



TETRA TECH EBA

2015 Hydrogeological Assessment Program Burwash Landing, Yukon



PRESENTED TO

Yukon Government

Community Services, Infrastructure Development Branch (C-13)

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1.0 INTRODUCTION

Tetra Tech EBA Inc. (Tetra Tech EBA), has been retained by the Yukon Government, Community Services, Infrastructure and Development Branch (C-13) (YG) to design the proposed new Burwash Landing Water Treatment Plant (WTP). The new WTP is intended to replace the existing WTP and provide drinking water for bulk delivery to the Kluane First Nation (KFN) community. Amongst Tetra Tech EBA's scope of work for this project was the siting, design and drilling of two new potable groundwater supply wells to serve the WTP. Additionally, as part of this scope of work, Tetra Tech EBA was engaged by YG to undertake a hydrogeological investigation program at two existing wells (identified herein as KFN-K and KFN-L) to the east of the Burwash Landing community to examine water quality and subsurface temperature information for the design of the proposed water treatment plant and potential future geotreatment system.

1.1 Objectives

The key objectives of this hydrogeological assessment project were to:

1. Obtain water quality data from an existing deep well to the east of the Burwash Landing community to provide data for potential potable water treatment system design;
2. Obtain water quality and temperature gradient data from a deep geo-exchange well to the east of the Burwash Landing community to provide data for geo-exchange design work; and,
3. Drill, install and test two groundwater supply wells with acceptable quality and quantity for use as a long term potable water supply for the KFN community.

1.2 Scope of Services

The scope of work for this project included the following tasks:

- Thawing of two deep groundwater wells (KFN-K and KFN-L) to gain access for sampling and to determine ice thickness;
- Collection of water samples from the two deep groundwater wells (KFN-K and KFN-L);
- Installation of temperature loggers and collection of data from one deep groundwater well (KFN-L);
- Installation of a pressure transducer and logger in one deep groundwater well (KFN-K);
- Implementation of wellhead freeze protection measures in four groundwater supply wells (KFN-K, KFN-L, KFN-M, and KFN-N); and,
- Drilling, installation, testing and sampling of two new groundwater supply wells (KFN-M and KFN-N) to serve the KFN community.

The work was carried out under two Yukon Government Contracts, and this report fulfills the deliverable obligation for both projects. The reporting was combined as the work is inter related, and with the permission of YG.

2.0 2015 HYDROGEOLOGICAL INVESTIGATION PROGRAM (KFN-K AND KFN-L)

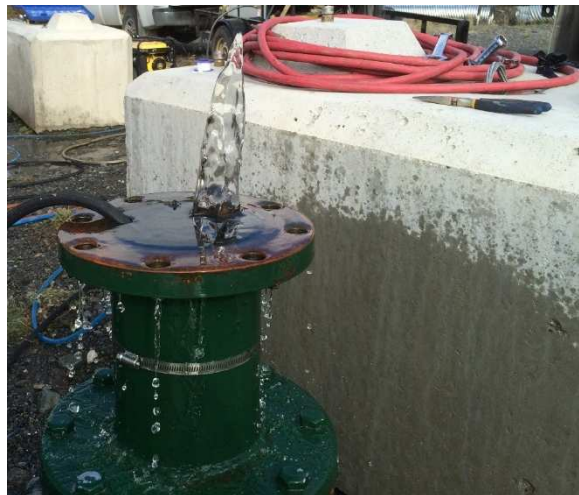
The following sections present a summary of the hydrogeological investigation program undertaken at KFN-K and KFN-L in 2015. Figure 1 shows the location of the two wells in reference to the KFN community and the proposed WTP.

2.1 Well Thawing and Purging

Well Thawing

To gain access to deep (70 m+) groundwater wells KFN-K and KFN-L ice in each well (due to permafrost) was thawed on August 11 and 12, 2015. Well thawing was conducted by staff from KFN under the observation of Tetra Tech EBA. Both wells were thawed by continuously jetting the ice mass in the well casing with high pressure warmed water. A summary of the well thawing procedure is provided below:

- A clean, washed and disinfected polyethylene water holding tank was provided for use as a water storage tank. This tank was filled/re-filled with water supplied from water supply well KFN-F which was delivered to the site by a KFN water truck.
- Using a clean, washed and disinfected high pressure washer, heated water from the holding tank was pumped through a clean, washed and disinfected high pressure hose and jetted out of a disinfected sewer nozzle into the ice mass in the well, melting and breaking apart the ice mass as the nozzle was lowered down the well.
- Return water/ice was allowed to overflow the well head and drain to ground (see Photograph 1). Runoff was directed to a drainage ditch to the west of the wells, adjacent to the road.
- Thawing was continued until the base of the frozen ice mass was broken through and free flowing flow commenced.



