DILLON CONSULTING

NOVA SCOTIA TRANSPORTATION AND INFRASTRUCTURE RENEWAL

# Environmental Assessment Highway 107 Burnside to Bedford

## Additional Information – Anderson Lake

FINAL June 8, 2018 – 13-8348-6000

June 8, 2018

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***Highway 107 Burnside to Bedford – Additional Information***

Attention: Sylvie Colomb, Environmental Analyst

The following provides the additional information requested by the Minister of Environment on August 25, 2017, for the proposed Highway 107 Burnside to Bedford Project in Halifax Regional Municipality, Nova Scotia.

Sincerely,

**DILLON CONSULTING LIMITED**

Karen March, M.Sc.
Dillon Project Manager

KLM:jes

Our file: 13-8348-6000

# Table of Contents

# 1.0 Background

This document provides additional information to the Environmental Assessment (EA) Registration Document for the Highway 107 Burnside to Bedford Project registered with the Nova Scotia Environmental Assessment Branch of Nova Scotia Environment (NSE) on July 7, 2017. The following information was requested by the Minister of the Environment on August 25, 2017 in order to evaluate potential environmental effects related to the undertaking:

- Provide updated baseline information on fish and fish habitat including Atlantic whitefish (*Coregonus huntsmani*) at Anderson Lake; and
- Based on the updated baseline information, develop appropriate mitigation measures accordingly (where applicable including but not limited to a discussion of highway alignment and/or design options) to mitigate potential project related impacts on Atlantic whitefish and Anderson Lake. Where applicable, provide also updated baseline information and impact analysis regarding all relevant valued environmental components.

## 1.1 Environmental Assessment Review Meeting

A meeting was held (August 30, 2017), subsequent to the Ministers request for information to discuss the requirements. The meeting was attended by representatives of Nova Scotia Transportation and Infrastructure Renewal (NSTIR), the Environmental Assessment Branch, federal Department of Fisheries and Oceans Canada (DFO), Nova Scotia Department of Fisheries and Aquaculture, and Nova Scotia Department of Natural Resources. Atlantic whitefish is listed as a Species at Risk and is protected federally under the *Species at Risk Act* (SARA – Schedule 1 Endangered) and provincially under the *Nova Scotia Endangered Species Act* (NSESA – Endangered). It is also globally listed by the International Union for Conservation of Nature (IUCN). The only locations known in the world to be inhabited by Atlantic whitefish are the wild populations of landlocked Atlantic whitefish in the Petite Riviere watershed and the stocked fish in Anderson Lake. An historic anadromous population was located in southwest Nova Scotia, the Tusket-Annis system, but this population is believed to be extirpated (COSEWIC 2010).

The historic context of the experimental stocking of Anderson Lake with Atlantic whitefish was reviewed during the meeting, as well as related DFO monitoring. It was concluded that Atlantic whitefish, if present, were at very low levels and thus conventional biological assessment methods were limited in their ability to detect the fish. It was agreed that NSTIR would investigate environmental DNA-Deoxyribonucleic acid (eDNA) methodology in order to provide improved resolution on the potential for the presence of Atlantic whitefish within Anderson Lake.

## 1.2 eDNA Technology

The eDNA technology is a relatively new and diverse biological assessment tool that was developed over a decade ago, and was first used in North America in 2009-2010 to detect Asian carp in the Great Lakes.

Since then, a wide range of applications have been developed. Analysis involves collection of genetic material that is shed into the environment from living organisms such as from skin, feces, eggs/sperm, fluids (blood, urine) or material from dead or degrading cells. Environmental samples (such as soil or water) are collected, and then DNA present in the samples is extracted and detected using molecular genetic techniques. Based on the DNA identified, information can be obtained regarding the presence of organisms in the environment. This eDNA technique is particularly useful for detecting species present at low abundances, where conventional sampling methods may have limitations such as requiring considerable effort to address presence/absence (Wilson and Wright 2013). It is noted that a positive eDNA detection for a targeted species indicates that DNA was present but does not confirm if the source was a live animal.

## 1.3 Background on Whitefish Biology

As outlined in the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Assessment and Status Report (2010), Atlantic whitefish were historically sea-run with migrations to freshwater in fall to spawn. Some of the individuals spent the winter in freshwater and returned to the sea in the spring. However, the remaining known natural wild population is landlocked and primarily remain within headwater lakes in the Petite Riviere watershed. Wild lake populations and captive born fish are observed to spawn from late November to early January (DFO 2009). It is reported that the fish are found more often in surface and midwaters of the lakes (COSEWIC 2010). One juvenile capture was recorded in June of 2000 along the shore zone in a Petite system lake (Hasselman *et al.* 2005). COSEWIC (2010) identifies Atlantic whitefish diet and longevity. The whitefish's diet ranges from zooplankton, to flying insects and small fish. Wild Atlantic whitefish may mature at 2+ years old, but typically between age 3 and 4. Maximum age is estimated to be 4 to 5 years in the wild. However, wild caught and hatchery reared Atlantic whitefish typically lived to 7 to 8 years in captivity (Whitelaw *et al.* 2015).

## 1.4 Background on Anderson Lake

Anderson Lake is a headwater lake with a total area of 0.62 $km^2$, mean depth of 7.8 m, and maximum depth of 26 m (Cook *et al.* 2014). Inflows to the lake include small intermittent (seasonal) watercourses, surface runoff, and groundwater flow through glacial boulder and bedrock. The southern border of the lake includes Department of National Defence (DND) property. An historic jetty remains at the end of a gravel access road in the southwest portion of the lake. DND has conducted environmental sampling in relation to potential contaminants and remediation planning. The remaining shoreline is forested. The lake outlet is a connection channel to a smaller pond (Little Lake) which then flows to Wrights Brook and ultimately Bedford Basin.

The lake shoreline is dominated by bedrock outcrops and boulders. Limited aquatic vegetation is present in shallower coves. Little Lake has more extensive aquatic vegetation (emergent lilies and submergents). Submerged boulder shelves with depths less than 2 m occur in the northern arm and southeastern embayment of the lake. Water quality was determined to be suitable for Atlantic whitefish with a pH in

the order of 6.2 units, low to moderate nutrient concentrations, and good dissolved oxygen levels (Bradford *et al.* 2015). The lake water column is thermally stratified typically starting in mid-May and ending in November with turnover. Summer surface water temperatures can be high (23°C noted), but below the thermocline water temperature is typically less than 9°C, and temperatures around the thermocline offer suitable warm water refuge habitat for whitefish, closer to the optimal growth temperature of 16.5°C (COSEWIC 2010). **Photos 1** and **2** below show Anderson Lake in the fall of 2017.

**Photo 1 Bedrock Shoreline and Jetty**

**Photo 2 Boulder Shoreline**

## 1.5 Summary of DFO Monitoring of Atlantic Whitefish and Anderson Lake

A report on the Atlantic whitefish stocking of Anderson Lake was issued in 2015 (Bradford *et al.* 2015). Stocking of Anderson Lake was undertaken by DFO as trial releases of surplus captive breed fish. A potential benefit of the experiment was the possible range extension of the species supporting recovery efforts. It was considered a trial as the study was not specifically designed to increase the likelihood of a self-sustaining population (Bradford 2017). Anderson Lake was chosen as a stocking location based on generally similar habitat characteristics (water chemistry, temperature, and bedrock geology) to the Petite system; on the natural obstruction of the outlet stream; and, on the absence of predatory invasive fish species that were identified to have been illegally introduced into the Petite system (smallmouth bass and chain pickerel).

The 2015 report identifies the habitat characteristics of the lake, the number of whitefish and the timing of stocking into Anderson Lake, and the monitoring undertaken to that date. Prior to introduction of Atlantic whitefish, fish sampling (gill net) in 2003 and 2004 identified the following fish species to be present in the lake: American eel, banded killifish, brook trout, common shiner, nine-spine stickleback, rainbow smelt and white sucker.

The 2005 to 2012 releases of captive breed and reared Atlantic whitefish to the lake and monitoring undertaken are summarized in **Table 1** below.

**Table 1 Summary of Stocking and DFO Trap Net Deployment and Atlantic Whitefish Captures (2005 to 2012) (data from Bradford *et al.* 2015) (na – not applicable)**

| Year | Days Fished | Stocking Data | Date or Month/s | Capture Data | Total Captures |
|---|---|---|---|---|---|
| 2005 | na | 1,500 age 1+ year old juveniles | November 4/5 | na | na |
| 2006 | na | 10 age 2+ year old fish with acoustic transmitters and 750 age 1+ juveniles | April 24 | na | na |
| 2006 | na | 5,000 larvae (age 0+ year old) | April 26 | na | na |
| 2006 | 4 | na | May 11-16 | na | 0 |
| 2006 | na | 5 age 2+ fish with acoustic transmitters | May 23 | na | na |
| 2006 | 4 | na | June 6-28 | Fish identified as from Nov. 5 release | 3 |
| 2006 | na | 750 age 1+ juveniles | Oct. 16 | na | na |
| 2006 | 5 | na | Nov. 15 – Dec. 1 | Average fork length 21; Range 15.6-25.9 | 7 |
| 2007 | na | 750 age 1+ juveniles and 2,000 larvae (age 0+) | May 1 | na | na |
| 2007 | 28 | na | May 15 – June 22 | 2007 Average fork length 22; Range 19.9-26.2 (includes Nov. data) | 6 |
| 2007 | na | 6 age 2+ juveniles with acoustic transmitters and 750 age 1+ juveniles | Oct. 3 | na | na |
| 2007 | 11 | na | Nov. 9 – Nov. 30 | 2007 Average fork length 22; Range 19.9-26.2 (includes spring. data) | 14 |
| 2008 | na | 212 age 4+ adults and 184 age 3+ adults | Nov. 25 | na | na |
| 2008 | 35 | na | Sep. 29-Dec.16 | Average fork length 23.5; Range 21.2-31.6 | 32 |
| 2009 | 22 | na | Nov.2-Dec.2 | Average fork length 26.5; Range 23-33.7 10 - Age 3+, 30 - Age 4+, 2 - Age 5+ | 44 |
| 2010 | 30 | na | Nov.1-Dec.10 | Average fork length 28.2; Range 25.7-31.6 | 41 |
| 2010 | 22 | na | Nov.9-Dec.10 | (second shallower set) | 0 |
| 2012 | na | 80 ages 5+ and 6+ years old fish | Nov. 5 | na | na |
| 2012 | 22 | na | Oct.23-Dec.12 | Average fork length 35.3; Range 34.4-36.2 | 2 |

Monitoring of the spring 2006 hatchery releases with acoustic tags is summarized in Cook *et al.* (2014). Monitoring was conducted over 342 days. The study noted that hatchery reared fish were slow to disperse from the release site and the fish swam at the surface for extended periods. It was suggested that the resulting higher densities at the water surface may have increased predation by visual predators (particularly fish eating birds). A high proportion of the releases were "lost" (were unable to be acoustically detected) within the first 100 days. The loss was always during daylight hours and last recorded location did not occur near or at the outflow. Once dispersed, the hatchery reared fish were distributed throughout the lake similarly to wild released fish. Typically fish were found within the thermally stratified photic (light) zone (that is: <10-12 m in water depth).

The 2015 stocking report (Bradford *et al.* 2015) also concluded that losses of the stocked juveniles from predation and perhaps starvation appeared to be high.

DFO has conducted additional monitoring since 2012, including angling assessments as recently as the summer of 2017 (pers. comm. J. Broome, DFO) which did not result in the capture of Atlantic whitefish.

Based on the age of the fishes released into Anderson Lake, it is not expected that any of the original stockings would currently be alive. Fish would only be present if reproduction had occurred and the resulting juveniles survived. Monitoring indicated that the fish captured were increasing in body size over time and that sexually mature fish were observed from 2008 to 2012, but no evidence of successful reproduction has been obtained during DFOs monitoring.

# 2.0 Anderson Lake eDNA Study Methodology

An eDNA survey was conducted in Anderson Lake in the fall of 2017 to detect the presence of Atlantic whitefish eDNA in the water column. eDNA is a highly suitable tool for this purpose owing to the comparatively higher sensitivity to detect target species compared with conventional fish sampling methods. Because of this high sensitivity, even populations with low abundance may be expected to shed enough eDNA to be detected by an assay given a robust sampling scheme and optimal eDNA assay development.

Water sampling was conducted with assistance from DFO (Jeremy Broome, Biologist, Population Ecology Division). The eDNA processing and analysis was conducted by Precision Biomonitoring (associated with Biodiversity Institute of Ontario University of Guelph).

## 2.1 Assay Development

The initial step required to conduct the eDNA study was the development by Precision Biomonitoring of reference DNA material (assay) for comparison to the DNA recovered from Anderson Lake. A molecular primer for real-time quantitative polymerase chain reaction (qPCR), the basis of an eDNA assay, was

designed by utilizing online sequence data for the Atlantic whitefish and related salmonids. The assay was designed to amplify only the Atlantic whitefish's DNA. A part of the assay development, additional Atlantic whitefish tissue was provided to Precision Biomonitoring by DFO from several different individuals of captive breeding stock for DNA sequencing to increase the sequence dataset, thereby increasing the confidence that the assay works across the standing genetic diversity found in this species. The assay was used to detect whitefish eDNA in total eDNA extracts derived from sampling Anderson Lake. The qPCR assays were validated to adhere to clinical publication standards - MIQE (minimum information for the publication of quantitative PCR experiments) guidelines, including elucidation of the assay's technical limit of detection (LOD) (the lowest concentration of target that yields 95% amplification among technical replicates), efficiency, and dynamic range (the concentrations of target eDNA over which PCR yields a positive result).

## 2.2 Field Program and Analysis

The field sampling program was developed in consultation with DFO and Precision Biomonitoring. The timing and locations of sampling was based on previous DFO experience at Anderson Lake and on discussions with Nova Scotia Department of Fisheries and Aquaculture (NSFA, pers. comm. J. LeBlanc, Manager) regarding knowledge of distribution and habitat preferences in the Petite system.

Sampling was undertaken both pre and post fall turnover. Samples were collected by Dillon Consulting Limited (Dillon) personnel and by Precision Biomonitoring's research scientist, Steven Crookes (Post Doctorate Fellow, University of Guelph). Pre turnover sampling was conducted on October 17, 2017 and post turnover was conducted on November 30, 2017. **Figure 1** (attached) provides the sample locations and **Appendix A** provides sample depths and temperature/depth profiles based on field meter measurement at the time of sampling. Samples collected on the pre-turnover date were collected in the upper to mid water column, just above the thermocline. Sample locations targeted areas where water depth was sufficient to provide a thermocline with cooler water temperatures. Additional samples were also collected in other areas to improve the spatial coverage, and in the outlet from Little Lake to capture water from that habitat. Samples collected post-turnover were collected mid-depth. Sample locations were picked by random number generator based on a lake grid. An outlet location was also added to the post turnover dataset.

Sampling and transportation equipment including the boat and compositing containers, were sterilized and rinsed with distilled water following Precision Biomonitoring instructions. Disposable nitrile gloves were used and changed between collections. Materials in contact with samples/water were kept separate from clean materials. At each eDNA sample location, water samples were simultaneously collected in three (3), two-litre (2L) horizontal water sampling grabs and combined to a composite sample. Once collected the water was filtered on-site and processed by Precision Biomonitoring's scientist for transport and laboratory analysis. Negative control on the analysis was undertaken using distilled water. An equivalent volume of distilled water was processed on-site in the same manner as water samples.

Samples were analysed by Precision Biomonitoring at a qPCR accredited laboratory using the custom-designed Atlantic whitefish assay. The qPCR analysis was not performed in the same building in which the Atlantic whitefish tissue processing and PCR development was previously performed. Each extraction was subject to three technical replicate qPCR reactions, and a positive signal (i.e., the presence of an above-threshold amplification curve) was determined if at least 1/3 replicates were positive.

