31	NC		%	20
			Dissolved Phosphorus (P)	2020/05/31	NC		%	20
			Dissolved Potassium (K)	2020/05/31	0.92		%	20
			Dissolved Silicon (Si)	2020/05/31	0.45		%	20
			Dissolved Sodium (Na)	2020/05/31	1.1		%	20
9868722	PL	Matrix Spike	Dissolved Strontium (Sr)	2020/05/31	0.91		%	20
			Dissolved Sulphur (S)	2020/05/31	0.94		%	20
			Dissolved Barium (Ba)	2020/06/02		82	%	80 - 120
			Dissolved Boron (B)	2020/06/02		98	%	80 - 120
			Dissolved Calcium (Ca)	2020/06/02		93	%	80 - 120
			Dissolved Iron (Fe)	2020/06/02		101	%	80 - 120
			Dissolved Lithium (Li)	2020/06/02		104	%	80 - 120
			Dissolved Magnesium (Mg)	2020/06/02		95	%	80 - 120
			Dissolved Manganese (Mn)	2020/06/02		102	%	80 - 120
			Dissolved Phosphorus (P)	2020/06/02		96	%	80 - 120
			Dissolved Potassium (K)	2020/06/02		100	%	80 - 120
			Dissolved Silicon (Si)	2020/06/02		90	%	80 - 120
			Dissolved Sodium (Na)	2020/06/02		96	%	80 - 120
			Dissolved Strontium (Sr)	2020/06/02		86	%	80 - 120
			Dissolved Sulphur (S)	2020/06/02		100	%	80 - 120
9868722	PL	Spiked Blank	Dissolved Barium (Ba)	2020/06/02		90	%	80 - 120
			Dissolved Boron (B)	2020/06/02		95	%	80 - 120
			Dissolved Calcium (Ca)	2020/06/02		96	%	80 - 120
			Dissolved Iron (Fe)	2020/06/02		101	%	80 - 120
			Dissolved Lithium (Li)	2020/06/02		104	%	80 - 120
			Dissolved Magnesium (Mg)	2020/06/02		96	%	80 - 120
			Dissolved Manganese (Mn)	2020/06/02		101	%	80 - 120
			Dissolved Phosphorus (P)	2020/06/02		93	%	80 - 120
			Dissolved Potassium (K)	2020/06/02		99	%	80 - 120
			Dissolved Silicon (Si)	2020/06/02		93	%	80 - 120
			Dissolved Sodium (Na)	2020/06/02		96	%	80 - 120
			Dissolved Strontium (Sr)	2020/06/02		87	%	80 - 120
			Dissolved Sulphur (S)	2020/06/02		94	%	80 - 120
9868722	PL	Method Blank	Dissolved Barium (Ba)	2020/06/02	<0.010		mg/L	
			Dissolved Boron (B)	2020/06/02	<0.020		mg/L	
			Dissolved Calcium (Ca)	2020/06/02	<0.30		mg/L	
			Dissolved Iron (Fe)	2020/06/02	<0.060		mg/L	
			Dissolved Lithium (Li)	2020/06/02	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2020/06/02	<0.20		mg/L	
			Dissolved Manganese (Mn)	2020/06/02	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2020/06/02	<0.10		mg/L	
			Dissolved Potassium (K)	2020/06/02	<0.30		mg/L	
			Dissolved Silicon (Si)	2020/06/02	<0.10		mg/L	



QUALITY ASSURANCE REPORT(CONT'D)

QA/QC	Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9868722	PL	RPD		Dissolved Sodium (Na)	2020/06/02	<0.50		mg/L	
				Dissolved Strontium (Sr)	2020/06/02	<0.020		mg/L	
				Dissolved Sulphur (S)	2020/06/02	<0.20		mg/L	
				Dissolved Barium (Ba)	2020/06/02	0.70		%	20
				Dissolved Boron (B)	2020/06/02	NC		%	20
				Dissolved Calcium (Ca)	2020/06/02	0.079		%	20
				Dissolved Iron (Fe)	2020/06/02	0.90		%	20
				Dissolved Lithium (Li)	2020/06/02	NC		%	20
				Dissolved Magnesium (Mg)	2020/06/02	0.47		%	20
				Dissolved Manganese (Mn)	2020/06/02	0.46		%	20
				Dissolved Phosphorus (P)	2020/06/02	NC		%	20
				Dissolved Potassium (K)	2020/06/02	0.52		%	20
				Dissolved Silicon (Si)	2020/06/02	0.66		%	20
				Dissolved Sodium (Na)	2020/06/02	0.35		%	20
				Dissolved Strontium (Sr)	2020/06/02	0.44		%	20
9869387	MB5	Matrix Spike [XV3753-01]		Dissolved Sulphur (S)	2020/06/02	0.34		%	20
				Dissolved Chloride (Cl)	2020/06/03		105	%	80 - 120
9869387	MB5	Spiked Blank		Dissolved Sulphate (SO4)	2020/06/03		NC	%	80 - 120
				Dissolved Chloride (Cl)	2020/06/03		103	%	80 - 120
9869387	MB5	Method Blank		Dissolved Sulphate (SO4)	2020/06/03		104	%	80 - 120
				Dissolved Chloride (Cl)	2020/06/03	<1.0		mg/L	
9869387	MB5	RPD [XV3753-01]		Dissolved Sulphate (SO4)	2020/06/03	<1.0		mg/L	
				Dissolved Chloride (Cl)	2020/06/03	4.6		%	20
9869735	FM0	Matrix Spike		Dissolved Sulphate (SO4)	2020/06/03	0.16		%	20
				Orthophosphate (P)	2020/06/02		NC	%	80 - 120
9869735	FM0	Spiked Blank		Orthophosphate (P)	2020/06/02		102	%	80 - 120
				Orthophosphate (P)	2020/06/02	<0.0030		mg/L	
9869735	FM0	Method Blank		Orthophosphate (P)	2020/06/02	0.51 (2)		%	20
				Orthophosphate (P)	2020/06/02			%	20
9870040	LQ1	Matrix Spike		Dissolved Barium (Ba)	2020/06/03		92	%	80 - 120
				Dissolved Boron (B)	2020/06/03		97	%	80 - 120
				Dissolved Calcium (Ca)	2020/06/03		NC	%	80 - 120
				Dissolved Iron (Fe)	2020/06/03		NC	%	80 - 120
				Dissolved Lithium (Li)	2020/06/03		96	%	80 - 120
				Dissolved Magnesium (Mg)	2020/06/03		97	%	80 - 120
				Dissolved Manganese (Mn)	2020/06/03		90	%	80 - 120
				Dissolved Phosphorus (P)	2020/06/03		101	%	80 - 120
				Dissolved Potassium (K)	2020/06/03		101	%	80 - 120
				Dissolved Silicon (Si)	2020/06/03		95	%	80 - 120
				Dissolved Sodium (Na)	2020/06/03		NC	%	80 - 120
				Dissolved Strontium (Sr)	2020/06/03		91	%	80 - 120
				Dissolved Sulphur (S)	2020/06/03		103	%	80 - 120
				Dissolved Barium (Ba)	2020/06/03		100	%	80 - 120
				Dissolved Boron (B)	2020/06/03		100	%	80 - 120
9870040	LQ1	Spiked Blank		Dissolved Calcium (Ca)	2020/06/03		106	%	80 - 120
				Dissolved Iron (Fe)	2020/06/03		102	%	80 - 120
				Dissolved Lithium (Li)	2020/06/03		99	%	80 - 120
				Dissolved Magnesium (Mg)	2020/06/03		102	%	80 - 120
				Dissolved Manganese (Mn)	2020/06/03		101	%	80 - 120
				Dissolved Phosphorus (P)	2020/06/03		101	%	80 - 120
				Dissolved Potassium (K)	2020/06/03		100	%	80 - 120
				Dissolved Silicon (Si)	2020/06/03		100	%	80 - 120
				Dissolved Sodium (Na)	2020/06/03		97	%	80 - 120
				Dissolved Strontium (Sr)	2020/06/03		100	%	80 - 120
				Dissolved Sulphur (S)	2020/06/03		99	%	80 - 120
				Dissolved Barium (Ba)	2020/06/03	<0.010		mg/L	
				Dissolved Barium (Ba)	2020/06/03				
				Dissolved Barium (Ba)	2020/06/03				
				Dissolved Barium (Ba)	2020/06/03				
				Dissolved Barium (Ba)	2020/06/03				
9870040	LQ1	Method Blank		Dissolved Barium (Ba)	2020/06/03	<0.010		mg/L	



QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9870040	LQ1	RPD	Dissolved Boron (B)	2020/06/03	<0.020		mg/L	
			Dissolved Calcium (Ca)	2020/06/03	<0.30		mg/L	
			Dissolved Iron (Fe)	2020/06/03	<0.060		mg/L	
			Dissolved Lithium (Li)	2020/06/03	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2020/06/03	<0.20		mg/L	
			Dissolved Manganese (Mn)	2020/06/03	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2020/06/03	<0.10		mg/L	
			Dissolved Potassium (K)	2020/06/03	<0.30		mg/L	
			Dissolved Silicon (Si)	2020/06/03	<0.10		mg/L	
			Dissolved Sodium (Na)	2020/06/03	<0.50		mg/L	
			Dissolved Strontium (Sr)	2020/06/03	<0.020		mg/L	
			Dissolved Sulphur (S)	2020/06/03	<0.20		mg/L	
9870997	HE1	Matrix Spike	Dissolved Iron (Fe)	2020/06/03	0.063		%	20
			Dissolved Manganese (Mn)	2020/06/03	0.058		%	20
9870997	HE1	Matrix Spike	Total Suspended Solids	2020/06/03		99	%	80 - 120
9870997	HE1	Spiked Blank	Total Suspended Solids	2020/06/03		95	%	80 - 120
9870997	HE1	Method Blank	Total Suspended Solids	2020/06/03	<1.0		mg/L	
9870997	HE1	RPD	Total Suspended Solids	2020/06/03	17		%	20
9871433	FM0	Matrix Spike [XV3750-06]	Dissolved Phosphorus (P)	2020/06/03		100	%	80 - 120
9871433	FM0	QC Standard	Dissolved Phosphorus (P)	2020/06/03		93	%	80 - 120
9871433	FM0	Spiked Blank	Dissolved Phosphorus (P)	2020/06/03		100	%	80 - 120
9871433	FM0	Method Blank	Dissolved Phosphorus (P)	2020/06/03	<0.0030		mg/L	
9871433	FM0	RPD [XV3750-06]	Dissolved Phosphorus (P)	2020/06/03	6.4		%	20
9871447	AP1	Matrix Spike	Total Dissolved Solids	2020/06/03		94	%	80 - 120
9871447	AP1	Spiked Blank	Total Dissolved Solids	2020/06/03		96	%	80 - 120
9871447	AP1	Method Blank	Total Dissolved Solids	2020/06/03	<10		mg/L	
9871447	AP1	RPD	Total Dissolved Solids	2020/06/03	3.8		%	20
9871485	FM0	Matrix Spike	Total Phosphorus (P)	2020/06/03		100	%	80 - 120
9871485	FM0	QC Standard	Total Phosphorus (P)	2020/06/03		93	%	80 - 120
9871485	FM0	Spiked Blank	Total Phosphorus (P)	2020/06/03		100	%	80 - 120
9871485	FM0	Method Blank	Total Phosphorus (P)	2020/06/03	<0.0030		mg/L	
9871485	FM0	RPD	Total Phosphorus (P)	2020/06/03	NC		%	20
9871497	FM0	Matrix Spike	Total Phosphorus (P)	2020/06/03		101	%	80 - 120
9871497	FM0	QC Standard	Total Phosphorus (P)	2020/06/03		93	%	80 - 120
9871497	FM0	Spiked Blank	Total Phosphorus (P)	2020/06/03		99	%	80 - 120
9871497	FM0	Method Blank	Total Phosphorus (P)	2020/06/03	<0.0030		mg/L	
9871497	FM0	RPD	Total Phosphorus (P)	2020/06/03	9.1		%	20
9871590	AP1	Matrix Spike [XV3750-01]	Chemical Oxygen Demand	2020/06/03		102	%	80 - 120
9871590	AP1	Spiked Blank	Chemical Oxygen Demand	2020/06/03		102	%	80 - 120
9871590	AP1	Method Blank	Chemical Oxygen Demand	2020/06/03	<10		mg/L	
9871590	AP1	RPD [XV3750-01]	Chemical Oxygen Demand	2020/06/03	16		%	20
9871760	FM0	Matrix Spike	Total Total Kjeldahl Nitrogen	2020/06/04		111	%	80 - 120
9871760	FM0	QC Standard	Total Total Kjeldahl Nitrogen	2020/06/04		103	%	80 - 120
9871760	FM0	Spiked Blank	Total Total Kjeldahl Nitrogen	2020/06/04		105	%	80 - 120
9871760	FM0	Method Blank	Total Total Kjeldahl Nitrogen	2020/06/04	<0.050		mg/L	
9871760	FM0	RPD	Total Total Kjeldahl Nitrogen	2020/06/04	10		%	20
9871942	FM0	Matrix Spike	Total Total Kjeldahl Nitrogen	2020/06/04		118	%	80 - 120
9871942	FM0	QC Standard	Total Total Kjeldahl Nitrogen	2020/06/04		108	%	80 - 120
9871942	FM0	Spiked Blank	Total Total Kjeldahl Nitrogen	2020/06/04		106	%	80 - 120
9871942	FM0	Method Blank	Total Total Kjeldahl Nitrogen	2020/06/04	<0.050		mg/L	
9871942	FM0	RPD	Total Total Kjeldahl Nitrogen	2020/06/04	7.2		%	20
9873198	AP1	Matrix Spike	Total Dissolved Solids	2020/06/04		102	%	80 - 120
9873198	AP1	Spiked Blank	Total Dissolved Solids	2020/06/04		98	%	80 - 120
9873198	AP1	Method Blank	Total Dissolved Solids	2020/06/04	<10		mg/L	
9873198	AP1	RPD	Total Dissolved Solids	2020/06/04	2.8		%	20



QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9874297	HG	Matrix Spike	Total Ammonia (N)	2020/06/05		172 (1)	%	80 - 120
9874297	HG	Spiked Blank	Total Ammonia (N)	2020/06/05		109	%	80 - 120
9874297	HG	Method Blank	Total Ammonia (N)	2020/06/05	<0.015		mg/L	
9874297	HG	RPD	Total Ammonia (N)	2020/06/05	NC		%	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference $\leq 2 \times$ RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(2) Detection limits raised due to dilution to bring analyte within the calibrated range.