Photograph 1: Ice returns in KFN-L during thawing

Well Purging

Following the completion of thawing on the evening of August 12, KFN-K and KFN-L were purged to remove stagnant water and water introduced from the thawing process from the casing prior to the sample collection. This

ensured samples representative of the aquifer could be collected for assessment of water quality for water treatment and geoechange system design.

Under free flowing artesian conditions, KFN-K and KFN-L flowed at approximately 150 L/min and 20 L/min, respectively. Both wells were capped on the evening of August 12 and allowed to flow overnight under artesian conditions. Valves at the wellhead were closed to reduce the overnight purge rate to approximately 13 L/min from both wells to limit unsupervised discharge and inundation of the discharge area. Purged water was discharged to the firebreak area approximately 60 m east of the wells via through lay flat hosing.

To increase the flow rate from KFN-L, a clean and disinfected Grundfos Redi-Flo2® submersible pump was placed in the well on the morning of August 13. This increased the flow rate from approximately 20 L/min under artesian pressure alone to approximately 30 L/min when pumped at maximum capacity.

Table 2-1 details the estimated flow rates and total volumes purged from KFN-K and KFN-L over the course of the work program.

Table 2-1: Well Purging Details, August 12 and 13, 2015

Well ID	1 x Casing Volume (L)	Purge Time (August 12 and 13)	Estimated purge rate (L/min)	Approximate Volume Purged (L)	Approximate Total Volume Purged (L)
KFN-K	1,326	18:00 - 19:36	150 ¹	14,400	24,460 (18.4 Casing Volumes)
		19:36 - 08:30 ⁴	13 ²	10,060	
KFN-L	6,857	18:34 - 19:40	20 ¹	1,320	17,240 (2.5 Casing Volumes)
		19:40 - 08:00	13 ²	9,620	
		08:00 - 11:30	30 ³	6,300	

¹Unrestricted artesian flow ²reduced overnight flow ³flow with Grundfos Redi-Flo2® pump installed

⁴Well shut-in for 15 min during this period

2.2 Groundwater Sampling

Tetra Tech EBA collected water samples from KFN-K and KFN-L on two occasions; one in mid-August 2015 and one in late August 2015.

Round 1 - August 12 and 13, 2015

Samples were collected from groundwater supply well KFN-K and deep geothermal well KFN-L in order to gain water quality information to assist in the design of the water treatment plant and potential future geoechange system. Two samples were collected from KFN-K; one after approximately 11 well casing volumes (14,400 L) and another after approximately 18 well casing volumes (24,460 L) had been discharged. One sample was collected from KFN-L, following the purging of approximately 2.5 well holding volumes (17,240 L).

The August 12 and 13, 2015 groundwater laboratory testing program is detailed in Table 2-2.

Table 2-2: Groundwater Laboratory Testing Program - August 12 and 13, 2015

Sample Location	Sampling Details	Analysis List
KFN-K (2 x samples)	<ul style="list-style-type: none"> ▪ Sample 1 collected after approximately 11 well casing volumes (14,400 L) discharged. ▪ Sample 2 collected after approximately 18 well casing volumes (24,460 L) discharged. 	<ul style="list-style-type: none"> ▪ Detailed potability (drinking water package); ▪ Dissolved and total metals suite; ▪ Total Suspended Solids, Total Phosphate; ▪ Bacteriological (total coliforms and E.coli); ▪ Hydrocarbon suite; and ▪ Nutrients and Total Organic Carbon (TOC)
KFN-L (1 x sample)	<ul style="list-style-type: none"> ▪ Sample collected following purging of approximately 2.5 well casing volumes (17,240 L). 	<ul style="list-style-type: none"> ▪ Bacteriological (plate count, sulfate reducing bacteria, anaerobic growth, adenosine triphosphate (ATP), Fe/Mn oxidizing bacteria, total coliforms, E.coli), General water quality parameters, Langelier Saturation Index (calculated from general water quality parameters), Tannin/Lignin, Total Organic Carbon (TOC)¹ ▪ Routine Chemistry, Major Ions, Nutrients, Total and Dissolved Metals.