Additional water chemistry samples were taken to confirm lake water quality at the time of sampling. On October 17, 2017 two surface water samples were collected; one from the general area of sampling near the deep area thermocline and one in the Little Lake outlet. Two water chemistry samples were also collected on November 30: from the central Anderson Lake area; and, from the Little Lake outlet. Samples were collected as whole water grabs and transported to the analytical laboratory following standard Dillon procedures. Samples were taken at depth comparable with the eDNA water sampling using the horizontal grab. Analysis was completed by Maxxam Analytics (a certified analytical laboratory) for general chemistry, metals and Total Suspended Solids parameters for the October date, with mercury and hydrocarbons also assessed in November, 2017.

# 3.0 2017 Water Sampling Results

## 3.1 eDNA Results

The eDNA testing within Anderson Lake, both pre and post turnover in the fall of 2017, tested negative for Atlantic whitefish DNA indicating it is unlikely that the fish are still present in the lake. The reports from Precision Biomonitoring are provided in **Appendix B**.

## 3.2 Surface Water Chemistry

Surface water chemistry results are provided in **Appendix C.** Water quality is fairly dilute reflective of rainwater inputs with conductivity in the order of 60 uS/cm, nutrients (nitrate, nitrite and total phosphorus) below detection, the highest Total Suspended Solids observed of 1.2 mg/L, and pH measured at between 5.96 and 6.4 units. Dissolved chlorides were also low at 12 mg/L. No mercury or hydrocarbons were detected. Exceedances to Canadian Council of the Ministers of the Environment (CCME) Fresh Water Aquatic Life guidelines were limited to aluminum (but still at concentrations typical of natural waters in the area) and a pH less than 6.5 units.

# 4.0 Proposed Mitigation Summary

As outlined in the EA, no infill of Anderson Lake or Little Lake is proposed and a clear span structure will be used over Wrights Brook at the outlet to Little Lake. Based on current design, a minimum 10 m no

disturbance buffer will be maintained between the Project footprint and Anderson/Little Lake. The current proposed Highway 107 Project footprint is shown on **Figure 2** (attached). With the exception of the southwest cove closest to the alignment and portions south of Little Lake, Anderson Lake is generally over 100 m to the north of the proposed Project footprint.

NSTIR has committed to ensuring NSTIR work and its contractors work for the Project use standard mitigation measures in line with NSTIRs generic Environmental Protection Plan (EPP) for the construction of 100 Series Highways (https://novascotia.ca/tran/works/enviroservices/EPP100series/Generic%20EPP_July%202007.pdf). The EPP identifies environmental policy and responsibilities, protection measures for areas of special environmental consideration, erosion and sediment control, clearing, watercourse crossing and other structures construction, grubbing, grading, access, winter work, stabilization, dust and noise control, management of petroleum, oil, lubricants, chemicals and wastes and road salt management. This document also includes direction to meet DFO requirements for blasting in the vicinity of fish habitat if applicable. In addition, monitoring, inspection and contingency planning requirements are identified. NSTIR has successfully used appropriate environmental planning and implementation of the EPP during construction to mitigate impacts to watercourses and fish habitat on similar 100 series highway projects throughout the province.

Although it is likely that the Atlantic whitefish are not currently present in Anderson Lake, additional mitigation measures are proposed following the precautionary principle.

***Site Specific EPP***

A site specific EPP will be developed for the Anderson Lake watershed which will be identified as an Area of Special Environmental Consideration. Construction contractors will be required to provide a site specific erosion and sediment control plan for this area and pre-locate staging areas and fueling areas in consultation with NSTIR environmental staff in addition to incorporating Generic EPP measures into a site specific plan. No disturbance will be permitted on the north side of the alignment outside of the proposed project footprint and work areas will be identified (flagged and/or silt fenced) prior to work.

***General Storm Water Conveyance and Spill Containment Design***

Traffic and/or road maintenance activities present a risk to the environment related to accidental spills. As a risk mitigation measure, a spill containment system will be designed and installed along the section of the alignment adjacent to Anderson Lake (as noted in **Figure 2**). The system will be located on the north side of the right-of-way and within the existing project footprint. The spill containment design will convey stormwater/spills away from flowing directly into Anderson Lake. A low permeability clay liner, a geomembrane liner, and oil/water separators will be implemented with the intent of controlling potential accidental spills. In addition to separating oil and grit from potential hazardous material spills, the oil/water separators will also help mitigate the risks associated with stormwater pollution, including suspended sediment, free oils, and other particle pollutants.

***Salt Management Planning***

Consistent with NSTIRs overriding Salt Management Plan, winter maintenance of the highway and associated Active Transportation (AT) trail will follow winter maintenance protocols designed to use minimum safe levels of salt including practices such as pre-wetting. The Anderson Lake watershed will be identified as a salt vulnerable area and applicable best management practices in relation to winter maintenance will be implemented and communicated to Halifax Regional Municipality or other potential parties involved in AT trail maintenance.

***Limitation on Unauthorized Access to the Anderson Lake Area***

NSTIR has committed to fencing along both sides of the Right-of-Way (RoW) to serve as wildlife exclusion fencing and limit trespass on adjacent lands. At a minimum fencing will be 10 foot high chain link installed in a manner to limit wildlife access both over and under the fence.

# 5.0 References

Bradford, R.G. 2017. Supplementation Options to Aid Recovery of the Endangered Atlantic Whitefish (*Coregonus huntsmani*). Canadian Manuscript Report of Fisheries and Aquatic Sciences 3134: 29p.

Bradford, R.G., D, Themelis, P. LeBlanc, D. Campbell, S. O'Neil and J. Whitelaw. 2015. Atlantic Whitefish Stocking in Anderson Lake, Nova Scotia. Canadian Technical Report of Fisheries and Aquatic Sciences 3142. Department of Fisheries and Oceans Canada (DFO).

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2010. COSEWIC assessment and status report on the Atlantic Whitefish *Coregonus huntsmani* in Canada. Ottawa.

Cook, A., R.G. Bradford and P. Bentzen. 2014. Hydroacoustic tracking of the endangered Atlantic whitefish (*Coregonus huntsmani*); comparative analysis from wild and hatchery reared populations. Environ. Biol. Fish 97:955-964.

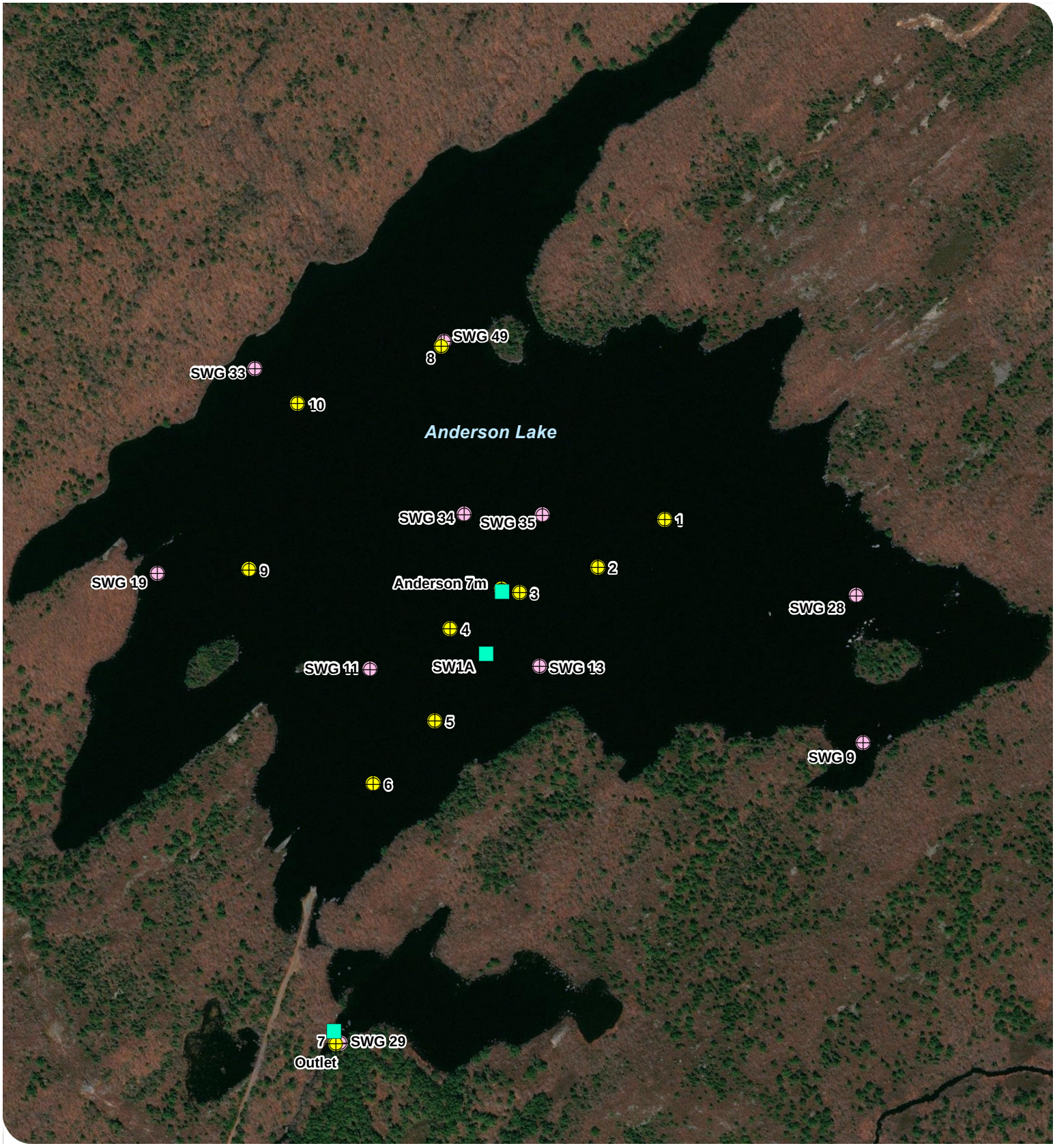
Fisheries and Oceans Canada (DFO). 2009. Recovery Potential Assessment for Atlantic whitefish (*Coregonus huntsmani*). Canadian Science Advisory Secretariat Science Advisory Report 2009/051.

Hasselman, D., P. Longue and R. Bradford. 2005. First Record of age 0+ Atlantic whitefish, *Coregonus huntsmani*, from the Wild. Canadian Field-Naturalist 119(2): 294-295.

Wilson, C and E. Wright. 2013. Using Environmental DNA (eDNA) as a Tool in Risk-Based Decision-Making. Ontario Ministry of Natural Resources. Aquatic Research and Development Section, Aquatic Research Series 2013-01.

Whitelaw, J., J. Manriquez-Hernandez, J. Duston, S.F. O'Neil and R.G. Bradford. 2015. Atlantic whitefish (*Coregonus huntsmani*) Culture Handbook. Canadian Manuscript Report of Fisheries and Aquatic Sciences 3074.

# Figures




Nova Scotia Transportation and Infrastructure Renewal

HIGHWAY 107 BURNSIDE TO BEDFORD ENVIRONMENTAL ASSESSMENT - REQUEST FOR ADDTIONAL INFORMAITON

FIGURE 1

Environmental DNA Sample Locations

NOVA SCOTIA

Pre Turnover Sample Locations - Oct. 2017

Post Turnover Sample Locations (SWG) - Nov.2017

Surface Water Chemistry Station

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSTIR, NSDNR

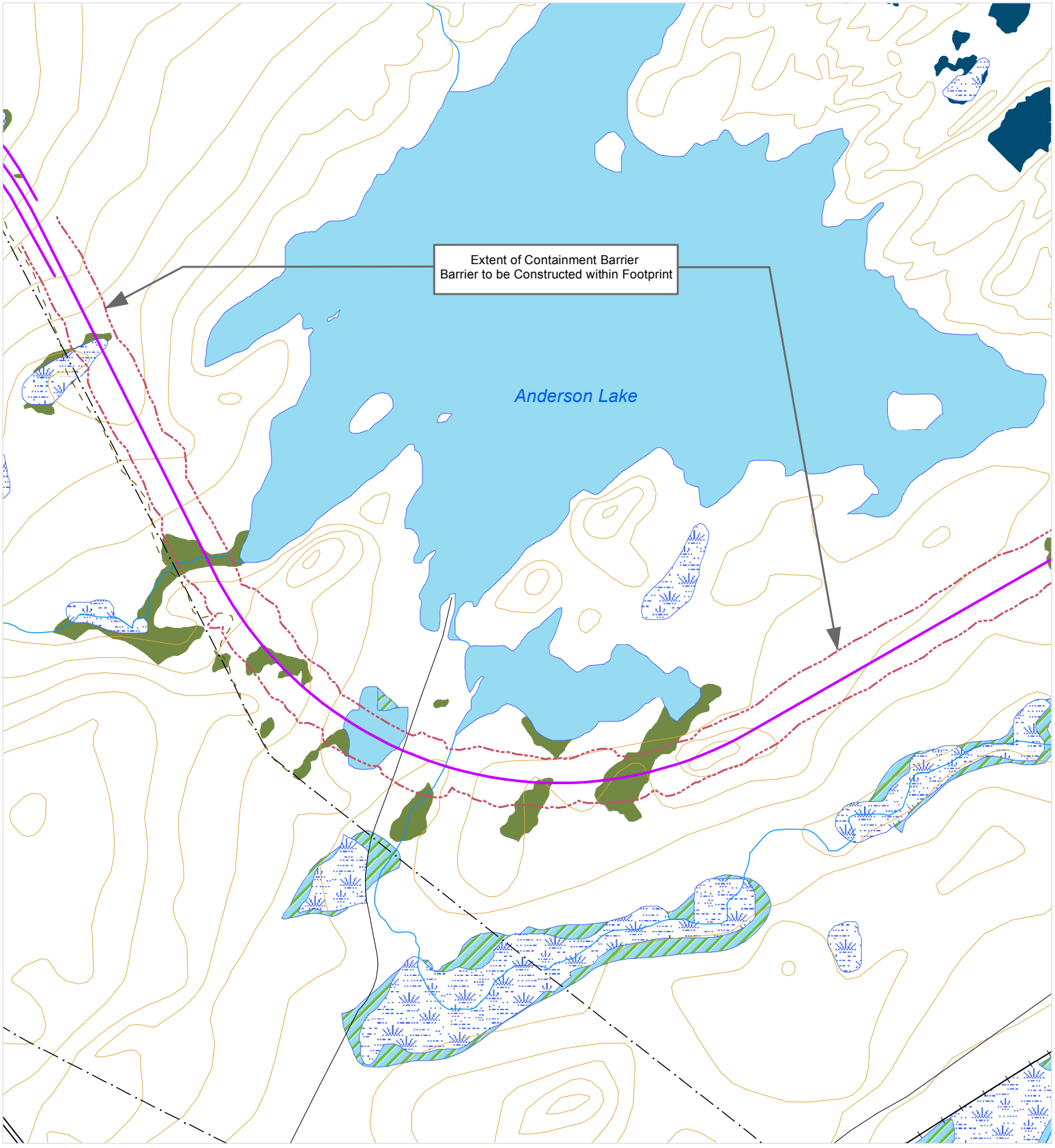
MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 25 50 100 150 Metres

N
W E
S

PROJECT: 13-8348

DATE: January 2018




Nova Scotia Transportation and Infrastructure Renewal

HIGHWAY 107 BURNSIDE TO BEDFORD ENVIRONMENTAL ASSESSMENT - REQUEST FOR ADDTIONAL INFORMAITON

FIGURE 2

Proposed Containment System Extent

NOVA SCOTIA

Proposed Alignment Centerline

Project Footprint

Watercourse

Dillon Field Defined Wetlands ( Sept 2013)

Stantec Field Defined Wetlands (June 2011)

Wetland (NS Topographic)

NSDNR Wetlands

Contour (5m)