BV Labs Job #: C036129
Report Date: 2020/06/05

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

A handwritten signature in black ink, appearing to read "M. Florescu", written over a horizontal line.

Maria Magdalena Florescu, Ph.D., P.Chem., QP, Inorganics Manager

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



Bureau Veritas Laboratories
4000 1st N.E., Calgary, Alberta Canada T2E 6P8 Tel: (403) 291-3077 Toll-free: 800-563-6266 Fax: (403) 291-9465 www.bvlabs.com

1121

CHAIN OF CUSTODY RECORD

Page 1 of 2

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name: #10658 HEMMERA ENVIROCHEM INC.		Company Name: Hemmera		Quotation #: B61187		BV Labs Job #:	
Attention: Accounts Payable		Attention: Jessica Eaton		P.O. #:		Bottle Order #:	
Address: SUITE 804, 322-11TH AVENUE SW		Address:		Project: 102604-01		COC #:	
CALGARY AB T2R 0C5		Tel: 403-200-4377 Fax:		Project Name:		Project Manager:	
Tel: (403) 264-0671 Fax:		Email: jessica.eaton@hemmera.com		Site #:		Gail Pedersen	
Email: accounts-payable@hemmera.com				Sampled By:		C46039351-01-01	

Regulatory Criteria:		Special Instructions		ANALYSIS REQUESTED (PLEASE BE SPECIFIC):												Turnaround Time (TAT) Required:	
☐ ATI																Please provide advance notice for rush projects	
☐ CCME																Regular (Standard) TAT:	
☐ Other																(will be applied if Rush TAT is not specified)	
																Standard TAT = 5-7 Working days for most tests.	
																Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details	
																Job Specific Rush TAT (if applies to entire submission)	
																Date Required:	
																Rush Confirmation Number:	
																(call lab for #)	
SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS																	
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y/N)	Routine Water & Diss. Regulated Metals	Orthophosphate by Konelab	Total Suspended Solids (NFR)	Total Dissolved Solids (Filt. Residue)	Turbidity	Total Kjeldahl Nitrogen	Ammonia-N (Total)	Total Phosphorus	Chemical Oxygen Demand	Phosphorus-P (Total, Dissolved)	# of Bottles	Comments
1	WQ-01	28-May	10:40	W		X	X	X	X	X	X	X	X	X	X	8	Confirm before destroying all
2	WQ-02	28-May	14:00	W		X	X	X	X	X	X	X	X	X	X	8	Samples
3	WQ-03	28-May	12:30	W		X	X	X	X	X	X	X	X	X	X	8	
4	WQ-04a	28-May	17:40	W		X	X	X	X	X	X	X	X	X	X	8	
5	WQ-04b	28-May	15:40	W		X	X	X	X	X	X	X	X	X	X	8	29-May-20 06:00
6	WQ-05a	28-May	17:15	W		X	X	X	X	X	X	X	X	X	X	8	Gail Pedersen
7	WQ-05b	28-May	16:25	W		X	X	X	X	X	X	X	X	X	X	8	C036129
8	WQ-06	28-May	15:00	W		X	X	X	X	X	X	X	X	X	X	8	SBZ INS-0200
9	WQ-07	28-May	14:30	W		X	X	X	X	X	X	X	X	X	X	8	
10																	

* RELINQUISHED BY: (Signature/Print)		Date: (YY/MM/DD)		Time		RECEIVED BY: (Signature/Print)		Date: (YY/MM/DD)		Time		# jars used and not submitted		Laboratory Use Only	
Dawn Foster Dawn		20/05/28		19:50		SARA BISCHOFF		2020/05/29		06:00				Time Sensitive	
														Temperature (°C) on Receipt	
														Custody Seal Intact on Cooler?	
														Yes No	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

5,2,7 ice-yes CS-No
4,1,5 ice-yes CS-No



Bureau Veritas Laboratories
4000 19st N.E., Calgary, Alberta Canada T2E 6P8 Tel:(403) 291-3077 Toll-free:800-563-6286 Fax:(403) 291-9468 www.bvlab.com

1121

CHAIN OF CUSTODY RECORD

Page 2 of 2

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#10658 HEMMERA ENVIROCHEM INC.	Company Name:	Hemmera	Quotation #:	B61187	BV Labs Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Jessica Eaton	P.O. #:			
Address:	SUITE 804, 322-11TH AVENUE SW	Address:		Project:	102604-01		
	CALGARY AB T2R 0C5			Project Name:		COC #:	Project Manager:
Tel:	(403) 264-0671	Tel:	403-200-4374	Site #:			Gail Pedersen
Email:	accounts-payable@hemmera.com	Email:	jessica.eaton@hemmera.com	Sampled By:			

Regulatory Criteria:		Special Instructions		ANALYSIS REQUESTED (PLEASE BE SPECIFIC)												Turnaround Time (TAT) Required:		
☐ ATI ☐ CCME ☐ Other																Please provide advance notice for rush projects		
																Regular (Standard) TAT: (will be applied if Rush TAT is not specified) Standard TAT ~ 5-7 Working days for most tests. Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details		
																Job Specific Rush TAT (if applies to entire submission) Date Required: Rush Confirmation Number: (call lab for #)		
SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS																		
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y/N)	Biochemical Oxygen Demand	Oxygen (Dissolved, Winkler)										# of Bottles	Comments
1	WQ-01	28-May	10:40	W		X	X											
2	WQ-02	28-May	14:00	W		X	X											
3	WQ-03	28-May	12:30	W		X	X											
4	WQ-04a	28-May	17:40	W		X	X											
5	WQ-04b	28-May	15:40	W		X	X											
6	WQ-05a	28-May	17:15	W		X	X											
7	WQ-05b	28-May	16:25	W		X	X											
8	WQ-06	28-May	15:00	W		X	X											
9	WQ-07	28-May	14:30	W		X	X											
10																		

* RELINQUISHED BY: (Signature/Print)		Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)		Date: (YY/MM/DD)	Time	# Jars used and not submitted	Laboratory Use Only		
Dean Foster		20/05/28	17:50	SARA BISCHOFF		2020/05/29	06:00		Time Sensitive: ☐	Temperature (°C) on Receipt: 5.8.9 ice-yes	Custody Seal Intact on Cooler? ☐ Yes ☒ No
* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM TERMS AND CONDITIONS.											
* IT IS THE RESPONSIBILITY OF THE RELINQUISHING TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.											
** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER											

5.2.7 ice-yes CS-No
4.1.5 ice-yes CS-No



Your Project #: 102604-01
Your C.O.C. #: 622292-01-01

Attention: Jessica Eaton

HEMMERA ENVIROCHEM INC.
SUITE 804, 322-11TH AVENUE SW
CALGARY, AB
CANADA T2R 0C5

Report Date: 2020/10/23

Report #: R2946301

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C075863

Received: 2020/10/15, 18:25

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO ₃ ,HCO ₃ ,OH	6	N/A	2020/10/17	AB SOP-00005	SM 23 2320 B m
Biochemical Oxygen Demand	6	2020/10/17	2020/10/22	AB SOP-00017	SM 23 5210B m
Cadmium - low level CCME - Dissolved	6	N/A	2020/10/20		Auto Calc
Chloride/Sulphate by Auto Colourimetry	6	N/A	2020/10/21	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO ₄ -E m
COD by Colorimeter	6	N/A	2020/10/21	AB SOP-00016	SM 23 5220D m
Oxygen (Dissolved) (1)	6	N/A	2020/10/16	AB SOP-00058	SM 23 4500-O C m
Conductivity @25C	6	N/A	2020/10/17	AB SOP-00005	SM 23 2510 B m
Hardness	6	N/A	2020/10/21		Auto Calc
Elements by ICP - Dissolved (2)	6	N/A	2020/10/19	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (2)	6	N/A	2020/10/19	AB SOP-00043	EPA 6020b R2 m
Ion Balance	6	N/A	2020/10/21		Auto Calc
Sum of cations, anions	6	N/A	2020/10/21		Auto Calc
Ammonia-N (Total)	1	N/A	2020/10/20	AB SOP-00007	SM 23 4500 NH ₃ A G m
Ammonia-N (Total)	5	N/A	2020/10/21	AB SOP-00007	SM 23 4500 NH ₃ A G m
Nitrate and Nitrite	6	N/A	2020/10/20		Auto Calc
NO ₂ - NO ₂ + NO ₃ (N) in Water	6	N/A	2020/10/17	AB SOP-00091	SM 23 4500 NO ₃ m
Nitrate (as N)	6	2020/10/16	2020/10/20		Auto Calc
pH @25°C (3)	6	N/A	2020/10/17	AB SOP-00005	SM 23 4500-H+B m
Orthophosphate by Konelab (4)	6	N/A	2020/10/17	AB SOP-00025	SM 23 4500-P A,B,F m
Total Dissolved Solids (Filt. Residue)	6	2020/10/21	2020/10/21	AB SOP-00065	SM 23 2540 C m
Total Dissolved Solids (Calculated)	6	N/A	2020/10/21		Auto Calc
Total Kjeldahl Nitrogen	6	2020/10/21	2020/10/22	AB SOP-00008	EPA 351.1 R1978 m
Phosphorus -P (Total, Dissolved) (5)	6	2020/10/21	2020/10/22	AB SOP-00024	SM 23 4500-P A,B,F m
Total Phosphorus	6	2020/10/21	2020/10/22	AB SOP-00024	SM 23 4500-P A,B,F m
Total Suspended Solids (NFR)	6	2020/10/22	2020/10/22	AB SOP-00061	SM 23 2540 D m
Turbidity	6	N/A	2020/10/17	CAL SOP-00081	SM 23 2130 B m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.



Your Project #: 102604-01
Your C.O.C. #: 622292-01-01

Attention: Jessica Eaton

HEMMERA ENVIROCHEM INC.
SUITE 804, 322-11TH AVENUE SW
CALGARY, AB
CANADA T2R 0C5

Report Date: 2020/10/23

Report #: R2946301

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C075863

Received: 2020/10/15, 18:25

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) The APHA Standard Method requires dissolved oxygen to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory dissolved oxygen analyses in this report are reported past the APHA Standard Method holding time. Bureau Veritas Laboratories endeavors to analyze samples as soon as possible after receipt.

(2) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.

(3) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavors to analyze samples as soon as possible after receipt.

(4) Orthophosphate > Total Phosphorus Imbalance: When applicable, Orthophosphate, Total Phosphorus and dissolved Phosphorus results were reviewed and data quality meets acceptable levels unless otherwise noted.

(5) Dissolved Phosphorus > Total Phosphorus Imbalance: When applicable, Dissolved Phosphorus and Total Phosphorus results were reviewed and data quality meets acceptable levels unless otherwise noted.

Encryption Key



Bureau Veritas Laboratories

23 Oct 2020 08:21:28

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Gail Pedersen, Key Account Specialist

Email: Gail.Pedersen@bvlabs.com

Phone# (403) 291-3077

=====

This report has been generated and distributed using a secure automated process.

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



BV Labs Job #: C075863
Report Date: 2020/10/23

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		YQ8419		YQ8420			YQ8421		
Sampling Date		2020/10/15 12:21		2020/10/15 11:30			2020/10/15 16:17		
COC Number		622292-01-01		622292-01-01			622292-01-01		
	UNITS	WQ-02	RDL	WQ-03	RDL	QC Batch	WQ-04A	RDL	QC Batch

Calculated Parameters

Anion Sum	meq/L	10	N/A	9.7	N/A	A049940	9.9	N/A	A049940
Cation Sum	meq/L	9.0	N/A	8.4	N/A	A049940	8.4	N/A	A049940
Hardness (CaCO ₃)	mg/L	360	0.50	330	0.50	A049831	330	0.50	A049831
Ion Balance (% Difference)	%	6.6	N/A	7.1	N/A	A049939	8.0	N/A	A049939
Dissolved Nitrate (NO ₃)	mg/L	0.71	0.044	<0.22	0.22	A049941	1.2	0.044	A049941
Dissolved Nitrite (NO ₂)	mg/L	<0.033	0.033	<0.033	0.033	A049941	<0.033	0.033	A049941
Calculated Total Dissolved Solids	mg/L	490	10	460	10	A049943	470	10	A049943

Misc. Inorganics

Conductivity	uS/cm	780	2.0	750	2.0	A051455	740	2.0	A051573
pH	pH	8.30	N/A	7.96	N/A	A051453	8.30	N/A	A051567

Low Level Elements

Dissolved Cadmium (Cd)	mg/L	<0.000020	0.000020	<0.000020	0.000020	A049793	<0.000020	0.000020	A049793
------------------------	------	-----------	----------	-----------	----------	---------	-----------	----------	---------

Anions

Alkalinity (PP as CaCO ₃)	mg/L	4.5	1.0	<1.0	1.0	A051449	3.8 (1)	1.0	A051561
Alkalinity (Total as CaCO ₃)	mg/L	440	1.0	410	1.0	A051449	410	1.0	A051561
Bicarbonate (HCO ₃)	mg/L	520	1.0	510	1.0	A051449	490	1.0	A051561
Carbonate (CO ₃)	mg/L	5.4	1.0	<1.0	1.0	A051449	4.5 (1)	1.0	A051561
Hydroxide (OH)	mg/L	<1.0	1.0	<1.0	1.0	A051449	<1.0	1.0	A051561
Dissolved Chloride (Cl)	mg/L	11	1.0	15	1.0	A057649	7.9	1.0	A057649
Dissolved Sulphate (SO ₄)	mg/L	62	1.0	49	1.0	A057649	67	1.0	A057649

Elements

Dissolved Aluminum (Al)	mg/L	<0.0030	0.0030	0.0043	0.0030	A054167	<0.0030	0.0030	A054167
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	<0.00060	0.00060	A054167	<0.00060	0.00060	A054167
Dissolved Arsenic (As)	mg/L	0.00040	0.00020	0.0023	0.00020	A054167	<0.00020	0.00020	A054167
Dissolved Barium (Ba)	mg/L	0.083	0.010	0.23	0.010	A054869	0.059	0.010	A054869
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	<0.0010	0.0010	A054167	<0.0010	0.0010	A054167
Dissolved Boron (B)	mg/L	0.030	0.020	0.051	0.020	A054869	0.037	0.020	A054869
Dissolved Calcium (Ca)	mg/L	68	0.30	60	0.30	A054869	67	0.30	A054869
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	<0.0010	0.0010	A054167	<0.0010	0.0010	A054167
Dissolved Cobalt (Co)	mg/L	<0.00030	0.00030	<0.00030	0.00030	A054167	<0.00030	0.00030	A054167
Dissolved Copper (Cu)	mg/L	0.00054	0.00020	<0.00020	0.00020	A054167	0.00048	0.00020	A054167

RDL = Reportable Detection Limit

N/A = Not Applicable

(1) Duplicate exceeds acceptance criteria due to sample non homogeneity. Reanalysis yields similar results.



ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		YQ8419		YQ8420			YQ8421		
Sampling Date		2020/10/15 12:21		2020/10/15 11:30			2020/10/15 16:17		
COC Number		622292-01-01		622292-01-01			622292-01-01		
	UNITS	WQ-02	RDL	WQ-03	RDL	QC Batch	WQ-04A	RDL	QC Batch
Dissolved Iron (Fe)	mg/L	0.083	0.060	0.10	0.060	A054869	0.072	0.060	A054869
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	<0.00020	0.00020	A054167	<0.00020	0.00020	A054167
Dissolved Lithium (Li)	mg/L	0.022	0.020	0.021	0.020	A054869	<0.020	0.020	A054869
Dissolved Magnesium (Mg)	mg/L	46	0.20	43	0.20	A054869	40	0.20	A054869
Dissolved Manganese (Mn)	mg/L	0.022	0.0040	0.12	0.0040	A054869	<0.0040	0.0040	A054869
Dissolved Molybdenum (Mo)	mg/L	0.0016	0.00020	0.0064	0.00020	A054167	0.0021	0.00020	A054167
Dissolved Nickel (Ni)	mg/L	<0.00050	0.00050	0.0010	0.00050	A054167	<0.00050	0.00050	A054167
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	<0.10	0.10	A054869	<0.10	0.10	A054869
Dissolved Potassium (K)	mg/L	4.3	0.30	8.6	0.30	A054869	4.2	0.30	A054869
Dissolved Selenium (Se)	mg/L	0.0013	0.00020	0.00049	0.00020	A054167	0.0017	0.00020	A054167
Dissolved Silicon (Si)	mg/L	4.7	0.10	3.1	0.10	A054869	4.3	0.10	A054869
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	<0.00010	0.00010	A054167	<0.00010	0.00010	A054167
Dissolved Sodium (Na)	mg/L	41	0.50	37	0.50	A054869	39	0.50	A054869
Dissolved Strontium (Sr)	mg/L	0.68	0.020	0.55	0.020	A054869	0.65	0.020	A054869
Dissolved Sulphur (S)	mg/L	18	0.20	13	0.20	A054869	18	0.20	A054869
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	<0.00020	0.00020	A054167	<0.00020	0.00020	A054167
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	<0.0010	0.0010	A054167	<0.0010	0.0010	A054167
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	<0.0010	0.0010	A054167	<0.0010	0.0010	A054167
Dissolved Uranium (U)	mg/L	0.0032	0.00010	0.0071	0.00010	A054167	0.0033	0.00010	A054167
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	<0.0010	0.0010	A054167	<0.0010	0.0010	A054167
Dissolved Zinc (Zn)	mg/L	0.0071	0.0030	<0.0030	0.0030	A054167	<0.0030	0.0030	A054167

RDL = Reportable Detection Limit



BV Labs Job #: C075863
Report Date: 2020/10/23

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		YQ8422	YQ8423		YQ8424		
Sampling Date		2020/10/15 13:47	2020/10/15 14:17		2020/10/15 12:57		
COC Number		622292-01-01	622292-01-01		622292-01-01		
	UNITS	WQ-04B	WQ-05B	RDL	WQ-06	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	9.9	13	N/A	9.8	N/A	A049940
Cation Sum	meq/L	8.5	12	N/A	8.6	N/A	A049940
Hardness (CaCO ₃)	mg/L	330	520	0.50	330	0.50	A049831
Ion Balance (% Difference)	%	7.4	1.6	N/A	6.5	N/A	A049939
Dissolved Nitrate (NO ₃)	mg/L	1.0	0.60	0.044	<0.22	0.22	A049941
Dissolved Nitrite (NO ₂)	mg/L	<0.033	<0.033	0.033	<0.033	0.033	A049941
Calculated Total Dissolved Solids	mg/L	470	640	10	470	10	A049943
Misc. Inorganics							
Conductivity	uS/cm	740	990	2.0	750	2.0	A051455
pH	pH	8.39	8.14	N/A	8.26	N/A	A051453
Low Level Elements							
Dissolved Cadmium (Cd)	mg/L	<0.000020	<0.000020	0.000020	<0.000020	0.000020	A049793
Anions							
Alkalinity (PP as CaCO ₃)	mg/L	7.5	<1.0	1.0	<1.0	1.0	A051449
Alkalinity (Total as CaCO ₃)	mg/L	420	470	1.0	420	1.0	A051449
Bicarbonate (HCO ₃)	mg/L	490	570	1.0	520	1.0	A051449
Carbonate (CO ₃)	mg/L	9.0	<1.0	1.0	<1.0	1.0	A051449
Hydroxide (OH)	mg/L	<1.0	<1.0	1.0	<1.0	1.0	A051449
Dissolved Chloride (Cl)	mg/L	8.4	12	1.0	9.5	1.0	A057649
Dissolved Sulphate (SO ₄)	mg/L	61	140	1.0	54	1.0	A057649
Elements							
Dissolved Aluminum (Al)	mg/L	<0.0030	<0.0030	0.0030	0.0033	0.0030	A054167
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	0.00060	<0.00060	0.00060	A054167
Dissolved Arsenic (As)	mg/L	0.00030	0.00078	0.00020	0.0012	0.00020	A054167
Dissolved Barium (Ba)	mg/L	0.062	0.11	0.010	0.15	0.010	A054869
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	A054167
Dissolved Boron (B)	mg/L	0.033	0.036	0.020	0.044	0.020	A054869
Dissolved Calcium (Ca)	mg/L	67	86	0.30	48	0.30	A054869
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	A054167
Dissolved Cobalt (Co)	mg/L	<0.00030	<0.00030	0.00030	<0.00030	0.00030	A054167
Dissolved Copper (Cu)	mg/L	<0.00020	0.0012	0.00020	0.0040	0.00020	A054167
Dissolved Iron (Fe)	mg/L	0.068	0.14	0.060	0.11	0.060	A054869
RDL = Reportable Detection Limit							
N/A = Not Applicable							



ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		YQ8422	YQ8423		YQ8424		
Sampling Date		2020/10/15 13:47	2020/10/15 14:17		2020/10/15 12:57		
COC Number		622292-01-01	622292-01-01		622292-01-01		
	UNITS	WQ-04B	WQ-05B	RDL	WQ-06	RDL	QC Batch
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	0.00020	<0.00020	0.00020	A054167
Dissolved Lithium (Li)	mg/L	0.020	0.024	0.020	0.024	0.020	A054869
Dissolved Magnesium (Mg)	mg/L	41	75	0.20	50	0.20	A054869
Dissolved Manganese (Mn)	mg/L	0.0044	0.028	0.0040	0.0099	0.0040	A054869
Dissolved Molybdenum (Mo)	mg/L	0.0021	0.0028	0.00020	0.0020	0.00020	A054167
Dissolved Nickel (Ni)	mg/L	<0.00050	0.00066	0.00050	<0.00050	0.00050	A054167
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	0.10	<0.10	0.10	A054869
Dissolved Potassium (K)	mg/L	4.3	4.2	0.30	4.5	0.30	A054869
Dissolved Selenium (Se)	mg/L	0.0014	0.0025	0.00020	0.00032	0.00020	A054167
Dissolved Silicon (Si)	mg/L	4.4	4.1	0.10	1.6	0.10	A054869
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010	<0.00010	0.00010	A054167
Dissolved Sodium (Na)	mg/L	39	38	0.50	46	0.50	A054869
Dissolved Strontium (Sr)	mg/L	0.65	0.80	0.020	0.65	0.020	A054869
Dissolved Sulphur (S)	mg/L	18	45	0.20	15	0.20	A054869
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	0.00020	<0.00020	0.00020	A054167
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	A054167
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	A054167
Dissolved Uranium (U)	mg/L	0.0032	0.012	0.00010	0.0032	0.00010	A054167
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	A054167
Dissolved Zinc (Zn)	mg/L	0.054	<0.0030	0.0030	0.0044	0.0030	A054167
RDL = Reportable Detection Limit							



RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		YQ8419			YQ8420			YQ8421		
Sampling Date		2020/10/15 12:21			2020/10/15 11:30			2020/10/15 16:17		
COC Number		622292-01-01			622292-01-01			622292-01-01		
	UNITS	WQ-02	RDL	QC Batch	WQ-03	RDL	QC Batch	WQ-04A	RDL	QC Batch
Calculated Parameters										
Dissolved Nitrate (N)	mg/L	0.16	0.010	A050456	<0.050	0.050	A051519	0.26	0.010	A051519
Demand Parameters										
Biochemical Oxygen Demand	mg/L	<2.0	2.0	A052334	4.3	2.0	A052334	<2.0 (1)	2.0	A052780
Chemical Oxygen Demand	mg/L	<10	10	A057112	41	10	A057112	12	10	A057112
Misc. Inorganics										
Dissolved Oxygen (O ₂)	mg/L	10	0.10	A051334	8.2	0.10	A051334	>15 (2)	0.10	A051334
Total Dissolved Solids	mg/L	460	10	A056878	380	10	A056878	470	10	A056878
Total Suspended Solids	mg/L	23	1.0	A058800	26	1.0	A058800	7.7	1.0	A058802
Nutrients										
Total Ammonia (N)	mg/L	0.063	0.015	A057484	0.48	0.015	A057426	<0.015	0.015	A057484
Orthophosphate (P)	mg/L	0.0053	0.0030	A052415	0.0053	0.0030	A052415	0.0036	0.0030	A052415
Dissolved Phosphorus (P)	mg/L	0.0042	0.0030	A057935	0.025	0.0030	A057935	<0.0030	0.0030	A057935
Total Phosphorus (P)	mg/L	0.014	0.0030	A057863	0.10	0.0030	A057863	<0.0030	0.0030	A057863
Total Total Kjeldahl Nitrogen	mg/L	0.31	0.050	A057470	1.9	0.050	A057470	0.22	0.050	A056929
Dissolved Nitrite (N)	mg/L	<0.010	0.010	A052474	<0.010	0.010	A052474	<0.010	0.010	A052474
Dissolved Nitrate plus Nitrite (N)	mg/L	0.16	0.010	A052474	<0.050 (3)	0.050	A052474	0.26	0.010	A052474
Physical Properties										
Turbidity	NTU	7.7	0.10	A052391	11	0.10	A052391	0.59	0.10	A052391
RDL = Reportable Detection Limit										
(1) Sample analyzed past hold time. Sample analysis is recommended within 48 hours of sampling.										
(2) Dissolved Oxygen result high; possibly due to matrix interference.										
Headspace in sample container was noted at the time of extraction										
(3) Detection limits raised due to matrix interference.										



RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		YQ8422	YQ8423			YQ8424		
Sampling Date		2020/10/15 13:47	2020/10/15 14:17			2020/10/15 12:57		
COC Number		622292-01-01	622292-01-01			622292-01-01		
	UNITS	WQ-04B	WQ-05B	RDL	QC Batch	WQ-06	RDL	QC Batch
Calculated Parameters								
Dissolved Nitrate (N)	mg/L	0.23	0.14	0.010	A051519	<0.050	0.050	A051519
Demand Parameters								
Biochemical Oxygen Demand	mg/L	<2.0	2.3	2.0	A052334	<2.0	2.0	A052334
Chemical Oxygen Demand	mg/L	<10	28	10	A057112	12	10	A057112
Misc. Inorganics								
Dissolved Oxygen (O2)	mg/L	11	>15 (1)	0.10	A051334	9.4	0.10	A051334
Total Dissolved Solids	mg/L	460	570	10	A056878	380	10	A056878
Total Suspended Solids	mg/L	2.3	13	1.0	A058802	28	1.0	A058802
Nutrients								
Total Ammonia (N)	mg/L	<0.015	<0.015	0.015	A057426	<0.015	0.015	A055628
Orthophosphate (P)	mg/L	0.0039	0.0033	0.0030	A052415	<0.0030	0.0030	A052414
Dissolved Phosphorus (P)	mg/L	<0.0030	<0.0030	0.0030	A057935	<0.0030	0.0030	A057935
Total Phosphorus (P)	mg/L	0.0043	0.053	0.0030	A057863	0.023	0.0030	A057863
Total Total Kjeldahl Nitrogen	mg/L	0.25	1.2	0.050	A057470	0.50	0.050	A057470
Dissolved Nitrite (N)	mg/L	<0.010	<0.010	0.010	A052474	<0.010	0.010	A052474
Dissolved Nitrate plus Nitrite (N)	mg/L	0.23	0.14	0.010	A052474	<0.050 (2)	0.050	A052474
Physical Properties								
Turbidity	NTU	0.90	2.3	0.10	A052391	4.5	0.10	A052391
RDL = Reportable Detection Limit								
(1) Dissolved Oxygen result high; possibly due to matrix interference.								
(2) Detection limits raised due to matrix interference.								



BV Labs Job #: C075863
Report Date: 2020/10/23

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	3.7°C
Package 2	3.0°C

Results relate only to the items tested.