¹ Analysis list undertaken by WSEI for

Sample Round 2 - August 28, 2015

A second round of groundwater sampling was conducted on August 28, 2015 to further investigate the detection of toluene in samples collected from KFN-K in Sample Round 1. Samples were collected from KFN-K and KFN-L and analyzed for benzene, toluene, ethylbenzene, xylenes (BTEX) and Methyl tert-butyl ether (MTBE). Samples from KFN-K and KFN-L were also analyzed for total iron and total arsenic to provide further information for the design of the WTP. Samples were also collected from a nearby monitoring well and the KFN Administration Building well as part of a separate investigation program being conducted in conjunction with this sampling.

The August 28, 2015 groundwater laboratory testing program and details of purging and sampling is detailed in Table 2-3.

Table 2-3: Groundwater Laboratory Testing Program, KFN-K and KFN-L (August 28, 2015)

Sample Location	Sampling Details	Analysis List
KFN-K (Sample ID - WS05)	<ul style="list-style-type: none"> ▪ Sample collected at well head after approximately 23 well casing volumes purged (31,000 L) 	<ul style="list-style-type: none"> ▪ BTEX ▪ MTBE ▪ Total iron and arsenic
KFN-L (Sample ID - WS03)	<ul style="list-style-type: none"> ▪ Casing sample (<100 L discharged) ▪ Sample collected at wellhead 	<ul style="list-style-type: none"> ▪ BTEX ▪ MTBE ▪ Total iron and arsenic

2.3 Datalogger Installation

Temperature Dataloggers

To obtain further data on the subsurface temperature gradient, temperature loggers were placed at three intervals in KFN-L at the completion of the sampling program on August 13, 2015. The loggers were placed at approximately 100 m below grade (bg), 177 m bg, and 352 m bg. After installation, the well was shut in to allow thermal equilibrium to be re-established.

Tetra Tech EBA retrieved the loggers and downloaded the data during site works on August 28, 2015, 15 days after deployment. The HOBO temperature logger, which has been purchased by the Client for this project, was re-installed in KFN-L at approximately 352 m bg after the data was downloaded and set to continue to log temperature data once every 12 hours. Based on this data collection interval, the HOBO logger can log 59 years of data before the memory is full. Tetra Tech EBA notes that from surface to approximately 100 m bg, the HOBO logger is hung on small diameter steel cable which will enable thawing of the well using a high pressure system without concern of breaking the hanger. Below 100 m bg, the logger has been hung on a heavy duty nylon string and care should be taken when removing or replacing the logger to avoid breakage of the string.

The loggers that had been placed at 100 m and 177 m bg were rental equipment and were not reinstalled in KFN-L after the data was downloaded.

Pressure Transducers and Datalogger

At the completion of the well sampling program on August 13, 2015, a pressure transducer and datalogger was placed approximately 65 m bg in KFN-K, and the well then shut-in. This equipment was installed to monitor effects on the aquifer from the pumping test program to be conducted on the planned new water supply wells. At the time of writing this report, this datalogger remains in KFN-K as the well head was frozen during the well installation and testing program. Due to cold weather and lack of manpower, KFN have been unable to thaw the well to remove the datalogger. KFN advised Tetra Tech EBA that the logger would be attempted to be removed at their earliest opportunity. Thus, the data collected by the KFN-K datalogger could not be downloaded and interpreted at this time.

2.4 Freeze Protection

In early October 2015, a valve at the well head of KFN-K was noted to have cracked and water was leaking from the valve. This damage was due to expansion of water in the well head due to freezing, prior to the permafrost freezing back so the well was still under artesian pressure. To reduce the chance of further damage to the well head, Tetra Tech EBA was asked by YG to investigate freeze protection options for KFN-K and KFN-L.

Following discussions with drillers experienced in implementation of freeze protection measures, Tetra Tech EBA determined that the most cost effective/passive solution (i.e. without a structure and heating) that was likely to work would be to place foam inside the well head that would compress upon freezing, reducing pressure in the well and protecting the well head. Freeze protection was implemented in both wells during the October 2015 site mobilization through the installation of foam “pool noodles” into the top of the casing in each well. Three noodles approximately 1 m long with a diameter of 0.07 m were placed in both KFN-K and KFN-L. Additionally, at each well, one 0.25 m long piece of foam was placed inside the t-piece connecting the pressure gauge and valve to the well. Given the buoyancy of the foam and the artesian pressure in the wells, the foam will be easily removed when the wells are next thawed.

3.0 GROUNDWATER SUPPLY WELL INSTALLATION PROGRAM

Two groundwater supply wells, intended for use by the KFN for potable water supply, were drilled, installed, tested and disinfected under the direction of Tetra Tech EBA in October 2015. The well identifications followed the sequential alphabetical naming system adopted by KFN and were named KFN-M and KFN-N.

