

# 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 23, 2020

**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

<b>LIST OF ACRONYMS AND ABBREVIATIONS.....</b>	<b>III</b>
<b>LIST OF SYMBOLS AND UNITS OF MEASURE.....</b>	<b>III</b>
<b>1.0 BACKGROUND.....</b>	<b>1</b>
<b>2.0 INTRODUCTION.....</b>	<b>2</b>
<b>3.0 SITE DESCRIPTION.....</b>	<b>3</b>
<b>4.0 METHODS .....</b>	<b>5</b>
4.1 Sample Locations.....	5
4.1.1 Water Quality Monitoring .....	5
4.1.2 Water Flow Monitoring .....	8
4.2 Water Quality Monitoring .....	9
4.3 Water Flow Monitoring .....	10
<b>5.0 RESULTS .....</b>	<b>12</b>
5.1 Water Quality Monitoring .....	12
5.1.1 2019 Water Quality Results .....	12
5.1.2 Comparison with Historic Measurements .....	16
5.2 Water Flow Monitoring .....	17
<b>6.0 SUMMARY.....</b>	<b>20</b>
<b>7.0 RECOMMENDATIONS.....</b>	<b>21</b>
<b>8.0 CLOSURE.....</b>	<b>22</b>
<b>9.0 REFERENCES.....</b>	<b>23</b>

## LIST OF TABLES

Table 1	Surface Water Quality Sample Locations .....	8
Table 2	Surface Water Flow Sample Locations.....	8
Table 3	Water Quality Monitoring Parameters.....	10
Table 4	Summary of 2018 to 2019 Water Quality Sampling Results.....	14
Table 5	Surface Water Quality Parameters Collected from Wetland 06 Sites from 2016 to 2019 .....	17
Table 6a	Summary of Water Flow Monitoring Site Channel Width and Depth.....	18
Table 6b	Summary of Water Flow Monitoring Site Velocity and Discharge .....	19
Table 7	Summary of Wetted Width Measurements from 2016 to 2019.....	20

## LIST OF FIGURES

Figure 1	Wetland Locations.....	4
Figure 2	Water Flow and Quality Sampling Locations .....	6
Figure 3	Water Flow and Quality Sampling Location Details.....	7

## LIST OF APPENDICES

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

## LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
the Approval	<i>Water Act</i> Approval No.: 00388473-00-00
Ausenco	Ausenco Engineering Canada Inc.
CCME	Canadian Council of Ministers of the Environment
DO	Dissolved Oxygen
GOA	Government of Alberta
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
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

## 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 2019 occurred with reference to the Project's Monitoring Plan (Hemmera 2018). Monitoring in 2019 represented Year 2 of the Monitoring Plan, which will remain in effect throughout construction, and for the first five years of operation of the SWCRR. The Monitoring Plan is presented in **Appendix A**.

The objective of Year 2 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 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. Information collected during Year 2 monitoring will facilitate comparative analysis with data collected during Year 1 regarding potential influences or lack thereof of the Project on surface water quality and flow in Wetland 06. Additionally, Year 2 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.

### 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 monitoring visits this constructed drainage ditch had been encompassed by the Projects 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 is 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.



Path: S:\GIS\mxd\Projects\102604\102604\_01\_Wetland\_Location\_201313.mxd



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

Wetland Locations

Map Extent

0 1 2 3 4 5  
Kilometres

**Legend**

- 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.

**Sources**

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

0 100 200 300 400 500  
Metres

1:7,500

NAD 1983 UTM Zone 11N  
Page Size: 11" x 17"

102604-01

Production Date: Mar 13, 2020

Figure 1

**Hemmera**  
An Anusenco Company

KGL



## 4.0 METHODS

Site visits of Wetland 06 and surrounding wetlands in 2019 were conducted by a crew of two, led by a Qualified Environmental Professional (QEP) from Hemmera. During Year 2 two site visits were conducted, once during the spring and once during the fall in order to capture seasonal variability of the wetlands. 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 29, 2019; and
- Fall – October 16, 2019

### 4.1 Sample Locations

Locations for surface water quality and flow monitoring are provided in **Figure 2**. The 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. Sampling sites in and near Wetland 06 are provided in an enhanced view in **Figure 3**.

#### 4.1.1 Water Quality Monitoring

Seven surface water quality monitoring sites were sampled during Year 2 monitoring (**Table 1**). All surface water quality monitoring sites were previously established during Year 1 (i.e., 2018).

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.

No supplementary water quality monitoring sites were required throughout Year 2 monitoring, as no abnormal site conditions or contaminant indicators were observed.



Water Flow and Quality  
Sampling Locations

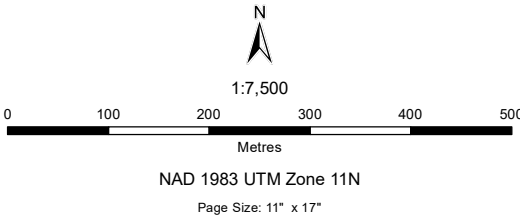
- Legend
- Water Flow Sample Location (Hemmera, 2018)
  - Water Quality Sample Location (Hemmera, 2018)
  - Decommissioned Water Quality Location (Hemmera, 2019)
  - Bypass Culvert
  - Pathway #1 Approximate Direction of Flow
  - Pathway #2 Approximate Direction of Flow
  - Pathway #2 Approximate Direction of Flow (Decommissioned)
  - Stormwater Drainage Line
  - City of Calgary Boundary
  - Natural Area
  - Transportation and Utility Corridor (TUC)
  - Watercourse
  - Wetland

Notes

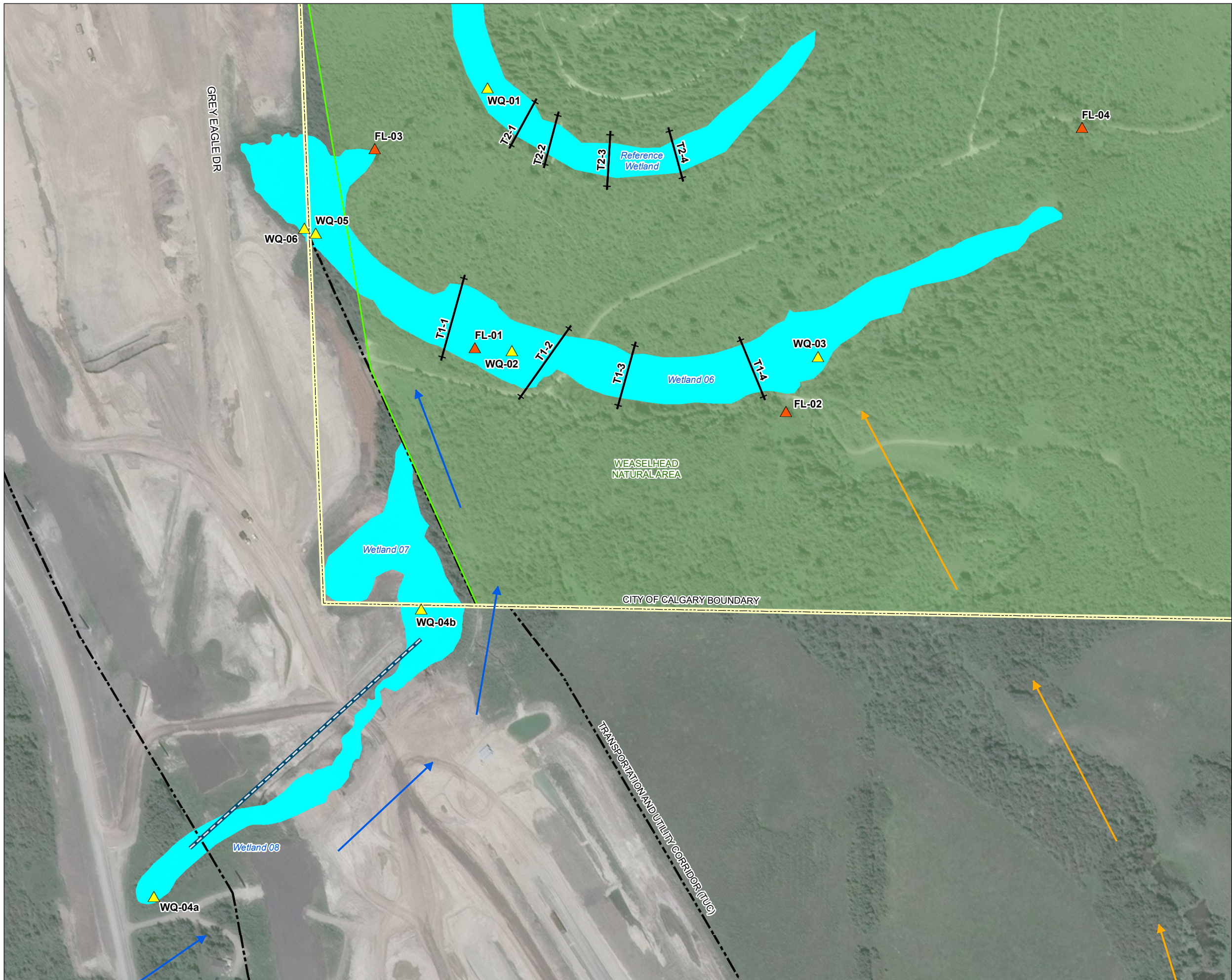
1. All mapped features are approximate and should be used for discussion purposes only.  
2. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations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

Sources

- Aerial Image: ESRI World Imagery, 2016







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

Water Flow and Quality  
Sampling Location Details

Legend

Water Flow Sample Location (Hemmera, 2018)

Water Quality Sample Location (Hemmera, 2018)

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

N

1:3,000

0 25 50 75 100 125

Metres

NAD 1983 UTM Zone 11N

Page Size: 11" x 17"

102604-01

Production Date: Mar 13, 2020

Figure 3

Hemmera  
An Ausenco Company

KGL



**Table 1 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-05b	699788	5651289	Watercourse 01 downslope of Wetland 09 and SWCRR Project	Comparison
WQ-05c	700061	5651274	WQ-05c was no longer accessible for sampling and eliminated from the monitoring plan in 2019	Comparison

#### 4.1.2 Water Flow Monitoring

Surface water flow monitoring sampling sites were established at four locations within Wetland 06 (**Table 2**). 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 1 monitoring, as no additional inflow or outflow locations were identified during field sampling visits.

**Table 2 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 1** 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 3**. 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 3 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 <sub>3</sub> -N)	
• Nitrate (NO <sub>3</sub> )		• Total Phosphorus (TP)	
• Nitrite (NO <sub>2</sub> )		• Dissolved Reactive Phosphorus (DRP)	
		• Ortho-Phosphate	
Dissolved Metals and 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)	• 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 and Salts			
• Sodium (Na <sup>2+</sup> )		• Calcium (Ca <sup>2+</sup> )	
• Potassium (K <sup>+</sup> )		• Chloride (Cl <sup>-</sup> )	
• Potassium (K <sup>+</sup> )		• Sulfate (SO <sub>4</sub> <sup>2-</sup> )	

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 a YSI water quality meter as per the manufacturer's instructions, following calibration.

Year 2 water quality parameters were compared to Year 1 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 Water Flow Monitoring

Surface flow monitoring was conducted by the crew at the sample sites provided in **Table 2** 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 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 2019 Water Quality Results

Water quality parameters outlined in **Table 3** 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 4** 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. Photographs taken at each sampling site are provided in **Appendix C**.

Water quality parameters outlined in **Table 3** 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 4** 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. Photographs taken at each sampling site are provided in **Appendix C**.

Water quality results from Year 2 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). Two water quality parameters (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.

**Dissolved Oxygen:** DO measured during water quality sample collection during fall sampling at site WQ-01 (i.e., the reference wetland) was 3.70 mg/L, less than the Environmental Quality Guidelines (GOA 2018) for the acceptable minimum DO concentration for freshwater biota of 5.0 mg/L.

The low DO measured within the reference wetland during fall sampling was not observed at either of the Wetland 06 sites (i.e., WQ-02 and WQ-03), where all measurements of DO were within the Environmental Quality Guidelines DO concentration criteria. The low DO concentration recorded at the reference wetland (i.e., site WQ-01) during fall sampling is likely related to the decomposition of algae or submerged plants consuming dissolved oxygen. The higher BOD levels recorded at this location during fall sampling supports this assumption.

In fall 2018, a low DO value (4.3 mg/L) measured at WQ-03 was attributed to the same decomposition conditions and supported by a higher BOD measurement at the same location.



**Zinc:** Analytical results from water quality samples collected during fall sampling at site WQ-02 (i.e., wetland 06) indicated a dissolved zinc concentration of 0.018 mg/L, which exceeds the CCME (GOA 2018) Freshwater Aquatic Life guidelines for long-term exposure of 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 WQ-03 were within the CCME zinc guideline criteria (GOA 2014); as were all samples collected from Wetland 06 sites (i.e., WQ-02 and WQ-03) during spring sampling.

Fall samples collected at WQ-04b (i.e., upslope from WQ-02 along Pathway 1, downslope of the SWCRR Project) were found to have a dissolved zinc concentration of 0.16 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 the SWCRR Project) had zinc levels below 0.003 mg/L during fall sampling.

In fall 2018, zinc levels at WQ-02 (0.013 mg/L) exceeded CCME guidelines for long-term exposure. This exceedance was explained as a result of the system becoming reducing with respect to iron (supported by the slight increase in iron and decrease in DO measurements at WQ-02 between summer and fall) resulting in the release of zinc to solution. Samples collected in fall 2018 at WQ-04a and WQ-04b were not analyzed for zinc.

Exceedances of zinc levels at WQ-02 during fall sampling in both 2018 and 2019, as well as the elevated zinc levels recorded at WQ-04b but not at WQ-04A (i.e., upslope of the SWCRR Project) in 2019, suggests the possibility that environmental conditions or project activities may be contributing to elevated levels of dissolved zinc along Pathway 1. In 2020, it is recommended that analytical results of water quality sampling 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 30 days of the original date of sample collection to verify results and attempt to identify potential project-related sources of elevated levels.

### **Comparison with 2018 results**

In addition to DO and zinc, pH and iron were also found to exceed the Environmental Quality Guidelines in 2018 at WQ-03 and WQ-01, respectively.

In-situ pH measured during 2018 summer sampling at site WQ-03 was recorded as 9.01 which exceeds the pH range provided by the AB SW Freshwater Aquatic Life (Long-term) of 6.5 to 9.0 (GOA 2014). The elevated pH level was likely a result of increased photosynthesis rates during a period of higher water temperatures and increased sunlight intensity. No exceedances in pH were documented in 2019.

An exceedance in iron levels above the CCME Guidelines (1999) - AB SW Freshwater Aquatic Life (long term) was recorded at WQ-01 (i.e., the reference wetland) during 2018 summer sampling. This wetland was observed to be stagnant and thus not regularly replenished with oxygen creating a surface water system that is reducing with respect to iron. In an oxidized system, iron is typically present as solid iron oxyhydroxide minerals, however in a low oxygenized system, iron is reductively dissolved and released into the surface water system. This interpretation is supported by other indicators of a low oxygen, reducing system (i.e., lower nitrate and sulphate concentrations, and higher manganese concentrations relative to WQ-02 and WQ-03). In 2019, higher iron levels were documented at WQ-01 in spring but did not exceed guidelines.