DILLON CONSULTING

MAP DRAWING INFORMATION:
DATA PROVIDED BY GeoNova, NSTIR, NSDNR

MAP CREATED BY: SCM
MAP CHECKED BY: KLM
MAP PROJECTION: NAD 1983 UTM Zone 20N

0 25 50 100 150 Metres

N W E S

PROJECT: 13-8348

DATE: January 2018

# Appendix A

## *2017 Temperature, Depth Profiles and Sample Depths*

Anderson Lake, Halifax Regional Municipality, Nova Scotia - Draft

October 17, 2017 Temperature Profile Data
Location: Sample Point 1 ~UTM 20 T 451107 4952788; Approximate time: 0930

| Depth (m) | Temperature (°C) | Dissolved Oxygen | Dissolved Oxygen (percent saturation) |
|---|---|---|---|
| 1 | 16.0 | 9.2 | 93 |
| 2 | 16.0 | 9.1 | 92 |
| 3 | 16.0 | 9.0 | 91 |
| 4 | 16.0 | 9.0 | 91 |
| 5 | 16.0 | 9.1 | 92 |
| 6 | 16.0 | 9.1 | 92 |
| 7 | 16.0 | 9.0 | 90 |
| 8 | 16.0 | 9.1 | 92 |
| 9 | 11.7 | 4.5 | 40 |
| 10 | 8.9 | 5.1 | 46 |
| 11 | 8.4 | 5.2 | 44 |
| 12 | 8.0 | 5.5 | 46 |
| 13 | 7.4 | 5.8 | 48 |
| 14 | 6.8 | 5.9 | 48 |
| 15 | 6.6 | 5.7 | 47 |
| 16 | 6.5 | 5.6 | 45 |
| 17 | 6.5 | 5.6 | 45 |
| 18 | 6.4 | 5.0 | 40 |
| 19 | 6.4 | 4.7 | 38 |
| 20 | 6.3 | 0.4 | 2 |

Meter: YSI Professional Plus meter (DFO); field pH ranged from 5.6 (below 9 m) to 6.7 (above 9 m)

October 17, 2017 Temperature Profile Data – Draft
Location: Sample Point 8 ~UTM 20 T 450827 4953005; Approximate time: 1030

| Depth (m) | Temperature (°C) | Dissolved Oxygen | Dissolved Oxygen (percent saturation) |
|---|---|---|---|
| 1 | 15.9 | 9.1 | 91 |
| 2 | 15.9 | 8.9 | 90 |
| 3 | 16.0 | 9.0 | 91 |
| 4 | 16.0 | 9.0 | 92 |
| 5 | 15.9 | 9.1 | 92 |
| 6 | 15.9 | 9.1 | 92 |
| 7 | 15.9 | 9.2 | 93 |

| Depth (m) | Temperature (°C) | Dissolved Oxygen | Dissolved Oxygen (percent saturation) |
|---|---|---|---|
| 8 | 14.9 | 7.6 | 75 |
| 9 | 10.5 | 4.5 | 40 |
| 10 | 10.0 | 3.7 | 33 |

Meter: YSI Professional Plus meter (DFO); field pH ranged from 5.7 (below 9 m) to 6.5 (above 9 m)

October 17, 2017 Temperature Profile Data

Location: Sample Point 7 ~UTM 20 T 450680 4952127; Approximate time: 1120

| Depth (m) | Temperature (°C) | Dissolved Oxygen | Dissolved Oxygen (percent saturation) |
|---|---|---|---|
| 0.5 | 14.3 | 9.3 | 91 |

Meter: YSI Professional Plus meter (DFO); field pH 6.4

November 30, 2017 Temperature Profile Data

Location: Sample Point SW1A ~UTM 20 T 450883 4952619; Approximate time: 1100

| Depth (m) | Temperature (°C) | Dissolved Oxygen | Dissolved Oxygen (percent saturation) |
|---|---|---|---|
| 1 | 6.6 | 11.1 | 91 |
| 2 | 6.6 | 11.4 | 93 |
| 3 | 6.6 | 11.4 | 93 |
| 4 | 6.6 | 11.4 | 93 |
| 5 | 6.6 | 11.4 | 92 |
| 6 | 6.6 | 11.3 | 92 |
| 7 | 6.6 | 11.4 | 93 |
| 8 | 6.6 | 11.3 | 92 |
| 9 | 6.6 | 11.3 | 92 |
| 10 | 6.6 | 11.3 | 92 |
| 11 | 6.6 | 11.3 | 92 |
| 12 | 6.6 | 11.2 | 91 |
| 13 | 6.6 | 11.2 | 91 |
| 14 | 6.6 | 11.2 | 91 |
| 15 | 6.6 | 11.3 | 92 |
| 16 | 6.6 | 11.3 | 92 |
| 17 | 6.6 | 11.3 | 92 |
| 18 | 6.6 | 11.2 | 92 |
| 19 | 6.5 | 11.2 | 91 |
| 20 | 6.5 | 11.3 | 92 |
| 21 | 6.5 | 11.2 | 91 |

| Depth (m) | Temperature (°C) | Dissolved Oxygen | Dissolved Oxygen (percent saturation) |
|---|---|---|---|
| 22 | 6.6 | <1 on bottom | <10% on bottom |

Meter: YSI Professional Plus meter (DFO); field pH ranged from 6.2 to 6.3

2017 Water Sample Locations in Relation to Water Depth

| Sample No. | Sample Depth (m) | Approx. Water Depth (m) |
|---|---|---|
| **October 17, 2017 Samples** | | |
| 1 | 7 | 22.7 |
| 2 | 7 | 18.5 |
| 3 | 7 | 24.6 |
| 4 | 7 | 21.4 |
| 5 | 7 | 17.7 |
| 6 | 7 | 15.4 |
| 7 (outlet) | 0.3 | 0.5 |
| 8 | 6 | 9.9 |
| 9 | 6 | 11.6 |
| 10 | 5 | 7.9 |
| Anderson 7m (water chem.) | 7 | ~20 |
| Outlet (water chem.) | 0.4 | 0.8 |
| **November 30, 2017 Samples** | | |
| SWG-09 | 2 | 4 |
| SWG-11 | 10<br>Note: fish observed on fish finder at 10 m | 20 |
| SWG-13 | 9 | 18 |
| SWG-19 | 2 | 4 |
| SWG-28 | 4 | 8 |
| SWG-29 (outlet) | 0.3 | 1 |
| SWG-33 | 1.5 | 3 |
| SWG-34 | 9 | 17.5 |
| SWG-35 | 10 | 20 |
| SWG-49 | 5 | 10 |
| SW1A (water chem.) | ~10 | ~20 |
| Outlet (water chem.) | 0.4 | 0.8 |

# Appendix B

## *Precision Biomonitoring Pre and Post Turnover 2017 Anderson Lake eDNA Reports*

**Environmental DNA (eDNA) Survey for the Atlantic Whitefish *Coregonus hunstmani* in Anderson Lake, Nova Scotia.**

## Introduction

The Atlantic whitefish *Coregonus hunstmani* is a federally protected endangered species of coregonid fish, found only in a limited number of waterbodies in Nova Scotia. As an evolutionary basal species, it represents an ancestral connection to the entire sub-family of whitefishes in the family Salmonidae, which, if lost, would represent a significant reduction in evolutionary and biological diversity of this family, to the detriment of the freshwater fish biota of this region.

Atlantic whitefish was subject of a captive breeding program by the Department of Fisheries and Oceans (DFO), before being terminated in 2012. Anderson Lake, near Halifax, received its last inoculation of Atlantic whitefish juveniles in this same year. Conventional monitoring methods have detected the species in this location with decreasing efficiency as time has elapsed, with more recent surveys failing to detect it at all. The decline of the species is likely due to predation due to a combination of incumbent and introduced predatory fishes. This decline poses the question: is it extirpated from this locale entirely, or is it present at such low abundances that are beyond the detectability of conventional methods? eDNA methods are significantly more sensitive than conventional methods, and represent the best available method to detect the species if it is still present, even in extremely sparse numbers.

## Methods

### *qPCR Assay design, validation and implementation*

qPCR primers and Taqman hydrolysis probes were designed for the COI barcode region of the mitochondrial genome. *In silico* parameters were designed and optimised so that the assay would amplify only this species within the coregonids, and would not amplify other species found in Anderson Lake (e.g., brook trout and white sucker, amongst others). The assay was tested *in vitro* against tissue-extracted Atlantic whitefish DNA and that of co-occurring species to ensure assay specificity.

### *Field sampling and processing*

Water samples were collected from the thermocline at ten coordinates in the system. Three 2 L samples were collected, pooled and subject to on site filtration until the 47 mm diameter, 1 µm pore-sized, nitrocellulose filter became saturated. A field blank of distilled water was also subject to the DNA extraction procedure as an extraction control. DNA was extracted in the field using our field-ready, heavy instrument-free DNA extraction kits. 5 µl of extracted DNA from each of the ten (plus field blank) DNA extractions was used as template for each 20 µl qPCR reaction.

*qPCR*

qPCR reactions were performed on the Biomeme two3 thermocycler using custom, programable thermocycler conditions optimised for the assay. Each eDNA sample, including the blank, was subject to three qPCR replicates (technical replicates). Positive control reactions were performed on extracted Atlantic whitefish tissue. One positive control reaction was performed per nine technical replicates (one per batch of reaction mastermix).

**Results**

All extractions generated DNA in sufficient quantity for qPCR assaying (mean concentration = 3.83 ng $\mu l^{-1}$, standard deviation = 2.75 ng $\mu l^{-1}$). However, all PCR reactions failed to yield a positive result, when performed in triplicate. All positive control reactions successfully amplified target DNA, indicating that PCR failure, due to denatured reagents, is not a causative factor. Field blank also tested negative for Atlantic whitefish DNA, as expected.

**Discussion**

Given that ten sites were sampled in a relatively small lake, a total of thirty qPCR technical replicates without a single positive hit indicates that the Atlantic whitefish is likely extirpated from this location, following the cessation of stocking in 2012. This observation is consistent with recent conventional monitoring efforts that have failed to find a single individual in recent surveys. Although, it is possible, albeit remote, that the survey has not detected the species when it *is* present in extreme low density, the likelihood of its continued existence in the wake of multiple failed detection efforts is increasingly small.

**Further work**

Further corroborative surveying will take place once the lake has undergone turnover, which likely plays a role in the distribution of eDNA particles and molecules in solution in the water column. During this period, eDNA particles will be subject to redistribution, allowing for a second, independent surveillance event of the lake.

**Environmental DNA (eDNA) Survey for the Atlantic Whitefish *Coregonus hunstmani* in Anderson Lake, Nova Scotia – Post-Turnover**

## Introduction

The Atlantic whitefish *Coregonus hunstmani* is a federally protected endangered species of coregonid fish, found only in a limited number of waterbodies in Nova Scotia. As an evolutionary basal species, it represents an ancestral connection to the entire sub-family of whitefishes in the family Salmonidae, which, if lost, would represent a significant reduction in evolutionary and biological diversity of this family, to the detriment of the freshwater fish biota of this region.

This report presents the results of a follow-up eDNA survey for the Atlantic whitefish to corroborate the previous survey's results of negative detection. The previous survey assessed the presence of Atlantic whitefish prior to the thermal turnover of Anderson Lake, which may redistribute eDNA molecules and cellular material from as-yet un-sampled enclaves within the lake which may have been missed.

## Methods

*qPCR Assay design, validation and implementation*

qPCR primers and Taqman hydrolysis probes were designed for the COI barcode region of the mitochondrial genome. *In silico* parameters were designed and optimised so that the assay would amplify only this species within the coregonids, and would not amplify other species found in Anderson Lake (e.g., brook trout and white sucker, amongst others). The assay was tested *in vitro* against tissue-extracted Atlantic whitefish DNA and that of co-occurring species to ensure assay specificity.

*Field sampling and processing*

Sampling followed a random-grid design, as the presence of a thermocline no longer dictated the optimal sampling strategy to focus on preferred whitefish habitat. Ten locations were sampled from the lake at mid-depth. As before, three 2 L samples were collected, pooled and subject to on site filtration until the 47 mm diameter, 1 µm pore-sized, nitrocellulose filter became saturated. The entire volume of water was filtered across multiple filter papers, as necessary. A field blank of distilled water was also subject to the DNA extraction procedure as an extraction control. DNA was extracted in the field using our field-ready, heavy instrument-free DNA extraction kits. After quantification, DNA was pooled per sampling location. 5 µl of extracted DNA from each of the ten (plus field blank) DNA extractions was used as template for each 20 µl qPCR reaction.

*qPCR*

qPCR reactions were performed on the Biomeme two3 thermocycler using custom, programable thermocycler conditions optimised for the assay. Each eDNA sample, including the blank, was subject to three qPCR replicates (technical replicates). Positive control reactions were performed on extracted

Atlantic whitefish tissue. One positive control reaction was performed per nine technical replicates (one per batch of reaction mastermix).

**Results**

All extractions generated DNA in sufficient quantity for qPCR assaying (mean concentration = 8.54 ng $\mu l^{-1}$, standard deviation = 5.72 ng $\mu l^{-1}$). There was observed to be a significant increase in eDNA yield over that which was recorded for the pre-turnover survey (non-parametric Mann-Whitney U-test, $p < 0.01$). However, all PCR reactions failed to yield a positive result (numerical Cq value derived from exponential phase of the amplification curve), when performed in triplicate. All positive control reactions successfully amplified target DNA, indicating that PCR failure, due to denatured reagents, is not a causative factor. The field blank also tested negative for Atlantic whitefish DNA, as expected.

**Discussion**

The results presented here are consistent with those derived from the previous study, corroborating the previous recorded absence of an Atlantic whitefish eDNA signal in Anderson Lake. The most likely explanation is the extirpation of the local population, with the probability of its continued occurrence diminishing with every unsuccessful attempt to detect it. Due to the increased sensitivity of eDNA versus conventional fishing methods, confidence in the lake as a continuing outpost of Atlantic whitefish must be necessarily weakened.

**Potential further work**

If the species is still in the lake, it is probably at extremely low abundance and any further efforts to detect it ought to focus on spawning periods, in which significant eDNA spikes are expected in the surrounding waters.

# Appendix C

## *2017 Water Chemistry*

Maxxam
A Bureau Veritas Group Company

Your Project #: 13-8348
Site Location: HIGHWAY 107 EA
Your C.O.C. #: N/A

**Attention:Karen March**

Dillon Consulting Limited
137 Chain Lake Dr
Suite 100
Halifax , NS
B3S 1B3

**Report Date: 2017/10/30**
Report #: R4810896
Version: 1 - Final

# CERTIFICATE OF ANALYSIS

**MAXXAM JOB #: B7N2747**
**Received: 2017/10/18, 12:07**

Sample Matrix: Water
# Samples Received: 2

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Reference |
|---|---|---|---|---|---|
| Carbonate, Bicarbonate and Hydroxide | 2 | N/A | 2017/10/25 | N/A | SM 22 4500-CO2 D |
| Alkalinity | 2 | N/A | 2017/10/25 | ATL SOP 00013 | EPA 310.2 R1974 m |
| Chloride | 2 | N/A | 2017/10/27 | ATL SOP 00014 | SM 22 4500-Cl- E m |
| Colour | 2 | N/A | 2017/10/27 | ATL SOP 00020 | SM 22 2120C m |
| Conductance - water | 2 | N/A | 2017/10/25 | ATL SOP 00004 | SM 22 2510B m |
| Hardness (calculated as CaCO3) | 2 | N/A | 2017/10/26 | ATL SOP 00048 | SM 22 2340 B |
| Metals Water Total MS | 2 | 2017/10/25 | 2017/10/25 | ATL SOP 00058 | EPA 6020A R1 m |
| Ion Balance (% Difference) | 2 | N/A | 2017/10/27 | N/A | Auto Calc. |
| Anion and Cation Sum | 2 | N/A | 2017/10/27 | N/A | Auto Calc. |
| Nitrogen Ammonia - water | 2 | N/A | 2017/10/26 | ATL SOP 00015 | EPA 350.1 R2 m |
| Nitrogen - Nitrate + Nitrite | 2 | N/A | 2017/10/27 | ATL SOP 00016 | USGS SOPINCF0452.2 m |
| Nitrogen - Nitrite | 2 | N/A | 2017/10/26 | ATL SOP 00017 | SM 22 4500-NO2- B m |
| Nitrogen - Nitrate (as N) | 2 | N/A | 2017/10/27 | ATL SOP 00018 | ASTM D3867-16 |
| pH (1) | 2 | N/A | 2017/10/25 | ATL SOP 00003 | SM 22 4500-H+ B m |
| Phosphorus - ortho | 2 | N/A | 2017/10/26 | ATL SOP 00021 | SM 22 4500-P E m |
| Sat. pH and Langelier Index (@ 20C) | 2 | N/A | 2017/10/26 | ATL SOP 00049 | Auto Calc. |
| Sat. pH and Langelier Index (@ 4C) | 2 | N/A | 2017/10/26 | ATL SOP 00049 | Auto Calc. |
| Reactive Silica | 2 | N/A | 2017/10/25 | ATL SOP 00022 | EPA 366.0 m |
| Sulphate | 2 | N/A | 2017/10/26 | ATL SOP 00023 | ASTM D516-16 m |
| Total Dissolved Solids (TDS calc) | 2 | N/A | 2017/10/27 | N/A | Auto Calc. |
| Organic carbon - Total (TOC) (2) | 2 | N/A | 2017/10/26 | ATL SOP 00037 | SM 22 5310C m |
| Total Suspended Solids | 2 | 2017/10/23 | 2017/10/25 | ATL SOP 00007 | SM 22 2540D m |
| Turbidity | 1 | N/A | 2017/10/24 | ATL SOP 00011 | EPA 180.1 R2 m |
| Turbidity | 1 | N/A | 2017/10/25 | ATL SOP 00011 | EPA 180.1 R2 m |

**Remarks:**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam 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 Maxxam's profession using



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Your Project #: 13-8348
Site Location: HIGHWAY 107 EA
Your C.O.C. #: N/A

**Attention:Karen March**

Dillon Consulting Limited
137 Chain Lake Dr
Suite 100
Halifax , NS
B3S 1B3

**Report Date: 2017/10/30**
Report #: R4810896
Version: 1 - Final

# CERTIFICATE OF ANALYSIS

**MAXXAM JOB #: B7N2747**
**Received: 2017/10/18, 12:07**

accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam 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.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam 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 Maxxam, unless otherwise agreed in writing.