The drilling program was conducted in recognition of the key objective of successfully completing two wells that could supply KFN with a potable water supply with sufficient yield to meet the community forecast 20 year average daily demand of 0.49 L/sec (7.8 USgpm) and peak pumping rate in the order of 2.5 L/sec (40 USgpm). The following sections present a summary of the drilling, testing and disinfection program conducted at KFN-M and KFN-N.

3.1 Well Locations

Groundwater supply wells KFN-M and KFN-N are located in a forested, previously undeveloped parcel of land adjacent to a firebreak to the east/southeast of the Burwash Landing community. The location of each well is shown in Figure 1.

Both KFN-M and KFN-N conform to the requirements of the Yukon Public Health and Safety Act (August 2007), which requires that wells are to be located a minimum distance of 60 m from any potential sources of pollution that may pose a health and safety risk and 120 m from a solid waste site, dump or cemetery.

Based on a background review conducted for the aquifer and well head protection plan, there were no current or former potential contamination sources identified within a 150 m radius of the two wells or within 1 km in the inferred hydraulically upgradient direction (to the south to southeast) of the wells. While a former dump was identified approximately 190 m to the northeast of KFN-M and KFN-N, the dump is considered down slope and hydraulically downgradient of both wells and groundwater potentially impacted by the dump is not expected to be in hydraulic connection to the aquifer KFN-M and KFN-N are completed in. This has been further verified by well capture zone analysis and a wellhead protection plan being completed by Tetra Tech EBA as part of another report that is to be delivered in 2016.

3.2 Well Installation and Testing Program (KFN-N)

3.2.1 Well Drilling and Construction

KFN-N was drilled and constructed from October 16 to 19, 2015 by Midnight Sun Drilling Inc. (Midnight Sun) of Whitehorse, Yukon. The well was drilled using a Sandvik Marlin 5 air rotary rig with an ATLAS casing advance hammer and was constructed in accordance with the Public Drinking Water Regulations and the Canadian Groundwater Association's Guidelines for Water Well Construction (Tetra Tech EBA notes that while the Canadian Groundwater Association is currently defunct, the Guidelines for Water Well Construction are still considered to be best practice guidance for a well of this nature and have not been superseded by more recent or relevant guidelines).

During key points of the drilling, a Tetra Tech EBA representative was on site to monitor and oversee the drilling activities and record the subsurface conditions. Soil samples were collected by the drilling contractor every 1.5 m through unsaturated and frozen material. The sample collection frequency was increased to every 0.6 m at key changes in soil type in the encountered aquifer zone.

In general, soils from the surface to approximately 48.8 m bg were comprised of glaciolacustrine deposits (till), with alternating layers of sand and silt and silt, sand and gravel. Permafrost was encountered from about 1.8 m to 53.6 m bg. A frozen gravel with some sand and trace silt unit was logged from 48.8 m bg to the base of the permafrost at 53.6 m bg. Immediately below the base of the permafrost, a productive aquifer was encountered within gravel and sand units. This aquifer extended from about 53.6 m to 57.9 m bg. From 57.9 m to 58.5 m bg, silt content increased, indicating return to a silty till unit. Figure 2 summarizes the subsurface conditions encountered at KFN-N. Tetra Tech EBA notes that a similar aquifer was encountered at approximately the same depth when drilling other community wells KFN-F and KFN-K (approximately 400 m to the west and 230 m to the northeast respectively), and at other areas of Burwash Landing indicating the aquifer is likely aurally extensive.

Drilling was halted at 58.5 m bg and a brief air lift pumping test was completed in the aquifer encountered from 53.6 m to 57.9 m bg to determine if it could be utilized for a water supply well. Midnight Sun tested the zone by air lifting for about 30 minutes and estimated the zone could produce about 3.78 to 5.05 L/sec (60 to 80 US gpm) (estimated both by driller's observations and by capturing air lifted flow in a 20 L [5 US gallon] bucket). During the

airlifting test, a sample of the return water was collected and the pH and electrical conductivity field tested. The sample indicated a pH of about 8.7 and an electrical conductivity of 201 µs/cm (indicating low mineralization).

With the aquifer encountered from 53.6 m to 57.9 m bg having an estimated yield that was above the average daily demand (0.29 L/sec (4.6 US gpm) [10 year] and 0.49 L/sec (7.8 US gpm) [20 year]) and field water quality testing indicating potentially good quality potable water. Tetra Tech EBA, in consultation with YG and KFN decided to complete the water supply well in this aquifer. The borehole was backfilled from 58.5 to 57.76 m bg with gravel (disinfected with a 12% chlorine bleach solution) to minimize silt intrusion into the water supply aquifer.