BV Labs Job #: C075863
Report Date: 2020/10/23

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A051334	JM0	Spiked Blank	Dissolved Oxygen (O2)	2020/10/16		95	%	80 - 120
A051334	JM0	RPD [YQ8419-07]	Dissolved Oxygen (O2)	2020/10/16	2.0		%	20
A051449	JLD	Spiked Blank	Alkalinity (Total as CaCO3)	2020/10/16		100	%	80 - 120
A051449	JLD	Method Blank	Alkalinity (PP as CaCO3)	2020/10/16	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2020/10/16	<1.0		mg/L	
			Bicarbonate (HCO3)	2020/10/16	<1.0		mg/L	
			Carbonate (CO3)	2020/10/16	<1.0		mg/L	
			Hydroxide (OH)	2020/10/16	<1.0		mg/L	
A051449	JLD	RPD	Alkalinity (PP as CaCO3)	2020/10/16	NC		%	20
			Alkalinity (Total as CaCO3)	2020/10/16	1.1		%	20
			Bicarbonate (HCO3)	2020/10/16	1.1		%	20
			Carbonate (CO3)	2020/10/16	NC		%	20
			Hydroxide (OH)	2020/10/16	NC		%	20
A051453	JLD	Spiked Blank	pH	2020/10/16		100	%	97 - 103
A051453	JLD	RPD	pH	2020/10/16	0.67		%	N/A
A051455	JLD	Spiked Blank	Conductivity	2020/10/16		101	%	90 - 110
A051455	JLD	Method Blank	Conductivity	2020/10/16	<2.0		uS/cm	
A051455	JLD	RPD	Conductivity	2020/10/16	0.066		%	10
A051561	JLD	Spiked Blank	Alkalinity (Total as CaCO3)	2020/10/17		100	%	80 - 120
A051561	JLD	Method Blank	Alkalinity (PP as CaCO3)	2020/10/17	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2020/10/17	<1.0		mg/L	
			Bicarbonate (HCO3)	2020/10/17	<1.0		mg/L	
			Carbonate (CO3)	2020/10/17	<1.0		mg/L	
			Hydroxide (OH)	2020/10/17	<1.0		mg/L	
A051561	JLD	RPD [YQ8421-01]	Alkalinity (PP as CaCO3)	2020/10/17	116 (1)		%	20
			Alkalinity (Total as CaCO3)	2020/10/17	0.41		%	20
			Bicarbonate (HCO3)	2020/10/17	2.3		%	20
			Carbonate (CO3)	2020/10/17	128 (1)		%	20
			Hydroxide (OH)	2020/10/17	NC		%	20
A051567	JLD	Spiked Blank	pH	2020/10/17		100	%	97 - 103
A051567	JLD	RPD [YQ8421-01]	pH	2020/10/17	0.73		%	N/A
A051573	JLD	Spiked Blank	Conductivity	2020/10/17		101	%	90 - 110
A051573	JLD	Method Blank	Conductivity	2020/10/17	<2.0		uS/cm	
A051573	JLD	RPD [YQ8421-01]	Conductivity	2020/10/17	0.41		%	10
A052334	SLL	Spiked Blank	Biochemical Oxygen Demand	2020/10/22		90	%	85 - 115
A052334	SLL	Method Blank	Biochemical Oxygen Demand	2020/10/22	<2.0		mg/L	
A052334	SLL	RPD	Biochemical Oxygen Demand	2020/10/22	16		%	20
A052391	NAP	Spiked Blank	Turbidity	2020/10/17		104	%	80 - 120
A052391	NAP	Method Blank	Turbidity	2020/10/17	<0.10		NTU	
A052391	NAP	RPD	Turbidity	2020/10/17	NC		%	20
A052414	CCQ	Matrix Spike	Orthophosphate (P)	2020/10/17		104	%	80 - 120
A052414	CCQ	Spiked Blank	Orthophosphate (P)	2020/10/17		101	%	80 - 120
A052414	CCQ	Method Blank	Orthophosphate (P)	2020/10/17	<0.0030		mg/L	
A052414	CCQ	RPD	Orthophosphate (P)	2020/10/17	6.9		%	20
A052415	CCQ	Matrix Spike [YQ8423-01]	Orthophosphate (P)	2020/10/17		100	%	80 - 120
A052415	CCQ	Spiked Blank	Orthophosphate (P)	2020/10/17		102	%	80 - 120
A052415	CCQ	Method Blank	Orthophosphate (P)	2020/10/17	<0.0030		mg/L	
A052415	CCQ	RPD [YQ8423-01]	Orthophosphate (P)	2020/10/17	8.3		%	20
A052474	IBL	Matrix Spike [YQ8421-01]	Dissolved Nitrite (N)	2020/10/17		110	%	80 - 120
			Dissolved Nitrate plus Nitrite (N)	2020/10/17		113	%	80 - 120
A052474	IBL	Spiked Blank	Dissolved Nitrite (N)	2020/10/17		105	%	80 - 120
			Dissolved Nitrate plus Nitrite (N)	2020/10/17		97	%	80 - 120
A052474	IBL	Method Blank	Dissolved Nitrite (N)	2020/10/17	<0.010		mg/L	
			Dissolved Nitrate plus Nitrite (N)	2020/10/17	<0.010		mg/L	
A052474	IBL	RPD [YQ8421-01]	Dissolved Nitrite (N)	2020/10/17	NC		%	20



QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Nitrate plus Nitrite (N)	2020/10/17	5.0		%	20
A052780	SLL	Spiked Blank	Biochemical Oxygen Demand	2020/10/22		91	%	85 - 115
A052780	SLL	Method Blank	Biochemical Oxygen Demand	2020/10/22	<2.0		mg/L	
A052780	SLL	RPD [YQ8421-02]	Biochemical Oxygen Demand	2020/10/22	NC		%	20
A054167	ANE	Matrix Spike	Dissolved Aluminum (Al)	2020/10/19		110	%	80 - 120
			Dissolved Antimony (Sb)	2020/10/19		107	%	80 - 120
			Dissolved Arsenic (As)	2020/10/19		108	%	80 - 120
			Dissolved Beryllium (Be)	2020/10/19		105	%	80 - 120
			Dissolved Chromium (Cr)	2020/10/19		103	%	80 - 120
			Dissolved Cobalt (Co)	2020/10/19		103	%	80 - 120
			Dissolved Copper (Cu)	2020/10/19		102	%	80 - 120
			Dissolved Lead (Pb)	2020/10/19		99	%	80 - 120
			Dissolved Molybdenum (Mo)	2020/10/19		111	%	80 - 120
			Dissolved Nickel (Ni)	2020/10/19		106	%	80 - 120
			Dissolved Selenium (Se)	2020/10/19		116	%	80 - 120
			Dissolved Silver (Ag)	2020/10/19		107	%	80 - 120
			Dissolved Thallium (Tl)	2020/10/19		101	%	80 - 120
			Dissolved Tin (Sn)	2020/10/19		111	%	80 - 120
			Dissolved Titanium (Ti)	2020/10/19		104	%	80 - 120
			Dissolved Uranium (U)	2020/10/19		103	%	80 - 120
			Dissolved Vanadium (V)	2020/10/19		106	%	80 - 120
			Dissolved Zinc (Zn)	2020/10/19		106	%	80 - 120
A054167	ANE	Spiked Blank	Dissolved Aluminum (Al)	2020/10/19		123 (1)	%	80 - 120
			Dissolved Antimony (Sb)	2020/10/19		101	%	80 - 120
			Dissolved Arsenic (As)	2020/10/19		103	%	80 - 120
			Dissolved Beryllium (Be)	2020/10/19		106	%	80 - 120
			Dissolved Chromium (Cr)	2020/10/19		98	%	80 - 120
			Dissolved Cobalt (Co)	2020/10/19		100	%	80 - 120
			Dissolved Copper (Cu)	2020/10/19		103	%	80 - 120
			Dissolved Lead (Pb)	2020/10/19		101	%	80 - 120
			Dissolved Molybdenum (Mo)	2020/10/19		104	%	80 - 120
			Dissolved Nickel (Ni)	2020/10/19		100	%	80 - 120
			Dissolved Selenium (Se)	2020/10/19		111	%	80 - 120
			Dissolved Silver (Ag)	2020/10/19		105	%	80 - 120
			Dissolved Thallium (Tl)	2020/10/19		102	%	80 - 120
			Dissolved Tin (Sn)	2020/10/19		105	%	80 - 120
			Dissolved Titanium (Ti)	2020/10/19		95	%	80 - 120
			Dissolved Uranium (U)	2020/10/19		101	%	80 - 120
			Dissolved Vanadium (V)	2020/10/19		101	%	80 - 120
			Dissolved Zinc (Zn)	2020/10/19		108	%	80 - 120
A054167	ANE	Method Blank	Dissolved Aluminum (Al)	2020/10/19	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2020/10/19	<0.00060		mg/L	
			Dissolved Arsenic (As)	2020/10/19	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2020/10/19	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2020/10/19	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2020/10/19	<0.00030		mg/L	
			Dissolved Copper (Cu)	2020/10/19	<0.00020		mg/L	
			Dissolved Lead (Pb)	2020/10/19	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2020/10/19	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2020/10/19	<0.00050		mg/L	
			Dissolved Selenium (Se)	2020/10/19	<0.00020		mg/L	
			Dissolved Silver (Ag)	2020/10/19	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2020/10/19	<0.00020		mg/L	
			Dissolved Tin (Sn)	2020/10/19	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2020/10/19	<0.0010		mg/L	



BV Labs Job #: C075863
Report Date: 2020/10/23

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A054167	ANE	RPD	Dissolved Uranium (U)	2020/10/19	<0.00010		mg/L	
			Dissolved Vanadium (V)	2020/10/19	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2020/10/19	<0.0030		mg/L	
			Dissolved Aluminum (Al)	2020/10/19	NC		%	20
			Dissolved Antimony (Sb)	2020/10/19	NC		%	20
			Dissolved Arsenic (As)	2020/10/19	NC		%	20
			Dissolved Beryllium (Be)	2020/10/19	NC		%	20
			Dissolved Chromium (Cr)	2020/10/19	NC		%	20
			Dissolved Cobalt (Co)	2020/10/19	NC		%	20
			Dissolved Copper (Cu)	2020/10/19	19		%	20
			Dissolved Lead (Pb)	2020/10/19	NC		%	20
			Dissolved Molybdenum (Mo)	2020/10/19	17		%	20
			Dissolved Nickel (Ni)	2020/10/19	8.8		%	20
			Dissolved Selenium (Se)	2020/10/19	NC		%	20
			Dissolved Silver (Ag)	2020/10/19	NC		%	20
			Dissolved Thallium (Tl)	2020/10/19	NC		%	20
			Dissolved Tin (Sn)	2020/10/19	NC		%	20
			Dissolved Titanium (Ti)	2020/10/19	NC		%	20
			Dissolved Uranium (U)	2020/10/19	2.6		%	20
			Dissolved Vanadium (V)	2020/10/19	NC		%	20
A054869	MAP	Matrix Spike	Dissolved Zinc (Zn)	2020/10/19	NC		%	20
			Dissolved Barium (Ba)	2020/10/19		83	%	80 - 120
			Dissolved Boron (B)	2020/10/19		NC	%	80 - 120
			Dissolved Calcium (Ca)	2020/10/19		84	%	80 - 120
			Dissolved Iron (Fe)	2020/10/19		87	%	80 - 120
			Dissolved Lithium (Li)	2020/10/19		83	%	80 - 120
			Dissolved Magnesium (Mg)	2020/10/19		70 (2)	%	80 - 120
			Dissolved Manganese (Mn)	2020/10/19		81	%	80 - 120
			Dissolved Phosphorus (P)	2020/10/19		102	%	80 - 120
			Dissolved Potassium (K)	2020/10/19		80	%	80 - 120
			Dissolved Silicon (Si)	2020/10/19		80	%	80 - 120
			Dissolved Sodium (Na)	2020/10/19		NC	%	80 - 120
			Dissolved Strontium (Sr)	2020/10/19		83	%	80 - 120
			Dissolved Sulphur (S)	2020/10/19		73 (1)	%	80 - 120
A054869	MAP	Spiked Blank	Dissolved Barium (Ba)	2020/10/19		94	%	80 - 120
			Dissolved Boron (B)	2020/10/19		95	%	80 - 120
			Dissolved Calcium (Ca)	2020/10/19		98	%	80 - 120
			Dissolved Iron (Fe)	2020/10/19		98	%	80 - 120
			Dissolved Lithium (Li)	2020/10/19		95	%	80 - 120
			Dissolved Magnesium (Mg)	2020/10/19		97	%	80 - 120
			Dissolved Manganese (Mn)	2020/10/19		94	%	80 - 120
			Dissolved Phosphorus (P)	2020/10/19		96	%	80 - 120
			Dissolved Potassium (K)	2020/10/19		94	%	80 - 120
			Dissolved Silicon (Si)	2020/10/19		97	%	80 - 120
			Dissolved Sodium (Na)	2020/10/19		94	%	80 - 120
			Dissolved Strontium (Sr)	2020/10/19		95	%	80 - 120
A054869	MAP	Method Blank	Dissolved Sulphur (S)	2020/10/19		94	%	80 - 120
			Dissolved Barium (Ba)	2020/10/19	<0.010		mg/L	
			Dissolved Boron (B)	2020/10/19	<0.020		mg/L	
			Dissolved Calcium (Ca)	2020/10/19	<0.30		mg/L	
			Dissolved Iron (Fe)	2020/10/19	<0.060		mg/L	
			Dissolved Lithium (Li)	2020/10/19	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2020/10/19	<0.20		mg/L	
			Dissolved Manganese (Mn)	2020/10/19	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2020/10/19	<0.10		mg/L	



QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A054869	MAP	RPD	Dissolved Potassium (K)	2020/10/19	<0.30		mg/L	
			Dissolved Silicon (Si)	2020/10/19	<0.10		mg/L	
			Dissolved Sodium (Na)	2020/10/19	<0.50		mg/L	
			Dissolved Strontium (Sr)	2020/10/19	<0.020		mg/L	
			Dissolved Sulphur (S)	2020/10/19	<0.20		mg/L	
			Dissolved Barium (Ba)	2020/10/20	4.7		%	20
			Dissolved Boron (B)	2020/10/20	2.1		%	20
			Dissolved Calcium (Ca)	2020/10/20	11		%	20
			Dissolved Iron (Fe)	2020/10/20	2.0		%	20
			Dissolved Lithium (Li)	2020/10/20	5.8		%	20
			Dissolved Magnesium (Mg)	2020/10/20	19		%	20
			Dissolved Manganese (Mn)	2020/10/20	8.1		%	20
			Dissolved Phosphorus (P)	2020/10/20	18		%	20
			Dissolved Potassium (K)	2020/10/20	9.3		%	20
			Dissolved Silicon (Si)	2020/10/20	10		%	20
			Dissolved Sodium (Na)	2020/10/20	2.3		%	20
			Dissolved Strontium (Sr)	2020/10/20	4.6		%	20
			Dissolved Sulphur (S)	2020/10/20	11		%	20
A055628	BFE	Matrix Spike [YQ8424-06]	Total Ammonia (N)	2020/10/20		106	%	80 - 120
A055628	BFE	Spiked Blank	Total Ammonia (N)	2020/10/20		100	%	80 - 120
A055628	BFE	Method Blank	Total Ammonia (N)	2020/10/20	<0.015		mg/L	
A055628	BFE	RPD [YQ8424-06]	Total Ammonia (N)	2020/10/20	NC		%	20
A056878	MLZ	Matrix Spike	Total Dissolved Solids	2020/10/21		NC	%	80 - 120
A056878	MLZ	Spiked Blank	Total Dissolved Solids	2020/10/21		99	%	80 - 120
A056878	MLZ	Method Blank	Total Dissolved Solids	2020/10/21	<10		mg/L	
A056878	MLZ	RPD	Total Dissolved Solids	2020/10/21	0.69		%	20
A056929	FM0	Matrix Spike	Total Total Kjeldahl Nitrogen	2020/10/22		105	%	80 - 120
A056929	FM0	QC Standard	Total Total Kjeldahl Nitrogen	2020/10/22		98	%	80 - 120
A056929	FM0	Spiked Blank	Total Total Kjeldahl Nitrogen	2020/10/22		103	%	80 - 120
A056929	FM0	Method Blank	Total Total Kjeldahl Nitrogen	2020/10/22	<0.050		mg/L	
A056929	FM0	RPD	Total Total Kjeldahl Nitrogen	2020/10/22	1.3		%	20
A057112	PK8	Matrix Spike	Chemical Oxygen Demand	2020/10/21		102	%	80 - 120
A057112	PK8	Spiked Blank	Chemical Oxygen Demand	2020/10/21		102	%	80 - 120
A057112	PK8	Method Blank	Chemical Oxygen Demand	2020/10/21	<10		mg/L	
A057112	PK8	RPD	Chemical Oxygen Demand	2020/10/21	6.9		%	20
A057426	BFE	Matrix Spike	Total Ammonia (N)	2020/10/21		107	%	80 - 120
A057426	BFE	Spiked Blank	Total Ammonia (N)	2020/10/21		102	%	80 - 120
A057426	BFE	Method Blank	Total Ammonia (N)	2020/10/21	<0.015		mg/L	
A057426	BFE	RPD	Total Ammonia (N)	2020/10/21	NC		%	20
A057470	FM0	Matrix Spike	Total Total Kjeldahl Nitrogen	2020/10/22		NC	%	80 - 120
A057470	FM0	QC Standard	Total Total Kjeldahl Nitrogen	2020/10/22		98	%	80 - 120
A057470	FM0	Spiked Blank	Total Total Kjeldahl Nitrogen	2020/10/22		103	%	80 - 120
A057470	FM0	Method Blank	Total Total Kjeldahl Nitrogen	2020/10/22	<0.050		mg/L	
A057470	FM0	RPD	Total Total Kjeldahl Nitrogen	2020/10/22	57 (1)		%	20
A057484	BFE	Matrix Spike [YQ8421-06]	Total Ammonia (N)	2020/10/21		107	%	80 - 120
A057484	BFE	Spiked Blank	Total Ammonia (N)	2020/10/21		101	%	80 - 120
A057484	BFE	Method Blank	Total Ammonia (N)	2020/10/21	<0.015		mg/L	
A057484	BFE	RPD [YQ8421-06]	Total Ammonia (N)	2020/10/21	NC		%	20
A057649	STI	Matrix Spike	Dissolved Chloride (Cl)	2020/10/21		127 (1)	%	80 - 120
A057649	STI	Spiked Blank	Dissolved Sulphate (SO4)	2020/10/21		102	%	80 - 120
			Dissolved Chloride (Cl)	2020/10/21		99	%	80 - 120
			Dissolved Sulphate (SO4)	2020/10/21		102	%	80 - 120
A057649	STI	Method Blank	Dissolved Chloride (Cl)	2020/10/21	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2020/10/21	<1.0		mg/L	
A057649	STI	RPD	Dissolved Chloride (Cl)	2020/10/21	NC		%	20



QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Sulphate (SO ₄)	2020/10/21	NC		%	20
A057863	FM0	Matrix Spike	Total Phosphorus (P)	2020/10/22		108	%	80 - 120
A057863	FM0	QC Standard	Total Phosphorus (P)	2020/10/22		103	%	80 - 120
A057863	FM0	Spiked Blank	Total Phosphorus (P)	2020/10/22		108	%	80 - 120
A057863	FM0	Method Blank	Total Phosphorus (P)	2020/10/22	<0.0030		mg/L	
A057935	FM0	Matrix Spike [YQ8422-04]	Dissolved Phosphorus (P)	2020/10/22		110	%	80 - 120
A057935	FM0	QC Standard	Dissolved Phosphorus (P)	2020/10/22		105	%	80 - 120
A057935	FM0	Spiked Blank	Dissolved Phosphorus (P)	2020/10/22		112	%	80 - 120
A057935	FM0	Method Blank	Dissolved Phosphorus (P)	2020/10/22	<0.0030		mg/L	
A057935	FM0	RPD [YQ8422-04]	Dissolved Phosphorus (P)	2020/10/22	NC		%	20
A058800	AP1	Matrix Spike	Total Suspended Solids	2020/10/22		109	%	80 - 120
A058800	AP1	Spiked Blank	Total Suspended Solids	2020/10/22		101	%	80 - 120
A058800	AP1	Method Blank	Total Suspended Solids	2020/10/22	<1.0		mg/L	
A058800	AP1	RPD	Total Suspended Solids	2020/10/22	5.3		%	20
A058802	AP1	Matrix Spike	Total Suspended Solids	2020/10/22		103	%	80 - 120
A058802	AP1	Spiked Blank	Total Suspended Solids	2020/10/22		94	%	80 - 120
A058802	AP1	Method Blank	Total Suspended Solids	2020/10/22	<1.0		mg/L	
A058802	AP1	RPD	Total Suspended Solids	2020/10/22	2.2		%	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference $\leq 2 \times$ RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(2) Matrix spike exceeds acceptance limits due to probable matrix interference.



BV Labs Job #: C075863
Report Date: 2020/10/23

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

Maria Magdalena Florescu, Ph.D., P.Chem., QP, Inorganics Manager

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



Bureau Veritas Laboratories
4000 19th N.E., Calgary, Alberta Canada T2E 6P8 Tel:(403) 291-3077 Toll-free: 800-553-6266 Fax:(403) 291-9468 www.bvlabs.com

0801

CHAIN OF CUSTODY RECORD

Page 01

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name:	#10658 HEMMERA ENVIROCHEM INC.	Company Name:	Hemmera Environmental	Quotation #:	B61187	BV Labs Job #:	Bottle Order #:
Attention:	Accounts Payable	Attention:	Jessica Eaton	P.O. #:			
Address:	SUITE 804, 322-11TH AVENUE SW CALGARY AB T2R 0C5	Address:		Project:	102604-01		
Tel:	(403) 264-0671	Tel:	403 264 4377	Project Name:	SWCRR	COC #:	622252
Email:	accounts-payable@hemmera.com	Email:	jessica.eaton@hemmera.com	Site #:			
				Sampled by:			

Regulatory Criteria:	Special Instructions	ANALYSIS REQUESTED (PLEASE BE SPECIFIC)										Turnaround Time (TAT) Required:	
☐ ATI												Please provide advance notice for rush projects	
☐ CCME												Regular (Standard) TAT:	
☐ Other:												(will be applied if Rush TAT is not specified)	

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS															Job Specific Rush TAT (If applies to entire submission)			
															Date Required: _____			
															Rush Confirmation Number: _____			
															(call lab for #)			
															Comments			
1	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered	Routine Water & Diss. Regulated Metals	Orthophosphate by Konelab	Total Suspended Solids (NFR)	Total Dissolved Solids (Filt. Residue)	Turbidity	Total Kjeldahl Nitrogen	Total Phosphorus	Chemical Oxygen Demand	Phosphorus-P (Total, Dissolved)	Biochemical Oxygen Demand	# of Bottles	
		WQ-01	20/10/15	-	W													
2		WQ-02	20/10/15	12:21	W	Y	X	X	X	X	X	X	X	X	X	X	X	Site Dry - Sample not collected
3		WQ-03	20/10/15	11:30	W	Y	X	X	X	X	X	X	X	X	X	X	X	Please call if any hits
4		WQ-04a	20/10/15	16:17	W	Y	X	X	X	X	X	X	X	X	X	X	X	Please call if any hits
5		WQ-04b	20/10/15	13:47	W	Y	X	X	X	X	X	X	X	X	X	X	X	Please call if any hits
6		WQ-05a	20/10/15	-	W													Please call if any hits
7		WQ-05b	20/10/15	14:17	W	Y	X	X	X	X	X	X	X	X	X	X	X	Site Dry - Sample not collected
8		WQ-06	20/10/15	12:57	W	Y	X	X	X	X	X	X	X	X	X	X	X	Please call if any hits
9		WQ-07	20/10/15	-	W													Please call if any hits
10			20/10/15		W													Site Dry - Sample not collected

* RELINQUISHED BY: (Signature/Print)		Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)		Date: (YY/MM/DD)	Time	# Jars used and not submitted	Laboratory Use Only		
Jessica Eaton		20/10/15		Laurin Teghtsoonian		20/10/15	18:25		Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
									☐	See ACTR	☐ Yes ☒ No

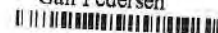
* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT. FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER.

15-Oct-20 18:25

Gail Pedersen



C075863

Bureau Veritas Canada (2019) Inc.

DKR INS-0174



Your Project #: 102604-01
Your C.O.C. #: 626139-01-01

Attention: Jessica Eaton

HEMMERA ENVIROCHEM INC.
SUITE 804, 322-11TH AVENUE SW
CALGARY, AB
CANADA T2R 0C5

Report Date: 2020/12/06

Report #: R2963686

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C087687

Received: 2020/11/27, 14:40

Sample Matrix: Water
Samples Received: 5

Analyses	Date		Laboratory Method	Analytical Method
	Quantity	Extracted	Analyzed	
Cadmium - low level CCME - Dissolved	5	N/A	2020/12/02	Auto Calc
Mercury (Dissolved) by CV	5	2020/12/04	2020/12/04 AB SOP-00084	BCMOE BCLM Oct2013 m
Elements by ICP - Dissolved (1)	5	N/A	2020/12/01 AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (1)	5	N/A	2020/12/02 AB SOP-00043	EPA 6020b R2 m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.



Your Project #: 102604-01
Your C.O.C. #: 626139-01-01

Attention: Jessica Eaton

HEMMERA ENVIROCHEM INC.
SUITE 804, 322-11TH AVENUE SW
CALGARY, AB
CANADA T2R 0C5

Report Date: 2020/12/06

Report #: R2963686

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C087687

Received: 2020/11/27, 14:40

Encryption Key



Bureau Veritas Laboratories

06 Dec 2020 12:36:43

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Gail Pedersen, Key Account Specialist

Email: Gail.Pedersen@bvlabs.com

Phone# (403) 291-3077

=====

This report has been generated and distributed using a secure automated process.

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



REGULATED METALS (CCME/AT1) - DISSOLVED

BV Labs ID		YY1397	YY1398	YY1399	YY1400	YY1401		
Sampling Date		2020/11/27 09:40	2020/11/27 10:20	2020/11/27 11:03	2020/11/27 11:20	2020/11/27 11:45		
COC Number		626139-01-01	626139-01-01	626139-01-01	626139-01-01	626139-01-01		
	UNITS	WQ-03	WQ-06	WQ-04C	WQ-04D	WQ-04B	RDL	QC Batch

Low Level Elements								
Dissolved Cadmium (Cd)	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	0.000020	A100247
Elements								
Dissolved Aluminum (Al)	mg/L	<0.0030	0.036 (1)	<0.0030	<0.0030	<0.0030	0.0030	A101515
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	0.00060	A101515
Dissolved Arsenic (As)	mg/L	0.0048	0.0017	0.00026	0.00034	0.00028	0.00020	A101515
Dissolved Barium (Ba)	mg/L	0.29	0.19	0.075	0.074	0.068	0.010	A100892
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	A101515
Dissolved Boron (B)	mg/L	0.051	0.051	0.043	0.044	0.047	0.020	A100892
Dissolved Calcium (Ca)	mg/L	96	95	74	75	73	0.30	A100892
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	A101515
Dissolved Cobalt (Co)	mg/L	0.00052	0.00035	<0.00030	<0.00030	<0.00030	0.00030	A101515
Dissolved Copper (Cu)	mg/L	0.0017	0.00089	0.00059	0.0018	0.0017	0.00020	A101515
Dissolved Iron (Fe)	mg/L	5.8	0.49	<0.060	<0.060	<0.060	0.060	A100892
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	A101515
Dissolved Lithium (Li)	mg/L	<0.020	0.022	0.022	<0.020	<0.020	0.020	A100892
Dissolved Magnesium (Mg)	mg/L	63	66	46	45	43	0.20	A100892
Dissolved Manganese (Mn)	mg/L	0.49	0.28	0.0068	0.013	0.015	0.0040	A100892
Dissolved Molybdenum (Mo)	mg/L	0.0021	0.0014	0.0021	0.0022	0.0022	0.00020	A101515
Dissolved Nickel (Ni)	mg/L	0.0015	0.00098	<0.00050	<0.00050	<0.00050	0.00050	A101515
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	A100892
Dissolved Potassium (K)	mg/L	9.2	6.6	4.1	4.1	4.2	0.30	A100892
Dissolved Selenium (Se)	mg/L	0.00022	0.00056	0.0018	0.0019	0.0020	0.00020	A101515
Dissolved Silicon (Si)	mg/L	5.2	5.5	4.5	4.5	4.6	0.10	A100892
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	A101515
Dissolved Sodium (Na)	mg/L	50	62	43	43	43	0.50	A100892
Dissolved Strontium (Sr)	mg/L	0.82	0.98	0.72	0.72	0.71	0.020	A100892
Dissolved Sulphur (S)	mg/L	20	23	19	19	19	0.20	A100892
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	A101515
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	A101515
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	A101515
Dissolved Uranium (U)	mg/L	0.0039	0.0032	0.0040	0.0037	0.0034	0.00010	A101515
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	A101515

RDL = Reportable Detection Limit

(1) Duplicate exceeds acceptance criteria due to sample non homogeneity. Reanalysis yields similar results.