Table 4    Summary of 2018 to 2019 Water Quality Sampling Results

	CCME Guidelines (1999)		Summer (05/06/2018)			Fall (11/10/2018)			Spring (29/05/2019)			Fall (16/10/2019)		
	AB SW Freshwater Aquatic Life (Long-term)	AB SW Freshwater Aquatic Life (Short-term)	WQ-01	WQ-02	WQ-03	WQ-01*	WQ-02	WQ-03	WQ-01	WQ-02	WQ-03	WQ-01	WQ-02	WQ-03
Sediment and Physical														
Total Suspended Solids (TSS) (mg/L)	Narr.	Narr.	18	17	3.5	-	9.7	25	3.1	2.1	14	8	17	8.4
Total Dissolved Solids (TDS) (mg/L)	N/A	N/A	530	470	270	-	490	390	520 - 570	430 - 450	370 - 390	490 - 510	450 - 460	440 - 450
Turbidity (NTU)	Narr.	Narr.	6.5	7	2.6	-	5.4	17	3.3	2	1.8	1.8	8.9	6.5
Conductivity (EC) (nS/cm)	N/A	N/A	950	850	500	-	850	710	970	780	690	900	810	800
pH	6.50 – 9.00	N/A	8.13	8.25	9.1	-	8.25	8.09	7.97	8.26	8.33	8.12	8.22	8.29
Dissolved Oxygen (mg/L)	Narr.	5.0	2.2	10	14	-	11	4.3	5.1	7.7	7.9	3.7	10	8
Nutrients and Others (mg/L)														
Biochemical Oxygen Demand (BOD)	N/A	N/A	3.2	<2.0	<2.0	-	<2.0	3.5	<2	<2	<2	3.3	<2	2.5
Chemical Oxygen Demand (COD)	N/A	N/A	36	35	27	-	15	37	30	30	40	34	18	44
Nitrate (NO3)	3.000	124.000	<0.044	<0.044	0.072	-	0.6	<0.044	<0.044	<0.044	<0.044	<0.044	0.079	<0.044
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
Total Kjelaahl Nitrogen (TKN)	N/A	N/A	1.5	0.81	0.86	-	0.44	0.9	0.58	0.55	0.64	0.72	0.37	1
Ammonia-Nitrogen (NH3-N)	N/A	N/A	0.043	0.045	0.024	-	<0.015	0.039	0.03	0.027	<0.015	0.058	0.065	0.11
Ortho-Phosphate	N/A	N/A	0.008	0.0068	0.0085	-	0.0034	<0.003	0.013	0.0037	0.0039	0.03	<0.003	<0.003
Dissolved Metals and Metals (mg/L)														
Silver (Ag)	N/A	0.0075 mg/L	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Aluminum (Al)	0.100 mg/L	N/A	<0.003	<0.003	<0.003	-	0.0034	0.0034	<0.003	<0.003	0.005	0.0037	0.0034	0.0051
Arsenic (As)	0.005 mg/L	N/A	0.0013	0.0021	0.0016	-	0.00061	0.0012	0.00063	0.0008	0.0011	0.0035	0.00046	0.0011
Boron (B)	1.500 mg/L	29.000mg/L	0.032	0.032	0.028	-	0.04	0.041	0.032	0.046	0.031	0.025	0.033	0.035
Berium (Ba)	N/A	N/A	0.23	0.13	0.069	-	0.11	0.21	0.15	0.14	0.15	0.13	0.1	0.18
Beryllium (Be)	N/A	N/A	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	N/A	N/A	97	80	30	-	73	52	93	58	57	83	67	67
Cadmium (Cd)	N/A	N/A	<0.00002	<0.00002	<0.00002	-	<0.00002	<0.00002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Colbalt (Co)	N/A	N/A	0.00074	0.00041	<0.0003	-	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.00058	<0.0003	<0.0003
Chromium (Cr)	N/A	N/A	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	N/A	N/A	0.00021	0.00025	0.0004	-	0.00036	<0.0002	0.00085	0.00071	0.00047	0.0016	<0.0002	0.00045
Iron (Fe)	0.30 mg/L	N/A	1	<0.06	<0.06	-	0.1	0.064	0.2	0.083	0.076	0.09	<0.06	<0.06
Potassium (K)	N/A	N/A	1.7	4.1	3.6	-	2.3	6.8	3.7	4.7	5.8	13	3.6	5.5
Lithium (Li)	N/A	N/A	<0.02	0.024	<0.02	-	0.026	<0.02	<0.02	<0.02	<0.02	<0.02	0.023	<0.02
Magnesium (Mg)	N/A	N/A	49	49	35	-	53	43	48	47	42	44	49	52

	CCME Guidelines (1999)		Summer (05/06/2018)			Fall (11/10/2018)			Spring (29/05/2019)			Fall (16/10/2019)		
	AB SW Freshwater Aquatic Life (Long-term)	AB SW Freshwater Aquatic Life (Short-term)	WQ-01	WQ-02	WQ-03	WQ-01*	WQ-02	WQ-03	WQ-01	WQ-02	WQ-03	WQ-01	WQ-02	WQ-03
Manganese (Mn)	N/A	N/A	0.44	0.12	0.0083	-	0.065	0.025	0.063	0.016	0.0098	0.53	0.02	0.012
Molybdenum (Mo)	0.073 mg/L	N/A	0.00036	0.0038	0.0028	-	0.0019	0.0057	0.001	0.0025	0.0025	0.0013	0.0017	0.0027
Nickel (Ni)	N/A	N/A	0.0011	0.0014	0.00098	-	0.00066	0.0014	0.00079	0.0008	0.0011	0.0016	0.00063	0.0027
Lead (P)	N/A	N/A	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Sulfur (S)	N/A	N/A	3	7.7	10	-	20	14	6.9	17	8.1	14	21	6.4
Antimony (Sb)	N/A	N/A	<0.0006	<0.0006	<0.0006	-	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006
Selenium (Se)	0.001 mg/L	N/A	<0.0002	0.0011	0.0006	-	0.0014	0.0004	<0.0002	0.0006	0.00033	<0.0002	0.0011	0.00036
Silicon (Si)	N/A	N/A	4.4	6	1.2	-	5.2	1.4	8.1	0.92	1.3	5.6	4.4	4
Tin (Sn)	N/A	N/A	<0.001	<0.001	<0.001	-	<0.001	<0.001	0.0013	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium (Sr)	N/A	N/A	0.63	0.85	0.37	-	0.74	0.52	0.58	0.64	0.51	0.53	0.72	0.62
Sodium (Na)	N/A	N/A	49	34	23	-	44	34	45	38	26	39	45	34
Titanium (Ti)	N/A	N/A	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium (Tl)	0.0008 mg/L	N/A	<0.0002	<0.0002	<0.0002	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Uranium (U)	0.015mg/L	0.033 mg/L	0.00044	0.0031	0.0023	-	0.0048	0.0083	0.0018	0.0059	0.0052	0.0022	0.0043	0.0056
Vanadium (V)	N/A	N/A	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (Zn)	0.007 mg/L	0.037mg/L	<0.003	<0.003	<0.003	-	0.013	<0.003	<0.003	<0.003	<0.003	0.0051	<b>0.018</b>	<0.003
Major Ions and Salts														
Chloride (Cl-)	120	640	12	41	51	-	12	29	17	13	12	27	7.3	12
Sulfate (SO4-)	N/A	N/A	6.6	24	34	-	59	40	21	56	24	40	65	20

**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.

### 5.1.2 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 Year 1 and Year 2 of 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** and demonstrates the natural variability in water quality between sites and season in Wetland 06.

**Chloride:** Water quality sampling of Wetland 06 in 2019 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 2019 spring site visit measured a chloride concentration of 13 mg/L and 12 mg/L at the WQ-02 and WQ-03 sample locations, respectively. During the 2019 fall site visit measured a chloride concentration of 7.5 mg/L and 12 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 several heavy rainfall events, occurring prior to Year 1 sampling in 2018, which resulting in overland runoff into Wetland 06. Following this event, KGL installed a series of culverts which directs Project-affected water away from the flow pathways into Wetland 06, and into settling ponds. A comparison between Year 1 (i.e., 2018) and Year 2 (i.e., 2019) of sampling shows that although chloride remains elevated from pre-construction levels, the chloride concentration at both Wetland 06 sample sites has decreased in 2019. 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 2019 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 2019 spring site visit measured a conductivity of 712  $\mu\text{S}/\text{cm}$  and 575  $\mu\text{S}/\text{cm}$  at the WQ-02 and WQ-03 sample locations, respectively. During the 2019 fall site visit measured a conductivity of 698  $\mu\text{S}/\text{cm}$  and 766  $\mu\text{S}/\text{cm}$  at the WQ-02 and WQ-03 sample locations, respectively. A comparison between Year 1 (i.e., 2018) and Year 2 (i.e., 2019) of sampling shows that although conductivity remains elevated from pre-construction levels, the conductivity sampled from WQ-02 has decreased in 2019.

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  $\mu\text{S}/\text{cm}$  and 1,500  $\mu\text{S}/\text{cm}$  (BC Ministry of Environment 2013). Variation in conductivity measured in Wetland 06 falls within this range.



**Table 5 Surface Water Quality Parameters Collected from Wetland 06 Sites from 2016 to 2019**

Surface Water Quality Parameters of Wetland 06									
		2016 <sup>1</sup>		2017 <sup>1</sup>		2018 <sup>2</sup>		2019 <sup>3</sup>	
		Summer	Fall	Summer	Fall	Summer	Fall	Spring <sup>4</sup>	Fall
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
	Temperature C	11.9	4.0	14.6	4.2	19.1	1.1	12.30	3.25
	pH	7.6	7.9	7.53	8.07	7.6	6.5	8.0	8.2
	Conductivity (nS/cm)	470	444	589	500	882	833	712	698
	DO (mg/L)	5.20	10.48	2.03	9.12	10.5	9.8	7.2	10.0
	Phosphate (mg/L)	0	0	0.01	0.01	0.0068	0.0034	0.0037	<0.003
	Chloride (mg/L)	2.88	5.26	3.68	5.25	41	12	13	7.3
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
	Temperature C	12.2	4.1	10.7	2.4	20.6	0.5	16.06	3.87
	pH	8	8	7.95	8.15	8.9	6.8	8.27	8.19
	Conductivity (nS/cm)	469	449	523	491	509	688	575	766
	DO (mg/L)	5.3	5.1	2.65	9.99	14.4	5.8	8.68	7.31
	Phosphate (mg/L)	0.16	0.01	0	0	0.0085	0.0085	0.0039	<0.003
	Chloride (mg/L)	4.18	5.85	7.70	4.68	51	29	12	12

**Note:** <sup>1</sup> Porto 2018

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

<sup>3</sup> Data collected at WQ-02 and WQ-03 in 2019 as part of the Monitoring Plan

## 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 2**). Information on channel width, channel depth, velocity and discharge were collected during each monitoring visit; the results are summarized in **Table 6a** and **Table 6b**.

Following procedures specified in the Monitoring Plan, and recommendations made following Year 1 surface water flow monitoring, the initial 2019 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) 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 had surface water present, but no measurable velocity in the channel. 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) monitoring.

**Table 6a 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	-	-	-	-
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	-	-	-	-

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

**Table 6b 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	-	-	-	-
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	-	-	-	-

**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 7**. 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) monitoring.

The staff gauge installed to measure water depths at Wetland 06 was located in an area which was intermittently within the wetted width of the wetland and did not accurately reflected water depths. As a result, water depth comparisons between the reference wetland and Wetland 06 were not completed during Year 2 monitoring; staff gauges will be relocated during Year 3 monitoring to a mid channel location to ensure water depths are accurately reflected during all monitoring visits.

**Table 7 Summary of Wetted Width Measurements from 2016 to 2019**

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

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

## 6.0 SUMMARY

Monitoring effort conducted in 2019 represents Year 2 of the Wetland 06 monitoring program. This report presents the 2019 results which will add to the sampling record within the Project area and facilitate additional comparison in subsequent monitoring years. Year 2 of the monitoring program was completed according to the criteria specified in the Monitoring Plan.

During Year 2 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 zinc exceeded CCME criteria for the protection of aquatic life during fall sampling. Within the reference wetland, DO did not meet guidelines for the protection of aquatic life during fall sampling.
- The two parameters previously identified as exceeding CCME criteria in 2018 (i.e., pH and DO) were no longer in exceedance within Wetland 06.
- Chloride and conductivity concentrations measured in Wetland 06 in 2019 were higher than historic measurements taken in 2016 and 2017. A comparison between Year 1 (i.e., 2018) and Year 2 (i.e., 2019) of sampling shows that although chloride remains elevated from pre-construction levels, the chloride concentration at both Wetland 06 sample sites has decreased in 2019.
- Initial site visits were conducted earlier in the year (i.e., 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. During the fall site visit the reference wetland was dry.



## 7.0 RECOMMENDATIONS

Based on the results of the Year 2 (i.e., 2019) monitoring program, the following recommendations are suggested for monitoring in 2020:

- Monitoring of water quality and quantity should be continued in 2020 using similar methods and effort as employed in 2019 and outlined in the Monitoring Plan.
- Water quality monitoring efforts will continue in Year 3 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 were in exceedance of CCME guidance during the Year 1 and 2 monitoring periods; 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 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 30 days of the original date of sample collection to verify results and attempt to identify potential project-related sources of elevated levels.
  - 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 in Year 1 and Year 2.
- Water flow monitoring will continue in Year 3 to determine if surface water quantity within Wetland 06 has been influenced by activities related to the SWCRR Project.
- The staff gauges used to measure water depth within Wetland 06 and the reference wetland should be relocated to an area that maintains surface water throughout the year (i.e., mid channel).

## 8.0 CLOSURE

The results of Year 2 monitoring provide initial comparison of the results of two years of monitoring the surface water quality parameters of Wetland 06 following the initiation of construction phase of the SWCRR; Year 2 results will be compared against 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](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](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.
- 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. 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.
- 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

<b>1.0</b>	<b>INTRODUCTION.....</b>	<b>1</b>
1.1	Monitoring Objectives.....	1
<b>2.0</b>	<b>DESCRIPTION OF WETLAND 06 .....</b>	<b>2</b>
<b>3.0</b>	<b>MONITORING SCHEDULE .....</b>	<b>3</b>
<b>4.0</b>	<b>METHODOLOGY .....</b>	<b>4</b>
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
<b>5.0</b>	<b>CLOSURE.....</b>	<b>9</b>
<b>6.0</b>	<b>REFERENCES.....</b>	<b>10</b>

## 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 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 <sup>a</sup>											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1. Water Quality Monitoring <sup>b</sup>												
2. Water Flow Monitoring <sup>b</sup>												
3. Seasonal Data Summary <sup>c</sup>												
4. Annual Report <sup>d</sup>												

<sup>a</sup> Plan year includes construction phase and first five years of the operational phase.

<sup>b</sup> 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.

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

<sup>d</sup>The 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	
<ul style="list-style-type: none"> <li>• Total Suspended Solids (TSS)</li> <li>• Total Dissolved Solids (TDS)</li> <li>• Turbidity</li> </ul>	<ul style="list-style-type: none"> <li>• Conductivity (EC)</li> <li>• pH</li> <li>• Dissolved Oxygen (DO)</li> </ul>
Nutrients and Others (mg/L)	
<ul style="list-style-type: none"> <li>• Biochemical Oxygen Demand (BOD)</li> <li>• Chemical Oxygen Demand (COD)</li> <li>• Nitrate (NO<sub>3</sub>)</li> <li>• Nitrite (NO<sub>2</sub>)</li> </ul>	<ul style="list-style-type: none"> <li>• Total Kjeldahl Nitrogen (TKN)</li> <li>• Ammonia-Nitrogen (NH<sub>3</sub>-N)</li> <li>• Total Phosphorus (TP)</li> <li>• Dissolved Reactive Phosphorus (TDP)</li> <li>• Ortho-Phosphate</li> </ul>

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 <sup>2+</sup> )	• Calcium (Ca <sup>2+</sup> )		
• Potassium (K <sup>+</sup> )	• Chloride (Cl <sup>-</sup> )		
• Potassium (K <sup>+</sup> )	• Sulfate (SO <sup>4-</sup> )		

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](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](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](http://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.

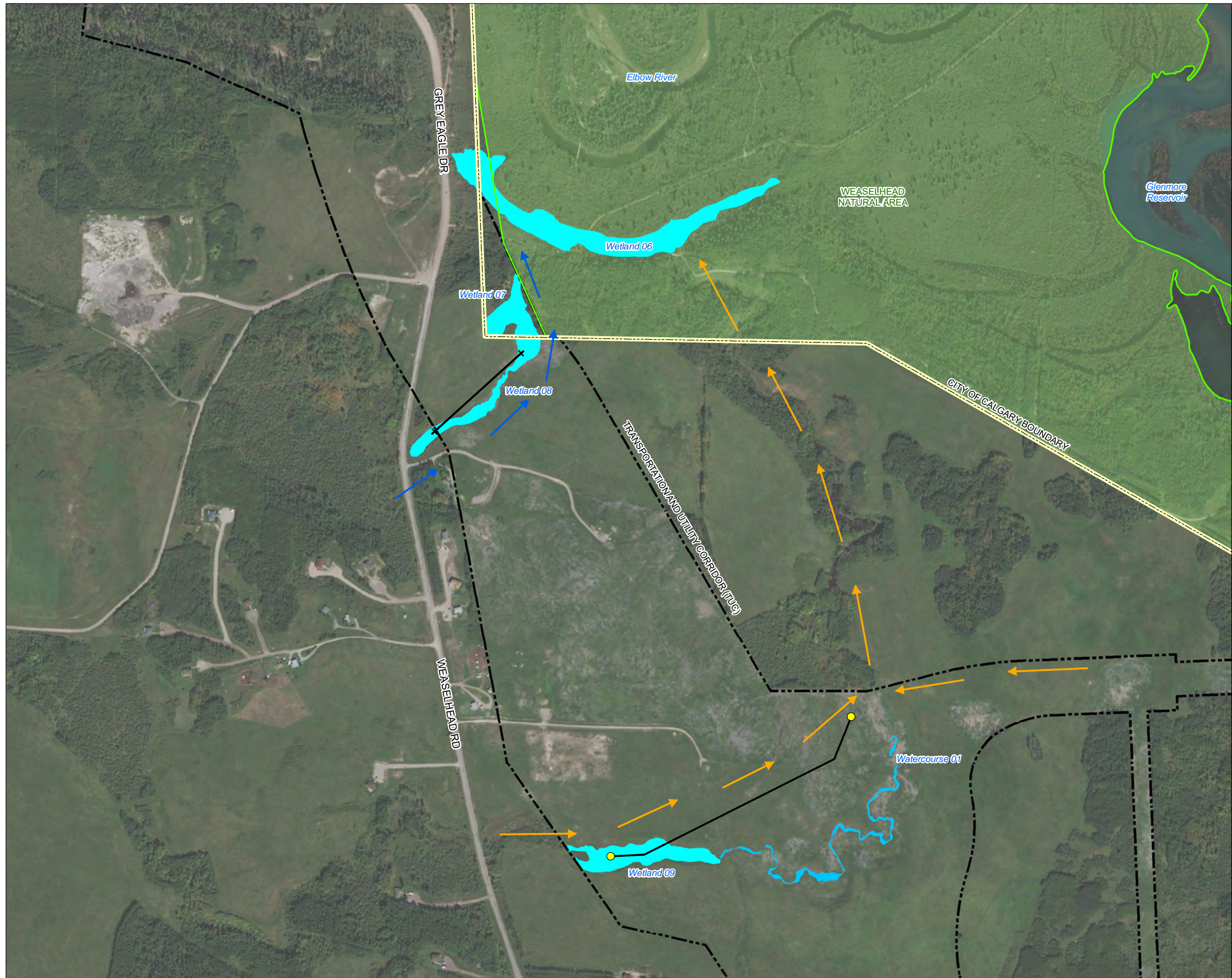


# FIGURES

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

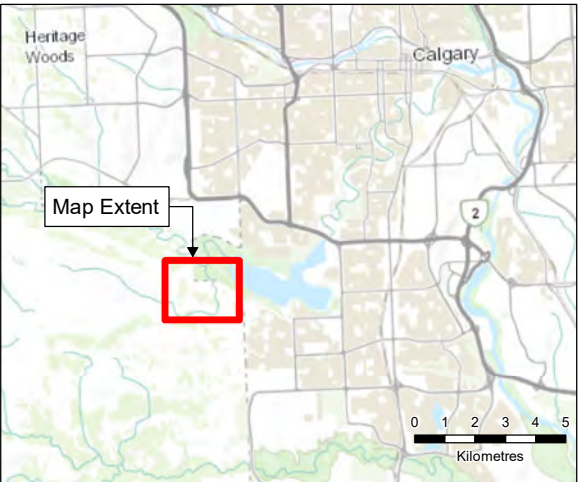


Path: S:\Geomatics\Projects\102604\01\mxd\fig\_1\102604\_01\_Wetland\_Location\_180517.mxd