Field particle size analysis was conducted on samples obtained at 54.9 m and 57.3 m bg to design an appropriate well screen for the aquifer. Particle size distribution results from these samples are included in Appendix C and indicate that the aquifer material is primarily medium to coarse sand with some fine gravel and trace silt. A thin layer with increased fine sand was noted from 54.6 to 55.0 m bg.

Based the results of the field particle size analysis (using a 50% passing rate) and the thickness of the aquifer, the well screen assembly was designed as detailed in Table 3-1.

Table 3-1: Well Construction Summary (KFN-N)

Well Detail	Interval		Internal Diameter (m)	Slot Size (inches)	Screen Type	Screen Open Area Length	
	m bg	ft bg				m	ft
Casing	-0.9 to 54.71	-3.0 to 179.5	0.1556	-	-	-	-
K-packer ¹	53.74 to 53.83	176.3 to 176.6	0.127	-	-	-	-
Riser	53.83 to 54.71	176.6 to 179.5	0.127	-	Johnson telescopic V-wire well screen	-	-
Well Screen	54.71 to 55.10	179.5 to 180.8	0.127	0.018	Johnson telescopic V-wire well screen	0.4	1.3
Well Screen	55.10 to 56.43	180.8 to 185.1	0.127	0.020	Johnson telescopic V-wire well screen	1.2	4
Well Screen	56.43 to 57.76	185.1 to 189.5	0.127	0.025	Johnson telescopic V-wire well screen	1.2	4

¹ The top of the K-packer is threaded with standard 5 inch pipe thread so the screen can be removed with a 5 inch male pipe thread.

Each of the three sections of screen was threaded together and then tack welded at the joins for additional security. A K-packer was fitted to the top of the riser/18-slot screen (Photo 2), then the screen assembly was fitted to the 0.127 m (5 inch) drill string via a threaded female fitting at the top of the K-packer and lowered to the base of the borehole.

The casing was pulled back from 58.5 m bg to approximately 54.7 m bg to expose the screen, with the rubber seal on the K-packer friction fitting the screen to the casing. The natural formation was allowed to collapse around the screen, then the screen assembly and K-packer was disengaged from the drill string and the drill string removed from the well. Tetra Tech EBA notes that as Midnight Sun had not brought a riser to site, a 1.3 m length of 0.018 in (18-slot) V-wire screen was approved for use as the screen riser. Approximately 0.4 m of the 18-slot screen was exposed to the aquifer, with the remaining 0.88 m remaining within the well casing.



Photo 2: K-Packer and top of 18-slot screen/riser (male thread) prior to installation in KFN-N

Following the well screen installation and pull back of the 150 mm casing, a neat portland cement grout was injected into the annulus between the 150 mm well casing and 254 mm surface casing to create a surface seal to provide a sanitary surface seal to protect the well from potential future surface-sourced contaminants. Following placement of the surface seal, the 254 mm casing was removed from the ground. The well was completed with a water tight Merrill well cap fitted with a 0 to 100 psi pressure gauge.

Construction details for KFN-N are included in Figure 2, and a driller's log is attached in Appendix C. A summary of the relevant well construction details is presented in Table 3-2.

Table 3-2: Summary of Well Information and Construction Details - KFN-N

Well ID:	KFN-N
Date of construction:	October 16 to 18, 2015
Owner of the well:	Kluane First Nation
Description of the property:	Burwash Landing, adjacent to fire break line
Owner of property	Kluane First Nation
UTM Coordinates (NAd 83) (+/- 5m):	UTM Zone 07 V, E 607987, N 6803686
Location of well on the property:	See Figure 1
Drilling contractor:	Midnight Sun Drilling Inc., Whitehorse, Yukon
Method of construction:	Air Rotary with casing advance
Description, depth, and thickness of geologic materials encountered during construction:	See well log in Figure 2 and driller's well log in Appendix C for details.
Depth and diameter of the well:	Total depth of well completion is 57.76 m (189.5 ft) bg. Construction details are included on Figure 2.
Type of casing materials and thickness:	Steel casing – I.D. 155.6 mm (6 1/8 "). O.D - 168.3 mm (6 5/8") 6.35 mm (0.250 in.) wall thickness

Table 3-2: Summary of Well Information and Construction Details - KFN-N

Static water level:	Approximately 1.5 m bg (October 18, 2015)
Location of major water-bearing zones:	Confined sand and gravel aquifer from approximately 53.6 m to 57.9 m (176 ft to 190 ft) bg.
Location, type and thickness of grout sealant placed around the well:	A neat Portland cement surface seal was placed the annulus between the casing and native sediments. Seal is completed from grade to 6.0 m (19.7 ft) bg.