BV Labs Job #: C087687
Report Date: 2020/12/06

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

REGULATED METALS (CCME/AT1) - DISSOLVED

BV Labs ID		YY1397	YY1398	YY1399	YY1400	YY1401		
Sampling Date		2020/11/27 09:40	2020/11/27 10:20	2020/11/27 11:03	2020/11/27 11:20	2020/11/27 11:45		
COC Number		626139-01-01	626139-01-01	626139-01-01	626139-01-01	626139-01-01		
	UNITS	WQ-03	WQ-06	WQ-04C	WQ-04D	WQ-04B	RDL	QC Batch
Dissolved Zinc (Zn)	mg/L	0.0065	0.0039	0.033	0.058	0.078	0.0030	A101515
RDL = Reportable Detection Limit								



BV Labs Job #: C087687
Report Date: 2020/12/06

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

MERCURY BY COLD VAPOR (WATER)

BV Labs ID		YY1397	YY1398	YY1399	YY1400	YY1401		
Sampling Date		2020/11/27 09:40	2020/11/27 10:20	2020/11/27 11:03	2020/11/27 11:20	2020/11/27 11:45		
COC Number		626139-01-01	626139-01-01	626139-01-01	626139-01-01	626139-01-01		
	UNITS	WQ-03	WQ-06	WQ-04C	WQ-04D	WQ-04B	RDL	QC Batch
Elements								
Dissolved Mercury (Hg)	ug/L	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	0.0019	A104066
RDL = Reportable Detection Limit								



BV Labs Job #: C087687
Report Date: 2020/12/06

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	3.3°C
-----------	-------

Results relate only to the items tested.



BV Labs Job #: C087687
Report Date: 2020/12/06

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A100892	MAP	Matrix Spike	Dissolved Barium (Ba)	2020/12/01		92	%	80 - 120
			Dissolved Boron (B)	2020/12/01		94	%	80 - 120
			Dissolved Calcium (Ca)	2020/12/01		NC	%	80 - 120
			Dissolved Iron (Fe)	2020/12/01		105	%	80 - 120
			Dissolved Lithium (Li)	2020/12/01		96	%	80 - 120
			Dissolved Magnesium (Mg)	2020/12/01		NC	%	80 - 120
			Dissolved Manganese (Mn)	2020/12/01		98	%	80 - 120
			Dissolved Phosphorus (P)	2020/12/01		98	%	80 - 120
			Dissolved Potassium (K)	2020/12/01		98	%	80 - 120
			Dissolved Silicon (Si)	2020/12/01		90	%	80 - 120
			Dissolved Sodium (Na)	2020/12/01		NC	%	80 - 120
			Dissolved Strontium (Sr)	2020/12/01		88	%	80 - 120
			Dissolved Sulphur (S)	2020/12/01		NC	%	80 - 120
			Dissolved Barium (Ba)	2020/12/01		100	%	80 - 120
A100892	MAP	Spiked Blank	Dissolved Boron (B)	2020/12/01		99	%	80 - 120
			Dissolved Calcium (Ca)	2020/12/01		102	%	80 - 120
			Dissolved Iron (Fe)	2020/12/01		110	%	80 - 120
			Dissolved Lithium (Li)	2020/12/01		98	%	80 - 120
			Dissolved Magnesium (Mg)	2020/12/01		98	%	80 - 120
			Dissolved Manganese (Mn)	2020/12/01		98	%	80 - 120
			Dissolved Phosphorus (P)	2020/12/01		97	%	80 - 120
			Dissolved Potassium (K)	2020/12/01		100	%	80 - 120
			Dissolved Silicon (Si)	2020/12/01		96	%	80 - 120
			Dissolved Sodium (Na)	2020/12/01		99	%	80 - 120
			Dissolved Strontium (Sr)	2020/12/01		97	%	80 - 120
			Dissolved Sulphur (S)	2020/12/01		96	%	80 - 120
A100892	MAP	Method Blank	Dissolved Barium (Ba)	2020/12/02	<0.010		mg/L	
			Dissolved Boron (B)	2020/12/02	<0.020		mg/L	
			Dissolved Calcium (Ca)	2020/12/02	<0.30		mg/L	
			Dissolved Iron (Fe)	2020/12/02	<0.060		mg/L	
			Dissolved Lithium (Li)	2020/12/02	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2020/12/02	<0.20		mg/L	
			Dissolved Manganese (Mn)	2020/12/02	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2020/12/02	<0.10		mg/L	
			Dissolved Potassium (K)	2020/12/02	<0.30		mg/L	
			Dissolved Silicon (Si)	2020/12/02	<0.10		mg/L	
			Dissolved Sodium (Na)	2020/12/02	<0.50		mg/L	
			Dissolved Strontium (Sr)	2020/12/02	<0.020		mg/L	
			Dissolved Sulphur (S)	2020/12/02	<0.20		mg/L	
A100892	MAP	RPD	Dissolved Calcium (Ca)	2020/12/02	0.54		%	20
			Dissolved Magnesium (Mg)	2020/12/02	0.50		%	20
			Dissolved Potassium (K)	2020/12/02	0.22		%	20
			Dissolved Sodium (Na)	2020/12/02	0.032		%	20
A101515	KH2	Matrix Spike [YY1398-01]	Dissolved Aluminum (Al)	2020/12/02		116	%	80 - 120
			Dissolved Antimony (Sb)	2020/12/02		91	%	80 - 120
			Dissolved Arsenic (As)	2020/12/02		100	%	80 - 120
			Dissolved Beryllium (Be)	2020/12/02		106	%	80 - 120
			Dissolved Chromium (Cr)	2020/12/02		99	%	80 - 120
			Dissolved Cobalt (Co)	2020/12/02		97	%	80 - 120
			Dissolved Copper (Cu)	2020/12/02		95	%	80 - 120
			Dissolved Lead (Pb)	2020/12/02		87	%	80 - 120
			Dissolved Molybdenum (Mo)	2020/12/02		103	%	80 - 120
			Dissolved Nickel (Ni)	2020/12/02		96	%	80 - 120
			Dissolved Selenium (Se)	2020/12/02		101	%	80 - 120
			Dissolved Silver (Ag)	2020/12/02		96	%	80 - 120



BV Labs Job #: C087687
Report Date: 2020/12/06

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A101515	KH2	Spiked Blank	Dissolved Thallium (Tl)	2020/12/02		88	%	80 - 120
			Dissolved Tin (Sn)	2020/12/02		89	%	80 - 120
			Dissolved Titanium (Ti)	2020/12/02		96	%	80 - 120
			Dissolved Uranium (U)	2020/12/02		89	%	80 - 120
			Dissolved Vanadium (V)	2020/12/02		102	%	80 - 120
			Dissolved Zinc (Zn)	2020/12/02		96	%	80 - 120
			Dissolved Aluminum (Al)	2020/12/02		103	%	80 - 120
			Dissolved Antimony (Sb)	2020/12/02		95	%	80 - 120
			Dissolved Arsenic (As)	2020/12/02		105	%	80 - 120
			Dissolved Beryllium (Be)	2020/12/02		105	%	80 - 120
			Dissolved Chromium (Cr)	2020/12/02		105	%	80 - 120
			Dissolved Cobalt (Co)	2020/12/02		104	%	80 - 120
			Dissolved Copper (Cu)	2020/12/02		104	%	80 - 120
			Dissolved Lead (Pb)	2020/12/02		95	%	80 - 120
			Dissolved Molybdenum (Mo)	2020/12/02		101	%	80 - 120
			Dissolved Nickel (Ni)	2020/12/02		106	%	80 - 120
			Dissolved Selenium (Se)	2020/12/02		105	%	80 - 120
			Dissolved Silver (Ag)	2020/12/02		98	%	80 - 120
			Dissolved Thallium (Tl)	2020/12/02		95	%	80 - 120
			Dissolved Tin (Sn)	2020/12/02		93	%	80 - 120
A101515	KH2	Method Blank	Dissolved Titanium (Ti)	2020/12/02		105	%	80 - 120
			Dissolved Uranium (U)	2020/12/02		93	%	80 - 120
			Dissolved Vanadium (V)	2020/12/02		107	%	80 - 120
			Dissolved Zinc (Zn)	2020/12/02		101	%	80 - 120
			Dissolved Aluminum (Al)	2020/12/02	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2020/12/02	<0.00060		mg/L	
			Dissolved Arsenic (As)	2020/12/02	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2020/12/02	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2020/12/02	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2020/12/02	<0.00030		mg/L	
			Dissolved Copper (Cu)	2020/12/02	<0.00020		mg/L	
			Dissolved Lead (Pb)	2020/12/02	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2020/12/02	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2020/12/02	<0.00050		mg/L	
			Dissolved Selenium (Se)	2020/12/02	<0.00020		mg/L	
			Dissolved Silver (Ag)	2020/12/02	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2020/12/02	<0.00020		mg/L	
			Dissolved Tin (Sn)	2020/12/02	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2020/12/02	<0.0010		mg/L	
			Dissolved Uranium (U)	2020/12/02	<0.00010		mg/L	
A101515	KH2	RPD [YY1398-01]	Dissolved Vanadium (V)	2020/12/02	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2020/12/02	<0.0030		mg/L	
			Dissolved Aluminum (Al)	2020/12/02	21 (1)		%	20
			Dissolved Antimony (Sb)	2020/12/02	NC		%	20
			Dissolved Arsenic (As)	2020/12/02	8.7		%	20
			Dissolved Beryllium (Be)	2020/12/02	NC		%	20
			Dissolved Chromium (Cr)	2020/12/02	NC		%	20
			Dissolved Cobalt (Co)	2020/12/02	9.4		%	20
			Dissolved Copper (Cu)	2020/12/02	7.3		%	20
			Dissolved Lead (Pb)	2020/12/02	NC		%	20
			Dissolved Molybdenum (Mo)	2020/12/02	3.9		%	20
			Dissolved Nickel (Ni)	2020/12/02	13		%	20
			Dissolved Selenium (Se)	2020/12/02	0		%	20
			Dissolved Silver (Ag)	2020/12/02	NC		%	20
			Dissolved Thallium (Tl)	2020/12/02	NC		%	20



QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Tin (Sn)	2020/12/02	NC		%	20
			Dissolved Titanium (Ti)	2020/12/02	NC		%	20
			Dissolved Uranium (U)	2020/12/02	0.28		%	20
			Dissolved Vanadium (V)	2020/12/02	NC		%	20
			Dissolved Zinc (Zn)	2020/12/02	1.7		%	20
A104066	RK3	Matrix Spike	Dissolved Mercury (Hg)	2020/12/04		98	%	80 - 120
A104066	RK3	Spiked Blank	Dissolved Mercury (Hg)	2020/12/04		104	%	80 - 120
A104066	RK3	Method Blank	Dissolved Mercury (Hg)	2020/12/04	<0.0019		ug/L	
A104066	RK3	RPD	Dissolved Mercury (Hg)	2020/12/04	NC		%	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference $\leq 2 \times \text{RDL}$).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.



BV Labs Job #: C087687
Report Date: 2020/12/06

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

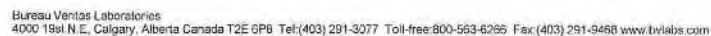
VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

A handwritten signature in black ink, appearing to be "Sandy (Wei) Yuan", written over a horizontal line.

Sandy (Wei) Yuan, M.Sc., QP, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



Page of

INVOICE TO: Company Name: #10658 HEMMERA ENVIROCHEM INC. Attention: Accounts Payable Address: SUITE 804, 322-11TH AVENUE SW CALGARY AB T2R 0C5 Tel: (403) 264-0671 Fax: _____ Email: procure2pay.hemmera@ausenco.com		REPORT TO: Company Name: _____ Attention: Jessica Eaton Address: _____ Tel: (403) 200 4377 Fax: _____ Email: jessica.eaton@hemmera.com		PROJECT INFORMATION: Quotation #: B61187 P.O. #: _____ Project: 102604-01 Project Name: _____ Site #: _____ Sampled By: _____		Laboratory Use Only: BV Labs Job #: _____ Bottle Order #:  C626139 COC #: _____  C626139-01-01 Project Manager: Gail Pedersen																																																																																																																																																																																																						
Regulatory Criteria: ☐ ATI ☐ CCME ☐ Other		Special Instructions 		ANALYSIS REQUESTED (PLEASE BE SPECIFIC) Metals Field Filtered ? (Y/N) <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:10%;"></td> <td style="width:10%;">Hg (total)</td> <td style="width:10%;">Hg (Dissolved)</td> <td style="width:10%;">Metals (total)</td> <td style="width:10%;">Metals (Dissolved)</td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> <td style="width:10%;"></td> </tr> <tr> <td>1</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>2</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>3</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>4</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>5</td> <td>X</td> <td>X</td> <td>X</td> <td>X</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>6</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>7</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>8</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>9</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>10</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>			Hg (total)	Hg (Dissolved)	Metals (total)	Metals (Dissolved)													1	X	X	X	X														2	X	X	X	X														3	X	X	X	X														4	X	X	X	X														5	X	X	X	X														6																		7																		8																		9																		10																		Turnaround Time (TAT) Required: Please provide advance notice for rush projects Regular (Standard) TAT: (will be applied if Rush TAT is not specified) Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details Job Specific Rush TAT (if applies to entire submission) Date Required: _____ Rush Confirmation Number: _____ (call lab for #)	
	Hg (total)	Hg (Dissolved)	Metals (total)	Metals (Dissolved)																																																																																																																																																																																																								
1	X	X	X	X																																																																																																																																																																																																								
2	X	X	X	X																																																																																																																																																																																																								
3	X	X	X	X																																																																																																																																																																																																								
4	X	X	X	X																																																																																																																																																																																																								
5	X	X	X	X																																																																																																																																																																																																								
6																																																																																																																																																																																																												
7																																																																																																																																																																																																												
8																																																																																																																																																																																																												
9																																																																																																																																																																																																												
10																																																																																																																																																																																																												
SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS										# of Bottles		Comments																																																																																																																																																																																																
	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix																																																																																																																																																																																																							
1		WQ-03	2020/11/27	9:40		X	X	X	X	X						42																																																																																																																																																																																												
2		WQ-06	2020/11/27	10:20		X	X	X	X	X						4																																																																																																																																																																																												
3		WQ-04c	2020/11/27	11:03		X	X	X	X	X						4																																																																																																																																																																																												
4		WQ-04d	2020/11/27	11:20		X	X	X	X	X						4																																																																																																																																																																																												
5		WQ-04b	2020/11/27	11:45		X	X	X	X	X						4																																																																																																																																																																																												
6																																																																																																																																																																																																												
7																																																																																																																																																																																																												
8																																																																																																																																																																																																												
9																																																																																																																																																																																																												
10																																																																																																																																																																																																												

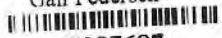
RELINQUISHED BY: (Signature/Print)

 Date: (YY/MM/DD) 20/11/27 Time 14:35

RECEIVED BY: (Signature/Print)

 Date: (YY/MM/DD) 20/11/27 Time 14:40

Laboratory Use Only
 # jars used and not submitted _____
 Time Spent: _____
 Temperature (°C) on Receipt 3/2/5
 Custody Seal Intact on Cooler? ☐ Yes ☒ No

27-Nov-20 14:40
 Gail Pedersen

 C087687
 LT5 INS-0135

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.
 * IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
 * ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT. FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER.