2018 Wetland Monitoring Program  
Weaselhead Rd, Calgary AB

Wetland Locations



Legend

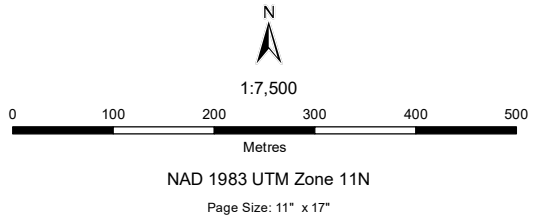
- +— Bypass Culvert
- Pathway #1 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow
- Stormwater Drainage Line
- - - City of Calgary Boundary
- Natural Area
- - - Transportation and Utility Corridor (TUC)
- Watercourse
- Wetland

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.

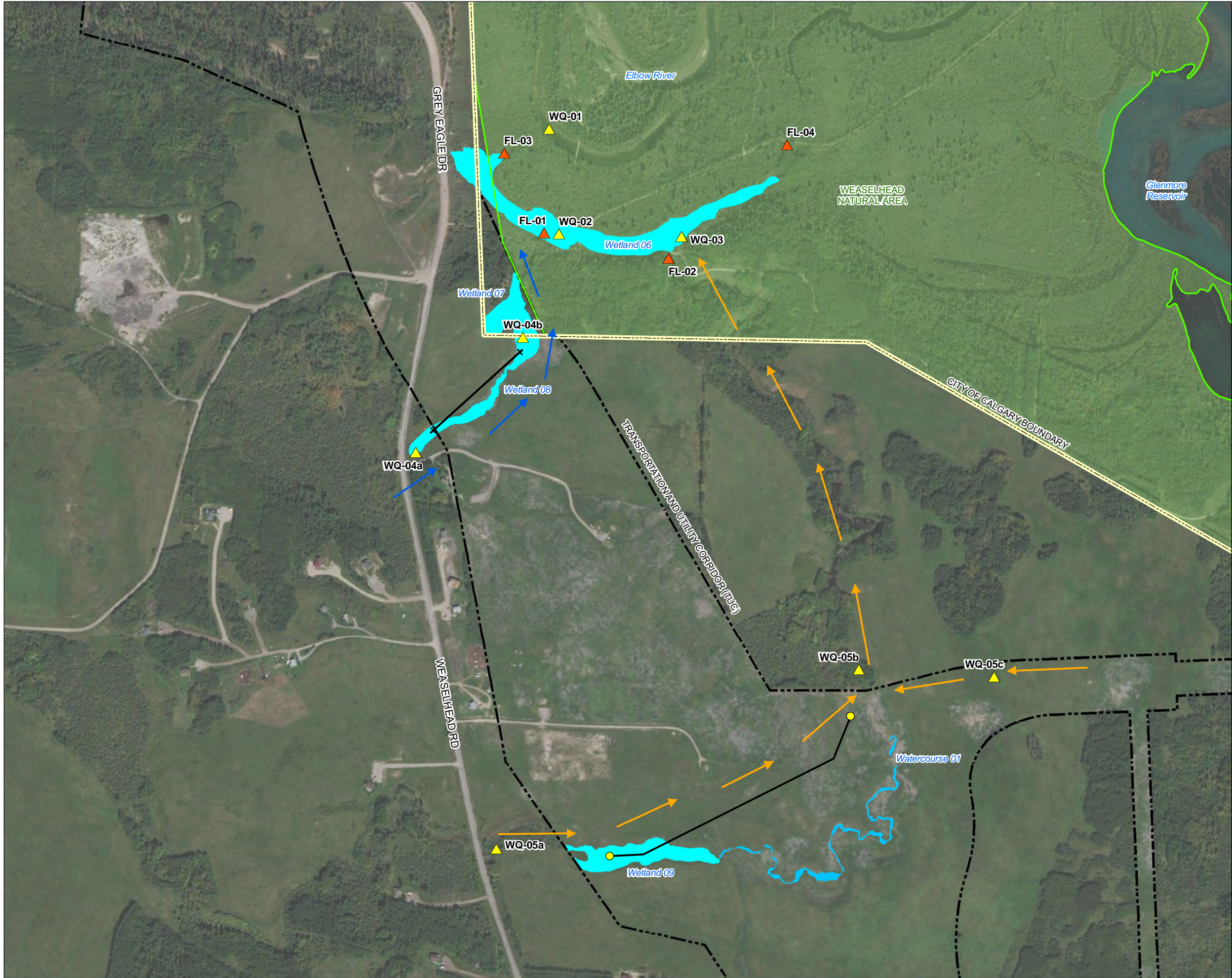
Sources

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



102604-01      Production Date: May 17, 2018      Figure 1





**Water Flow and Quality  
Sampling Locations**

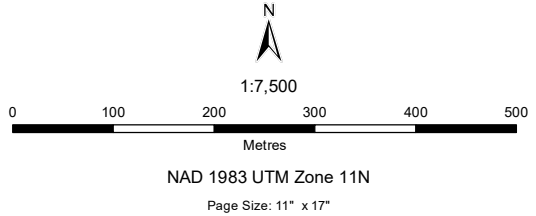
- Legend**
- ▲ Water Flow Sample Location (Hemmera, 2018)
  - ▲ Water Quality Sample Location (Hemmera, 2018)
  - ✚ Bypass Culvert
  - ➡ Pathway #1 Approximate Direction of Flow
  - ➡ Pathway #2 Approximate Direction of Flow
  - Stormwater Drainage Line
  - City of Calgary Boundary
  - Natural Area
  - 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







Water Flow and Quality  
Sampling Location Details

Legend

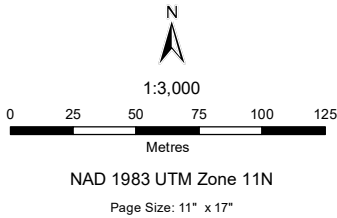
- Water Flow Sample Location (Hemmera, 2018)
- Water Quality Sample Location (Hemmera, 2018)
- Bypass Culvert
- Pathway #1 Approximate Direction of Flow
- Pathway #2 Approximate Direction of Flow
- City of Calgary Boundary
- Natural Area
- Transportation and Utility Corridor (TUC)
- Wetland

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



Path: S:\Geomatics\Projects\102604\01\mxd\fig\_102604\_01\_Sample\_Locations\_Details\_180517.mxd



## **APPENDIX B**

### **Raw Water Quality Data**



Your Project #: 102604-01  
Your C.O.C. #: 583206-01-01

**Attention: Jessica Eaton**

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

**Report Date: 2019/06/07**

Report #: R2734345

Version: 1 - Final

## CERTIFICATE OF ANALYSIS

**BV LABS JOB #: B940971**

**Received: 2019/05/29, 17:00**

Sample Matrix: Water  
# Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO <sub>3</sub> ,HCO <sub>3</sub> ,OH	4	N/A	2019/06/04	AB SOP-00005	SM 23 2320 B m
Biochemical Oxygen Demand	7	2019/05/30	2019/06/04	AB SOP-00017	SM 23 5210B m
Cadmium - low level CCME - Dissolved	7	N/A	2019/06/02		Auto Calc
Chloride by Automated Colourimetry	4	N/A	2019/06/06	AB SOP-00020	SM 23-4500-Cl-E m
COD by Colorimeter	3	N/A	2019/05/31	AB SOP-00016	SM 23 5220D m
Oxygen (Dissolved, winkler) (1)	7	N/A	2019/05/31	AB SOP-00058	SM 23 4500-O C m
Conductivity @25C	4	N/A	2019/06/04	AB SOP-00005	SM 23 2510 B m
Hardness	4	N/A	2019/06/01		Auto Calc
Elements by ICP - Dissolved (2)	7	N/A	2019/05/30	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (2)	7	N/A	2019/05/31	AB SOP-00043	EPA 6020b R2 m
Ion Balance	4	N/A	2019/05/30		Auto Calc
Sum of cations, anions	4	N/A	2019/06/01		Auto Calc
Ammonia-N (Total)	1	N/A	2019/05/30	AB SOP-00007	SM 23 4500 NH3 A G m
Ammonia-N (Total)	2	N/A	2019/05/31	AB SOP-00007	SM 23 4500 NH3 A G m
Nitrate and Nitrite	7	N/A	2019/06/02		Auto Calc
Nitrate + Nitrite-N (calculated)	7	N/A	2019/06/02		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	7	N/A	2019/05/31	AB SOP-00023	SM 23 4110 B m
pH @25°C (3)	4	N/A	2019/06/04	AB SOP-00005	SM 23 4500-H+B m
Orthophosphate by Konelab (4)	6	N/A	2019/05/30	AB SOP-00025	SM 23 4500-P A,F m
Orthophosphate by Konelab (4)	1	N/A	2019/05/31	AB SOP-00025	SM 23 4500-P A,F m
Sulphate by Automated Colourimetry	4	N/A	2019/06/06	AB SOP-00018	SM 23 4500-SO4 E m
Total Dissolved Solids (Filt. Residue)	3	2019/06/03	2019/06/03	AB SOP-00065	SM 23 2540 C m
Total Dissolved Solids (Calculated)	4	N/A	2019/06/06		Auto Calc
Total Kjeldahl Nitrogen	3	2019/06/04	2019/06/04	AB SOP-00008	EPA 351.1 R1978 m
Phosphorus -P (Total, Dissolved) (5)	2	2019/06/03	2019/06/03	AB SOP-00024	SM 23 4500-P A,B,F m
Phosphorus -P (Total, Dissolved) (5)	1	2019/06/04	2019/06/04	AB SOP-00024	SM 23 4500-P A,B,F m
Total Phosphorus	1	2019/06/04	2019/06/04	AB SOP-00024	SM 23 4500-P A,B,F m
Total Phosphorus	2	2019/06/04	2019/06/05	AB SOP-00024	SM 23 4500-P A,B,F m
Total Suspended Solids (NFR)	3	2019/06/04	2019/06/04	AB SOP-00061	SM 23 2540 D m
Turbidity	7	N/A	2019/05/31	CAL SOP-00081	SM 23 2130 B m

**Remarks:**



Your Project #: 102604-01  
Your C.O.C. #: 583206-01-01

**Attention: Jessica Eaton**

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

**Report Date: 2019/06/07**

Report #: R2734345

Version: 1 - Final

## **CERTIFICATE OF ANALYSIS**

**BV LABS JOB #: B940971**

**Received: 2019/05/29, 17:00**

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, MDDELCC, 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.

(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.





Your Project #: 102604-01  
Your C.O.C. #: 583206-01-01

**Attention: Jessica Eaton**

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

**Report Date: 2019/06/07**

Report #: R2734345

Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BV LABS JOB #: B940971**

**Received: 2019/05/29, 17:00**

Encryption Key



**AUTHORIZED REPORT  
RAPPORT AUTORISÉ**

Bureau Veritas Laboratories

07 Jun 2019 15:11:34

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

Gail Pedersen, Key Account Specialist

Email: GPedersen@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 section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BUREAU  
VERITAS

BV Labs Job #: B940971

Report Date: 2019/06/07

HEMMERA ENVIROCHEM INC.

Client Project #: 102604-01

**ROUTINE WATER & DISS. REGULATED METALS (WATER)**

BV Labs ID		VT6457	VT6458	VT6459	VT6463		
Sampling Date		2019/05/29 09:25	2019/05/29 11:20	2019/05/29 10:20	2019/05/29 15:00		
COC Number		583206-01-01	583206-01-01	583206-01-01	583206-01-01		
	UNITS	WQ1	WQ2	WQ3	WQ5B	RDL	QC Batch
<b>Calculated Parameters</b>							
Anion Sum	meq/L	11	8.6	7.5	11	N/A	9440358
Cation Sum	meq/L	11	8.5	7.6	11	N/A	9440358
Hardness (CaCO <sub>3</sub> )	mg/L	430	340	320	480	0.50	9440347
Ion Balance (% Difference)	%	0.12	0.27	0.90	0.042	N/A	9440352
Dissolved Nitrate (NO <sub>3</sub> )	mg/L	<0.044	<0.044	<0.044	1.8	0.044	9440367
Nitrate plus Nitrite (N)	mg/L	<0.014	<0.014	<0.014	0.42	0.014	9440372
Dissolved Nitrite (NO <sub>2</sub> )	mg/L	<0.033	<0.033	<0.033	<0.033	0.033	9440367
Calculated Total Dissolved Solids	mg/L	520	430	370	560	1.0	9440380
<b>Misc. Inorganics</b>							
Conductivity	uS/cm	970	780	690	990	2.0	9448003
pH	pH	7.97	8.26	8.33	8.18	N/A	9448002
<b>Low Level Elements</b>							
Dissolved Cadmium (Cd)	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	0.000020	9440606
<b>Anions</b>							
Alkalinity (PP as CaCO <sub>3</sub> )	mg/L	<1.0	<1.0	<1.0	<1.0	1.0	9447998
Alkalinity (Total as CaCO <sub>3</sub> )	mg/L	490	350	330	420	1.0	9447998
Bicarbonate (HCO <sub>3</sub> )	mg/L	590	430	400	510	1.0	9447998
Carbonate (CO <sub>3</sub> )	mg/L	<1.0	<1.0	<1.0	<1.0	1.0	9447998
Hydroxide (OH)	mg/L	<1.0	<1.0	<1.0	<1.0	1.0	9447998
Dissolved Sulphate (SO <sub>4</sub> )	mg/L	21	56	24	110	1.0	9451665
Dissolved Chloride (Cl)	mg/L	17	13	12	11	1.0	9451598
<b>Nutrients</b>							
Dissolved Nitrite (N)	mg/L	<0.010	<0.010	<0.010	<0.010	0.010	9441387
Dissolved Nitrate (N)	mg/L	<0.010	<0.010	<0.010	0.42	0.010	9441387
<b>Elements</b>							
Dissolved Aluminum (Al)	mg/L	<0.0030	<0.0030	0.0050	<0.0030	0.0030	9443807
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	<0.00060	<0.00060	0.00060	9443807
Dissolved Arsenic (As)	mg/L	0.00063	0.00080	0.0011	0.00040	0.00020	9443807
Dissolved Barium (Ba)	mg/L	0.15	0.14	0.15	0.13	0.010	9441336
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9443807
Dissolved Boron (B)	mg/L	0.032	0.046	0.031	0.030	0.020	9441336
Dissolved Calcium (Ca)	mg/L	93	58	57	92	0.30	9441336
RDL = Reportable Detection Limit N/A = Not Applicable							