The static water level was estimated by the driller to be approximately 1.5m bg on October 18, 2015, approximately 18 hrs after the cessation of drilling KFN-N. Tetra Tech EBA notes that given sufficient recovery time, the water level may recover to an elevation closer to the ground surface. Tetra Tech EBA recommends that to collect further information on the static groundwater elevation, the well should be thawed in summer of 2016 and the recovering water level monitored daily for a minimum of one week, to provide information for final well completion. KFN-N was developed on October 18 and 19 for approximately 10 hours by air lifting and jetting. KFN-N At the completion of development, the field turbidity was 8.4 NTU. The visual clarity and turbidity measurements of the development water were considered acceptable to stop further development at 10 hours.

A sample was collected two hours into development and rushed laboratory analysis conducted to determine if the aquifer was of suitable quality to use as a drinking water supply. Based on the results of this analysis, Tetra Tech EBA considered the water quality of the aquifer that the KFN-N was constructed in was suitable for potable water supply.

3.2.2 Well and Aquifer Testing

3.2.2.1 Hydraulic Testing Method

Hydraulic testing was conducted from October 21 to 24 by Midnight Sun and overseen by Tetra Tech EBA. A temporary submersible pump was installed in the well with the intake positioned at 51.8 m bg. A pressure transducer was installed within a one-inch sounding tube installed in the well to monitor the water level response during the pumping test. Manual water level data was also collected during the testing program using a manual water level sounder. Manual data collected during the pumping test program completed on this well is included in Appendix E. A barologger was placed at the wellhead to monitor the barometric pressure for the duration of testing so that water level data could be corrected for changes in atmospheric pressure.

Flow rates were controlled using a ball valve and rates monitored using a digital flow meter. Tetra Tech EBA measured water temperature and field water quality parameters through the duration of the pumping test program.

Water from the test was discharged to ground approximately 100 m to the east of KFN-N. Given the thick permafrost and low-permeability layers overlying the aquifer tested, Tetra Tech EBA considers it is very unlikely that the discharge had any hydraulic effect on the well response.

3.2.2.2 Step Rate Pumping Test

A step rate pumping test consisting of four 1-hour steps of 1.26, 2.52, 3.78 and 3.94 L/sec (20, 40, 60 and 62.5 US gpm) was completed on KFN-N on October 21, 2015. Tetra Tech EBA had intended to conduct the fourth step at 5.05 L/sec (80 US gpm); however, the maximum flow rate attainable with the ball valve fully open was 3.94 L/sec (62.5 US gpm). The maximum drawdown during the 3.94 L/sec (62.5 US gpm) step was 23.35 m below the pre-

step rate test water level (3.06 bg). After completing the step test, Tetra Tech EBA determined that the well could be pumped at 2.52 L/sec (40 US gpm) for the 24-hour constant rate test.

3.2.2.3 Constant Rate Pumping Test

A constant rate pumping test was conducted from October 22 to 24, 2015 after the well had recovered to 98% of the pre-step rate pumping test water level. The well was pumped at 2.52 L/sec (40 US gpm) for 24 hours and the maximum drawdown during this test was 42.68 m.

3.2.3 Water Sample Collection

Tetra Tech EBA collected water samples from KFN-N on the following two occasions:

- A sample was collected on October 18, 2015, two hours into development and analyzed for a drinking water package (excluding microbiological parameters) and dissolved metals. This sample was collected to provide indicative water quality results to determine if the aquifer is of suitable quality to use as a drinking water supply.
- A second sample was collected on October 23, 2015 at the completion of the 24 hour constant rate pumping test and analyzed for a drinking water package and radio-nuclides.

Both sets of samples were collected in laboratory supplied sample bottles in accordance with laboratory sampling procedures. All samples were transported to Whitehorse by Tetra Tech EBA personnel then shipped on ice by air cargo either to ALS Environmental, an accredited ISO/IEC 17025 testing laboratory located in Burnaby, B.C. or to SRC Environmental Analytical Laboratories in Saskatoon, SK for analysis.

Field turbidity measurements were also taken over the course of the pumping test program to assess well sand production under pumping conditions and the adequacy of well development. At the completion of the 24 hour constant rate pumping test, the turbidity was measured at 0.63 NTU.