APPENDIX C

Raw Sediment Sampling Data



Your Project #: 102604-01
Your C.O.C. #: 626139-02-01

Attention: Jessica Eaton

HEMMERA ENVIROCHEM INC.
SUITE 804, 322-11TH AVENUE SW
CALGARY, AB
CANADA T2R 0C5

Report Date: 2020/12/04

Report #: R2963261

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C087702

Received: 2020/11/27, 14:40

Sample Matrix: Soil
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Hexavalent Chromium (1)	5	2020/12/01	2020/12/01	AB SOP-00063	SM 23 3500-Cr B m
Elements by ICPMS - Soils	4	2020/12/02	2020/12/02	AB SOP-00001 / AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS - Soils	1	2020/12/03	2020/12/03	AB SOP-00001 / AB SOP-00043	EPA 6020b R2 m
Moisture	5	N/A	2020/12/01	AB SOP-00002	CCME PHC-CWS m
Soluble Ions	4	2020/12/02	2020/12/02	AB SOP-00033 / AB SOP-00042	EPA 6010d R5 m
Soluble Ions	1	2020/12/03	2020/12/03	AB SOP-00033 / AB SOP-00042	EPA 6010d R5 m
Soluble Paste	4	2020/12/02	2020/12/02	AB SOP-00033	Carter 2nd ed 15.2 m
Soluble Paste	1	2020/12/03	2020/12/03	AB SOP-00033	Carter 2nd ed 15.2 m
Soluble Ions Calculation	5	N/A	2020/12/01		Auto Calc
Total Carbon, Nitrogen & Sulphur in Soil	5	N/A	2020/12/02	CAL SOP-00243	LECO 203-821-498 m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.



Your Project #: 102604-01
Your C.O.C. #: 626139-02-01

Attention: Jessica Eaton

HEMMERA ENVIROCHEM INC.
SUITE 804, 322-11TH AVENUE SW
CALGARY, AB
CANADA T2R 0C5

Report Date: 2020/12/04
Report #: R2963261
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C087702

Received: 2020/11/27, 14:40

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Some soil samples may react with the Cr(VI) spike reducing it to Cr(III). These samples are highly unlikely to contain native hexavalent chromium. Thus a failed spike recovery does not invalidate a negative result on the native sample.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Gail Pedersen, Key Account Specialist

Email: Gail.Pedersen@bvlabs.com

Phone# (403) 291-3077

=====

This report has been generated and distributed using a secure automated process.

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



AT1 REGULATED METALS - SOILS (SOIL)

BV Labs ID		YY1466			YY1467			YY1468		
Sampling Date		2020/11/27 09:45			2020/11/27 10:45			2020/11/27 11:00		
COC Number		626139-02-01			626139-02-01			626139-02-01		
	UNITS	WQ-03	RDL	QC Batch	WQ-06	RDL	QC Batch	WQ-04C	RDL	QC Batch
Calculated Parameters										
Calculated Boron (B)	mg/kg	0.13	0.091	A099330	<0.066	0.066	A099330	0.12	0.065	A099330
Elements										
Hex. Chromium (Cr 6+)	mg/kg	<0.080	0.080	A100568	<0.080	0.080	A100578	<0.080	0.080	A100568
Soluble Parameters										
Soluble Boron (B)	mg/L	0.14	0.10	A102139	<0.10	0.10	A102139	0.18	0.10	A102139
Saturation %	%	91	N/A	A101443	66	N/A	A101443	65	N/A	A101443
Elements										
Total Antimony (Sb)	mg/kg	<0.50	0.50	A101641	0.51	0.50	A101641	<0.50	0.50	A101641
Total Arsenic (As)	mg/kg	4.2	1.0	A101641	6.2	1.0	A101641	4.6	1.0	A101641
Total Barium (Ba)	mg/kg	280	1.0	A101641	290	1.0	A101641	290	1.0	A101641
Total Beryllium (Be)	mg/kg	0.55	0.40	A101641	0.67	0.40	A101641	0.45	0.40	A101641
Total Cadmium (Cd)	mg/kg	0.60	0.050	A101641	0.49	0.050	A101641	0.40	0.050	A101641
Total Chromium (Cr)	mg/kg	15	1.0	A101641	17	1.0	A101641	19	1.0	A101641
Total Cobalt (Co)	mg/kg	6.3	0.50	A101641	7.2	0.50	A101641	5.8	0.50	A101641
Total Copper (Cu)	mg/kg	18	1.0	A101641	19	1.0	A101641	13	1.0	A101641
Total Lead (Pb)	mg/kg	12	0.50	A101641	11	0.50	A101641	7.9	0.50	A101641
Total Mercury (Hg)	mg/kg	<0.050	0.050	A101641	<0.050	0.050	A101641	<0.050	0.050	A101641
Total Molybdenum (Mo)	mg/kg	0.69	0.40	A101641	0.95	0.40	A101641	0.86	0.40	A101641
Total Nickel (Ni)	mg/kg	20	1.0	A101641	23	1.0	A101641	19	1.0	A101641
Total Selenium (Se)	mg/kg	2.1	0.50	A101641	0.62	0.50	A101641	2.6	0.50	A101641
Total Silver (Ag)	mg/kg	<0.20	0.20	A101641	<0.20	0.20	A101641	<0.20	0.20	A101641
Total Thallium (Tl)	mg/kg	0.15	0.10	A101641	0.20	0.10	A101641	0.13	0.10	A101641
Total Tin (Sn)	mg/kg	<1.0	1.0	A101641	<1.0	1.0	A101641	<1.0	1.0	A101641
Total Uranium (U)	mg/kg	1.5	0.20	A101641	1.2	0.20	A101641	1.1	0.20	A101641
Total Vanadium (V)	mg/kg	24	1.0	A101641	29	1.0	A101641	20	1.0	A101641
Total Zinc (Zn)	mg/kg	88	10	A101641	78	10	A101641	330	10	A101641
RDL = Reportable Detection Limit										
N/A = Not Applicable										



AT1 REGULATED METALS - SOILS (SOIL)

BV Labs ID		YY1469			YY1470		
Sampling Date		2020/11/27 11:20			2020/11/27 11:45		
COC Number		626139-02-01			626139-02-01		
	UNITS	WQ-04D	RDL	QC Batch	WQ-04B	RDL	QC Batch
Calculated Parameters							
Calculated Boron (B)	mg/kg	<0.060	0.060	A099330	0.11	0.062	A099330
Elements							
Hex. Chromium (Cr 6+)	mg/kg	<0.080	0.080	A100578	<0.080	0.080	A100568
Soluble Parameters							
Soluble Boron (B)	mg/L	<0.10	0.10	A103322	0.18	0.10	A102139
Saturation %	%	60	N/A	A102173	62	N/A	A101443
Elements							
Total Antimony (Sb)	mg/kg	<0.50	0.50	A102924	<0.50	0.50	A101641
Total Arsenic (As)	mg/kg	2.9	1.0	A102924	5.9	1.0	A101641
Total Barium (Ba)	mg/kg	170	1.0	A102924	290	1.0	A101641
Total Beryllium (Be)	mg/kg	0.41	0.40	A102924	0.57	0.40	A101641
Total Cadmium (Cd)	mg/kg	0.35	0.050	A102924	0.43	0.050	A101641
Total Chromium (Cr)	mg/kg	11	1.0	A102924	16	1.0	A101641
Total Cobalt (Co)	mg/kg	4.5	0.50	A102924	7.0	0.50	A101641
Total Copper (Cu)	mg/kg	11	1.0	A102924	16	1.0	A101641
Total Lead (Pb)	mg/kg	6.7	0.50	A102924	9.6	0.50	A101641
Total Mercury (Hg)	mg/kg	<0.050	0.050	A102924	<0.050	0.050	A101641
Total Molybdenum (Mo)	mg/kg	0.48	0.40	A102924	0.86	0.40	A101641
Total Nickel (Ni)	mg/kg	14	1.0	A102924	21	1.0	A101641
Total Selenium (Se)	mg/kg	2.5	0.50	A102924	1.4	0.50	A101641
Total Silver (Ag)	mg/kg	<0.20	0.20	A102924	<0.20	0.20	A101641
Total Thallium (Tl)	mg/kg	0.11	0.10	A102924	0.16	0.10	A101641
Total Tin (Sn)	mg/kg	<1.0	1.0	A102924	<1.0	1.0	A101641
Total Uranium (U)	mg/kg	0.91	0.20	A102924	1.0	0.20	A101641
Total Vanadium (V)	mg/kg	15	1.0	A102924	25	1.0	A101641
Total Zinc (Zn)	mg/kg	230	10	A102924	340	10	A101641
RDL = Reportable Detection Limit N/A = Not Applicable							



BV Labs Job #: C087702
Report Date: 2020/12/04

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

PHYSICAL TESTING (SOIL)

BV Labs ID		YY1466	YY1467	YY1468	YY1469	YY1470		
Sampling Date		2020/11/27 09:45	2020/11/27 10:45	2020/11/27 11:00	2020/11/27 11:20	2020/11/27 11:45		
COC Number		626139-02-01	626139-02-01	626139-02-01	626139-02-01	626139-02-01		
	UNITS	WQ-03	WQ-06	WQ-04C	WQ-04D	WQ-04B	RDL	QC Batch
Physical Properties								
Moisture	%	50	42	48	48	40	0.30	A099960
RDL = Reportable Detection Limit								



BV Labs Job #: C087702
Report Date: 2020/12/04

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

MISCELLANEOUS (SOIL)

BV Labs ID		YY1466	YY1467	YY1468	YY1469	YY1470		
Sampling Date		2020/11/27 09:45	2020/11/27 10:45	2020/11/27 11:00	2020/11/27 11:20	2020/11/27 11:45		
COC Number		626139-02-01	626139-02-01	626139-02-01	626139-02-01	626139-02-01		
	UNITS	WQ-03	WQ-06	WQ-04C	WQ-04D	WQ-04B	RDL	QC Batch
Misc. Inorganics								
Total Carbon	%	8.1	5.2	7.3	7.1	6.5	0.05	A101588
RDL = Reportable Detection Limit								



BV Labs Job #: C087702
Report Date: 2020/12/04

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	3.3°C
-----------	-------

Results relate only to the items tested.



BV Labs Job #: C087702
Report Date: 2020/12/04

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT

QA/QC	Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A099960	KLB		Method Blank	Moisture	2020/12/01	<0.30		%	
A099960	KLB		RPD [YY1470-01]	Moisture	2020/12/01	2.0		%	20
A100568	CCQ		Matrix Spike	Hex. Chromium (Cr 6+)	2020/12/01		97	%	75 - 125
A100568	CCQ		Spiked Blank	Hex. Chromium (Cr 6+)	2020/12/01		105	%	80 - 120
A100568	CCQ		Method Blank	Hex. Chromium (Cr 6+)	2020/12/01	<0.080		mg/kg	
A100568	CCQ		RPD	Hex. Chromium (Cr 6+)	2020/12/01	NC		%	35
A100578	CCQ		Matrix Spike	Hex. Chromium (Cr 6+)	2020/12/01		90	%	75 - 125
A100578	CCQ		Spiked Blank	Hex. Chromium (Cr 6+)	2020/12/01		102	%	80 - 120
A100578	CCQ		Method Blank	Hex. Chromium (Cr 6+)	2020/12/01	<0.080		mg/kg	
A100578	CCQ		RPD	Hex. Chromium (Cr 6+)	2020/12/01	NC		%	35
A101443	JLD		QC Standard	Saturation %	2020/12/02		99	%	75 - 125
A101443	JLD		RPD	Saturation %	2020/12/02	2.0		%	12
A101588	PL		QC Standard	Total Carbon	2020/12/02		107	%	75 - 125
A101588	PL		Spiked Blank	Total Carbon	2020/12/02		104	%	80 - 120
A101588	PL		Method Blank	Total Carbon	2020/12/02	<0.05		%	
A101588	PL		RPD [YY1466-01]	Total Carbon	2020/12/02	3.0		%	30
A101641	KH2		Matrix Spike	Total Antimony (Sb)	2020/12/02		89	%	75 - 125
				Total Arsenic (As)	2020/12/02		101	%	75 - 125
				Total Barium (Ba)	2020/12/02		NC	%	75 - 125
				Total Beryllium (Be)	2020/12/02		98	%	75 - 125
				Total Cadmium (Cd)	2020/12/02		100	%	75 - 125
				Total Chromium (Cr)	2020/12/02		108	%	75 - 125
				Total Cobalt (Co)	2020/12/02		100	%	75 - 125
				Total Copper (Cu)	2020/12/02		97	%	75 - 125
				Total Lead (Pb)	2020/12/02		95	%	75 - 125
				Total Mercury (Hg)	2020/12/02		109	%	75 - 125
				Total Molybdenum (Mo)	2020/12/02		104	%	75 - 125
				Total Nickel (Ni)	2020/12/02		99	%	75 - 125
				Total Selenium (Se)	2020/12/02		100	%	75 - 125
				Total Silver (Ag)	2020/12/02		98	%	75 - 125
				Total Thallium (Tl)	2020/12/02		99	%	75 - 125
				Total Tin (Sn)	2020/12/02		103	%	75 - 125
				Total Uranium (U)	2020/12/02		101	%	75 - 125
				Total Vanadium (V)	2020/12/02		115	%	75 - 125
				Total Zinc (Zn)	2020/12/02		96	%	75 - 125
A101641	KH2		QC Standard	Total Antimony (Sb)	2020/12/02		116	%	15 - 182
				Total Arsenic (As)	2020/12/02		115	%	53 - 147
				Total Barium (Ba)	2020/12/02		106	%	80 - 119
				Total Cadmium (Cd)	2020/12/02		103	%	72 - 128
				Total Chromium (Cr)	2020/12/02		103	%	59 - 141
				Total Cobalt (Co)	2020/12/02		103	%	58 - 142
				Total Copper (Cu)	2020/12/02		107	%	83 - 117
				Total Lead (Pb)	2020/12/02		112	%	79 - 121
				Total Molybdenum (Mo)	2020/12/02		122	%	67 - 133
				Total Nickel (Ni)	2020/12/02		113	%	79 - 121
				Total Silver (Ag)	2020/12/02		106	%	47 - 153
				Total Tin (Sn)	2020/12/02		101	%	67 - 133
				Total Uranium (U)	2020/12/02		99	%	77 - 123
				Total Vanadium (V)	2020/12/02		109	%	79 - 121
				Total Zinc (Zn)	2020/12/02		110	%	79 - 121
A101641	KH2		Spiked Blank	Total Antimony (Sb)	2020/12/02		91	%	80 - 120
				Total Arsenic (As)	2020/12/02		103	%	80 - 120
				Total Barium (Ba)	2020/12/02		100	%	80 - 120
				Total Beryllium (Be)	2020/12/02		102	%	80 - 120
				Total Cadmium (Cd)	2020/12/02		101	%	80 - 120