BV Labs Job #: B940971  
Report Date: 2019/06/07

HEMMERA ENVIROCHEM INC.  
Client Project #: 102604-01

### ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		VT6457	VT6458	VT6459	VT6463		
Sampling Date		2019/05/29 09:25	2019/05/29 11:20	2019/05/29 10:20	2019/05/29 15:00		
COC Number		583206-01-01	583206-01-01	583206-01-01	583206-01-01		
	UNITS	WQ1	WQ2	WQ3	WQ5B	RDL	QC Batch
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9443807
Dissolved Cobalt (Co)	mg/L	<0.00030	<0.00030	<0.00030	<0.00030	0.00030	9443807
Dissolved Copper (Cu)	mg/L	0.00085	0.00071	0.00047	0.00077	0.00020	9443807
Dissolved Iron (Fe)	mg/L	0.20	0.083	0.076	0.081	0.060	9441336
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	9443807
Dissolved Lithium (Li)	mg/L	<0.020	<0.020	<0.020	0.020	0.020	9441336
Dissolved Magnesium (Mg)	mg/L	48	47	42	60	0.20	9441336
Dissolved Manganese (Mn)	mg/L	0.063	0.016	0.0098	0.0058	0.0040	9441336
Dissolved Molybdenum (Mo)	mg/L	0.0010	0.0025	0.0025	0.0017	0.00020	9443807
Dissolved Nickel (Ni)	mg/L	0.00079	0.00080	0.0011	<0.00050	0.00050	9443807
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	<0.10	0.10	9441336
Dissolved Potassium (K)	mg/L	3.7	4.7	5.8	4.3	0.30	9441336
Dissolved Selenium (Se)	mg/L	<0.00020	0.00060	0.00033	0.0048	0.00020	9443807
Dissolved Silicon (Si)	mg/L	8.1	0.92	1.3	5.2	0.10	9441336
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	9443807
Dissolved Sodium (Na)	mg/L	45	38	26	32	0.50	9441336
Dissolved Strontium (Sr)	mg/L	0.58	0.64	0.51	0.76	0.020	9441336
Dissolved Sulphur (S)	mg/L	6.9	17	8.1	35	0.20	9441336
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	9443807
Dissolved Tin (Sn)	mg/L	0.0013	<0.0010	<0.0010	<0.0010	0.0010	9443807
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9443807
Dissolved Uranium (U)	mg/L	0.0018	0.0059	0.0052	0.0094	0.00010	9443807
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9443807
Dissolved Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	0.0030	9443807
RDL = Reportable Detection Limit							

BUREAU  
VERITAS

BV Labs Job #: B940971  
Report Date: 2019/06/07

HEMMERA ENVIROCHEM INC.  
Client Project #: 102604-01

### REGULATED METALS (CCME/AT1) - DISSOLVED

BV Labs ID		VT6460	VT6461	VT6462		
Sampling Date		2019/05/29 12:00	2019/05/29 12:30	2019/05/29 14:40		
COC Number		583206-01-01	583206-01-01	583206-01-01		
	UNITS	WQ4A	WQ4B	WQ5A	RDL	QC Batch
<b>Low Level Elements</b>						
Dissolved Cadmium (Cd)	mg/L	<0.000020	<0.000020	<0.000020	0.000020	9440606
<b>Elements</b>						
Dissolved Aluminum (Al)	mg/L	<0.0030	<0.0030	<0.0030	0.0030	9443807
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	<0.00060	0.00060	9443807
Dissolved Arsenic (As)	mg/L	<0.00020	0.00068	0.0017	0.00020	9443807
Dissolved Barium (Ba)	mg/L	0.062	0.10	0.092	0.010	9441336
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9443807
Dissolved Boron (B)	mg/L	0.045	0.049	0.054	0.020	9441336
Dissolved Calcium (Ca)	mg/L	70	72	88	0.30	9441336
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9443807
Dissolved Cobalt (Co)	mg/L	<0.00030	<0.00030	<0.00030	0.00030	9443807
Dissolved Copper (Cu)	mg/L	<0.00020	0.00021	0.0013	0.00020	9443807
Dissolved Iron (Fe)	mg/L	<0.060	0.077	0.13	0.060	9441336
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9443807
Dissolved Lithium (Li)	mg/L	<0.020	0.020	0.027	0.020	9441336
Dissolved Magnesium (Mg)	mg/L	38	45	61	0.20	9441336
Dissolved Manganese (Mn)	mg/L	<0.0040	0.069	0.053	0.0040	9441336
Dissolved Molybdenum (Mo)	mg/L	0.0022	0.0017	0.0093	0.00020	9443807
Dissolved Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	9443807
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	0.10	9441336
Dissolved Potassium (K)	mg/L	3.6	3.9	6.4	0.30	9441336
Dissolved Selenium (Se)	mg/L	0.0028	0.0013	0.00043	0.00020	9443807
Dissolved Silicon (Si)	mg/L	4.2	4.0	6.3	0.10	9441336
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	9443807
Dissolved Sodium (Na)	mg/L	37	39	37	0.50	9441336
Dissolved Strontium (Sr)	mg/L	0.67	0.72	0.76	0.020	9441336
Dissolved Sulphur (S)	mg/L	17	19	50	0.20	9441336
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9443807
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9443807
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9443807
Dissolved Uranium (U)	mg/L	0.0043	0.0038	0.029	0.00010	9443807
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9443807
Dissolved Zinc (Zn)	mg/L	<0.0030	0.19	0.0031	0.0030	9443807
RDL = Reportable Detection Limit						

BUREAU  
VERITAS

BV Labs Job #: B940971

Report Date: 2019/06/07

HEMMERA ENVIROCHEM INC.

Client Project #: 102604-01

**RESULTS OF CHEMICAL ANALYSES OF WATER**

BV Labs ID		VT6457		VT6458			VT6459		
Sampling Date		2019/05/29 09:25		2019/05/29 11:20			2019/05/29 10:20		
COC Number		583206-01-01		583206-01-01			583206-01-01		
	UNITS	WQ1	QC Batch	WQ2	RDL	QC Batch	WQ3	RDL	QC Batch
<b>Demand Parameters</b>									
Biochemical Oxygen Demand	mg/L	<2.0	9441167	<2.0	2.0	9441167	<2.0	2.0	9441167
Chemical Oxygen Demand	mg/L	30	9442588	30	10	9442588	40	10	9442588
<b>Misc. Inorganics</b>									
Dissolved Oxygen (O2)	mg/L	5.1	9442591	7.7	0.10	9442591	7.9	0.10	9442591
Total Dissolved Solids	mg/L	570	9446658	450	10	9446658	390	10	9446658
Total Suspended Solids	mg/L	3.1	9448049	2.1	1.0	9448049	14 (1)	6.0	9448049
<b>Nutrients</b>									
Total Ammonia (N)	mg/L	0.030	9441410	0.027	0.015	9441410	<0.015	0.015	9436065
Orthophosphate (P)	mg/L	0.013	9440879	0.0037	0.0030	9440879	0.0039	0.0030	9440879
Dissolved Phosphorus (P)	mg/L	0.0065	9447760	0.0049	0.0030	9444509	0.0060	0.0030	9444509
Total Phosphorus (P)	mg/L	0.018	9448021	0.014	0.0030	9448021	0.016	0.0030	9448021
Total Total Kjeldahl Nitrogen	mg/L	0.58	9447323	0.55	0.050	9447323	0.64	0.050	9447323
<b>Physical Properties</b>									
Turbidity	NTU	3.3	9443506	2.0	0.10	9443506	1.8	0.10	9443506
RDL = Reportable Detection Limit									
(1) Detection limit raised based on sample volume used for analysis.									

BUREAU  
VERITAS

BV Labs Job #: B940971

Report Date: 2019/06/07

HEMMERA ENVIROCHEM INC.

Client Project #: 102604-01

**RESULTS OF CHEMICAL ANALYSES OF WATER**

<b>BV Labs ID</b>		VT6460		VT6461		VT6462		
<b>Sampling Date</b>		2019/05/29 12:00		2019/05/29 12:30		2019/05/29 14:40		
<b>COC Number</b>		583206-01-01		583206-01-01		583206-01-01		
	<b>UNITS</b>	<b>WQ4A</b>	<b>QC Batch</b>	<b>WQ4B</b>	<b>QC Batch</b>	<b>WQ5A</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Calculated Parameters</b>								
Dissolved Nitrate (NO3)	mg/L	3.4	9440367	0.32	9440367	0.11	0.044	9440367
Nitrate plus Nitrite (N)	mg/L	0.77	9440372	0.073	9440372	0.024	0.014	9440372
Dissolved Nitrite (NO2)	mg/L	<0.033	9440367	<0.033	9440367	<0.033	0.033	9440367
<b>Demand Parameters</b>								
Biochemical Oxygen Demand	mg/L	<2.0	9441167	<2.0	9441167	4.0	2.0	9441167
<b>Misc. Inorganics</b>								
Dissolved Oxygen (O2)	mg/L	1.8	9442591	8.9	9442591	9.6	0.10	9442591
<b>Nutrients</b>								
Orthophosphate (P)	mg/L	0.0056	9440879	0.010	9443386	0.035	0.0030	9440879
Dissolved Nitrite (N)	mg/L	<0.010	9441387	<0.010	9441387	<0.010	0.010	9441387
Dissolved Nitrate (N)	mg/L	0.77	9441387	0.073	9441387	0.024	0.010	9441387
<b>Physical Properties</b>								
Turbidity	NTU	0.74	9443506	2.0	9443506	1.6	0.10	9443506
RDL = Reportable Detection Limit								

<b>BV Labs ID</b>		VT6463		
<b>Sampling Date</b>		2019/05/29 15:00		
<b>COC Number</b>		583206-01-01		
	<b>UNITS</b>	<b>WQ5B</b>	<b>RDL</b>	<b>QC Batch</b>
<b>Demand Parameters</b>				
Biochemical Oxygen Demand	mg/L	<2.0	2.0	9441167
<b>Misc. Inorganics</b>				
Dissolved Oxygen (O2)	mg/L	10	0.10	9442591
<b>Nutrients</b>				
Orthophosphate (P)	mg/L	0.0072	0.0030	9440879
<b>Physical Properties</b>				
Turbidity	NTU	2.4	0.10	9443506
RDL = Reportable Detection Limit				



BUREAU  
VERITAS

BV Labs Job #: B940971

Report Date: 2019/06/07

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	7.3°C

Sample VT6457 [WQ1] : Orthophosphate (PO<sub>4</sub>) is greater than total phosphorus; Reanalysis yields similar results.

**Results relate only to the items tested.**





BV Labs Job #: B940971  
Report Date: 2019/06/07

HEMMERA ENVIROCHEM INC.  
Client Project #: 102604-01

### QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9436065	JLD	Matrix Spike	Total Ammonia (N)	2019/05/30		93	%	80 - 120
9436065	JLD	Spiked Blank	Total Ammonia (N)	2019/05/30		108	%	80 - 120
9436065	JLD	Method Blank	Total Ammonia (N)	2019/05/30	<0.015		mg/L	
9436065	JLD	RPD	Total Ammonia (N)	2019/05/30	7.1		%	20
9440879	FM0	Matrix Spike	Orthophosphate (P)	2019/05/30		94	%	80 - 120
9440879	FM0	Spiked Blank	Orthophosphate (P)	2019/05/30		98	%	80 - 120
9440879	FM0	Method Blank	Orthophosphate (P)	2019/05/30	<0.0030		mg/L	
9440879	FM0	RPD	Orthophosphate (P)	2019/05/30	2.5		%	20
9441167	PK8	Spiked Blank	Biochemical Oxygen Demand	2019/06/04		94	%	85 - 115
9441167	PK8	Method Blank	Biochemical Oxygen Demand	2019/06/04	<2.0		mg/L	
9441167	PK8	RPD [VT6457-02]	Biochemical Oxygen Demand	2019/06/04	NC		%	20
9441336	ALX	Matrix Spike	Dissolved Barium (Ba)	2019/05/30		94	%	80 - 120
			Dissolved Boron (B)	2019/05/30		98	%	80 - 120
			Dissolved Calcium (Ca)	2019/05/30		NC	%	80 - 120
			Dissolved Iron (Fe)	2019/05/30		98	%	80 - 120
			Dissolved Lithium (Li)	2019/05/30		93	%	80 - 120
			Dissolved Magnesium (Mg)	2019/05/30		95	%	80 - 120
			Dissolved Manganese (Mn)	2019/05/30		100	%	80 - 120
			Dissolved Phosphorus (P)	2019/05/30		105	%	80 - 120
			Dissolved Potassium (K)	2019/05/30		96	%	80 - 120
			Dissolved Silicon (Si)	2019/05/30		98	%	80 - 120
			Dissolved Sodium (Na)	2019/05/30		90	%	80 - 120
			Dissolved Strontium (Sr)	2019/05/30		92	%	80 - 120
			Dissolved Sulphur (S)	2019/05/30		96	%	80 - 120
9441336	ALX	Spiked Blank	Dissolved Barium (Ba)	2019/05/30		91	%	80 - 120
			Dissolved Boron (B)	2019/05/30		93	%	80 - 120
			Dissolved Calcium (Ca)	2019/05/30		96	%	80 - 120
			Dissolved Iron (Fe)	2019/05/30		95	%	80 - 120
			Dissolved Lithium (Li)	2019/05/30		89	%	80 - 120
			Dissolved Magnesium (Mg)	2019/05/30		95	%	80 - 120
			Dissolved Manganese (Mn)	2019/05/30		97	%	80 - 120
			Dissolved Phosphorus (P)	2019/05/30		95	%	80 - 120
			Dissolved Potassium (K)	2019/05/30		92	%	80 - 120
			Dissolved Silicon (Si)	2019/05/30		89	%	80 - 120
			Dissolved Sodium (Na)	2019/05/30		91	%	80 - 120
			Dissolved Strontium (Sr)	2019/05/30		92	%	80 - 120
			Dissolved Sulphur (S)	2019/05/30		93	%	80 - 120
9441336	ALX	Method Blank	Dissolved Barium (Ba)	2019/05/30	<0.010		mg/L	
			Dissolved Boron (B)	2019/05/30	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/05/30	<0.30		mg/L	
			Dissolved Iron (Fe)	2019/05/30	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/05/30	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/05/30	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/05/30	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2019/05/30	<0.10		mg/L	
			Dissolved Potassium (K)	2019/05/30	<0.30		mg/L	
			Dissolved Silicon (Si)	2019/05/30	<0.10		mg/L	
			Dissolved Sodium (Na)	2019/05/30	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/05/30	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/05/30	<0.20		mg/L	
9441336	ALX	RPD	Dissolved Calcium (Ca)	2019/05/30	0.22		%	20
			Dissolved Iron (Fe)	2019/05/30	NC		%	20
			Dissolved Magnesium (Mg)	2019/05/30	0.76		%	20
			Dissolved Manganese (Mn)	2019/05/30	0.78		%	20
			Dissolved Potassium (K)	2019/05/30	0.58		%	20



BV Labs Job #: B940971  
Report Date: 2019/06/07

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
9441387	CT6	Matrix Spike	Dissolved Sodium (Na)	2019/05/30	0.14		%	20
			Dissolved Nitrite (N)	2019/05/31		98	%	80 - 120
			Dissolved Nitrate (N)	2019/05/31		103	%	80 - 120
9441387	CT6	Spiked Blank	Dissolved Nitrite (N)	2019/05/31		100	%	80 - 120
			Dissolved Nitrate (N)	2019/05/31		102	%	80 - 120
			Dissolved Nitrite (N)	2019/05/31	<0.010		mg/L	
9441387	CT6	Method Blank	Dissolved Nitrate (N)	2019/05/31	<0.010		mg/L	
			Dissolved Nitrite (N)	2019/05/31	NC		%	20
			Dissolved Nitrate (N)	2019/05/31	0.15		%	20
9441410	JLD	Matrix Spike	Total Ammonia (N)	2019/05/31		84	%	80 - 120
9441410	JLD	Spiked Blank	Total Ammonia (N)	2019/05/31		104	%	80 - 120
9441410	JLD	Method Blank	Total Ammonia (N)	2019/05/31	<0.015		mg/L	
9441410	JLD	RPD	Total Ammonia (N)	2019/05/31	NC		%	20
9442588	MWX	Matrix Spike	Chemical Oxygen Demand	2019/05/31		97	%	80 - 120
9442588	MWX	Spiked Blank	Chemical Oxygen Demand	2019/05/31		100	%	80 - 120
9442588	MWX	Method Blank	Chemical Oxygen Demand	2019/05/31	<10		mg/L	
9442591	MWX	Spiked Blank	Dissolved Oxygen (O2)	2019/05/31		94	%	80 - 120
9442591	MWX	RPD [VT6457-06]	Dissolved Oxygen (O2)	2019/05/31	2.0		%	20
9443386	FM0	Matrix Spike [VT6461-01]	Orthophosphate (P)	2019/05/31		95	%	80 - 120
9443386	FM0	Spiked Blank	Orthophosphate (P)	2019/05/31		100	%	80 - 120
9443386	FM0	Method Blank	Orthophosphate (P)	2019/05/31	<0.0030		mg/L	
9443386	FM0	RPD [VT6461-01]	Orthophosphate (P)	2019/05/31	15		%	20
9443506	EH2	Spiked Blank	Turbidity	2019/05/31		96	%	80 - 120
9443506	EH2	Method Blank	Turbidity	2019/05/31	<0.10		NTU	
9443506	EH2	RPD [VT6457-03]	Turbidity	2019/05/31	2.7		%	20
9443807	ANE	Matrix Spike	Dissolved Aluminum (Al)	2019/05/31		94	%	80 - 120
			Dissolved Antimony (Sb)	2019/05/31		92	%	80 - 120
			Dissolved Arsenic (As)	2019/05/31		97	%	80 - 120
			Dissolved Beryllium (Be)	2019/05/31		96	%	80 - 120
			Dissolved Chromium (Cr)	2019/05/31		96	%	80 - 120
			Dissolved Cobalt (Co)	2019/05/31		95	%	80 - 120
			Dissolved Copper (Cu)	2019/05/31		95	%	80 - 120
			Dissolved Lead (Pb)	2019/05/31		92	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/05/31		99	%	80 - 120
			Dissolved Nickel (Ni)	2019/05/31		94	%	80 - 120
			Dissolved Selenium (Se)	2019/05/31		97	%	80 - 120
			Dissolved Silver (Ag)	2019/05/31		96	%	80 - 120
			Dissolved Thallium (Tl)	2019/05/31		94	%	80 - 120
			Dissolved Tin (Sn)	2019/05/31		92	%	80 - 120
			Dissolved Titanium (Ti)	2019/05/31		99	%	80 - 120
			Dissolved Uranium (U)	2019/05/31		98	%	80 - 120
			Dissolved Vanadium (V)	2019/05/31		93	%	80 - 120
			Dissolved Zinc (Zn)	2019/05/31		94	%	80 - 120
			Dissolved Aluminum (Al)	2019/05/31		97	%	80 - 120
			Dissolved Antimony (Sb)	2019/05/31		99	%	80 - 120
			Dissolved Arsenic (As)	2019/05/31		101	%	80 - 120
			Dissolved Beryllium (Be)	2019/05/31		97	%	80 - 120
			Dissolved Chromium (Cr)	2019/05/31		101	%	80 - 120
			Dissolved Cobalt (Co)	2019/05/31		102	%	80 - 120
			Dissolved Copper (Cu)	2019/05/31		103	%	80 - 120
			Dissolved Lead (Pb)	2019/05/31		100	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/05/31		101	%	80 - 120
			Dissolved Nickel (Ni)	2019/05/31		98	%	80 - 120
			Dissolved Selenium (Se)	2019/05/31		101	%	80 - 120
			Dissolved Silver (Ag)	2019/05/31		102	%	80 - 120