3.3 Well Installation and Testing Program (KFN-M)

3.3.1 Well Drilling and Construction

KFN-M is located approximately 20 m to the northwest of KFN-N. This well was drilled and constructed from October 22 to 24, 2015, also by Midnight Sun. The well was drilled using a Sandvik Marlin 5 air rotary rig with an ATLAS casing advance hammer and was constructed in accordance with the Public Drinking Water Regulations and the Canadian Groundwater Association's Guidelines for Water Well Construction. This well was intended to intercept the same aquifer as KFN-N to increase the likelihood of similar water chemistry, and is intended to be used in tandem with KFN-N as a community water supply to offer mechanical redundancy rather than to supplement flow.

During key points of the drilling, a Tetra Tech EBA representative was on site to monitor and oversee the drilling activities and record the subsurface conditions. Soil samples were collected by the drilling contractor every 1.5 m through unsaturated and frozen material. The sample collection frequency was increased to every 0.6 m at key changes in soil type within the encountered aquifer zone.

In general, soils from the surface to approximately 48.8 m bg were comprised of glaciolacustrine deposits (till), with alternating layers of sand and silt and sand and gravel with permafrost encountered from approximately 1.8 to 53.6 m bg. A frozen sand and gravel unit was logged from 48.8 m bg to the base of the permafrost at 53.6 m bg. Immediately below the base of the permafrost, a productive aquifer was encountered within the same sand and gravel unit. Saturated sand and gravel continued to 54.9 m bg prior to transitioning to sand from 54.9 to 57.6 m bg.

From 57.6 m bg silt increased considerably in returns, indicating return to a silty till unit. Figure 3 summarizes the subsurface conditions encountered at KFN-M.

Drilling was halted at 57.6 m and a brief air lift pumping test was completed in the aquifer encountered from 53.6 m to 57.6 m bg to determine if it could be utilized for a water supply well. Midnight Sun tested the zone by air lifting for about 30 minutes and estimated the zone could produce about 3.78 to 4.42 L/sec (60 to 70 US gpm) (estimated both by drillers observations and by capturing air lifted flow in a 20 L [5 US gallon] bucket). During the airlifting test, a sample of the return water was collected and the pH and electrical conductivity tested. The sample showed a pH and electrical conductivity very similar to that at KFN-N indicating the same aquifer had been intercepted. Additionally, when the base of the permafrost had been drilled through, a response (decrease in water elevation) was immediately noted in KFN-N, indicating hydraulic connection between KFN-N and the aquifer intercepted at KFN-M.

With the aquifer encountered from 53.6 m to 57.6 m bg having an estimated yield that was above the required average daily demand (0.29 L/sec (4.6 US gpm) [10 year] and 0.49 L/sec (7.8 US gpm) [20 year]), field water quality testing indicating potentially good quality potable water and the strong evidence indicating the aquifer intercepted was the same that KFN-N had been completed in (same depth below grade, similar water quality, strong hydraulic response in KFN-N), Tetra Tech EBA decided to complete this second water supply well in this aquifer.

Field particle size analysis was conducted on samples obtained at 53.6 m, 55.5 m and 57.3 m bg to design an appropriate well screen for the aquifer. Particle size distribution results from these samples are included in Appendix C and indicate that the aquifer material is primarily medium to coarse grained sand and fine gravel through the top 1.2 m of the aquifer. From 54.9 m to 56.1 m bg, fine to medium grained sand was intercepted and from 56.1 m to 57.6 m bg, coarse sand and gravel increased in returns.

Based the results of the field particle size analysis (using a 50% passing rate) and the thickness of the aquifer, the well screen assembly was designed as detailed in Table 3-3.

Table 3-3: Well Construction Summary (KFN-M)

Well Detail	Interval		Internal Diameter (m)	Slot Size (inches)	Screen Type	Screen Open Area Length	
	m bg	ft bg				m	ft
Surface Seal	0 to 6.0	0 to 19.69	Neat Portland cement surface seal Surface seal installed in annulus between 150 mm well casing and 254 mm				
Casing	-0.9 to 54.25	-3.0 to 178.0	0.155	-	-	-	-
K-packer ¹	53.28 to 53.37	174.8 to 175.1	0.127	-	-	-	-
Riser	53.37 to 54.25	175.1 to 178.0	0.127	-	Johnson telescopic V-wire well screen	-	-
Well Screen	54.25 to 54.64	178.0 to 179.3	0.127	0.025	Johnson telescopic V-wire well screen	0.39	1.3
Well Screen	54.64 to 55.97	179.3 to 183.6	0.127	0.018	Johnson telescopic V-wire well screen	1.2	4
Well Screen	55.97 to 57.30 ²	183.6 to 188.0	0.127	0.020	Johnson telescopic V-wire well screen	1.2	4

¹ The top of the K-packer is threaded with standard 5 inch pipe thread so the screen can be removed with a 5 inch male pipe thread.