BV Labs Job #: C087702
Report Date: 2020/12/04

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A101641	KH2	Method Blank	Total Chromium (Cr)	2020/12/02		103	%	80 - 120
			Total Cobalt (Co)	2020/12/02		104	%	80 - 120
			Total Copper (Cu)	2020/12/02		106	%	80 - 120
			Total Lead (Pb)	2020/12/02		98	%	80 - 120
			Total Mercury (Hg)	2020/12/02		114	%	80 - 120
			Total Molybdenum (Mo)	2020/12/02		101	%	80 - 120
			Total Nickel (Ni)	2020/12/02		104	%	80 - 120
			Total Selenium (Se)	2020/12/02		103	%	80 - 120
			Total Silver (Ag)	2020/12/02		99	%	80 - 120
			Total Thallium (Tl)	2020/12/02		101	%	80 - 120
			Total Tin (Sn)	2020/12/02		99	%	80 - 120
			Total Uranium (U)	2020/12/02		100	%	80 - 120
			Total Vanadium (V)	2020/12/02		103	%	80 - 120
			Total Zinc (Zn)	2020/12/02		106	%	80 - 120
			Total Antimony (Sb)	2020/12/02	<0.50		mg/kg	
			Total Arsenic (As)	2020/12/02	<1.0		mg/kg	
			Total Barium (Ba)	2020/12/02	<1.0		mg/kg	
			Total Beryllium (Be)	2020/12/02	<0.40		mg/kg	
			Total Cadmium (Cd)	2020/12/02	<0.050		mg/kg	
			Total Chromium (Cr)	2020/12/02	<1.0		mg/kg	
			Total Cobalt (Co)	2020/12/02	<0.50		mg/kg	
			Total Copper (Cu)	2020/12/02	<1.0		mg/kg	
			Total Lead (Pb)	2020/12/02	<0.50		mg/kg	
			Total Mercury (Hg)	2020/12/02	<0.050		mg/kg	
			Total Molybdenum (Mo)	2020/12/02	<0.40		mg/kg	
			Total Nickel (Ni)	2020/12/02	<1.0		mg/kg	
			Total Selenium (Se)	2020/12/02	<0.50		mg/kg	
			Total Silver (Ag)	2020/12/02	<0.20		mg/kg	
			Total Thallium (Tl)	2020/12/02	<0.10		mg/kg	
			Total Tin (Sn)	2020/12/02	<1.0		mg/kg	
			Total Uranium (U)	2020/12/02	<0.20		mg/kg	
			Total Vanadium (V)	2020/12/02	<1.0		mg/kg	
			Total Zinc (Zn)	2020/12/02	<10		mg/kg	
A101641	KH2	RPD	Total Arsenic (As)	2020/12/02	1.3		%	30
			Total Barium (Ba)	2020/12/02	2.7		%	35
			Total Chromium (Cr)	2020/12/02	1.3		%	30
			Total Copper (Cu)	2020/12/02	4.4		%	30
			Total Lead (Pb)	2020/12/02	0.78		%	35
			Total Zinc (Zn)	2020/12/02	2.7		%	30
A102139	MAP	Matrix Spike	Soluble Boron (B)	2020/12/02		100	%	75 - 125
A102139	MAP	Spiked Blank	Soluble Boron (B)	2020/12/02		99	%	80 - 120
A102139	MAP	Method Blank	Soluble Boron (B)	2020/12/02	<0.10		mg/L	
A102139	MAP	RPD	Soluble Boron (B)	2020/12/02	NC		%	30
A102173	NSW	QC Standard	Saturation %	2020/12/03		102	%	75 - 125
A102173	NSW	RPD	Saturation %	2020/12/03	1.9		%	12
A102924	ANE	Matrix Spike	Total Antimony (Sb)	2020/12/03		87	%	75 - 125
			Total Arsenic (As)	2020/12/03		102	%	75 - 125
			Total Barium (Ba)	2020/12/03		NC	%	75 - 125
			Total Beryllium (Be)	2020/12/03		102	%	75 - 125
			Total Cadmium (Cd)	2020/12/03		103	%	75 - 125
			Total Chromium (Cr)	2020/12/03		127 (1)	%	75 - 125
			Total Cobalt (Co)	2020/12/03		107	%	75 - 125
			Total Copper (Cu)	2020/12/03		106	%	75 - 125
			Total Lead (Pb)	2020/12/03		102	%	75 - 125
			Total Mercury (Hg)	2020/12/03		101	%	75 - 125



BV Labs Job #: C087702
Report Date: 2020/12/04

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
A102924	ANE	QC Standard	Total Molybdenum (Mo)	2020/12/03		101	%	75 - 125
			Total Nickel (Ni)	2020/12/03		111	%	75 - 125
			Total Selenium (Se)	2020/12/03		99	%	75 - 125
			Total Silver (Ag)	2020/12/03		95	%	75 - 125
			Total Thallium (Tl)	2020/12/03		94	%	75 - 125
			Total Tin (Sn)	2020/12/03		102	%	75 - 125
			Total Uranium (U)	2020/12/03		97	%	75 - 125
			Total Vanadium (V)	2020/12/03		132 (1)	%	75 - 125
			Total Zinc (Zn)	2020/12/03		NC	%	75 - 125
			Total Antimony (Sb)	2020/12/03		121	%	15 - 182
			Total Arsenic (As)	2020/12/03		113	%	53 - 147
			Total Barium (Ba)	2020/12/03		104	%	80 - 119
			Total Cadmium (Cd)	2020/12/03		90	%	72 - 128
			Total Chromium (Cr)	2020/12/03		89	%	59 - 141
			Total Cobalt (Co)	2020/12/03		97	%	58 - 142
			Total Copper (Cu)	2020/12/03		104	%	83 - 117
			Total Lead (Pb)	2020/12/03		110	%	79 - 121
			Total Molybdenum (Mo)	2020/12/03		112	%	67 - 133
			Total Nickel (Ni)	2020/12/03		108	%	79 - 121
			Total Silver (Ag)	2020/12/03		99	%	47 - 153
A102924	ANE	Spiked Blank	Total Tin (Sn)	2020/12/03		97	%	67 - 133
			Total Uranium (U)	2020/12/03		95	%	77 - 123
			Total Vanadium (V)	2020/12/03		99	%	79 - 121
			Total Zinc (Zn)	2020/12/03		111	%	79 - 121
			Total Antimony (Sb)	2020/12/03		104	%	80 - 120
			Total Arsenic (As)	2020/12/03		105	%	80 - 120
			Total Barium (Ba)	2020/12/03		103	%	80 - 120
			Total Beryllium (Be)	2020/12/03		101	%	80 - 120
			Total Cadmium (Cd)	2020/12/03		105	%	80 - 120
			Total Chromium (Cr)	2020/12/03		102	%	80 - 120
			Total Cobalt (Co)	2020/12/03		101	%	80 - 120
			Total Copper (Cu)	2020/12/03		104	%	80 - 120
			Total Lead (Pb)	2020/12/03		101	%	80 - 120
			Total Mercury (Hg)	2020/12/03		110	%	80 - 120
			Total Molybdenum (Mo)	2020/12/03		103	%	80 - 120
			Total Nickel (Ni)	2020/12/03		103	%	80 - 120
			Total Selenium (Se)	2020/12/03		105	%	80 - 120
			Total Silver (Ag)	2020/12/03		96	%	80 - 120
			Total Thallium (Tl)	2020/12/03		103	%	80 - 120
			Total Tin (Sn)	2020/12/03		101	%	80 - 120
A102924	ANE	Method Blank	Total Uranium (U)	2020/12/03		100	%	80 - 120
			Total Vanadium (V)	2020/12/03		102	%	80 - 120
			Total Zinc (Zn)	2020/12/03		110	%	80 - 120
			Total Antimony (Sb)	2020/12/03	<0.50		mg/kg	
			Total Arsenic (As)	2020/12/03	<1.0		mg/kg	
			Total Barium (Ba)	2020/12/03	<1.0		mg/kg	
			Total Beryllium (Be)	2020/12/03	<0.40		mg/kg	
			Total Cadmium (Cd)	2020/12/03	<0.050		mg/kg	
			Total Chromium (Cr)	2020/12/03	<1.0		mg/kg	
			Total Cobalt (Co)	2020/12/03	<0.50		mg/kg	
			Total Copper (Cu)	2020/12/03	<1.0		mg/kg	
			Total Lead (Pb)	2020/12/03	<0.50		mg/kg	
			Total Mercury (Hg)	2020/12/03	<0.050		mg/kg	
			Total Molybdenum (Mo)	2020/12/03	<0.40		mg/kg	
			Total Nickel (Ni)	2020/12/03	<1.0		mg/kg	



QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Selenium (Se)	2020/12/03	<0.50		mg/kg	
			Total Silver (Ag)	2020/12/03	<0.20		mg/kg	
			Total Thallium (Tl)	2020/12/03	<0.10		mg/kg	
			Total Tin (Sn)	2020/12/03	<1.0		mg/kg	
			Total Uranium (U)	2020/12/03	<0.20		mg/kg	
			Total Vanadium (V)	2020/12/03	<1.0		mg/kg	
			Total Zinc (Zn)	2020/12/03	<10		mg/kg	
A102924	ANE	RPD	Total Selenium (Se)	2020/12/03	5.7		%	30
A103322	MAP	Matrix Spike	Soluble Boron (B)	2020/12/03		98	%	75 - 125
A103322	MAP	Spiked Blank	Soluble Boron (B)	2020/12/03		98	%	80 - 120
A103322	MAP	Method Blank	Soluble Boron (B)	2020/12/03	<0.10		mg/L	
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement. Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference. QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy. Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy. Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination. NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration) NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL). (1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.								



BV Labs Job #: C087702
Report Date: 2020/12/04

HEMMERA ENVIROCHEM INC.
Client Project #: 102604-01

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.



Bureau Veritas Laboratories
4000 19th N.E., Calgary, Alberta Canada T2E 6P8 Tel: (403) 291-3077 Toll-free: 800-563-6266 Fax: (403) 291-9466 www.bvlab.com

1065

CHAIN OF CUSTODY RECORD

Page of

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name: #10658 HEMMERA ENVIROCHEM INC.		Company Name:		Quotation #: B61187		BV Labs Job #:	
Attention: Accounts Payable		Attention: Jessica Eaton		P.O. #:		Bottle Order #:	
Address: SUITE 804, 322-11TH AVENUE SW		Address:		Project: 102604-01		COC #:	
Tel: (403) 264-0671 Fax:		Tel: (403) 264-4377 Fax:		Project Name:		Project Manager:	
Email: procure2pay.hemmera@ausenco.com		Email: jessica.eaton@hemmera.com		Site #:		Gail Pedersen	
				Sampled By:		C#626139-02-01	

Regulatory Criteria:		Special Instructions		ANALYSIS REQUESTED (PLEASE BE SPECIFIC)										Turnaround Time (TAT) Required:			
☐ ATI ☐ CCME ☐ Other														Please provide advance notice for rush projects Regular (Standard) TAT: (will be applied if Rush TAT is not specified) Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details Job Specific Rush TAT (if applies to entire submission) Date Required: Rush Confirmation Number:			
SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS																	
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y/N)	Soils (metals)	Soils (total carbon)										
1	WQ-03	2020/11/27	9:45			X	X									2	
2	WQ-06	2020/11/27	10:45			X	X									2	
3	WQ-04c	2020/11/27	11:00			X	X									2	
4	WQ-04d	2020/11/27	11:20			X	X									2	
5	WQ-04b	2020/11/27	11:45			X	X									2	
6																	
7																	
8																	
9																	
10																	

27-Nov-20 14:40
Gail Pedersen
C087702
LT5 INS-0135

* RELINQUISHED BY: (Signature/Print)		Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)		Date: (YY/MM/DD)	Time	# jars used and not submitted	Laboratory Use Only	
Jessica Eaton		20/11/27	14:35	Lauren Teghtsoonian		20/11/27	14:40		Time Sensitive: ☐ Temperature (°C) on Receipt: 3/2/5 Custody Seal Intact on Cooler? ☐ Yes ☒ No	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.
 * IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
 ** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT. FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

White: BV Labs Yellow: Client
10-yes