BV Labs Job #: B940971  
Report Date: 2019/06/07

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
9443807	ANE	Method Blank	Dissolved Thallium (Tl)	2019/05/31		101	%	80 - 120
			Dissolved Tin (Sn)	2019/05/31		100	%	80 - 120
			Dissolved Titanium (Ti)	2019/05/31		97	%	80 - 120
			Dissolved Uranium (U)	2019/05/31		103	%	80 - 120
			Dissolved Vanadium (V)	2019/05/31		101	%	80 - 120
			Dissolved Zinc (Zn)	2019/05/31		97	%	80 - 120
			Dissolved Aluminum (Al)	2019/05/31	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2019/05/31	<0.00060		mg/L	
			Dissolved Arsenic (As)	2019/05/31	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2019/05/31	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2019/05/31	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/05/31	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/05/31	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/05/31	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2019/05/31	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/05/31	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/05/31	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/05/31	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2019/05/31	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/05/31	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/05/31	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/05/31	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/05/31	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/05/31	<0.0030		mg/L	
9443807	ANE	RPD	Dissolved Aluminum (Al)	2019/05/31	NC		%	20
			Dissolved Antimony (Sb)	2019/05/31	NC		%	20
			Dissolved Arsenic (As)	2019/05/31	NC		%	20
			Dissolved Beryllium (Be)	2019/05/31	NC		%	20
			Dissolved Chromium (Cr)	2019/05/31	NC		%	20
			Dissolved Cobalt (Co)	2019/05/31	NC		%	20
			Dissolved Copper (Cu)	2019/05/31	NC		%	20
			Dissolved Lead (Pb)	2019/05/31	NC		%	20
			Dissolved Molybdenum (Mo)	2019/05/31	NC		%	20
			Dissolved Nickel (Ni)	2019/05/31	NC		%	20
			Dissolved Selenium (Se)	2019/05/31	NC		%	20
			Dissolved Silver (Ag)	2019/05/31	NC		%	20
			Dissolved Thallium (Tl)	2019/05/31	NC		%	20
			Dissolved Tin (Sn)	2019/05/31	NC		%	20
			Dissolved Titanium (Ti)	2019/05/31	NC		%	20
			Dissolved Uranium (U)	2019/05/31	NC		%	20
			Dissolved Vanadium (V)	2019/05/31	NC		%	20
			Dissolved Zinc (Zn)	2019/05/31	NC		%	20
9444509	JLD	Matrix Spike	Dissolved Phosphorus (P)	2019/06/03		110	%	80 - 120
9444509	JLD	QC Standard	Dissolved Phosphorus (P)	2019/06/03		99	%	80 - 120
9444509	JLD	Spiked Blank	Dissolved Phosphorus (P)	2019/06/03		107	%	80 - 120
9444509	JLD	Method Blank	Dissolved Phosphorus (P)	2019/06/03	<0.0030		mg/L	
9444509	JLD	RPD	Dissolved Phosphorus (P)	2019/06/03	NC		%	20
9446658	AP1	Matrix Spike	Total Dissolved Solids	2019/06/03		NC	%	80 - 120
9446658	AP1	Spiked Blank	Total Dissolved Solids	2019/06/03		99	%	80 - 120
9446658	AP1	Method Blank	Total Dissolved Solids	2019/06/03	<10		mg/L	
9446658	AP1	RPD	Total Dissolved Solids	2019/06/03	0.79		%	20
9447323	FM0	Matrix Spike	Total Total Kjeldahl Nitrogen	2019/06/04		72 (1)	%	80 - 120
9447323	FM0	QC Standard	Total Total Kjeldahl Nitrogen	2019/06/04		102	%	80 - 120
9447323	FM0	Spiked Blank	Total Total Kjeldahl Nitrogen	2019/06/04		103	%	80 - 120
9447323	FM0	Method Blank	Total Total Kjeldahl Nitrogen	2019/06/04	<0.050		mg/L	



### QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9447323	FM0	RPD	Total Total Kjeldahl Nitrogen	2019/06/04	NC		%	20
9447760	FM0	Matrix Spike	Dissolved Phosphorus (P)	2019/06/04		95	%	80 - 120
9447760	FM0	QC Standard	Dissolved Phosphorus (P)	2019/06/04		88	%	80 - 120
9447760	FM0	Spiked Blank	Dissolved Phosphorus (P)	2019/06/04		95	%	80 - 120
9447760	FM0	Method Blank	Dissolved Phosphorus (P)	2019/06/04	<0.0030		mg/L	
9447760	FM0	RPD	Dissolved Phosphorus (P)	2019/06/04	9.3		%	20
9447998	LZO	Spiked Blank	Alkalinity (Total as CaCO <sub>3</sub> )	2019/06/04		93	%	80 - 120
9447998	LZO	Method Blank	Alkalinity (PP as CaCO <sub>3</sub> )	2019/06/04	<1.0		mg/L	
			Alkalinity (Total as CaCO <sub>3</sub> )	2019/06/04	<1.0		mg/L	
			Bicarbonate (HCO <sub>3</sub> )	2019/06/04	<1.0		mg/L	
			Carbonate (CO <sub>3</sub> )	2019/06/04	<1.0		mg/L	
			Hydroxide (OH)	2019/06/04	<1.0		mg/L	
9447998	LZO	RPD	Alkalinity (PP as CaCO <sub>3</sub> )	2019/06/04	NC		%	20
			Alkalinity (Total as CaCO <sub>3</sub> )	2019/06/04	0.00097		%	20
			Bicarbonate (HCO <sub>3</sub> )	2019/06/04	0.00097		%	20
			Carbonate (CO <sub>3</sub> )	2019/06/04	NC		%	20
			Hydroxide (OH)	2019/06/04	NC		%	20
9448002	LZO	Spiked Blank	pH	2019/06/04		101	%	97 - 103
9448002	LZO	RPD	pH	2019/06/04	0.10		%	N/A
9448003	LZO	Spiked Blank	Conductivity	2019/06/04		101	%	90 - 110
9448003	LZO	Method Blank	Conductivity	2019/06/04	<2.0		uS/cm	
9448003	LZO	RPD	Conductivity	2019/06/04	0.49		%	10
9448021	FM0	Matrix Spike	Total Phosphorus (P)	2019/06/04		95	%	80 - 120
9448021	FM0	QC Standard	Total Phosphorus (P)	2019/06/04		88	%	80 - 120
9448021	FM0	Spiked Blank	Total Phosphorus (P)	2019/06/04		96	%	80 - 120
9448021	FM0	Method Blank	Total Phosphorus (P)	2019/06/04	<0.0030		mg/L	
9448021	FM0	RPD	Total Phosphorus (P)	2019/06/05	1.6		%	20
9448049	AP1	Matrix Spike	Total Suspended Solids	2019/06/04		108	%	80 - 120
9448049	AP1	Spiked Blank	Total Suspended Solids	2019/06/04		101	%	80 - 120
9448049	AP1	Method Blank	Total Suspended Solids	2019/06/04	<1.0		mg/L	
9448049	AP1	RPD	Total Suspended Solids	2019/06/04	NC		%	20
9451598	FM0	Matrix Spike	Dissolved Chloride (Cl)	2019/06/06		101	%	80 - 120
9451598	FM0	Spiked Blank	Dissolved Chloride (Cl)	2019/06/06		103	%	80 - 120
9451598	FM0	Method Blank	Dissolved Chloride (Cl)	2019/06/06	<1.0		mg/L	
9451598	FM0	RPD	Dissolved Chloride (Cl)	2019/06/06	11		%	20
9451665	FM0	Matrix Spike	Dissolved Sulphate (SO <sub>4</sub> )	2019/06/06		NC	%	80 - 120
9451665	FM0	Spiked Blank	Dissolved Sulphate (SO <sub>4</sub> )	2019/06/06		96	%	80 - 120
9451665	FM0	Method Blank	Dissolved Sulphate (SO <sub>4</sub> )	2019/06/06	<1.0		mg/L	
9451665	FM0	RPD	Dissolved Sulphate (SO <sub>4</sub> )	2019/06/06	1.2		%	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 <= 2x RDL).

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



BUREAU  
VERITAS

BV Labs Job #: B940971

Report Date: 2019/06/07

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).

Andy Lu, Ph.D., P.Chem., Scientific Specialist

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

Harry (Peng) Liang, Senior Analyst

---

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



<b>INVOICE TO:</b>		<b>REPORT TO:</b>		<b>PROJECT INFORMATION:</b>		<b>Laboratory Use Only:</b>	
Company Name: #10658 HEMMERA ENVIROCHEM INC.		Company Name: Jessica Eaton		Quotation #: B61187		Maxxam Job #:	
Attention: Accounts Payable		Attention: Jessica Eaton		P.O. #:		Bottle Order #:	
Address: SUITE 804, 322-11TH AVENUE SW		Address:		Project: 102604-01		583206	
CALGARY AB T2R 0C5				Project Name: SWCRD		COC #:	
Tel: (403) 264-0671 Fax:		Tel: Fax:		Site #:		Project Manager:	
Email: accounts-payable@hemmera.com		Email: jessica.eaton@hemmera.com		Sampled By:		Gail Pedersen	

Regulatory Criteria:		Special Instructions		ANALYSIS REQUESTED (PLEASE BE SPECIFIC)										Turnaround Time (TAT) Required:	
<input type="checkbox"/> ATI <input type="checkbox"/> CCME <input type="checkbox"/> Other				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)										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 MAXXAM					Metals Field F.	Routine Water Regulated Metals	Orthophosph	Total Suspended Solids	Total Dissolved Solids (Residue)	Turbidity	Total Kjeldahl N	Ammonia-N	Total Phosphorus	Chemical Oxygen Demand	Phosphorus - Dissolved	Date Required:	Rush Confirmation Number:
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix												# of Bottles	Comments
1	WQ1	19/05/29	0925	W		X	X	X	X	X	X	X	X	X	X		Call if any hits
2	WQ2		1120	W		X	X	X	X	X	X	X	X	X	X		Call if any hits
3	WQ3		1020	W		X	X	X	X	X	X	X	X	X	X		Call if any hits
4	WQ4A		1200	W		X	X			X							Just nitrate from routine
5	WQ4B		1230	W		X	X			X							Just nitrate from routine
6	WQ5A		1440	W		X	X			X							Just nitrate from routine
7	WQ5B		19/05/29	1500	W		X	X			X						
8				W													
9																	
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		
[Signature]		19/05/29	1650	[Signature]		19/05/29	1650		Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
									<input type="checkbox"/>	21.2 / 7	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

\* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S 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.MAXXAM.CA/TERMS.

\* 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

29-May-19 17:00

Gail Pedersen  
B940971

SBZ INS-0191

**Maxxam** A Bureau Veritas Group Company  
 Maxxam Analytics International Corporation o/a Maxxam Analytics  
 4000 19th N.E., Calgary, Alberta Canada T2E 6P8 Tel: (403) 291-3077 Toll-free: 800-553-6266 Fax: (403) 291-9466 www.maxxam.ca

1058

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:		Quotation #: B61187		Maxxam 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		Tel:		Project Name:		Project Manager:												
Email: accounts-payable@hemmera.com		Email: jessica.eaton@hemmera.com		Site #:		Gail Pedersen												
Fax:		Fax:		Sampled By:		C#583206-01-01												
Regulatory Criteria:		Special Instructions:		ANALYSIS REQUESTED (PLEASE BE SPECIFIC)														
<input type="checkbox"/> ATI <input type="checkbox"/> CCME <input type="checkbox"/> Other				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:														
SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM				Metals Field Filtered ? (Y/N) Routine Water & Diss. Biochemical Regulated Metals Oxygen Demand Orthophosphate by Kjeltech Oxygen (Dissolved, Winkler) Total Suspended Solids (TSS) Total Dissolved Solids (TDS) Residue Turbidity Total Kjeldahl Nitrogen Ammonia-N (Total) Total Phosphorus Chemical Oxygen Demand Phosphorus-P (Total) Dissolved														
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y/N)													
1	WQ1	19/05/29	0925	W	X	X											8	Call on any hts
2	WQ2		1120	W	X	X											8	Call on hts
3	WQ3		1020	W	X	X											8	Call on hts
4	WQ4A		1200	W	X	X											8	
5	WQ4B		1230	W	X	X											8	
6	WQ5A		1440	W	X	X											8	
7	WQ5B	19/05/29	1500	W	X	X											8	
8				W														
9																		
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		Time Sensitive		Temperature (°C) on Receipt	Custody Seal Intact on Cooler?				
Gail Pedersen		19/05/29	1650	JESSICA EATON		2019/05/29	16:50		<input type="checkbox"/> Time Sensitive <input type="checkbox"/> Yes <input type="checkbox"/> No		22.7		<input type="checkbox"/> Yes <input type="checkbox"/> No					

\* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO MAXXAM'S 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.MAXXAM.CA/TERMS.

\* 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

29-May-19 17:00  
 Gail Pedersen  
 B940971  
 SBZ INS-0191

8, 5, 9 days



Your Project #: 102604-01  
Your C.O.C. #: 596675-01-01

**Attention: Jessica Eaton**

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

**Report Date: 2019/10/24**

Report #: R2800858

Version: 1 - Final

## CERTIFICATE OF ANALYSIS

**BV LABS JOB #: B989002**

**Received: 2019/10/16, 19:00**

Sample Matrix: Water  
# Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO <sub>3</sub> ,HCO <sub>3</sub> ,OH	5	N/A	2019/10/20	AB SOP-00005	SM 23 2320 B m
Alkalinity @25C (pp, total), CO <sub>3</sub> ,HCO <sub>3</sub> ,OH	1	N/A	2019/10/21	AB SOP-00005	SM 23 2320 B m
Biochemical Oxygen Demand	6	2019/10/17	2019/10/22	AB SOP-00017	SM 23 5210B m
Cadmium - low level CCME - Dissolved	6	N/A	2019/10/19		Auto Calc
Chloride/Sulphate by Auto Colourimetry	6	N/A	2019/10/23	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO <sub>4</sub> -E m
COD by Colorimeter	3	N/A	2019/10/20	AB SOP-00016	SM 23 5220D m
Oxygen (Dissolved, winkler) (1)	6	N/A	2019/10/21	AB SOP-00058	SM 23 4500-O C m
Conductivity @25C	5	N/A	2019/10/20	AB SOP-00005	SM 23 2510 B m
Conductivity @25C	1	N/A	2019/10/21	AB SOP-00005	SM 23 2510 B m
Hardness	6	N/A	2019/10/23		Auto Calc
Elements by ICP - Dissolved (2)	6	N/A	2019/10/22	AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Dissolved (2)	6	N/A	2019/10/18	AB SOP-00043	EPA 6020b R2 m
Ion Balance	6	N/A	2019/10/18		Auto Calc
Sum of cations, anions	6	N/A	2019/10/23		Auto Calc
Ammonia-N (Total)	2	N/A	2019/10/23	AB SOP-00007	SM 23 4500 NH <sub>3</sub> A G m
Ammonia-N (Total)	1	N/A	2019/10/24	AB SOP-00007	SM 23 4500 NH <sub>3</sub> A G m
Nitrate and Nitrite	5	N/A	2019/10/21		Auto Calc
Nitrate and Nitrite	1	N/A	2019/10/22		Auto Calc
Nitrate + Nitrite-N (calculated)	5	N/A	2019/10/21		Auto Calc
Nitrate + Nitrite-N (calculated)	1	N/A	2019/10/22		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	5	N/A	2019/10/19	AB SOP-00023	SM 23 4110 B m
Nitrogen (Nitrite - Nitrate) by IC	1	N/A	2019/10/21	AB SOP-00023	SM 23 4110 B m
pH @25°C (3)	5	N/A	2019/10/20	AB SOP-00005	SM 23 4500-H+B m
pH @25°C (3)	1	N/A	2019/10/21	AB SOP-00005	SM 23 4500-H+B m
Orthophosphate by Konelab (4)	6	N/A	2019/10/18	AB SOP-00025	SM 23 4500-P A,F m
Total Dissolved Solids (Filt. Residue)	3	2019/10/21	2019/10/21	AB SOP-00065	SM 23 2540 C m
Total Dissolved Solids (Calculated)	6	N/A	2019/10/24		Auto Calc
Total Kjeldahl Nitrogen	3	2019/10/21	2019/10/23	AB SOP-00008	EPA 351.1 R1978 m
Phosphorus -P (Total, Dissolved) (5)	3	2019/10/21	2019/10/22	AB SOP-00024	SM 23 4500-P A,B,F m
Total Phosphorus	3	2019/10/22	2019/10/23	AB SOP-00024	SM 23 4500-P A,B,F m
Total Suspended Solids (NFR)	3	2019/10/20	2019/10/20	AB SOP-00061	SM 23 2540 D m





Your Project #: 102604-01  
Your C.O.C. #: 596675-01-01

**Attention: Jessica Eaton**

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

**Report Date: 2019/10/24**

Report #: R2800858

Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BV LABS JOB #: B989002**

**Received: 2019/10/16, 19:00**

Sample Matrix: Water  
# Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Turbidity	6	N/A	2019/10/18	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.