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.
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 require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.
(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Heather Macumber, Senior Project Manager
Email: HMacumber@maxxam.ca
Phone# (902)420-0203 Ext:226

==========

Maxxam 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.

Maxxam Job #: B7N2747
Report Date: 2017/10/30

Dillon Consulting Limited
Client Project #: 13-8348
Site Location: HIGHWAY 107 EA
Sampler Initials: PKA

## RESULTS OF ANALYSES OF WATER

| Maxxam ID | | FJI329 | FJI329 | | | FJI330 | | |
|---|---|---|---|---|---|---|---|---|
| Sampling Date | | 2017/10/17 10:55 | 2017/10/17 10:55 | | | 2017/10/17 11:20 | | |
| COC Number | | N/A | N/A | | | N/A | | |
| | UNITS | ANDERSON 7 M | ANDERSON 7 M Lab-Dup | RDL | QC Batch | ANDERSON OUTLET | RDL | QC Batch |
| **Calculated Parameters** | | | | | | | | |
| Anion Sum | me/L | 0.400 | | N/A | 5225423 | 0.390 | N/A | 5225423 |
| Bicarb. Alkalinity (calc. as CaCO3) | mg/L | ND | | 1.0 | 5225419 | ND | 1.0 | 5225419 |
| Calculated TDS | mg/L | 26 | | 1.0 | 5225428 | 26 | 1.0 | 5225428 |
| Carb. Alkalinity (calc. as CaCO3) | mg/L | ND | | 1.0 | 5225419 | ND | 1.0 | 5225419 |
| Cation Sum | me/L | 0.480 | | N/A | 5225423 | 0.480 | N/A | 5225423 |
| Hardness (CaCO3) | mg/L | 6.8 | | 1.0 | 5225421 | 6.5 | 1.0 | 5225421 |
| Ion Balance (% Difference) | % | 9.09 | | N/A | 5225422 | 10.3 | N/A | 5225422 |
| Langelier Index (@ 20C) | N/A | NC | | | 5225426 | NC | | 5225426 |
| Langelier Index (@ 4C) | N/A | NC | | | 5225427 | NC | | 5225427 |
| Nitrate (N) | mg/L | ND | | 0.050 | 5225424 | ND | 0.050 | 5225424 |
| Saturation pH (@ 20C) | N/A | NC | | | 5225426 | NC | | 5225426 |
| Saturation pH (@ 4C) | N/A | NC | | | 5225427 | NC | | 5225427 |
| **Inorganics** | | | | | | | | |
| Total Alkalinity (Total as CaCO3) | mg/L | ND | | 5.0 | 5230314 | ND | 5.0 | 5230314 |
| Dissolved Chloride (Cl) | mg/L | 12 | | 1.0 | 5230318 | 12 | 1.0 | 5230318 |
| Colour | TCU | 23 | | 5.0 | 5230322 | 22 | 5.0 | 5230322 |
| Nitrate + Nitrite (N) | mg/L | ND | | 0.050 | 5230324 | ND | 0.050 | 5230324 |
| Nitrite (N) | mg/L | ND | | 0.010 | 5230326 | ND | 0.010 | 5230326 |
| Nitrogen (Ammonia Nitrogen) | mg/L | 0.099 | 0.15 | 0.050 | 5232188 | 0.28 | 0.050 | 5232188 |
| Total Organic Carbon (C) | mg/L | 6.0 | 6.2 | 0.50 | 5232877 | 5.3 | 0.50 | 5232877 |
| Orthophosphate (P) | mg/L | ND | | 0.010 | 5230323 | ND | 0.010 | 5230323 |
| pH | pH | 6.40 | | N/A | 5229703 | 6.18 | N/A | 5229701 |
| Reactive Silica (SiO2) | mg/L | 0.87 | | 0.50 | 5230321 | 0.89 | 0.50 | 5230321 |
| Total Suspended Solids | mg/L | 1.2 | | 1.0 | 5225781 | ND | 2.0 | 5225781 |
| Dissolved Sulphate (SO4) | mg/L | 3.2 | | 2.0 | 5230320 | 3.0 | 2.0 | 5230320 |
| Turbidity | NTU | 0.60 | | 0.10 | 5227367 | 0.45 | 0.10 | 5229749 |
| Conductivity | uS/cm | 57 | | 1.0 | 5229704 | 59 | 1.0 | 5229702 |

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
ND = Not detected



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Maxxam Job #: B7N2747
Report Date: 2017/10/30

Dillon Consulting Limited
Client Project #: 13-8348
Site Location: HIGHWAY 107 EA
Sampler Initials: PKA

## ELEMENTS BY ICP/MS (WATER)

| Maxxam ID | | FJI329 | FJI330 | | |
|---|---|---|---|---|---|
| Sampling Date | | 2017/10/17 10:55 | 2017/10/17 11:20 | | |
| COC Number | | N/A | N/A | | |
| | UNITS | ANDERSON 7 M | ANDERSON OUTLET | RDL | QC Batch |
| **Metals** | | | | | |
| Total Aluminum (Al) | ug/L | 60 | 57 | 5.0 | 5229692 |
| Total Antimony (Sb) | ug/L | ND | ND | 1.0 | 5229692 |
| Total Arsenic (As) | ug/L | ND | ND | 1.0 | 5229692 |
| Total Barium (Ba) | ug/L | 4.8 | 4.8 | 1.0 | 5229692 |
| Total Beryllium (Be) | ug/L | ND | ND | 1.0 | 5229692 |
| Total Bismuth (Bi) | ug/L | ND | ND | 2.0 | 5229692 |
| Total Boron (B) | ug/L | ND | ND | 50 | 5229692 |
| Total Cadmium (Cd) | ug/L | ND | ND | 0.010 | 5229692 |
| Total Calcium (Ca) | ug/L | 1900 | 1800 | 100 | 5229692 |
| Total Chromium (Cr) | ug/L | ND | ND | 1.0 | 5229692 |
| Total Cobalt (Co) | ug/L | ND | ND | 0.40 | 5229692 |
| Total Copper (Cu) | ug/L | ND | ND | 2.0 | 5229692 |
| Total Iron (Fe) | ug/L | ND | 69 | 50 | 5229692 |
| Total Lead (Pb) | ug/L | ND | ND | 0.50 | 5229692 |
| Total Magnesium (Mg) | ug/L | 470 | 470 | 100 | 5229692 |
| Total Manganese (Mn) | ug/L | 22 | 17 | 2.0 | 5229692 |
| Total Molybdenum (Mo) | ug/L | ND | ND | 2.0 | 5229692 |
| Total Nickel (Ni) | ug/L | ND | ND | 2.0 | 5229692 |
| Total Phosphorus (P) | ug/L | ND | ND | 100 | 5229692 |
| Total Potassium (K) | ug/L | 390 | 360 | 100 | 5229692 |
| Total Selenium (Se) | ug/L | ND | ND | 1.0 | 5229692 |
| Total Silver (Ag) | ug/L | ND | ND | 0.10 | 5229692 |
| Total Sodium (Na) | ug/L | 7600 | 7300 | 100 | 5229692 |
| Total Strontium (Sr) | ug/L | 9.3 | 8.4 | 2.0 | 5229692 |
| Total Thallium (Tl) | ug/L | ND | ND | 0.10 | 5229692 |
| Total Tin (Sn) | ug/L | ND | ND | 2.0 | 5229692 |
| Total Titanium (Ti) | ug/L | ND | ND | 2.0 | 5229692 |
| Total Uranium (U) | ug/L | ND | ND | 0.10 | 5229692 |
| Total Vanadium (V) | ug/L | ND | ND | 2.0 | 5229692 |
| Total Zinc (Zn) | ug/L | ND | ND | 5.0 | 5229692 |

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected



Maxxam Analytics International Corporation o/a Maxxam Analytics 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.maxxamanalytics.com

Maxxam Job #: B7N2747
Report Date: 2017/10/30

Dillon Consulting Limited
Client Project #: 13-8348
Site Location: HIGHWAY 107 EA
Sampler Initials: PKA

## GENERAL COMMENTS

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

| | |
|---|---|
| Package 1 | 2.0°C |

Sample FJI329 [ANDERSON 7 M] : RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

Sample FJI330 [ANDERSON OUTLET] : TSS:Used all of the sample provided, DL raised. RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

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



Maxxam Analytics International Corporation o/a Maxxam Analytics 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.maxxamanalytics.com

Maxxam Job #: B7N2747
Report Date: 2017/10/30

Dillon Consulting Limited
Client Project #: 13-8348
Site Location: HIGHWAY 107 EA
Sampler Initials: PKA

## QUALITY ASSURANCE REPORT

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| 5225781 | LPW | QC Standard | Total Suspended Solids | 2017/10/25 | | 96 | % | 80 - 120 |
| 5225781 | LPW | Method Blank | Total Suspended Solids | 2017/10/25 | ND, RDL=1.0 | | mg/L | |
| 5225781 | LPW | RPD | Total Suspended Solids | 2017/10/25 | 20 | | % | 25 |
| 5227367 | JMV | QC Standard | Turbidity | 2017/10/24 | | 94 | % | 80 - 120 |
| 5227367 | JMV | Spiked Blank | Turbidity | 2017/10/24 | | 92 | % | 80 - 120 |
| 5227367 | JMV | Method Blank | Turbidity | 2017/10/24 | ND, RDL=0.10 | | NTU | |
| 5227367 | JMV | RPD | Turbidity | 2017/10/24 | 2.1 | | % | 20 |
| 5229692 | BAN | Matrix Spike | Total Aluminum (Al) | 2017/10/25 | | NC | % | 80 - 120 |
| | | | Total Antimony (Sb) | 2017/10/25 | | 103 | % | 80 - 120 |
| | | | Total Arsenic (As) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Barium (Ba) | 2017/10/25 | | 99 | % | 80 - 120 |
| | | | Total Beryllium (Be) | 2017/10/25 | | 103 | % | 80 - 120 |
| | | | Total Bismuth (Bi) | 2017/10/25 | | 102 | % | 80 - 120 |
| | | | Total Boron (B) | 2017/10/25 | | 104 | % | 80 - 120 |
| | | | Total Cadmium (Cd) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Calcium (Ca) | 2017/10/25 | | NC | % | 80 - 120 |
| | | | Total Chromium (Cr) | 2017/10/25 | | 100 | % | 80 - 120 |
| | | | Total Cobalt (Co) | 2017/10/25 | | 102 | % | 80 - 120 |
| | | | Total Copper (Cu) | 2017/10/25 | | 100 | % | 80 - 120 |
| | | | Total Iron (Fe) | 2017/10/25 | | NC | % | 80 - 120 |
| | | | Total Lead (Pb) | 2017/10/25 | | 98 | % | 80 - 120 |
| | | | Total Magnesium (Mg) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Manganese (Mn) | 2017/10/25 | | NC | % | 80 - 120 |
| | | | Total Molybdenum (Mo) | 2017/10/25 | | 108 | % | 80 - 120 |
| | | | Total Nickel (Ni) | 2017/10/25 | | 102 | % | 80 - 120 |
| | | | Total Phosphorus (P) | 2017/10/25 | | 104 | % | 80 - 120 |
| | | | Total Potassium (K) | 2017/10/25 | | 105 | % | 80 - 120 |
| | | | Total Selenium (Se) | 2017/10/25 | | 103 | % | 80 - 120 |
| | | | Total Silver (Ag) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Sodium (Na) | 2017/10/25 | | 103 | % | 80 - 120 |
| | | | Total Strontium (Sr) | 2017/10/25 | | NC | % | 80 - 120 |
| | | | Total Thallium (Tl) | 2017/10/25 | | 103 | % | 80 - 120 |
| | | | Total Tin (Sn) | 2017/10/25 | | 108 | % | 80 - 120 |
| | | | Total Titanium (Ti) | 2017/10/25 | | 111 | % | 80 - 120 |
| | | | Total Uranium (U) | 2017/10/25 | | 108 | % | 80 - 120 |
| | | | Total Vanadium (V) | 2017/10/25 | | 102 | % | 80 - 120 |
| | | | Total Zinc (Zn) | 2017/10/25 | | 99 | % | 80 - 120 |
| 5229692 | BAN | Spiked Blank | Total Aluminum (Al) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Antimony (Sb) | 2017/10/25 | | 98 | % | 80 - 120 |
| | | | Total Arsenic (As) | 2017/10/25 | | 100 | % | 80 - 120 |
| | | | Total Barium (Ba) | 2017/10/25 | | 98 | % | 80 - 120 |
| | | | Total Beryllium (Be) | 2017/10/25 | | 102 | % | 80 - 120 |
| | | | Total Bismuth (Bi) | 2017/10/25 | | 102 | % | 80 - 120 |
| | | | Total Boron (B) | 2017/10/25 | | 103 | % | 80 - 120 |
| | | | Total Cadmium (Cd) | 2017/10/25 | | 100 | % | 80 - 120 |
| | | | Total Calcium (Ca) | 2017/10/25 | | 104 | % | 80 - 120 |
| | | | Total Chromium (Cr) | 2017/10/25 | | 100 | % | 80 - 120 |
| | | | Total Cobalt (Co) | 2017/10/25 | | 102 | % | 80 - 120 |
| | | | Total Copper (Cu) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Iron (Fe) | 2017/10/25 | | 104 | % | 80 - 120 |



Maxxam Analytics International Corporation o/a Maxxam Analytics 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.maxxamanalytics.com

## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| | | | Total Lead (Pb) | 2017/10/25 | | 98 | % | 80 - 120 |
| | | | Total Magnesium (Mg) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Manganese (Mn) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Molybdenum (Mo) | 2017/10/25 | | 102 | % | 80 - 120 |
| | | | Total Nickel (Ni) | 2017/10/25 | | 102 | % | 80 - 120 |
| | | | Total Phosphorus (P) | 2017/10/25 | | 104 | % | 80 - 120 |
| | | | Total Potassium (K) | 2017/10/25 | | 104 | % | 80 - 120 |
| | | | Total Selenium (Se) | 2017/10/25 | | 102 | % | 80 - 120 |
| | | | Total Silver (Ag) | 2017/10/25 | | 98 | % | 80 - 120 |
| | | | Total Sodium (Na) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Strontium (Sr) | 2017/10/25 | | 102 | % | 80 - 120 |
| | | | Total Thallium (Tl) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Tin (Sn) | 2017/10/25 | | 104 | % | 80 - 120 |
| | | | Total Titanium (Ti) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Uranium (U) | 2017/10/25 | | 105 | % | 80 - 120 |
| | | | Total Vanadium (V) | 2017/10/25 | | 101 | % | 80 - 120 |
| | | | Total Zinc (Zn) | 2017/10/25 | | 99 | % | 80 - 120 |
| 5229692 | BAN | Method Blank | Total Aluminum (Al) | 2017/10/25 | ND, RDL=5.0 | | ug/L | |
| | | | Total Antimony (Sb) | 2017/10/25 | ND, RDL=1.0 | | ug/L | |
| | | | Total Arsenic (As) | 2017/10/25 | ND, RDL=1.0 | | ug/L | |
| | | | Total Barium (Ba) | 2017/10/25 | ND, RDL=1.0 | | ug/L | |
| | | | Total Beryllium (Be) | 2017/10/25 | ND, RDL=1.0 | | ug/L | |
| | | | Total Bismuth (Bi) | 2017/10/25 | ND, RDL=2.0 | | ug/L | |
| | | | Total Boron (B) | 2017/10/25 | ND, RDL=50 | | ug/L | |
| | | | Total Cadmium (Cd) | 2017/10/25 | ND, RDL=0.010 | | ug/L | |
| | | | Total Calcium (Ca) | 2017/10/25 | ND, RDL=100 | | ug/L | |
| | | | Total Chromium (Cr) | 2017/10/25 | ND, RDL=1.0 | | ug/L | |
| | | | Total Cobalt (Co) | 2017/10/25 | ND, RDL=0.40 | | ug/L | |
| | | | Total Copper (Cu) | 2017/10/25 | ND, RDL=2.0 | | ug/L | |
| | | | Total Iron (Fe) | 2017/10/25 | ND, RDL=50 | | ug/L | |
| | | | Total Lead (Pb) | 2017/10/25 | ND, RDL=0.50 | | ug/L | |
| | | | Total Magnesium (Mg) | 2017/10/25 | ND, RDL=100 | | ug/L | |
| | | | Total Manganese (Mn) | 2017/10/25 | ND, RDL=2.0 | | ug/L | |
| | | | Total Molybdenum (Mo) | 2017/10/25 | ND, RDL=2.0 | | ug/L | |



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## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| | | | Total Nickel (Ni) | 2017/10/25 | ND, RDL=2.0 | | ug/L | |
| | | | Total Phosphorus (P) | 2017/10/25 | ND, RDL=100 | | ug/L | |
| | | | Total Potassium (K) | 2017/10/25 | ND, RDL=100 | | ug/L | |
| | | | Total Selenium (Se) | 2017/10/25 | ND, RDL=1.0 | | ug/L | |
| | | | Total Silver (Ag) | 2017/10/25 | ND, RDL=0.10 | | ug/L | |
| | | | Total Sodium (Na) | 2017/10/25 | ND, RDL=100 | | ug/L | |
| | | | Total Strontium (Sr) | 2017/10/25 | ND, RDL=2.0 | | ug/L | |
| | | | Total Thallium (Tl) | 2017/10/25 | ND, RDL=0.10 | | ug/L | |
| | | | Total Tin (Sn) | 2017/10/25 | ND, RDL=2.0 | | ug/L | |
| | | | Total Titanium (Ti) | 2017/10/25 | ND, RDL=2.0 | | ug/L | |
| | | | Total Uranium (U) | 2017/10/25 | ND, RDL=0.10 | | ug/L | |
| | | | Total Vanadium (V) | 2017/10/25 | ND, RDL=2.0 | | ug/L | |
| | | | Total Zinc (Zn) | 2017/10/25 | ND, RDL=5.0 | | ug/L | |
| 5229692 | BAN | RPD | Total Aluminum (Al) | 2017/10/25 | NC | | % | 20 |
| | | | Total Antimony (Sb) | 2017/10/25 | NC | | % | 20 |
| | | | Total Arsenic (As) | 2017/10/25 | NC | | % | 20 |
| | | | Total Barium (Ba) | 2017/10/25 | 0.39 | | % | 20 |
| | | | Total Beryllium (Be) | 2017/10/25 | NC | | % | 20 |
| | | | Total Bismuth (Bi) | 2017/10/25 | NC | | % | 20 |
| | | | Total Boron (B) | 2017/10/25 | NC | | % | 20 |
| | | | Total Cadmium (Cd) | 2017/10/25 | 14 | | % | 20 |
| | | | Total Calcium (Ca) | 2017/10/25 | 1.2 | | % | 20 |
| | | | Total Chromium (Cr) | 2017/10/25 | NC | | % | 20 |
| | | | Total Cobalt (Co) | 2017/10/25 | NC | | % | 20 |
| | | | Total Copper (Cu) | 2017/10/25 | 0.15 | | % | 20 |
| | | | Total Iron (Fe) | 2017/10/25 | 3.8 | | % | 20 |
| | | | Total Lead (Pb) | 2017/10/25 | NC | | % | 20 |
| | | | Total Magnesium (Mg) | 2017/10/25 | 1.6 | | % | 20 |
| | | | Total Manganese (Mn) | 2017/10/25 | 0.65 | | % | 20 |
| | | | Total Molybdenum (Mo) | 2017/10/25 | NC | | % | 20 |
| | | | Total Nickel (Ni) | 2017/10/25 | NC | | % | 20 |
| | | | Total Phosphorus (P) | 2017/10/25 | NC | | % | 20 |
| | | | Total Potassium (K) | 2017/10/25 | 5.1 | | % | 20 |
| | | | Total Selenium (Se) | 2017/10/25 | NC | | % | 20 |
| | | | Total Silver (Ag) | 2017/10/25 | NC | | % | 20 |
| | | | Total Sodium (Na) | 2017/10/25 | 0.23 | | % | 20 |
| | | | Total Strontium (Sr) | 2017/10/25 | 1.2 | | % | 20 |
| | | | Total Thallium (Tl) | 2017/10/25 | NC | | % | 20 |
| | | | Total Tin (Sn) | 2017/10/25 | NC | | % | 20 |



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## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| | | | Total Titanium (Ti) | 2017/10/25 | NC | | % | 20 |
| | | | Total Uranium (U) | 2017/10/25 | NC | | % | 20 |
| | | | Total Vanadium (V) | 2017/10/25 | NC | | % | 20 |
| | | | Total Zinc (Zn) | 2017/10/25 | 4.3 | | % | 20 |
| 5229701 | JMV | QC Standard | pH | 2017/10/25 | | 100 | % | 97 - 103 |
| 5229701 | JMV | RPD | pH | 2017/10/25 | 1.6 | | % | N/A |
| 5229702 | JMV | Spiked Blank | Conductivity | 2017/10/25 | | 103 | % | 80 - 120 |
| 5229702 | JMV | Method Blank | Conductivity | 2017/10/25 | 1.4, RDL=1.0 | | uS/cm | |
| 5229702 | JMV | RPD | Conductivity | 2017/10/25 | 0.27 | | % | 25 |
| 5229703 | JMV | QC Standard | pH | 2017/10/25 | | 100 | % | 97 - 103 |
| 5229703 | JMV | RPD | pH | 2017/10/25 | 0.50 | | % | N/A |
| 5229704 | JMV | Spiked Blank | Conductivity | 2017/10/25 | | 103 | % | 80 - 120 |
| 5229704 | JMV | Method Blank | Conductivity | 2017/10/25 | 1.5, RDL=1.0 | | uS/cm | |
| 5229704 | JMV | RPD | Conductivity | 2017/10/25 | 0.40 | | % | 25 |
| 5229749 | JMV | QC Standard | Turbidity | 2017/10/25 | | 94 | % | 80 - 120 |
| 5229749 | JMV | Spiked Blank | Turbidity | 2017/10/25 | | 92 | % | 80 - 120 |
| 5229749 | JMV | Method Blank | Turbidity | 2017/10/25 | ND, RDL=0.10 | | NTU | |
| 5229749 | JMV | RPD | Turbidity | 2017/10/25 | 4.7 | | % | 20 |
| 5230314 | NRG | Matrix Spike | Total Alkalinity (Total as CaCO3) | 2017/10/25 | | 103 | % | 80 - 120 |
| 5230314 | NRG | Spiked Blank | Total Alkalinity (Total as CaCO3) | 2017/10/25 | | 105 | % | 80 - 120 |
| 5230314 | NRG | Method Blank | Total Alkalinity (Total as CaCO3) | 2017/10/25 | ND, RDL=5.0 | | mg/L | |
| 5230314 | NRG | RPD | Total Alkalinity (Total as CaCO3) | 2017/10/25 | 6.8 | | % | 25 |
| 5230318 | NRG | Matrix Spike | Dissolved Chloride (Cl) | 2017/10/27 | | 96 | % | 80 - 120 |
| 5230318 | NRG | QC Standard | Dissolved Chloride (Cl) | 2017/10/27 | | 107 | % | 80 - 120 |
| 5230318 | NRG | Spiked Blank | Dissolved Chloride (Cl) | 2017/10/27 | | 99 | % | 80 - 120 |
| 5230318 | NRG | Method Blank | Dissolved Chloride (Cl) | 2017/10/27 | ND, RDL=1.0 | | mg/L | |
| 5230318 | NRG | RPD | Dissolved Chloride (Cl) | 2017/10/27 | 1.3 | | % | 25 |
| 5230320 | NRG | Matrix Spike | Dissolved Sulphate (SO4) | 2017/10/26 | | 119 | % | 80 - 120 |
| 5230320 | NRG | Spiked Blank | Dissolved Sulphate (SO4) | 2017/10/26 | | 101 | % | 80 - 120 |
| 5230320 | NRG | Method Blank | Dissolved Sulphate (SO4) | 2017/10/26 | ND, RDL=2.0 | | mg/L | |
| 5230320 | NRG | RPD | Dissolved Sulphate (SO4) | 2017/10/26 | NC | | % | 25 |
| 5230321 | NRG | Matrix Spike | Reactive Silica (SiO2) | 2017/10/25 | | 96 | % | 80 - 120 |
| 5230321 | NRG | Spiked Blank | Reactive Silica (SiO2) | 2017/10/25 | | 92 | % | 80 - 120 |
| 5230321 | NRG | Method Blank | Reactive Silica (SiO2) | 2017/10/25 | ND, RDL=0.50 | | mg/L | |
| 5230322 | NRG | Spiked Blank | Colour | 2017/10/27 | | 97 | % | 80 - 120 |
| 5230322 | NRG | Method Blank | Colour | 2017/10/27 | ND, RDL=5.0 | | TCU | |
| 5230322 | NRG | RPD | Colour | 2017/10/27 | 14 (1) | | % | 20 |
| 5230323 | NRG | Matrix Spike | Orthophosphate (P) | 2017/10/26 | | 94 | % | 80 - 120 |
| 5230323 | NRG | Spiked Blank | Orthophosphate (P) | 2017/10/26 | | 98 | % | 80 - 120 |
| 5230323 | NRG | Method Blank | Orthophosphate (P) | 2017/10/26 | ND, RDL=0.010 | | mg/L | |
| 5230324 | MCN | Matrix Spike | Nitrate + Nitrite (N) | 2017/10/27 | | 98 | % | 80 - 120 |
| 5230324 | MCN | Spiked Blank | Nitrate + Nitrite (N) | 2017/10/27 | | 97 | % | 80 - 120 |



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Maxxam Job #: B7N2747
Report Date: 2017/10/30

Dillon Consulting Limited
Client Project #: 13-8348
Site Location: HIGHWAY 107 EA
Sampler Initials: PKA

## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| 5230324 | MCN | Method Blank | Nitrate + Nitrite (N) | 2017/10/27 | ND, RDL=0.050 | | mg/L | |
| 5230326 | NRG | Matrix Spike | Nitrite (N) | 2017/10/26 | | 95 | % | 80 - 120 |
| 5230326 | NRG | Spiked Blank | Nitrite (N) | 2017/10/26 | | 99 | % | 80 - 120 |
| 5230326 | NRG | Method Blank | Nitrite (N) | 2017/10/26 | ND, RDL=0.010 | | mg/L | |
| 5230326 | NRG | RPD | Nitrite (N) | 2017/10/26 | NC | | % | 25 |
| 5232188 | NRG | Matrix Spike [FJI329-03] | Nitrogen (Ammonia Nitrogen) | 2017/10/26 | | 91 | % | 80 - 120 |
| 5232188 | NRG | Spiked Blank | Nitrogen (Ammonia Nitrogen) | 2017/10/26 | | 109 | % | 80 - 120 |
| 5232188 | NRG | Method Blank | Nitrogen (Ammonia Nitrogen) | 2017/10/26 | ND, RDL=0.050 | | mg/L | |
| 5232188 | NRG | RPD [FJI329-03] | Nitrogen (Ammonia Nitrogen) | 2017/10/26 | NC | | % | 20 |
| 5232877 | SSI | Matrix Spike [FJI329-03] | Total Organic Carbon (C) | 2017/10/26 | | 99 | % | 80 - 120 |
| 5232877 | SSI | Spiked Blank | Total Organic Carbon (C) | 2017/10/26 | | 103 | % | 80 - 120 |
| 5232877 | SSI | Method Blank | Total Organic Carbon (C) | 2017/10/26 | ND, RDL=0.50 | | mg/L | |
| 5232877 | SSI | RPD [FJI329-03] | Total Organic Carbon (C) | 2017/10/26 | 3.0 | | % | 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) Elevated reporting limit due to sample matrix.



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Maxxam Job #: B7N2747
Report Date: 2017/10/30

Dillon Consulting Limited
Client Project #: 13-8348
Site Location: HIGHWAY 107 EA
Sampler Initials: PKA

## VALIDATION SIGNATURE PAGE

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

Eric Dearman, Scientific Specialist

Maxxam 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.