(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.



Your Project #: 102604-01  
Your C.O.C. #: 596675-01-01

**Attention: Jessica Eaton**

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

**Report Date: 2019/10/24**

Report #: R2800858

Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BV LABS JOB #: B989002**

**Received: 2019/10/16, 19:00**

Encryption Key



**AUTHORIZED REPORT  
RAPPORT AUTORISÉ**

Bureau Veritas Laboratories

24 Oct 2019 12:01:05

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.



BUREAU  
VERITAS

BV Labs Job #: B989002

Report Date: 2019/10/24

HEMMERA ENVIROCHEM INC.

Client Project #: 102604-01

**ROUTINE WATER & DISS. REGULATED METALS (WATER)**

<b>BV Labs ID</b>		WS4245			WS4246		WS4247		
<b>Sampling Date</b>		2019/10/16 11:30			2019/10/16 11:00		2019/10/16 12:30		
<b>COC Number</b>		596675-01-01			596675-01-01		596675-01-01		
	<b>UNITS</b>	<b>WQ1</b>	<b>RDL</b>	<b>QC Batch</b>	<b>WQ2</b>	<b>QC Batch</b>	<b>WQ3</b>	<b>RDL</b>	<b>QC Batch</b>

<b>Calculated Parameters</b>									
Anion Sum	meq/L	9.7	N/A	9631038	9.0	9631038	8.9	N/A	9631038
Cation Sum	meq/L	9.9	N/A	9631038	9.4	9631038	9.3	N/A	9631038
Hardness (CaCO <sub>3</sub> )	mg/L	390	0.50	9631032	370	9631032	380	0.50	9631032
Ion Balance (% Difference)	%	0.94	N/A	9631034	2.3	9631034	2.3	N/A	9631034
Dissolved Nitrate (NO <sub>3</sub> )	mg/L	<0.044	0.044	9631461	0.079	9631461	<0.044	0.044	9631461
Nitrate plus Nitrite (N)	mg/L	<0.014	0.014	9631462	0.018	9631462	<0.014	0.014	9631462
Dissolved Nitrite (NO <sub>2</sub> )	mg/L	<0.033	0.033	9631461	<0.033	9631461	<0.033	0.033	9631461
Calculated Total Dissolved Solids	mg/L	490	10	9631042	460	9631042	440	10	9631042

<b>Misc. Inorganics</b>									
Conductivity	uS/cm	900	2.0	9634622	810	9634618	800	2.0	9634545
pH	pH	8.12	N/A	9634620	8.22	9634617	8.29	N/A	9634544

<b>Low Level Elements</b>									
Dissolved Cadmium (Cd)	mg/L	<0.000020	0.000020	9630934	<0.000020	9630934	<0.000020	0.000020	9630934

<b>Anions</b>									
Alkalinity (PP as CaCO <sub>3</sub> )	mg/L	<1.0	1.0	9634619	<1.0	9634562	<1.0	1.0	9634543
Alkalinity (Total as CaCO <sub>3</sub> )	mg/L	400	1.0	9634619	370	9634562	410	1.0	9634543
Bicarbonate (HCO <sub>3</sub> )	mg/L	490	1.0	9634619	460	9634562	500	1.0	9634543
Carbonate (CO <sub>3</sub> )	mg/L	<1.0	1.0	9634619	<1.0	9634562	<1.0	1.0	9634543
Hydroxide (OH)	mg/L	<1.0	1.0	9634619	<1.0	9634562	<1.0	1.0	9634543
Dissolved Chloride (Cl)	mg/L	27	1.0	9640265	7.3	9640265	12	1.0	9640265
Dissolved Sulphate (SO <sub>4</sub> )	mg/L	40 (1)	2.0	9640265	65	9640265	20	1.0	9640265

<b>Nutrients</b>									
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9633356	<0.010	9633356	<0.010	0.010	9633356
Dissolved Nitrate (N)	mg/L	<0.010	0.010	9633356	0.018	9633356	<0.010	0.010	9633356

<b>Elements</b>									
Dissolved Aluminum (Al)	mg/L	0.0037	0.0030	9633138	0.0034	9633138	0.0051	0.0030	9633138
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	9633138	<0.00060	9633138	<0.00060	0.00060	9633138
Dissolved Arsenic (As)	mg/L	0.0035	0.00020	9633138	0.00046	9633138	0.0011	0.00020	9633138
Dissolved Barium (Ba)	mg/L	0.13	0.010	9637743	0.10	9637743	0.18	0.010	9637742
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	9633138	<0.0010	9633138	<0.0010	0.0010	9633138
Dissolved Boron (B)	mg/L	0.025	0.020	9637743	0.033	9637743	0.035	0.020	9637742

RDL = Reportable Detection Limit

N/A = Not Applicable

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

BUREAU  
VERITAS

BV Labs Job #: B989002

Report Date: 2019/10/24

HEMMERA ENVIROCHEM INC.

Client Project #: 102604-01

**ROUTINE WATER & DISS. REGULATED METALS (WATER)**

BV Labs ID		WS4245			WS4246		WS4247		
Sampling Date		2019/10/16 11:30			2019/10/16 11:00		2019/10/16 12:30		
COC Number		596675-01-01			596675-01-01		596675-01-01		
	UNITS	WQ1	RDL	QC Batch	WQ2	QC Batch	WQ3	RDL	QC Batch
Dissolved Calcium (Ca)	mg/L	83	0.30	9637743	67	9637743	67	0.30	9637742
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	9633138	<0.0010	9633138	<0.0010	0.0010	9633138
Dissolved Cobalt (Co)	mg/L	0.00058	0.00030	9633138	<0.00030	9633138	<0.00030	0.00030	9633138
Dissolved Copper (Cu)	mg/L	0.0016	0.00020	9633138	<0.00020	9633138	0.00045	0.00020	9633138
Dissolved Iron (Fe)	mg/L	0.090	0.060	9637743	<0.060	9637743	<0.060	0.060	9637742
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	9633138	<0.00020	9633138	<0.00020	0.00020	9633138
Dissolved Lithium (Li)	mg/L	<0.020	0.020	9637743	0.023	9637743	<0.020	0.020	9637742
Dissolved Magnesium (Mg)	mg/L	44	0.20	9637743	49	9637743	52	0.20	9637742
Dissolved Manganese (Mn)	mg/L	0.53	0.0040	9637743	0.020	9637743	0.012	0.0040	9637742
Dissolved Molybdenum (Mo)	mg/L	0.0013	0.00020	9633138	0.0017	9633138	0.0027	0.00020	9633138
Dissolved Nickel (Ni)	mg/L	0.0016	0.00050	9633138	0.00063	9633138	0.0027	0.00050	9633138
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	9637743	<0.10	9637743	<0.10	0.10	9637742
Dissolved Potassium (K)	mg/L	13	0.30	9637743	3.6	9637743	5.5	0.30	9637742
Dissolved Selenium (Se)	mg/L	<0.00020	0.00020	9633138	0.0011	9633138	0.00036	0.00020	9633138
Dissolved Silicon (Si)	mg/L	5.6	0.10	9637743	4.4	9637743	4.0	0.10	9637742
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	9633138	<0.00010	9633138	<0.00010	0.00010	9633138
Dissolved Sodium (Na)	mg/L	39	0.50	9637743	45	9637743	34	0.50	9637742
Dissolved Strontium (Sr)	mg/L	0.53	0.020	9637743	0.72	9637743	0.62	0.020	9637742
Dissolved Sulphur (S)	mg/L	14	0.20	9637743	21	9637743	6.4	0.20	9637742
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	9633138	<0.00020	9633138	<0.00020	0.00020	9633138
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	9633138	<0.0010	9633138	<0.0010	0.0010	9633138
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	9633138	<0.0010	9633138	<0.0010	0.0010	9633138
Dissolved Uranium (U)	mg/L	0.0022	0.00010	9633138	0.0043	9633138	0.0056	0.00010	9633138
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	9633138	<0.0010	9633138	<0.0010	0.0010	9633138
Dissolved Zinc (Zn)	mg/L	0.0051	0.0030	9633138	0.018	9633138	<0.0030	0.0030	9633138
RDL = Reportable Detection Limit									

BUREAU  
VERITAS

BV Labs Job #: B989002

Report Date: 2019/10/24

HEMMERA ENVIROCHEM INC.

Client Project #: 102604-01

**ROUTINE WATER & DISS. REGULATED METALS (WATER)**

BV Labs ID		WS4248		WS4249		WS4250		
Sampling Date		2019/10/16 16:10		2019/10/16 14:30		2019/10/16 15:20		
COC Number		596675-01-01		596675-01-01		596675-01-01		
	UNITS	WQ4A	QC Batch	WQ4B	QC Batch	WQ5B	RDL	QC Batch
<b>Calculated Parameters</b>								
Anion Sum	meq/L	8.2	9631038	8.2	9631038	12	N/A	9631038
Cation Sum	meq/L	8.7	9631038	8.9	9631038	12	N/A	9631038
Hardness (CaCO <sub>3</sub> )	mg/L	340	9631032	340	9631032	490	0.50	9631032
Ion Balance (% Difference)	%	2.4	9631034	4.2	9631034	0.089	N/A	9631034
Dissolved Nitrate (NO <sub>3</sub> )	mg/L	3.3	9631461	0.071	9631461	3.4	0.044	9631461
Nitrate plus Nitrite (N)	mg/L	0.75	9631462	0.016	9631462	0.78	0.014	9631462
Dissolved Nitrite (NO <sub>2</sub> )	mg/L	<0.033	9631461	<0.033	9631461	0.036	0.033	9631461
Calculated Total Dissolved Solids	mg/L	420	9631042	420	9631042	600	10	9631042
<b>Misc. Inorganics</b>								
Conductivity	uS/cm	770	9634622	750	9634545	1000	2.0	9634622
pH	pH	8.06	9634620	8.48	9634544	8.28	N/A	9634620
<b>Low Level Elements</b>								
Dissolved Cadmium (Cd)	mg/L	<0.000020	9630934	<0.000020	9630934	<0.000020	0.000020	9630934
<b>Anions</b>								
Alkalinity (PP as CaCO <sub>3</sub> )	mg/L	<1.0	9634619	9.9	9634543	<1.0	1.0	9634619
Alkalinity (Total as CaCO <sub>3</sub> )	mg/L	360	9634619	350	9634543	410	1.0	9634619
Bicarbonate (HCO <sub>3</sub> )	mg/L	430	9634619	400	9634543	500	1.0	9634619
Carbonate (CO <sub>3</sub> )	mg/L	<1.0	9634619	12	9634543	<1.0	1.0	9634619
Hydroxide (OH)	mg/L	<1.0	9634619	<1.0	9634543	<1.0	1.0	9634619
Dissolved Chloride (Cl)	mg/L	6.3	9640265	7.0	9640265	11	1.0	9640265
Dissolved Sulphate (SO <sub>4</sub> )	mg/L	44	9640265	51	9640265	140	1.0	9640265
<b>Nutrients</b>								
Dissolved Nitrite (N)	mg/L	<0.010	9633356	<0.010	9633356	0.011	0.010	9634546
Dissolved Nitrate (N)	mg/L	0.75	9633356	0.016	9633356	0.77	0.010	9634546
<b>Elements</b>								
Dissolved Aluminum (Al)	mg/L	<0.0030	9633138	<0.0030	9633138	0.0058	0.0030	9633138
Dissolved Antimony (Sb)	mg/L	<0.00060	9633138	<0.00060	9633138	<0.00060	0.00060	9633138
Dissolved Arsenic (As)	mg/L	<0.00020	9633138	0.00028	9633138	0.00067	0.00020	9633138
Dissolved Barium (Ba)	mg/L	0.065	9637741	0.079	9637743	0.20	0.010	9637742
Dissolved Beryllium (Be)	mg/L	<0.0010	9633138	<0.0010	9633138	<0.0010	0.0010	9633138
Dissolved Boron (B)	mg/L	0.046	9637741	0.034	9637743	0.028	0.020	9637742
Dissolved Calcium (Ca)	mg/L	70	9637741	66	9637743	92	0.30	9637742
RDL = Reportable Detection Limit								
N/A = Not Applicable								

BUREAU  
VERITAS

BV Labs Job #: B989002

Report Date: 2019/10/24

HEMMERA ENVIROCHEM INC.

Client Project #: 102604-01

**ROUTINE WATER & DISS. REGULATED METALS (WATER)**

BV Labs ID		WS4248		WS4249		WS4250		
Sampling Date		2019/10/16 16:10		2019/10/16 14:30		2019/10/16 15:20		
COC Number		596675-01-01		596675-01-01		596675-01-01		
	UNITS	WQ4A	QC Batch	WQ4B	QC Batch	WQ5B	RDL	QC Batch
Dissolved Chromium (Cr)	mg/L	<0.0010	9633138	<0.0010	9633138	<0.0010	0.0010	9633138
Dissolved Cobalt (Co)	mg/L	<0.00030	9633138	<0.00030	9633138	<0.00030	0.00030	9633138
Dissolved Copper (Cu)	mg/L	0.00050	9633138	<0.00020	9633138	0.00086	0.00020	9633138
Dissolved Iron (Fe)	mg/L	<0.060	9637741	<0.060	9637743	<0.060	0.060	9637742
Dissolved Lead (Pb)	mg/L	<0.00020	9633138	<0.00020	9633138	<0.00020	0.00020	9633138
Dissolved Lithium (Li)	mg/L	0.021	9637741	0.024	9637743	0.020	0.020	9637742
Dissolved Magnesium (Mg)	mg/L	40	9637741	44	9637743	63	0.20	9637742
Dissolved Manganese (Mn)	mg/L	<0.0040	9637741	0.012	9637743	0.061	0.0040	9637742
Dissolved Molybdenum (Mo)	mg/L	0.0023	9633138	0.0017	9633138	0.0024	0.00020	9633138
Dissolved Nickel (Ni)	mg/L	<0.00050	9633138	<0.00050	9633138	0.00084	0.00050	9633138
Dissolved Phosphorus (P)	mg/L	<0.10	9637741	<0.10	9637743	<0.10	0.10	9637742
Dissolved Potassium (K)	mg/L	3.9	9637741	3.9	9637743	4.7	0.30	9637742
Dissolved Selenium (Se)	mg/L	0.0028	9633138	0.00092	9633138	0.0026	0.00020	9633138
Dissolved Silicon (Si)	mg/L	4.3	9637741	4.1	9637743	4.2	0.10	9637742
Dissolved Silver (Ag)	mg/L	<0.00010	9633138	<0.00010	9633138	<0.00010	0.00010	9633138
Dissolved Sodium (Na)	mg/L	41	9637741	43	9637743	38	0.50	9637742
Dissolved Strontium (Sr)	mg/L	0.69	9637741	0.71	9637743	0.73	0.020	9637742
Dissolved Sulphur (S)	mg/L	17	9637741	20	9637743	45	0.20	9637742
Dissolved Thallium (Tl)	mg/L	<0.00020	9633138	<0.00020	9633138	<0.00020	0.00020	9633138
Dissolved Tin (Sn)	mg/L	<0.0010	9633138	<0.0010	9633138	<0.0010	0.0010	9633138
Dissolved Titanium (Ti)	mg/L	<0.0010	9633138	<0.0010	9633138	<0.0010	0.0010	9633138
Dissolved Uranium (U)	mg/L	0.0051	9633138	0.0029	9633138	0.013	0.00010	9633138
Dissolved Vanadium (V)	mg/L	<0.0010	9633138	<0.0010	9633138	<0.0010	0.0010	9633138
Dissolved Zinc (Zn)	mg/L	<0.0030	9633138	0.16	9633138	<0.0030	0.0030	9633138
RDL = Reportable Detection Limit								

BUREAU  
VERITAS

BV Labs Job #: B989002

Report Date: 2019/10/24

HEMMERA ENVIROCHEM INC.