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Maxxam
A Bureau Veritas Group Company

Your Project #: 13-8348-6000
Site Location: HWY 107 EA
Your C.O.C. #: N/A

**Attention:Karen March**

Dillon Consulting Limited
137 Chain Lake Dr
Suite 100
Halifax , NS
B3S 1B3

**Report Date: 2017/12/11**
Report #: R4905922
Version: 1 - Final

# CERTIFICATE OF ANALYSIS

**MAXXAM JOB #: B7R2025**
**Received: 2017/12/01, 15:15**

Sample Matrix: Water
# Samples Received: 2

| Analyses | Quantity | Date Extracted | Date Analyzed | Laboratory Method | Reference |
|---|---|---|---|---|---|
| Carbonate, Bicarbonate and Hydroxide | 2 | N/A | 2017/12/05 | N/A | SM 22 4500-CO2 D |
| Alkalinity | 2 | N/A | 2017/12/08 | ATL SOP 00013 | EPA 310.2 R1974 m |
| Chloride | 2 | N/A | 2017/12/07 | ATL SOP 00014 | SM 22 4500-Cl- E m |
| Colour | 2 | N/A | 2017/12/07 | ATL SOP 00020 | SM 22 2120C m |
| Conductance - water | 2 | N/A | 2017/12/05 | ATL SOP 00004 | SM 22 2510B m |
| TEH in Water (PIRI) | 2 | 2017/12/04 | 2017/12/04 | ATL SOP 00113 | Atl. RBCA v3.1 m |
| Hardness (calculated as CaCO3) | 2 | N/A | 2017/12/06 | ATL SOP 00048 | SM 22 2340 B |
| Mercury - Total (CVAA,LL) | 2 | 2017/12/07 | 2017/12/08 | ATL SOP 00026 | EPA 245.1 R3 m |
| Metals Water Total MS | 1 | 2017/12/05 | 2017/12/05 | ATL SOP 00058 | EPA 6020A R1 m |
| Metals Water Total MS | 1 | 2017/12/05 | 2017/12/06 | ATL SOP 00058 | EPA 6020A R1 m |
| Ion Balance (% Difference) | 2 | N/A | 2017/12/08 | N/A | Auto Calc. |
| Anion and Cation Sum | 2 | N/A | 2017/12/07 | N/A | Auto Calc. |
| Nitrogen Ammonia - water | 2 | N/A | 2017/12/06 | ATL SOP 00015 | EPA 350.1 R2 m |
| Nitrogen - Nitrate + Nitrite | 2 | N/A | 2017/12/08 | ATL SOP 00016 | USGS SOPINCF0452.2 m |
| Nitrogen - Nitrite | 2 | N/A | 2017/12/07 | ATL SOP 00017 | SM 22 4500-NO2- B m |
| Nitrogen - Nitrate (as N) | 2 | N/A | 2017/12/08 | ATL SOP 00018 | ASTM D3867-16 |
| pH (1) | 2 | N/A | 2017/12/05 | ATL SOP 00003 | SM 22 4500-H+ B m |
| Phosphorus - ortho | 2 | N/A | 2017/12/07 | ATL SOP 00021 | SM 22 4500-P E m |
| VPH in Water (PIRI) | 2 | N/A | 2017/12/05 | ATL SOP 00118 | Atl. RBCA v3.1 m |
| Sat. pH and Langelier Index (@ 20C) | 2 | N/A | 2017/12/08 | ATL SOP 00049 | Auto Calc. |
| Sat. pH and Langelier Index (@ 4C) | 2 | N/A | 2017/12/08 | ATL SOP 00049 | Auto Calc. |
| Reactive Silica | 2 | N/A | 2017/12/08 | ATL SOP 00022 | EPA 366.0 m |
| Sulphate | 2 | N/A | 2017/12/07 | ATL SOP 00023 | ASTM D516-16 m |
| Total Dissolved Solids (TDS calc) | 2 | N/A | 2017/12/11 | N/A | Auto Calc. |
| Organic carbon - Total (TOC) (2) | 2 | N/A | 2017/12/11 | ATL SOP 00037 | SM 22 5310C m |
| ModTPH (T1) Calc. for Water | 2 | N/A | 2017/12/06 | N/A | Atl. RBCA v3 m |
| Total Suspended Solids | 2 | 2017/12/07 | 2017/12/08 | ATL SOP 00007 | SM 22 2540D m |
| Turbidity | 2 | N/A | 2017/12/05 | ATL SOP 00011 | EPA 180.1 R2 m |

**Remarks:**



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Maxxam
A Bureau Veritas Group Company

Your Project #: 13-8348-6000
Site Location: HWY 107 EA
Your C.O.C. #: N/A

**Attention:Karen March**

Dillon Consulting Limited
137 Chain Lake Dr
Suite 100
Halifax , NS
B3S 1B3

**Report Date: 2017/12/11**
Report #: R4905922
Version: 1 - Final

# CERTIFICATE OF ANALYSIS

**MAXXAM JOB #: B7R2025**
**Received: 2017/12/01, 15:15**

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam 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 Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam 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.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam 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 Maxxam, unless otherwise agreed in writing.

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.
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 require pH to be analyzed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the APHA Standard Method holding time.
(2) TOC / DOC present in the sample should be considered as non-purgeable TOC / DOC.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Heather Macumber, Senior Project Manager
Email: HMacumber@maxxam.ca
Phone# (902)420-0203 Ext:226

==========

Maxxam 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.

Maxxam Job #: B7R2025
Report Date: 2017/12/11

Dillon Consulting Limited
Client Project #: 13-8348-6000
Site Location: HWY 107 EA
Sampler Initials: PKA

## RESULTS OF ANALYSES OF WATER

| Maxxam ID | | FRD269 | | FRD270 | | |
|---|---|---|---|---|---|---|
| Sampling Date | | 2017/11/30 12:10 | | 2017/11/30 12:44 | | |
| COC Number | | N/A | | N/A | | |
| | UNITS | SW1A | QC Batch | OUTLET | RDL | QC Batch |
| **Calculated Parameters** | | | | | | |
| Anion Sum | me/L | 0.410 | 5294150 | 0.410 | N/A | 5294150 |
| Bicarb. Alkalinity (calc. as CaCO3) | mg/L | ND | 5294146 | ND | 1.0 | 5294146 |
| Calculated TDS | mg/L | 28 | 5294155 | 28 | 1.0 | 5294155 |
| Carb. Alkalinity (calc. as CaCO3) | mg/L | ND | 5294146 | ND | 1.0 | 5294146 |
| Cation Sum | me/L | 0.480 | 5294150 | 0.480 | N/A | 5294150 |
| Hardness (CaCO3) | mg/L | 6.8 | 5294148 | 6.7 | 1.0 | 5294148 |
| Ion Balance (% Difference) | % | 7.87 | 5294149 | 7.87 | N/A | 5294149 |
| Langelier Index (@ 20C) | N/A | NC | 5294153 | NC | | 5294153 |
| Langelier Index (@ 4C) | N/A | NC | 5294154 | NC | | 5294154 |
| Nitrate (N) | mg/L | ND | 5294151 | ND | 0.050 | 5294151 |
| Saturation pH (@ 20C) | N/A | NC | 5294153 | NC | | 5294153 |
| Saturation pH (@ 4C) | N/A | NC | 5294154 | NC | | 5294154 |
| **Inorganics** | | | | | | |
| Total Alkalinity (Total as CaCO3) | mg/L | ND | 5302218 | ND | 5.0 | 5302218 |
| Dissolved Chloride (Cl) | mg/L | 12 | 5302227 | 12 | 1.0 | 5302227 |
| Colour | TCU | 24 | 5302238 | 31 | 5.0 | 5302238 |
| Nitrate + Nitrite (N) | mg/L | ND | 5302244 | ND | 0.050 | 5302244 |
| Nitrite (N) | mg/L | ND | 5302247 | ND | 0.010 | 5302247 |
| Nitrogen (Ammonia Nitrogen) | mg/L | 0.070 | 5301619 | 0.19 | 0.050 | 5301619 |
| Total Organic Carbon (C) | mg/L | 4.6 | 5309052 | 5.9 | 0.50 | 5309052 |
| Orthophosphate (P) | mg/L | ND | 5302243 | ND | 0.010 | 5302243 |
| pH | pH | 5.97 | 5298939 | 5.96 | N/A | 5298937 |
| Reactive Silica (SiO2) | mg/L | 1.6 | 5302234 | 1.7 | 0.50 | 5302234 |
| Total Suspended Solids | mg/L | 1.2 | 5303681 | ND | 1.0 | 5303681 |
| Dissolved Sulphate (SO4) | mg/L | 3.3 | 5302231 | 3.1 | 2.0 | 5302231 |
| Turbidity | NTU | 1.0 | 5298944 | 0.77 | 0.10 | 5298943 |
| Conductivity | uS/cm | 57 | 5298940 | 56 | 1.0 | 5298938 |

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
ND = Not detected



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Maxxam Job #: B7R2025
Report Date: 2017/12/11

Dillon Consulting Limited
Client Project #: 13-8348-6000
Site Location: HWY 107 EA
Sampler Initials: PKA

## MERCURY BY COLD VAPOUR AA (WATER)

| Maxxam ID | | FRD269 | FRD270 | | |
|---|---|---|---|---|---|
| Sampling Date | | 2017/11/30 12:10 | 2017/11/30 12:44 | | |
| COC Number | | N/A | N/A | | |
| | UNITS | SW1A | OUTLET | RDL | QC Batch |
| **Metals** | | | | | |
| Total Mercury (Hg) | ug/L | ND | ND | 0.013 | 5303626 |

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected



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Maxxam Job #: B7R2025
Report Date: 2017/12/11

Dillon Consulting Limited
Client Project #: 13-8348-6000
Site Location: HWY 107 EA
Sampler Initials: PKA

## ELEMENTS BY ICP/MS (WATER)

| Maxxam ID | | FRD269 | | FRD270 | | |
|---|---|---|---|---|---|---|
| Sampling Date | | 2017/11/30 12:10 | | 2017/11/30 12:44 | | |
| COC Number | | N/A | | N/A | | |
| | UNITS | SW1A | QC Batch | OUTLET | RDL | QC Batch |
| **Metals** | | | | | | |
| Total Aluminum (Al) | ug/L | 110 | 5298959 | 110 | 5.0 | 5299013 |
| Total Antimony (Sb) | ug/L | ND | 5298959 | ND | 1.0 | 5299013 |
| Total Arsenic (As) | ug/L | ND | 5298959 | ND | 1.0 | 5299013 |
| Total Barium (Ba) | ug/L | 5.4 | 5298959 | 5.0 | 1.0 | 5299013 |
| Total Beryllium (Be) | ug/L | ND | 5298959 | ND | 1.0 | 5299013 |
| Total Bismuth (Bi) | ug/L | ND | 5298959 | ND | 2.0 | 5299013 |
| Total Boron (B) | ug/L | ND | 5298959 | ND | 50 | 5299013 |
| Total Cadmium (Cd) | ug/L | ND | 5298959 | ND | 0.010 | 5299013 |
| Total Calcium (Ca) | ug/L | 1900 | 5298959 | 1900 | 100 | 5299013 |
| Total Chromium (Cr) | ug/L | ND | 5298959 | ND | 1.0 | 5299013 |
| Total Cobalt (Co) | ug/L | ND | 5298959 | ND | 0.40 | 5299013 |
| Total Copper (Cu) | ug/L | ND | 5298959 | ND | 2.0 | 5299013 |
| Total Iron (Fe) | ug/L | 170 | 5298959 | 170 | 50 | 5299013 |
| Total Lead (Pb) | ug/L | ND | 5298959 | ND | 0.50 | 5299013 |
| Total Magnesium (Mg) | ug/L | 490 | 5298959 | 480 | 100 | 5299013 |
| Total Manganese (Mn) | ug/L | 78 | 5298959 | 52 | 2.0 | 5299013 |
| Total Molybdenum (Mo) | ug/L | ND | 5298959 | ND | 2.0 | 5299013 |
| Total Nickel (Ni) | ug/L | ND | 5298959 | ND | 2.0 | 5299013 |
| Total Phosphorus (P) | ug/L | ND | 5298959 | ND | 100 | 5299013 |
| Total Potassium (K) | ug/L | 420 | 5298959 | 390 | 100 | 5299013 |
| Total Selenium (Se) | ug/L | ND | 5298959 | ND | 1.0 | 5299013 |
| Total Silver (Ag) | ug/L | ND | 5298959 | ND | 0.10 | 5299013 |
| Total Sodium (Na) | ug/L | 7500 | 5298959 | 7300 | 100 | 5299013 |
| Total Strontium (Sr) | ug/L | 8.6 | 5298959 | 9.1 | 2.0 | 5299013 |
| Total Thallium (Tl) | ug/L | ND | 5298959 | ND | 0.10 | 5299013 |
| Total Tin (Sn) | ug/L | ND | 5298959 | ND | 2.0 | 5299013 |
| Total Titanium (Ti) | ug/L | ND | 5298959 | ND | 2.0 | 5299013 |
| Total Uranium (U) | ug/L | ND | 5298959 | ND | 0.10 | 5299013 |
| Total Vanadium (V) | ug/L | ND | 5298959 | ND | 2.0 | 5299013 |
| Total Zinc (Zn) | ug/L | ND | 5298959 | ND | 5.0 | 5299013 |

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected



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Maxxam Job #: B7R2025
Report Date: 2017/12/11

Dillon Consulting Limited
Client Project #: 13-8348-6000
Site Location: HWY 107 EA
Sampler Initials: PKA

## ATLANTIC RBCA HYDROCARBONS (WATER)

| **Maxxam ID** | | FRD269 | FRD270 | | |
|---|---|---|---|---|---|
| **Sampling Date** | | 2017/11/30 12:10 | 2017/11/30 12:44 | | |
| **COC Number** | | N/A | N/A | | |
| | **UNITS** | **SW1A** | **OUTLET** | **RDL** | **QC Batch** |
| **Petroleum Hydrocarbons** | | | | | |
| Benzene | mg/L | ND | ND | 0.0010 | 5297200 |
| Toluene | mg/L | ND | ND | 0.0010 | 5297200 |
| Ethylbenzene | mg/L | ND | ND | 0.0010 | 5297200 |
| Total Xylenes | mg/L | ND | ND | 0.0020 | 5297200 |
| C6 - C10 (less BTEX) | mg/L | ND | ND | 0.010 | 5297200 |
| >C10-C16 Hydrocarbons | mg/L | ND | ND | 0.050 | 5297111 |
| >C16-C21 Hydrocarbons | mg/L | ND | ND | 0.050 | 5297111 |
| >C21-<C32 Hydrocarbons | mg/L | ND | ND | 0.10 | 5297111 |
| Modified TPH (Tier1) | mg/L | ND | ND | 0.10 | 5294204 |
| Reached Baseline at C32 | mg/L | NA | NA | N/A | 5297111 |
| Hydrocarbon Resemblance | mg/L | NA | NA | N/A | 5297111 |
| **Surrogate Recovery (%)** | | | | | |
| Isobutylbenzene - Extractable | % | 90 | 87 | | 5297111 |
| n-Dotriacontane - Extractable | % | 98 | 97 | | 5297111 |
| Isobutylbenzene - Volatile | % | 103 | 102 | | 5297200 |

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable



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Maxxam Job #: B7R2025
Report Date: 2017/12/11

Dillon Consulting Limited
Client Project #: 13-8348-6000
Site Location: HWY 107 EA
Sampler Initials: PKA

## GENERAL COMMENTS

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

| | |
|---|---|
| Package 1 | 2.0°C |

Sample FRD269 [SW1A] : RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

Sample FRD270 [OUTLET] : RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

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



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Maxxam Job #: B7R2025
Report Date: 2017/12/11

Dillon Consulting Limited
Client Project #: 13-8348-6000
Site Location: HWY 107 EA
Sampler Initials: PKA

## QUALITY ASSURANCE REPORT

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| 5297111 | BCD | Matrix Spike | Isobutylbenzene - Extractable | 2017/12/04 | | 105 | % | 30 - 130 |
| | | | n-Dotriacontane - Extractable | 2017/12/04 | | 129 | % | 30 - 130 |
| | | | >C10-C16 Hydrocarbons | 2017/12/04 | | 93 | % | 70 - 130 |
| | | | >C16-C21 Hydrocarbons | 2017/12/04 | | 91 | % | 70 - 130 |
| | | | >C21-<C32 Hydrocarbons | 2017/12/04 | | 100 | % | 70 - 130 |
| 5297111 | BCD | Spiked Blank | Isobutylbenzene - Extractable | 2017/12/04 | | 103 | % | 30 - 130 |
| | | | n-Dotriacontane - Extractable | 2017/12/04 | | 110 | % | 30 - 130 |
| | | | >C10-C16 Hydrocarbons | 2017/12/04 | | 88 | % | 70 - 130 |
| | | | >C16-C21 Hydrocarbons | 2017/12/04 | | 88 | % | 70 - 130 |
| | | | >C21-<C32 Hydrocarbons | 2017/12/04 | | 98 | % | 70 - 130 |
| 5297111 | BCD | Method Blank | Isobutylbenzene - Extractable | 2017/12/04 | | 101 | % | 30 - 130 |
| | | | n-Dotriacontane - Extractable | 2017/12/04 | | 110 | % | 30 - 130 |
| | | | >C10-C16 Hydrocarbons | 2017/12/04 | ND, RDL=0.050 | | mg/L | |
| | | | >C16-C21 Hydrocarbons | 2017/12/04 | ND, RDL=0.050 | | mg/L | |
| | | | >C21-<C32 Hydrocarbons | 2017/12/04 | ND, RDL=0.10 | | mg/L | |
| 5297111 | BCD | RPD | >C10-C16 Hydrocarbons | 2017/12/04 | NC | | % | 40 |
| | | | >C16-C21 Hydrocarbons | 2017/12/04 | NC | | % | 40 |
| | | | >C21-<C32 Hydrocarbons | 2017/12/04 | NC | | % | 40 |
| 5297200 | MS3 | Matrix Spike | Isobutylbenzene - Volatile | 2017/12/05 | | 105 | % | 70 - 130 |
| | | | Benzene | 2017/12/05 | | 102 | % | 70 - 130 |
| | | | Toluene | 2017/12/05 | | 103 | % | 70 - 130 |
| | | | Ethylbenzene | 2017/12/05 | | 101 | % | 70 - 130 |
| | | | Total Xylenes | 2017/12/05 | | 101 | % | 70 - 130 |
| 5297200 | MS3 | Spiked Blank | Isobutylbenzene - Volatile | 2017/12/05 | | 105 | % | 70 - 130 |
| | | | Benzene | 2017/12/05 | | 103 | % | 70 - 130 |
| | | | Toluene | 2017/12/05 | | 104 | % | 70 - 130 |
| | | | Ethylbenzene | 2017/12/05 | | 104 | % | 70 - 130 |
| | | | Total Xylenes | 2017/12/05 | | 103 | % | 70 - 130 |
| 5297200 | MS3 | Method Blank | Isobutylbenzene - Volatile | 2017/12/05 | | 103 | % | 70 - 130 |
| | | | Benzene | 2017/12/05 | ND, RDL=0.0010 | | mg/L | |
| | | | Toluene | 2017/12/05 | ND, RDL=0.0010 | | mg/L | |
| | | | Ethylbenzene | 2017/12/05 | ND, RDL=0.0010 | | mg/L | |
| | | | Total Xylenes | 2017/12/05 | ND, RDL=0.0020 | | mg/L | |
| | | | C6 - C10 (less BTEX) | 2017/12/05 | ND, RDL=0.010 | | mg/L | |
| 5297200 | MS3 | RPD | Benzene | 2017/12/05 | NC | | % | 40 |
| | | | Toluene | 2017/12/05 | NC | | % | 40 |
| | | | Ethylbenzene | 2017/12/05 | NC | | % | 40 |
| | | | Total Xylenes | 2017/12/05 | NC | | % | 40 |
| | | | C6 - C10 (less BTEX) | 2017/12/05 | NC | | % | 40 |
| 5298937 | JMV | QC Standard | pH | 2017/12/05 | | 100 | % | 97 - 103 |
| 5298937 | JMV | RPD | pH | 2017/12/05 | 1.6 | | % | N/A |
| 5298938 | JMV | Spiked Blank | Conductivity | 2017/12/05 | | 104 | % | 80 - 120 |
| 5298938 | JMV | Method Blank | Conductivity | 2017/12/05 | 1.5, RDL=1.0 | | uS/cm | |



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Maxxam Job #: B7R2025
Report Date: 2017/12/11

Dillon Consulting Limited
Client Project #: 13-8348-6000
Site Location: HWY 107 EA
Sampler Initials: PKA

## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| 5298938 | JMV | RPD | Conductivity | 2017/12/05 | 0.72 | | % | 25 |
| 5298939 | JMV | QC Standard | pH | 2017/12/05 | | 100 | % | 97 - 103 |
| 5298939 | JMV | RPD | pH | 2017/12/05 | 0.76 | | % | N/A |
| 5298940 | JMV | Spiked Blank | Conductivity | 2017/12/05 | | 104 | % | 80 - 120 |
| 5298940 | JMV | Method Blank | Conductivity | 2017/12/05 | 1.7, RDL=1.0 | | uS/cm | |
| 5298940 | JMV | RPD | Conductivity | 2017/12/05 | 1.1 | | % | 25 |
| 5298943 | JMV | QC Standard | Turbidity | 2017/12/05 | | 97 | % | 80 - 120 |
| 5298943 | JMV | Spiked Blank | Turbidity | 2017/12/05 | | 92 | % | 80 - 120 |
| 5298943 | JMV | Method Blank | Turbidity | 2017/12/05 | ND, RDL=0.10 | | NTU | |
| 5298943 | JMV | RPD | Turbidity | 2017/12/05 | NC | | % | 20 |
| 5298944 | JMV | QC Standard | Turbidity | 2017/12/05 | | 97 | % | 80 - 120 |
| 5298944 | JMV | Spiked Blank | Turbidity | 2017/12/05 | | 92 | % | 80 - 120 |
| 5298944 | JMV | Method Blank | Turbidity | 2017/12/05 | ND, RDL=0.10 | | NTU | |
| 5298944 | JMV | RPD | Turbidity | 2017/12/05 | 15 | | % | 20 |
| 5298959 | BAN | Matrix Spike | Total Aluminum (Al) | 2017/12/05 | | 101 | % | 80 - 120 |
| | | | Total Antimony (Sb) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Arsenic (As) | 2017/12/05 | | 99 | % | 80 - 120 |
| | | | Total Barium (Ba) | 2017/12/05 | | 96 | % | 80 - 120 |
| | | | Total Beryllium (Be) | 2017/12/05 | | 102 | % | 80 - 120 |
| | | | Total Bismuth (Bi) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Boron (B) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Cadmium (Cd) | 2017/12/05 | | 99 | % | 80 - 120 |
| | | | Total Calcium (Ca) | 2017/12/05 | | 101 | % | 80 - 120 |
| | | | Total Chromium (Cr) | 2017/12/05 | | 98 | % | 80 - 120 |
| | | | Total Cobalt (Co) | 2017/12/05 | | 98 | % | 80 - 120 |
| | | | Total Copper (Cu) | 2017/12/05 | | 99 | % | 80 - 120 |
| | | | Total Iron (Fe) | 2017/12/05 | | 102 | % | 80 - 120 |
| | | | Total Lead (Pb) | 2017/12/05 | | 97 | % | 80 - 120 |
| | | | Total Magnesium (Mg) | 2017/12/05 | | 102 | % | 80 - 120 |
| | | | Total Manganese (Mn) | 2017/12/05 | | 99 | % | 80 - 120 |
| | | | Total Molybdenum (Mo) | 2017/12/05 | | 101 | % | 80 - 120 |
| | | | Total Nickel (Ni) | 2017/12/05 | | 99 | % | 80 - 120 |
| | | | Total Phosphorus (P) | 2017/12/05 | | 103 | % | 80 - 120 |
| | | | Total Potassium (K) | 2017/12/05 | | 102 | % | 80 - 120 |
| | | | Total Selenium (Se) | 2017/12/05 | | 99 | % | 80 - 120 |
| | | | Total Silver (Ag) | 2017/12/05 | | 99 | % | 80 - 120 |
| | | | Total Sodium (Na) | 2017/12/05 | | 101 | % | 80 - 120 |
| | | | Total Strontium (Sr) | 2017/12/05 | | 101 | % | 80 - 120 |
| | | | Total Thallium (Tl) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Tin (Sn) | 2017/12/05 | | 101 | % | 80 - 120 |
| | | | Total Titanium (Ti) | 2017/12/05 | | 99 | % | 80 - 120 |
| | | | Total Uranium (U) | 2017/12/05 | | 103 | % | 80 - 120 |
| | | | Total Vanadium (V) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Zinc (Zn) | 2017/12/05 | | 101 | % | 80 - 120 |
| 5298959 | BAN | Spiked Blank | Total Aluminum (Al) | 2017/12/05 | | 103 | % | 80 - 120 |
| | | | Total Antimony (Sb) | 2017/12/05 | | 101 | % | 80 - 120 |
| | | | Total Arsenic (As) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Barium (Ba) | 2017/12/05 | | 98 | % | 80 - 120 |
| | | | Total Beryllium (Be) | 2017/12/05 | | 103 | % | 80 - 120 |



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## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| | | | Total Bismuth (Bi) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Boron (B) | 2017/12/05 | | 103 | % | 80 - 120 |
| | | | Total Cadmium (Cd) | 2017/12/05 | | 101 | % | 80 - 120 |
| | | | Total Calcium (Ca) | 2017/12/05 | | 103 | % | 80 - 120 |
| | | | Total Chromium (Cr) | 2017/12/05 | | 99 | % | 80 - 120 |
| | | | Total Cobalt (Co) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Copper (Cu) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Iron (Fe) | 2017/12/05 | | 103 | % | 80 - 120 |
| | | | Total Lead (Pb) | 2017/12/05 | | 98 | % | 80 - 120 |
| | | | Total Magnesium (Mg) | 2017/12/05 | | 104 | % | 80 - 120 |
| | | | Total Manganese (Mn) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Molybdenum (Mo) | 2017/12/05 | | 104 | % | 80 - 120 |
| | | | Total Nickel (Ni) | 2017/12/05 | | 101 | % | 80 - 120 |
| | | | Total Phosphorus (P) | 2017/12/05 | | 105 | % | 80 - 120 |
| | | | Total Potassium (K) | 2017/12/05 | | 103 | % | 80 - 120 |
| | | | Total Selenium (Se) | 2017/12/05 | | 101 | % | 80 - 120 |
| | | | Total Silver (Ag) | 2017/12/05 | | 101 | % | 80 - 120 |
| | | | Total Sodium (Na) | 2017/12/05 | | 104 | % | 80 - 120 |
| | | | Total Strontium (Sr) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Thallium (Tl) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Tin (Sn) | 2017/12/05 | | 103 | % | 80 - 120 |
| | | | Total Titanium (Ti) | 2017/12/05 | | 103 | % | 80 - 120 |
| | | | Total Uranium (U) | 2017/12/05 | | 103 | % | 80 - 120 |
| | | | Total Vanadium (V) | 2017/12/05 | | 100 | % | 80 - 120 |
| | | | Total Zinc (Zn) | 2017/12/05 | | 102 | % | 80 - 120 |
| 5298959 | BAN | Method Blank | Total Aluminum (Al) | 2017/12/05 | ND, RDL=5.0 | | ug/L | |
| | | | Total Antimony (Sb) | 2017/12/05 | ND, RDL=1.0 | | ug/L | |
| | | | Total Arsenic (As) | 2017/12/05 | ND, RDL=1.0 | | ug/L | |
| | | | Total Barium (Ba) | 2017/12/05 | ND, RDL=1.0 | | ug/L | |
| | | | Total Beryllium (Be) | 2017/12/05 | ND, RDL=1.0 | | ug/L | |
| | | | Total Bismuth (Bi) | 2017/12/05 | ND, RDL=2.0 | | ug/L | |
| | | | Total Boron (B) | 2017/12/05 | ND, RDL=50 | | ug/L | |
| | | | Total Cadmium (Cd) | 2017/12/05 | ND, RDL=0.010 | | ug/L | |
| | | | Total Calcium (Ca) | 2017/12/05 | ND, RDL=100 | | ug/L | |
| | | | Total Chromium (Cr) | 2017/12/05 | ND, RDL=1.0 | | ug/L | |
| | | | Total Cobalt (Co) | 2017/12/05 | ND, RDL=0.40 | | ug/L | |
| | | | Total Copper (Cu) | 2017/12/05 | ND, RDL=2.0 | | ug/L | |
| | | | Total Iron (Fe) | 2017/12/05 | ND, RDL=50 | | ug/L | |



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## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| | | | Total Lead (Pb) | 2017/12/05 | ND, RDL=0.50 | | ug/L | |
| | | | Total Magnesium (Mg) | 2017/12/05 | ND, RDL=100 | | ug/L | |
| | | | Total Manganese (Mn) | 2017/12/05 | ND, RDL=2.0 | | ug/L | |
| | | | Total Molybdenum (Mo) | 2017/12/05 | ND, RDL=2.0 | | ug/L | |
| | | | Total Nickel (Ni) | 2017/12/05 | ND, RDL=2.0 | | ug/L | |
| | | | Total Phosphorus (P) | 2017/12/05 | ND, RDL=100 | | ug/L | |
| | | | Total Potassium (K) | 2017/12/05 | ND, RDL=100 | | ug/L | |
| | | | Total Selenium (Se) | 2017/12/05 | ND, RDL=1.0 | | ug/L | |
| | | | Total Silver (Ag) | 2017/12/05 | ND, RDL=0.10 | | ug/L | |
| | | | Total Sodium (Na) | 2017/12/05 | ND, RDL=100 | | ug/L | |
| | | | Total Strontium (Sr) | 2017/12/05 | ND, RDL=2.0 | | ug/L | |
| | | | Total Thallium (Tl) | 2017/12/05 | ND, RDL=0.10 | | ug/L | |
| | | | Total Tin (Sn) | 2017/12/05 | ND, RDL=2.0 | | ug/L | |
| | | | Total Titanium (Ti) | 2017/12/05 | ND, RDL=2.0 | | ug/L | |
| | | | Total Uranium (U) | 2017/12/05 | ND, RDL=0.10 | | ug/L | |
| | | | Total Vanadium (V) | 2017/12/05 | ND, RDL=2.0 | | ug/L | |
| | | | Total Zinc (Zn) | 2017/12/05 | ND, RDL=5.0 | | ug/L | |
| 5298959 | BAN | RPD | Total Aluminum (Al) | 2017/12/05 | 3.1 | | % | 20 |
| | | | Total Antimony (Sb) | 2017/12/05 | NC | | % | 20 |
| | | | Total Arsenic (As) | 2017/12/05 | NC | | % | 20 |
| | | | Total Barium (Ba) | 2017/12/05 | 2.4 | | % | 20 |
| | | | Total Beryllium (Be) | 2017/12/05 | NC | | % | 20 |
| | | | Total Bismuth (Bi) | 2017/12/05 | NC | | % | 20 |
| | | | Total Boron (B) | 2017/12/05 | NC | | % | 20 |
| | | | Total Cadmium (Cd) | 2017/12/05 | NC | | % | 20 |
| | | | Total Calcium (Ca) | 2017/12/05 | 0.98 | | % | 20 |
| | | | Total Chromium (Cr) | 2017/12/05 | NC | | % | 20 |
| | | | Total Cobalt (Co) | 2017/12/05 | NC | | % | 20 |
| | | | Total Copper (Cu) | 2017/12/05 | 8.1 | | % | 20 |
| | | | Total Iron (Fe) | 2017/12/05 | 2.0 | | % | 20 |
| | | | Total Lead (Pb) | 2017/12/05 | 2.5 | | % | 20 |
| | | | Total Magnesium (Mg) | 2017/12/05 | 2.9 | | % | 20 |
| | | | Total Manganese (Mn) | 2017/12/05 | 2.7 | | % | 20 |
| | | | Total Molybdenum (Mo) | 2017/12/05 | NC | | % | 20 |
| | | | Total Nickel (Ni) | 2017/12/05 | NC | | % | 20 |