Client Project #: 102604-01

## RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WS4245	WS4246	WS4247			WS4248	WS4249		
Sampling Date		2019/10/16 11:30	2019/10/16 11:00	2019/10/16 12:30			2019/10/16 16:10	2019/10/16 14:30		
COC Number		596675-01-01	596675-01-01	596675-01-01			596675-01-01	596675-01-01		
	UNITS	WQ1	WQ2	WQ3	RDL	QC Batch	WQ4A	WQ4B	RDL	QC Batch

## Demand Parameters

Biochemical Oxygen Demand	mg/L	3.3	<2.0	2.5	2.0	9630915	<2.0	<2.0	2.0	9630915
Chemical Oxygen Demand	mg/L	34	18	44	10	9634974				

## Misc. Inorganics

Dissolved Oxygen (O2)	mg/L	3.7	10	8.0	0.10	9637131	3.6	11	0.10	9637131
Total Dissolved Solids	mg/L	510	450	450	10	9636016				
Total Suspended Solids	mg/L	8.0	17	8.4	1.0	9635610				

## Nutrients

Total Ammonia (N)	mg/L	0.058	0.065	0.11	0.015	9639226				
Orthophosphate (P)	mg/L	0.030	<0.0030	<0.0030	0.0030	9633228	<0.0030	<0.0030	0.0030	9633228
Dissolved Phosphorus (P)	mg/L	0.064	0.0041	0.037	0.0030	9636381				
Total Phosphorus (P)	mg/L	0.057	0.013	0.028	0.0030	9637648				
Total Total Kjeldahl Nitrogen	mg/L	0.72	0.37	1.0	0.050	9636916				

## Physical Properties

Turbidity	NTU	1.8	8.9	6.5	0.10	9632895	0.59	0.53	0.10	9632895
-----------	-----	-----	-----	-----	------	---------	------	------	------	---------

RDL = Reportable Detection Limit

BV Labs ID		WS4250		
Sampling Date		2019/10/16 15:20		
COC Number		596675-01-01		
	UNITS	WQ5B	RDL	QC Batch

## Demand Parameters

Biochemical Oxygen Demand	mg/L	<2.0	2.0	9630915
---------------------------	------	------	-----	---------

## Misc. Inorganics

Dissolved Oxygen (O2)	mg/L	10	0.10	9637131
-----------------------	------	----	------	---------

## Nutrients

Orthophosphate (P)	mg/L	<0.0030	0.0030	9633228
--------------------	------	---------	--------	---------

## Physical Properties

Turbidity	NTU	13	0.10	9632895
-----------	-----	----	------	---------

RDL = Reportable Detection Limit





BUREAU  
VERITAS

BV Labs Job #: B989002  
Report Date: 2019/10/24

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	9.3°C
Package 2	6.7°C

Sample WS4250 [WQ5B] : 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.**

BUREAU  
VERITAS

BV Labs Job #: B989002

Report Date: 2019/10/24

HEMMERA ENVIROCHEM INC.

Client Project #: 102604-01

## QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9630915	PK8	Spiked Blank	Biochemical Oxygen Demand	2019/10/22		99	%	85 - 115
9630915	PK8	Method Blank	Biochemical Oxygen Demand	2019/10/22	<2.0		mg/L	
9630915	PK8	RPD	Biochemical Oxygen Demand	2019/10/22	NC		%	20
9632895	AP1	Spiked Blank	Turbidity	2019/10/18		96	%	80 - 120
9632895	AP1	Method Blank	Turbidity	2019/10/18	<0.10		NTU	
9632895	AP1	RPD	Turbidity	2019/10/18	1.1		%	20
9633138	HC7	Matrix Spike [WS4245-05]	Dissolved Aluminum (Al)	2019/10/18		123 (1)	%	80 - 120
			Dissolved Antimony (Sb)	2019/10/18		93	%	80 - 120
			Dissolved Arsenic (As)	2019/10/18		105	%	80 - 120
			Dissolved Beryllium (Be)	2019/10/18		102	%	80 - 120
			Dissolved Chromium (Cr)	2019/10/18		105	%	80 - 120
			Dissolved Cobalt (Co)	2019/10/18		102	%	80 - 120
			Dissolved Copper (Cu)	2019/10/18		101	%	80 - 120
			Dissolved Lead (Pb)	2019/10/18		100	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/10/18		105	%	80 - 120
			Dissolved Nickel (Ni)	2019/10/18		103	%	80 - 120
			Dissolved Selenium (Se)	2019/10/18		101	%	80 - 120
			Dissolved Silver (Ag)	2019/10/18		102	%	80 - 120
			Dissolved Thallium (Tl)	2019/10/18		101	%	80 - 120
			Dissolved Tin (Sn)	2019/10/18		102	%	80 - 120
			Dissolved Titanium (Ti)	2019/10/18		104	%	80 - 120
			Dissolved Uranium (U)	2019/10/18		114	%	80 - 120
			Dissolved Vanadium (V)	2019/10/18		107	%	80 - 120
			Dissolved Zinc (Zn)	2019/10/18		107	%	80 - 120
9633138	HC7	Spiked Blank	Dissolved Aluminum (Al)	2019/10/18		118	%	80 - 120
			Dissolved Antimony (Sb)	2019/10/18		94	%	80 - 120
			Dissolved Arsenic (As)	2019/10/18		102	%	80 - 120
			Dissolved Beryllium (Be)	2019/10/18		98	%	80 - 120
			Dissolved Chromium (Cr)	2019/10/18		102	%	80 - 120
			Dissolved Cobalt (Co)	2019/10/18		100	%	80 - 120
			Dissolved Copper (Cu)	2019/10/18		104	%	80 - 120
			Dissolved Lead (Pb)	2019/10/18		100	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/10/18		103	%	80 - 120
			Dissolved Nickel (Ni)	2019/10/18		99	%	80 - 120
			Dissolved Selenium (Se)	2019/10/18		104	%	80 - 120
			Dissolved Silver (Ag)	2019/10/18		102	%	80 - 120
			Dissolved Thallium (Tl)	2019/10/18		102	%	80 - 120
			Dissolved Tin (Sn)	2019/10/18		98	%	80 - 120
			Dissolved Titanium (Ti)	2019/10/18		97	%	80 - 120
			Dissolved Uranium (U)	2019/10/18		111	%	80 - 120
			Dissolved Vanadium (V)	2019/10/18		101	%	80 - 120
			Dissolved Zinc (Zn)	2019/10/18		102	%	80 - 120
9633138	HC7	Method Blank	Dissolved Aluminum (Al)	2019/10/18	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2019/10/18	<0.00060		mg/L	
			Dissolved Arsenic (As)	2019/10/18	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2019/10/18	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2019/10/18	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/10/18	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/10/18	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/10/18	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2019/10/18	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/10/18	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/10/18	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/10/18	<0.00010		mg/L	



BV Labs Job #: B989002  
Report Date: 2019/10/24

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
9633138	HC7	RPD [WS4245-05]	Dissolved Thallium (Tl)	2019/10/18	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/10/18	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/10/18	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/10/18	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/10/18	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/10/18	<0.0030		mg/L	
			Dissolved Aluminum (Al)	2019/10/18	11		%	20
			Dissolved Antimony (Sb)	2019/10/18	NC		%	20
			Dissolved Arsenic (As)	2019/10/18	2.2		%	20
			Dissolved Beryllium (Be)	2019/10/18	NC		%	20
			Dissolved Chromium (Cr)	2019/10/18	NC		%	20
			Dissolved Cobalt (Co)	2019/10/18	11		%	20
			Dissolved Copper (Cu)	2019/10/18	2.6		%	20
			Dissolved Lead (Pb)	2019/10/18	NC		%	20
			Dissolved Molybdenum (Mo)	2019/10/18	9.7		%	20
			Dissolved Nickel (Ni)	2019/10/18	1.0		%	20
			Dissolved Selenium (Se)	2019/10/18	NC		%	20
			Dissolved Silver (Ag)	2019/10/18	NC		%	20
			Dissolved Thallium (Tl)	2019/10/18	NC		%	20
			Dissolved Tin (Sn)	2019/10/18	NC		%	20
			Dissolved Titanium (Ti)	2019/10/18	NC		%	20
			Dissolved Uranium (U)	2019/10/18	0.14		%	20
			Dissolved Vanadium (V)	2019/10/18	NC		%	20
			Dissolved Zinc (Zn)	2019/10/18	8.0		%	20
9633228	JLD	Matrix Spike	Orthophosphate (P)	2019/10/18		110	%	80 - 120
9633228	JLD	Spiked Blank	Orthophosphate (P)	2019/10/18		103	%	80 - 120
9633228	JLD	Method Blank	Orthophosphate (P)	2019/10/18	<0.0030		mg/L	
9633228	JLD	RPD	Orthophosphate (P)	2019/10/18	20		%	20
9633356	KD9	Matrix Spike [WS4248-01]	Dissolved Nitrite (N)	2019/10/19		99	%	80 - 120
9633356	KD9	Spiked Blank	Dissolved Nitrate (N)	2019/10/19		105	%	80 - 120
			Dissolved Nitrite (N)	2019/10/19		95	%	80 - 120
			Dissolved Nitrate (N)	2019/10/19		100	%	80 - 120
9633356	KD9	Method Blank	Dissolved Nitrite (N)	2019/10/19	<0.010		mg/L	
9633356	KD9	RPD [WS4248-01]	Dissolved Nitrate (N)	2019/10/19	<0.010		mg/L	
			Dissolved Nitrite (N)	2019/10/19	NC		%	20
			Dissolved Nitrate (N)	2019/10/19	1.1		%	20
9634543	IK0	Spiked Blank	Alkalinity (Total as CaCO <sub>3</sub> )	2019/10/20		93	%	80 - 120
9634543	IK0	Method Blank	Alkalinity (PP as CaCO <sub>3</sub> )	2019/10/20	<1.0		mg/L	
9634543	IK0	RPD	Alkalinity (Total as CaCO <sub>3</sub> )	2019/10/20	<1.0		mg/L	
			Bicarbonate (HCO <sub>3</sub> )	2019/10/20	<1.0		mg/L	
			Carbonate (CO <sub>3</sub> )	2019/10/20	<1.0		mg/L	
			Hydroxide (OH)	2019/10/20	<1.0		mg/L	
			Alkalinity (PP as CaCO <sub>3</sub> )	2019/10/20	NC		%	20
			Alkalinity (Total as CaCO <sub>3</sub> )	2019/10/20	2.0		%	20
			Bicarbonate (HCO <sub>3</sub> )	2019/10/20	2.0		%	20
9634543	IK0	RPD	Carbonate (CO <sub>3</sub> )	2019/10/20	NC		%	20
			Hydroxide (OH)	2019/10/20	NC		%	20
			pH	2019/10/20		100	%	97 - 103
9634544	IK0	Spiked Blank	pH	2019/10/20	0.36		%	N/A
9634545	IK0	Spiked Blank	Conductivity	2019/10/20		99	%	90 - 110
9634545	IK0	Method Blank	Conductivity	2019/10/20	<2.0		uS/cm	
9634545	IK0	RPD	Conductivity	2019/10/20	0.33		%	10
9634546	PR6	Matrix Spike	Dissolved Nitrite (N)	2019/10/21		109	%	80 - 120
			Dissolved Nitrate (N)	2019/10/21		115	%	80 - 120



BV Labs Job #: B989002  
Report Date: 2019/10/24

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
9634546	PR6	Spiked Blank	Dissolved Nitrite (N)	2019/10/21		102	%	80 - 120
			Dissolved Nitrate (N)	2019/10/21		105	%	80 - 120
9634546	PR6	Method Blank	Dissolved Nitrite (N)	2019/10/21	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/10/21	<0.010		mg/L	
9634546	PR6	RPD	Dissolved Nitrite (N)	2019/10/21	NC		%	20
			Dissolved Nitrate (N)	2019/10/21	0.026		%	20
9634562	IK0	Spiked Blank	Alkalinity (Total as CaCO3)	2019/10/21		93	%	80 - 120
9634562	IK0	Method Blank	Alkalinity (PP as CaCO3)	2019/10/21	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/10/21	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/10/21	<1.0		mg/L	
			Carbonate (CO3)	2019/10/21	<1.0		mg/L	
			Hydroxide (OH)	2019/10/21	<1.0		mg/L	
9634562	IK0	RPD	Alkalinity (PP as CaCO3)	2019/10/21	NC		%	20
			Alkalinity (Total as CaCO3)	2019/10/21	2.5		%	20
			Bicarbonate (HCO3)	2019/10/21	2.5		%	20
			Carbonate (CO3)	2019/10/21	NC		%	20
			Hydroxide (OH)	2019/10/21	NC		%	20
9634617	IK0	Spiked Blank	pH	2019/10/21		100	%	97 - 103
9634617	IK0	RPD	pH	2019/10/21	0.39		%	N/A
9634618	IK0	Spiked Blank	Conductivity	2019/10/21		100	%	90 - 110
9634618	IK0	Method Blank	Conductivity	2019/10/21	<2.0		uS/cm	
9634618	IK0	RPD	Conductivity	2019/10/21	0.20		%	10
9634619	IK0	Spiked Blank	Alkalinity (Total as CaCO3)	2019/10/20		92	%	80 - 120
9634619	IK0	Method Blank	Alkalinity (PP as CaCO3)	2019/10/20	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/10/20	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/10/20	<1.0		mg/L	
			Carbonate (CO3)	2019/10/20	<1.0		mg/L	
			Hydroxide (OH)	2019/10/20	<1.0		mg/L	
9634619	IK0	RPD	Alkalinity (PP as CaCO3)	2019/10/20	0.93		%	20
			Alkalinity (Total as CaCO3)	2019/10/20	1.1		%	20
			Bicarbonate (HCO3)	2019/10/20	1.2		%	20
			Carbonate (CO3)	2019/10/20	0.93		%	20
			Hydroxide (OH)	2019/10/20	NC		%	20
9634620	IK0	Spiked Blank	pH	2019/10/20		100	%	97 - 103
9634620	IK0	RPD	pH	2019/10/20	0.11		%	N/A
9634622	IK0	Spiked Blank	Conductivity	2019/10/20		100	%	90 - 110
9634622	IK0	Method Blank	Conductivity	2019/10/20	<2.0		uS/cm	
9634622	IK0	RPD	Conductivity	2019/10/20	0.097		%	10
9634974	JM0	Matrix Spike	Chemical Oxygen Demand	2019/10/20		NC	%	80 - 120
9634974	JM0	Spiked Blank	Chemical Oxygen Demand	2019/10/20		103	%	80 - 120
9634974	JM0	Method Blank	Chemical Oxygen Demand	2019/10/20	<10		mg/L	
9634974	JM0	RPD	Chemical Oxygen Demand	2019/10/20	0.20		%	20
9635610	HE1	Matrix Spike	Total Suspended Solids	2019/10/20		86	%	80 - 120
9635610	HE1	Spiked Blank	Total Suspended Solids	2019/10/20		95	%	80 - 120
9635610	HE1	Method Blank	Total Suspended Solids	2019/10/20	<1.0		mg/L	
9635610	HE1	RPD	Total Suspended Solids	2019/10/20	NC		%	20
9636016	HE1	Matrix Spike	Total Dissolved Solids	2019/10/21		98	%	80 - 120
9636016	HE1	Spiked Blank	Total Dissolved Solids	2019/10/21		100	%	80 - 120
9636016	HE1	Method Blank	Total Dissolved Solids	2019/10/21	<10		mg/L	
9636016	HE1	RPD	Total Dissolved Solids	2019/10/21	0		%	20
9636381	ZI	Matrix Spike	Dissolved Phosphorus (P)	2019/10/22		105	%	80 - 120
9636381	ZI	QC Standard	Dissolved Phosphorus (P)	2019/10/22		100	%	80 - 120
9636381	ZI	Spiked Blank	Dissolved Phosphorus (P)	2019/10/22		97	%	80 - 120
9636381	ZI	Method Blank	Dissolved Phosphorus (P)	2019/10/22	<0.0030		mg/L	
9636381	ZI	RPD	Dissolved Phosphorus (P)	2019/10/22	0		%	20