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## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| | | | Total Phosphorus (P) | 2017/12/05 | NC | | % | 20 |
| | | | Total Potassium (K) | 2017/12/05 | 3.3 | | % | 20 |
| | | | Total Selenium (Se) | 2017/12/05 | NC | | % | 20 |
| | | | Total Silver (Ag) | 2017/12/05 | NC | | % | 20 |
| | | | Total Sodium (Na) | 2017/12/05 | 3.3 | | % | 20 |
| | | | Total Strontium (Sr) | 2017/12/05 | 2.3 | | % | 20 |
| | | | Total Thallium (Tl) | 2017/12/05 | NC | | % | 20 |
| | | | Total Tin (Sn) | 2017/12/05 | NC | | % | 20 |
| | | | Total Titanium (Ti) | 2017/12/05 | NC | | % | 20 |
| | | | Total Uranium (U) | 2017/12/05 | NC | | % | 20 |
| | | | Total Vanadium (V) | 2017/12/05 | NC | | % | 20 |
| | | | Total Zinc (Zn) | 2017/12/05 | 8.6 | | % | 20 |
| 5299013 | BAN | Matrix Spike | Total Aluminum (Al) | 2017/12/06 | | NC | % | 80 - 120 |
| | | | Total Antimony (Sb) | 2017/12/06 | | 99 | % | 80 - 120 |
| | | | Total Arsenic (As) | 2017/12/06 | | 97 | % | 80 - 120 |
| | | | Total Barium (Ba) | 2017/12/06 | | 92 | % | 80 - 120 |
| | | | Total Beryllium (Be) | 2017/12/06 | | 100 | % | 80 - 120 |
| | | | Total Bismuth (Bi) | 2017/12/06 | | 100 | % | 80 - 120 |
| | | | Total Boron (B) | 2017/12/06 | | 100 | % | 80 - 120 |
| | | | Total Cadmium (Cd) | 2017/12/06 | | 99 | % | 80 - 120 |
| | | | Total Calcium (Ca) | 2017/12/06 | | 100 | % | 80 - 120 |
| | | | Total Chromium (Cr) | 2017/12/06 | | 95 | % | 80 - 120 |
| | | | Total Cobalt (Co) | 2017/12/06 | | 96 | % | 80 - 120 |
| | | | Total Copper (Cu) | 2017/12/06 | | 93 | % | 80 - 120 |
| | | | Total Iron (Fe) | 2017/12/06 | | 95 | % | 80 - 120 |
| | | | Total Lead (Pb) | 2017/12/06 | | 95 | % | 80 - 120 |
| | | | Total Magnesium (Mg) | 2017/12/06 | | 98 | % | 80 - 120 |
| | | | Total Manganese (Mn) | 2017/12/06 | | 93 | % | 80 - 120 |
| | | | Total Molybdenum (Mo) | 2017/12/06 | | 102 | % | 80 - 120 |
| | | | Total Nickel (Ni) | 2017/12/06 | | 96 | % | 80 - 120 |
| | | | Total Phosphorus (P) | 2017/12/06 | | 102 | % | 80 - 120 |
| | | | Total Potassium (K) | 2017/12/06 | | 100 | % | 80 - 120 |
| | | | Total Selenium (Se) | 2017/12/06 | | 99 | % | 80 - 120 |
| | | | Total Silver (Ag) | 2017/12/06 | | 97 | % | 80 - 120 |
| | | | Total Sodium (Na) | 2017/12/06 | | 98 | % | 80 - 120 |
| | | | Total Strontium (Sr) | 2017/12/06 | | NC | % | 80 - 120 |
| | | | Total Thallium (Tl) | 2017/12/06 | | 99 | % | 80 - 120 |
| | | | Total Tin (Sn) | 2017/12/06 | | 103 | % | 80 - 120 |
| | | | Total Titanium (Ti) | 2017/12/06 | | 96 | % | 80 - 120 |
| | | | Total Uranium (U) | 2017/12/06 | | 102 | % | 80 - 120 |
| | | | Total Vanadium (V) | 2017/12/06 | | 97 | % | 80 - 120 |
| | | | Total Zinc (Zn) | 2017/12/06 | | 94 | % | 80 - 120 |
| 5299013 | BAN | Spiked Blank | Total Aluminum (Al) | 2017/12/06 | | 103 | % | 80 - 120 |
| | | | Total Antimony (Sb) | 2017/12/06 | | 103 | % | 80 - 120 |
| | | | Total Arsenic (As) | 2017/12/06 | | 101 | % | 80 - 120 |
| | | | Total Barium (Ba) | 2017/12/06 | | 98 | % | 80 - 120 |
| | | | Total Beryllium (Be) | 2017/12/06 | | 102 | % | 80 - 120 |
| | | | Total Bismuth (Bi) | 2017/12/06 | | 105 | % | 80 - 120 |
| | | | Total Boron (B) | 2017/12/06 | | 102 | % | 80 - 120 |
| | | | Total Cadmium (Cd) | 2017/12/06 | | 100 | % | 80 - 120 |
| | | | Total Calcium (Ca) | 2017/12/06 | | 103 | % | 80 - 120 |
| | | | Total Chromium (Cr) | 2017/12/06 | | 100 | % | 80 - 120 |



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## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| | | | Total Cobalt (Co) | 2017/12/06 | | 101 | % | 80 - 120 |
| | | | Total Copper (Cu) | 2017/12/06 | | 101 | % | 80 - 120 |
| | | | Total Iron (Fe) | 2017/12/06 | | 104 | % | 80 - 120 |
| | | | Total Lead (Pb) | 2017/12/06 | | 100 | % | 80 - 120 |
| | | | Total Magnesium (Mg) | 2017/12/06 | | 104 | % | 80 - 120 |
| | | | Total Manganese (Mn) | 2017/12/06 | | 102 | % | 80 - 120 |
| | | | Total Molybdenum (Mo) | 2017/12/06 | | 106 | % | 80 - 120 |
| | | | Total Nickel (Ni) | 2017/12/06 | | 102 | % | 80 - 120 |
| | | | Total Phosphorus (P) | 2017/12/06 | | 105 | % | 80 - 120 |
| | | | Total Potassium (K) | 2017/12/06 | | 104 | % | 80 - 120 |
| | | | Total Selenium (Se) | 2017/12/06 | | 101 | % | 80 - 120 |
| | | | Total Silver (Ag) | 2017/12/06 | | 101 | % | 80 - 120 |
| | | | Total Sodium (Na) | 2017/12/06 | | 102 | % | 80 - 120 |
| | | | Total Strontium (Sr) | 2017/12/06 | | 104 | % | 80 - 120 |
| | | | Total Thallium (Tl) | 2017/12/06 | | 103 | % | 80 - 120 |
| | | | Total Tin (Sn) | 2017/12/06 | | 105 | % | 80 - 120 |
| | | | Total Titanium (Ti) | 2017/12/06 | | 105 | % | 80 - 120 |
| | | | Total Uranium (U) | 2017/12/06 | | 105 | % | 80 - 120 |
| | | | Total Vanadium (V) | 2017/12/06 | | 103 | % | 80 - 120 |
| | | | Total Zinc (Zn) | 2017/12/06 | | 104 | % | 80 - 120 |
| 5299013 | BAN | Method Blank | Total Aluminum (Al) | 2017/12/06 | ND, RDL=5.0 | | ug/L | |
| | | | Total Antimony (Sb) | 2017/12/06 | ND, RDL=1.0 | | ug/L | |
| | | | Total Arsenic (As) | 2017/12/06 | ND, RDL=1.0 | | ug/L | |
| | | | Total Barium (Ba) | 2017/12/06 | ND, RDL=1.0 | | ug/L | |
| | | | Total Beryllium (Be) | 2017/12/06 | ND, RDL=1.0 | | ug/L | |
| | | | Total Bismuth (Bi) | 2017/12/06 | ND, RDL=2.0 | | ug/L | |
| | | | Total Boron (B) | 2017/12/06 | ND, RDL=50 | | ug/L | |
| | | | Total Cadmium (Cd) | 2017/12/06 | ND, RDL=0.010 | | ug/L | |
| | | | Total Calcium (Ca) | 2017/12/06 | 100, RDL=100 (1) | | ug/L | |
| | | | Total Chromium (Cr) | 2017/12/06 | ND, RDL=1.0 | | ug/L | |
| | | | Total Cobalt (Co) | 2017/12/06 | ND, RDL=0.40 | | ug/L | |
| | | | Total Copper (Cu) | 2017/12/06 | ND, RDL=2.0 | | ug/L | |
| | | | Total Iron (Fe) | 2017/12/06 | ND, RDL=50 | | ug/L | |
| | | | Total Lead (Pb) | 2017/12/06 | ND, RDL=0.50 | | ug/L | |
| | | | Total Magnesium (Mg) | 2017/12/06 | ND, RDL=100 | | ug/L | |
| | | | Total Manganese (Mn) | 2017/12/06 | ND, RDL=2.0 | | ug/L | |



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## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| | | | Total Molybdenum (Mo) | 2017/12/06 | ND, RDL=2.0 | | ug/L | |
| | | | Total Nickel (Ni) | 2017/12/06 | ND, RDL=2.0 | | ug/L | |
| | | | Total Phosphorus (P) | 2017/12/06 | ND, RDL=100 | | ug/L | |
| | | | Total Potassium (K) | 2017/12/06 | ND, RDL=100 | | ug/L | |
| | | | Total Selenium (Se) | 2017/12/06 | ND, RDL=1.0 | | ug/L | |
| | | | Total Silver (Ag) | 2017/12/06 | ND, RDL=0.10 | | ug/L | |
| | | | Total Sodium (Na) | 2017/12/06 | ND, RDL=100 | | ug/L | |
| | | | Total Strontium (Sr) | 2017/12/06 | ND, RDL=2.0 | | ug/L | |
| | | | Total Thallium (Tl) | 2017/12/06 | ND, RDL=0.10 | | ug/L | |
| | | | Total Tin (Sn) | 2017/12/06 | ND, RDL=2.0 | | ug/L | |
| | | | Total Titanium (Ti) | 2017/12/06 | ND, RDL=2.0 | | ug/L | |
| | | | Total Uranium (U) | 2017/12/06 | ND, RDL=0.10 | | ug/L | |
| | | | Total Vanadium (V) | 2017/12/06 | ND, RDL=2.0 | | ug/L | |
| | | | Total Zinc (Zn) | 2017/12/06 | ND, RDL=5.0 | | ug/L | |
| 5299013 | BAN | RPD | Total Aluminum (Al) | 2017/12/06 | 2.1 | | % | 20 |
| 5301619 | MCN | Matrix Spike | Nitrogen (Ammonia Nitrogen) | 2017/12/06 | | 98 | % | 80 - 120 |
| 5301619 | MCN | Spiked Blank | Nitrogen (Ammonia Nitrogen) | 2017/12/06 | | 102 | % | 80 - 120 |
| 5301619 | MCN | Method Blank | Nitrogen (Ammonia Nitrogen) | 2017/12/06 | ND, RDL=0.050 | | mg/L | |
| 5301619 | MCN | RPD | Nitrogen (Ammonia Nitrogen) | 2017/12/06 | 2.0 | | % | 20 |
| 5302218 | NRG | Matrix Spike | Total Alkalinity (Total as CaCO3) | 2017/12/07 | | NC | % | 80 - 120 |
| 5302218 | NRG | Spiked Blank | Total Alkalinity (Total as CaCO3) | 2017/12/07 | | 103 | % | 80 - 120 |
| 5302218 | NRG | Method Blank | Total Alkalinity (Total as CaCO3) | 2017/12/07 | ND, RDL=5.0 | | mg/L | |
| 5302218 | NRG | RPD | Total Alkalinity (Total as CaCO3) | 2017/12/07 | 0.75 | | % | 25 |
| 5302227 | NRG | Matrix Spike | Dissolved Chloride (Cl) | 2017/12/07 | | 100 | % | 80 - 120 |
| 5302227 | NRG | QC Standard | Dissolved Chloride (Cl) | 2017/12/07 | | 107 | % | 80 - 120 |
| 5302227 | NRG | Spiked Blank | Dissolved Chloride (Cl) | 2017/12/07 | | 104 | % | 80 - 120 |
| 5302227 | NRG | Method Blank | Dissolved Chloride (Cl) | 2017/12/07 | ND, RDL=1.0 | | mg/L | |
| 5302227 | NRG | RPD | Dissolved Chloride (Cl) | 2017/12/07 | 1.7 | | % | 25 |
| 5302231 | NRG | Matrix Spike | Dissolved Sulphate (SO4) | 2017/12/07 | | NC | % | 80 - 120 |
| 5302231 | NRG | Spiked Blank | Dissolved Sulphate (SO4) | 2017/12/07 | | 98 | % | 80 - 120 |
| 5302231 | NRG | Method Blank | Dissolved Sulphate (SO4) | 2017/12/07 | ND, RDL=2.0 | | mg/L | |
| 5302231 | NRG | RPD | Dissolved Sulphate (SO4) | 2017/12/07 | 4.9 (2) | | % | 25 |
| 5302234 | NRG | Matrix Spike | Reactive Silica (SiO2) | 2017/12/08 | | 98 | % | 80 - 120 |
| 5302234 | NRG | Spiked Blank | Reactive Silica (SiO2) | 2017/12/08 | | 98 | % | 80 - 120 |



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Maxxam Job #: B7R2025
Report Date: 2017/12/11

Dillon Consulting Limited
Client Project #: 13-8348-6000
Site Location: HWY 107 EA
Sampler Initials: PKA

## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| 5302234 | NRG | Method Blank | Reactive Silica (SiO2) | 2017/12/08 | ND, RDL=0.50 | | mg/L | |
| 5302234 | NRG | RPD | Reactive Silica (SiO2) | 2017/12/08 | 5.0 | | % | 25 |
| 5302238 | NRG | Spiked Blank | Colour | 2017/12/07 | | 100 | % | 80 - 120 |
| 5302238 | NRG | Method Blank | Colour | 2017/12/07 | ND, RDL=5.0 | | TCU | |
| 5302238 | NRG | RPD | Colour | 2017/12/07 | NC | | % | 20 |
| 5302243 | NRG | Matrix Spike | Orthophosphate (P) | 2017/12/08 | | 107 | % | 80 - 120 |
| 5302243 | NRG | Spiked Blank | Orthophosphate (P) | 2017/12/08 | | 100 | % | 80 - 120 |
| 5302243 | NRG | Method Blank | Orthophosphate (P) | 2017/12/08 | 0.051, RDL=0.010 | | mg/L | |
| 5302243 | NRG | RPD | Orthophosphate (P) | 2017/12/08 | 14 | | % | 25 |
| 5302244 | NRG | Matrix Spike | Nitrate + Nitrite (N) | 2017/12/08 | | 96 | % | 80 - 120 |
| 5302244 | NRG | Spiked Blank | Nitrate + Nitrite (N) | 2017/12/08 | | 94 | % | 80 - 120 |
| 5302244 | NRG | Method Blank | Nitrate + Nitrite (N) | 2017/12/08 | ND, RDL=0.050 | | mg/L | |
| 5302244 | NRG | RPD | Nitrate + Nitrite (N) | 2017/12/08 | 0.40 | | % | 25 |
| 5302247 | NRG | Matrix Spike | Nitrite (N) | 2017/12/07 | | 100 | % | 80 - 120 |
| 5302247 | NRG | Spiked Blank | Nitrite (N) | 2017/12/07 | | 103 | % | 80 - 120 |
| 5302247 | NRG | Method Blank | Nitrite (N) | 2017/12/07 | ND, RDL=0.010 | | mg/L | |
| 5302247 | NRG | RPD | Nitrite (N) | 2017/12/07 | 0.83 | | % | 25 |
| 5303626 | ARS | Matrix Spike [FRD269-05] | Total Mercury (Hg) | 2017/12/08 | | 102 | % | 80 - 120 |
| 5303626 | ARS | Spiked Blank | Total Mercury (Hg) | 2017/12/08 | | 101 | % | 80 - 120 |
| 5303626 | ARS | Method Blank | Total Mercury (Hg) | 2017/12/08 | ND, RDL=0.013 | | ug/L | |
| 5303626 | ARS | RPD | Total Mercury (Hg) | 2017/12/08 | NC | | % | 20 |
| 5303681 | AM6 | QC Standard | Total Suspended Solids | 2017/12/08 | | 95 | % | 80 - 120 |
| 5303681 | AM6 | Method Blank | Total Suspended Solids | 2017/12/08 | ND, RDL=1.0 | | mg/L | |
| 5303681 | AM6 | RPD | Total Suspended Solids | 2017/12/08 | 17 | | % | 25 |
| 5309052 | LMP | Matrix Spike | Total Organic Carbon (C) | 2017/12/11 | | 97 | % | 80 - 120 |
| 5309052 | LMP | Spiked Blank | Total Organic Carbon (C) | 2017/12/11 | | 101 | % | 80 - 120 |
| 5309052 | LMP | Method Blank | Total Organic Carbon (C) | 2017/12/11 | ND, RDL=0.50 | | mg/L | |



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Maxxam Job #: B7R2025
Report Date: 2017/12/11

Dillon Consulting Limited
Client Project #: 13-8348-6000
Site Location: HWY 107 EA
Sampler Initials: PKA

## QUALITY ASSURANCE REPORT(CONT'D)

| QA/QC Batch | Init | QC Type | Parameter | Date Analyzed | Value | Recovery | UNITS | QC Limits |
|---|---|---|---|---|---|---|---|---|
| 5309052 | LMP | RPD | Total Organic Carbon (C) | 2017/12/11 | 5.8 | | % | 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.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

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) Low level lab contamination. Minimal impact on sample data quality.

(2) Elevated reporting limit due to sample matrix.



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Maxxam Job #: B7R2025
Report Date: 2017/12/11

Dillon Consulting Limited
Client Project #: 13-8348-6000
Site Location: HWY 107 EA
Sampler Initials: PKA

## VALIDATION SIGNATURE PAGE

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

Kevin MacDonald, Inorganics Supervisor

Mike MacGillivray, Scientific Specialist (Inorganics)

Rosemarie MacDonald, Scientific Specialist (Organics)

Maxxam 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.



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