BV Labs Job #: B989002  
Report Date: 2019/10/24

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
9636916	JLD	Matrix Spike	Total Total Kjeldahl Nitrogen	2019/10/23		100	%	80 - 120
9636916	JLD	QC Standard	Total Total Kjeldahl Nitrogen	2019/10/23		104	%	80 - 120
9636916	JLD	Spiked Blank	Total Total Kjeldahl Nitrogen	2019/10/23		102	%	80 - 120
9636916	JLD	Method Blank	Total Total Kjeldahl Nitrogen	2019/10/23	<0.050		mg/L	
9636916	JLD	RPD	Total Total Kjeldahl Nitrogen	2019/10/23	NC		%	20
9637131	KD9	Spiked Blank	Dissolved Oxygen (O2)	2019/10/21		98	%	80 - 120
9637131	KD9	RPD [WS4245-06]	Dissolved Oxygen (O2)	2019/10/21	18		%	20
9637648	JLD	Matrix Spike	Total Phosphorus (P)	2019/10/23		102	%	80 - 120
9637648	JLD	QC Standard	Total Phosphorus (P)	2019/10/23		92	%	80 - 120
9637648	JLD	Spiked Blank	Total Phosphorus (P)	2019/10/23		89	%	80 - 120
9637648	JLD	Method Blank	Total Phosphorus (P)	2019/10/23	<0.0030		mg/L	
9637648	JLD	RPD	Total Phosphorus (P)	2019/10/23	2.0		%	20
9637741	MAP	Matrix Spike [WS4248-05]	Dissolved Barium (Ba)	2019/10/22		98	%	80 - 120
			Dissolved Boron (B)	2019/10/22		87	%	80 - 120
			Dissolved Calcium (Ca)	2019/10/22		95	%	80 - 120
			Dissolved Iron (Fe)	2019/10/22		105	%	80 - 120
			Dissolved Lithium (Li)	2019/10/22		96	%	80 - 120
			Dissolved Magnesium (Mg)	2019/10/22		96	%	80 - 120
			Dissolved Manganese (Mn)	2019/10/22		103	%	80 - 120
			Dissolved Phosphorus (P)	2019/10/22		101	%	80 - 120
			Dissolved Potassium (K)	2019/10/22		100	%	80 - 120
			Dissolved Silicon (Si)	2019/10/22		98	%	80 - 120
			Dissolved Sodium (Na)	2019/10/22		97	%	80 - 120
			Dissolved Strontium (Sr)	2019/10/22		91	%	80 - 120
			Dissolved Sulphur (S)	2019/10/22		102	%	80 - 120
9637741	MAP	Spiked Blank	Dissolved Barium (Ba)	2019/10/22		99	%	80 - 120
			Dissolved Boron (B)	2019/10/22		90	%	80 - 120
			Dissolved Calcium (Ca)	2019/10/22		96	%	80 - 120
			Dissolved Iron (Fe)	2019/10/22		103	%	80 - 120
			Dissolved Lithium (Li)	2019/10/22		96	%	80 - 120
			Dissolved Magnesium (Mg)	2019/10/22		98	%	80 - 120
			Dissolved Manganese (Mn)	2019/10/22		101	%	80 - 120
			Dissolved Phosphorus (P)	2019/10/22		97	%	80 - 120
			Dissolved Potassium (K)	2019/10/22		99	%	80 - 120
			Dissolved Silicon (Si)	2019/10/22		98	%	80 - 120
			Dissolved Sodium (Na)	2019/10/22		100	%	80 - 120
			Dissolved Strontium (Sr)	2019/10/22		95	%	80 - 120
			Dissolved Sulphur (S)	2019/10/22		97	%	80 - 120
9637741	MAP	Method Blank	Dissolved Barium (Ba)	2019/10/22	<0.010		mg/L	
			Dissolved Boron (B)	2019/10/22	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/10/22	<0.30		mg/L	
			Dissolved Iron (Fe)	2019/10/22	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/10/22	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/10/22	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/10/22	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2019/10/22	<0.10		mg/L	
			Dissolved Potassium (K)	2019/10/22	<0.30		mg/L	
			Dissolved Silicon (Si)	2019/10/22	<0.10		mg/L	
			Dissolved Sodium (Na)	2019/10/22	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/10/22	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/10/22	<0.20		mg/L	
9637741	MAP	RPD [WS4248-05]	Dissolved Barium (Ba)	2019/10/22	0.15		%	20
			Dissolved Boron (B)	2019/10/22	3.1		%	20
			Dissolved Calcium (Ca)	2019/10/22	0.095		%	20



BUREAU  
VERITAS

BV Labs Job #: B989002

Report Date: 2019/10/24

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
9637742	MAP	Matrix Spike	Dissolved Iron (Fe)	2019/10/22	NC		%	20
			Dissolved Lithium (Li)	2019/10/22	0.95		%	20
			Dissolved Magnesium (Mg)	2019/10/22	0.85		%	20
			Dissolved Manganese (Mn)	2019/10/22	NC		%	20
			Dissolved Phosphorus (P)	2019/10/22	NC		%	20
			Dissolved Potassium (K)	2019/10/22	0.023		%	20
			Dissolved Silicon (Si)	2019/10/22	0.12		%	20
			Dissolved Sodium (Na)	2019/10/22	0.31		%	20
			Dissolved Strontium (Sr)	2019/10/22	0.34		%	20
			Dissolved Sulphur (S)	2019/10/22	0.45		%	20
9637742	MAP	Spiked Blank	Dissolved Barium (Ba)	2019/10/22		96	%	80 - 120
			Dissolved Boron (B)	2019/10/22		87	%	80 - 120
			Dissolved Calcium (Ca)	2019/10/22		NC	%	80 - 120
			Dissolved Iron (Fe)	2019/10/22		104	%	80 - 120
			Dissolved Lithium (Li)	2019/10/22		95	%	80 - 120
			Dissolved Magnesium (Mg)	2019/10/22		97	%	80 - 120
			Dissolved Manganese (Mn)	2019/10/22		101	%	80 - 120
			Dissolved Phosphorus (P)	2019/10/22		102	%	80 - 120
			Dissolved Potassium (K)	2019/10/22		101	%	80 - 120
			Dissolved Silicon (Si)	2019/10/22		98	%	80 - 120
9637742	MAP	Method Blank	Dissolved Sodium (Na)	2019/10/22		98	%	80 - 120
			Dissolved Strontium (Sr)	2019/10/22		90	%	80 - 120
			Dissolved Sulphur (S)	2019/10/22		103	%	80 - 120
			Dissolved Barium (Ba)	2019/10/22		99	%	80 - 120
			Dissolved Boron (B)	2019/10/22		91	%	80 - 120
			Dissolved Calcium (Ca)	2019/10/22		97	%	80 - 120
			Dissolved Iron (Fe)	2019/10/22		107	%	80 - 120
			Dissolved Lithium (Li)	2019/10/22		98	%	80 - 120
			Dissolved Magnesium (Mg)	2019/10/22		99	%	80 - 120
			Dissolved Manganese (Mn)	2019/10/22		105	%	80 - 120
9637742	MAP	RPD	Dissolved Phosphorus (P)	2019/10/22		99	%	80 - 120
			Dissolved Potassium (K)	2019/10/22		100	%	80 - 120
			Dissolved Silicon (Si)	2019/10/22		99	%	80 - 120
			Dissolved Sodium (Na)	2019/10/22		103	%	80 - 120
			Dissolved Strontium (Sr)	2019/10/22		97	%	80 - 120
			Dissolved Sulphur (S)	2019/10/22		98	%	80 - 120
			Dissolved Barium (Ba)	2019/10/22	<0.010		mg/L	
			Dissolved Boron (B)	2019/10/22	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/10/22	<0.30		mg/L	
			Dissolved Iron (Fe)	2019/10/22	<0.060		mg/L	
9637742	MAP	RPD	Dissolved Lithium (Li)	2019/10/22	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/10/22	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/10/22	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2019/10/22	<0.10		mg/L	
			Dissolved Potassium (K)	2019/10/22	<0.30		mg/L	
			Dissolved Silicon (Si)	2019/10/22	<0.10		mg/L	
			Dissolved Sodium (Na)	2019/10/22	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/10/22	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/10/22	<0.20		mg/L	
			Dissolved Calcium (Ca)	2019/10/22	1.4		%	20
9637742	MAP	RPD	Dissolved Iron (Fe)	2019/10/22	1.3		%	20
			Dissolved Magnesium (Mg)	2019/10/22	1.1		%	20
			Dissolved Manganese (Mn)	2019/10/22	0.87		%	20
			Dissolved Potassium (K)	2019/10/22	0.81		%	20
			Dissolved Sodium (Na)	2019/10/22	1.6		%	20

BUREAU  
VERITAS

BV Labs Job #: B989002

Report Date: 2019/10/24

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
9637743	MAP	Matrix Spike	Dissolved Barium (Ba)	2019/10/22		95	%	80 - 120
			Dissolved Boron (B)	2019/10/22		80	%	80 - 120
			Dissolved Calcium (Ca)	2019/10/22		NC	%	80 - 120
			Dissolved Iron (Fe)	2019/10/22		103	%	80 - 120
			Dissolved Lithium (Li)	2019/10/22		93	%	80 - 120
			Dissolved Magnesium (Mg)	2019/10/22		93	%	80 - 120
			Dissolved Manganese (Mn)	2019/10/22		101	%	80 - 120
			Dissolved Phosphorus (P)	2019/10/22		102	%	80 - 120
			Dissolved Potassium (K)	2019/10/22		98	%	80 - 120
			Dissolved Silicon (Si)	2019/10/22		97	%	80 - 120
			Dissolved Sodium (Na)	2019/10/22		NC	%	80 - 120
			Dissolved Strontium (Sr)	2019/10/22		86	%	80 - 120
			Dissolved Sulphur (S)	2019/10/22		NC	%	80 - 120
			Dissolved Barium (Ba)	2019/10/22		98	%	80 - 120
9637743	MAP	Spiked Blank	Dissolved Boron (B)	2019/10/22		90	%	80 - 120
			Dissolved Calcium (Ca)	2019/10/22		96	%	80 - 120
			Dissolved Iron (Fe)	2019/10/22		102	%	80 - 120
			Dissolved Lithium (Li)	2019/10/22		95	%	80 - 120
			Dissolved Magnesium (Mg)	2019/10/22		96	%	80 - 120
			Dissolved Manganese (Mn)	2019/10/22		101	%	80 - 120
			Dissolved Phosphorus (P)	2019/10/22		98	%	80 - 120
			Dissolved Potassium (K)	2019/10/22		99	%	80 - 120
			Dissolved Silicon (Si)	2019/10/22		99	%	80 - 120
			Dissolved Sodium (Na)	2019/10/22		101	%	80 - 120
			Dissolved Strontium (Sr)	2019/10/22		97	%	80 - 120
			Dissolved Sulphur (S)	2019/10/22		98	%	80 - 120
9637743	MAP	Method Blank	Dissolved Barium (Ba)	2019/10/22	<0.010		mg/L	
			Dissolved Boron (B)	2019/10/22	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/10/22	<0.30		mg/L	
			Dissolved Iron (Fe)	2019/10/22	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/10/22	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/10/22	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/10/22	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2019/10/22	<0.10		mg/L	
			Dissolved Potassium (K)	2019/10/22	<0.30		mg/L	
			Dissolved Silicon (Si)	2019/10/22	<0.10		mg/L	
			Dissolved Sodium (Na)	2019/10/22	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/10/22	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/10/22	<0.20		mg/L	
9637743	MAP	RPD	Dissolved Barium (Ba)	2019/10/22	1.5		%	20
			Dissolved Boron (B)	2019/10/22	1.8		%	20
			Dissolved Calcium (Ca)	2019/10/22	1.6		%	20
			Dissolved Iron (Fe)	2019/10/22	NC		%	20
			Dissolved Lithium (Li)	2019/10/22	1.1		%	20
			Dissolved Magnesium (Mg)	2019/10/22	1.6		%	20
			Dissolved Manganese (Mn)	2019/10/22	1.5		%	20
			Dissolved Phosphorus (P)	2019/10/22	NC		%	20
			Dissolved Potassium (K)	2019/10/22	1.2		%	20
			Dissolved Silicon (Si)	2019/10/22	1.4		%	20
			Dissolved Sodium (Na)	2019/10/22	5.7		%	20
			Dissolved Strontium (Sr)	2019/10/22	0.48		%	20
			Dissolved Sulphur (S)	2019/10/22	1.1		%	20
9639226	FM0	Matrix Spike	Total Ammonia (N)	2019/10/23		109	%	80 - 120
9639226	FM0	Spiked Blank	Total Ammonia (N)	2019/10/23		115	%	80 - 120
9639226	FM0	Method Blank	Total Ammonia (N)	2019/10/23	<0.015		mg/L	

BUREAU  
VERITAS

BV Labs Job #: B989002

Report Date: 2019/10/24

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
9639226	FM0	RPD	Total Ammonia (N)	2019/10/23	13		%	20
9640265	STI	Matrix Spike	Dissolved Chloride (Cl)	2019/10/23		NC	%	80 - 120
			Dissolved Sulphate (SO4)	2019/10/23		NC	%	80 - 120
9640265	STI	Spiked Blank	Dissolved Chloride (Cl)	2019/10/23		107	%	80 - 120
			Dissolved Sulphate (SO4)	2019/10/23		102	%	80 - 120
9640265	STI	Method Blank	Dissolved Chloride (Cl)	2019/10/23	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/10/23	<1.0		mg/L	
9640265	STI	RPD	Dissolved Chloride (Cl)	2019/10/23	0.13		%	20
			Dissolved Sulphate (SO4)	2019/10/23	5.2		%	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  $\leq 2 \times \text{RDL}$ ).

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



BUREAU  
VERITAS

BV Labs Job #: B989002  
Report Date: 2019/10/24

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).

---

Harry (Peng) Liang, Senior Analyst

---

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) 291-9468 www.bvlabs.com

599

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:		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:		Site #:			
Email:	accounts-payable@hemmera.com	Email:	jessica.eaton@hemmera.com	Sampled By:			Gail Pedersen

Regulatory Criteria:		Special Instructions		ANALYSIS REQUESTED (PLEASE BE SPECIFIC)												Turnaround Time (TAT) Required:		
<input type="checkbox"/> ATI																Please provide advance notice for rush projects		
<input type="checkbox"/> CCME																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		
<input type="checkbox"/> Other																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	WQ1	19/10/16	11:30	w		X	X	X	X	X	X	X	X	X	X		Call if any hits	
2	WQ2	↑	11:00	w		X	X	X	X	X	X	X	X	X	X		Call if any hits	
3	WQ3		12:30	w		X	X	X	X	X	X	X	X	X	X		Call if any hits	
4	WQ4a		16:10	w		X	X			X							Just nitrate from routine	
5	WQ4b		14:30	w		X	X			X							Just nitrate from routine	
6	WQ5b	19/10/16	15:20	w		X	X			X							Just nitrate from routine	
7				w														
8				w														
9																		
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		
Jessica Eaton		19/10/16		Craig Choquette		2019/10/16	19:00		Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
									<input type="checkbox"/>	10/19/19	<input type="checkbox"/> Yes <input type="checkbox"/> No
										016/6	White: BV Labs Yellow: Client

\* 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.

16-Oct-19 19:00  
Gail Pedersen  
B989002  
SBZ INS-0220

Bureau Veritas Canada (2019) Inc.







Bureau Veritas Laboratories  
4000 19th N.E., Calgary, Alberta Canada T2E 6P8 Tel: (403) 291-3077 Toll-free: 800-563-6266 Fax: (403) 291-9468 www.bvlabs.com

# CHAIN OF CUSTODY RECORD

Page 22

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name: #10658 HEMMERA ENVIROCHEM INC.		Company Name:		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			506675
CALGARY AB T2R 0C5				Project Name:		COC #:	Project Manager:
Tel: (403) 264-0671 Fax:		Tel:		Site #:			Gail Pedersen
Email: accounts-payable@hemmera.com		Email: jessica.eaton@hemmera.com		Sampled By:		C#590675-01-02	

Regulatory Criteria:		Special Instructions		ANALYSIS REQUESTED (PLEASE BE SPECIFIC)										Turnaround Time (TAT) Required:		
<input type="checkbox"/> ATI															Please provide advance notice for rush projects	
<input type="checkbox"/> CCME															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	
<input type="checkbox"/> Other															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														# of Bottles	Comments	
Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y/N)	Biochemical Oxygen Demand	Oxygen (Dissolved, Winkler)									
1 WQ1	WQ1	19/10/16	11:30	W		X	X								8	Call on hits
2 WQ2	WQ2	↑	11:00	W		X	X								8	Call on hits
3 WQ3	WQ3		12:30	W		X	X								8	Call on hits
4 WQ4a	WQ4a		14:30	W		X	X								8	
5 WQ4b	WQ4b	↓	14:30	W		X	X								8	
6 WQ5b	WQ5b	19/10/16	15:20	W		X	X								8	
7				W												
8				W												
9																
10																

16-Oct-19 19:00

Gail Pedersen



B989002

SBZ INS-0220

* 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	
Gail Pedersen / Jessica Eaton				Craig Choquette		20/10/16	19:00		Time Sensitive	Temperature (°C) on Receipt
						20/10/16			<input type="checkbox"/>	10/19/19
										Custody Seal Intact on Cooler?
										<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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 90 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

While: BV Labs Yellow: Client

ice yes