² Slough from 57.61 to 57.30 m bg

Each of the three sections of screen was threaded together and then tack welded at the joins for additional security. A K-packer was fitted to the top of the riser/25-slot screen, then the screen assembly was fitted to the 5 inch drill string via a threaded female fitting at the top of the K-packer and lowered to the base of the borehole on the drill string (Photo 3).

The casing was pulled back from 57.3 m bg to 54.25 m bg to expose the screen, with the rubber seal on the K-packer friction fitting the screen to the casing. The natural formation was allowed to collapse around the screen, then the screen assembly and K-packer was disengaged from the drill string and the drill string removed from the well. Tetra Tech EBA notes that as Midnight Sun had not brought a riser to site, a 1.3 m length of 0.025 in (25-slot) V-wire screen was used as the screen riser. Approximately 0.4 m of the 25-slot screen was exposed to the aquifer, with the remaining 0.88 m within the well casing.



Photo 3: Screen assembly being installed into KFN-M prior to being fitted to the drill string.

Following the well screen installation and pull back of the 150 mm casing, a neat Portland cement grout was injected into the annulus between the 150 mm well casing and 254 mm surface casing to create a surface seal to provide a sanitary surface seal to protect the well from surface-sourced contaminants. Following placement of the surface seal, the 254 mm surface casing was removed from the ground. The well was completed with a water tight Merrill well cap fitted with a 0 to 100 psi pressure gauge. Construction details for KFN-M are included in Figure 3, and a driller's log is attached in Appendix C. A summary of the relevant well construction details is presented in Table 3-4.

Table 3-4: Summary of Well Information and Construction Details - KFN-M

Well ID:	KFN-M
Date of construction:	October 22 to 24, 2015
Owner of the well:	Kluane First Nation
Description of the property:	Burwash Landing, adjacent to fire break line
Owner of property	Kluane First Nation
UTM Coordinates (Nad 83) (+/- 5m):	UTM Zone 07 V, E 0 607987, N 6803686
Location of well on the property:	See Figure 1
Drilling contractor:	Midnight Sun Drilling Inc., Whitehorse, Yukon
Method of construction:	Air Rotary with casing advance
Description, depth, and thickness of geologic materials encountered during construction:	See well log in Figure 3 and driller's well log in Appendix C for details.
Depth and diameter of the well:	Total depth of well completion is 57.30 m (188.0 ft) bg. Construction details are included on Figure 3.
Type of casing materials and thickness:	Steel casing – I.D. 155.6 mm (6 1/8 "). O.D - 168.3 mm (6 5/8) 6.35 mm (0.250 in.) wall thickness
Static water level:	Approximately 1.5 m bg (October 2015)
Location of major water-bearing zones:	Confined sand and gravel aquifer from approximately 53.6 m to 57.6 m (176 ft to 189 ft)
Location, type and thickness of grout sealant placed around the well:	A neat Portland cement surface seal was placed the annulus between the casing and native sediments. Seal is completed from grade to 6.0 m (19.7 ft) bg.

KFN-M was developed on October 24 and 25 for eight hours by air lifting and jetting. At the completion of development, the field turbidity was 9.2 NTU. The visual clarity and turbidity measurements of the development water were considered acceptable to stop further development at eight hours.

3.3.2 Well and Aquifer Testing

3.3.2.1 Hydraulic Testing Method

Hydraulic testing was conducted from October 27 to 28 by Midnight Sun and overseen by Tetra Tech EBA. A temporary submersible pump was installed in the well with the intake positioned at 51.8 m bg. A pressure transducer was installed within a one-inch sounding tube installed in the well to monitor the water level response during the pumping test. Manual water level data was also collected during the testing program using a manual water level sounder. Manual data collected during the pumping test program completed on this well is included in Appendix D. A barologger was placed at the wellhead to monitor the barometric pressure for the duration of testing so that water level data could be corrected for changes in atmospheric pressure. A logger was also placed in KFN-N to assess hydraulic connection between the two wells and to obtain data to further assess aquifer characteristics.

Flow rates were controlled using a ball valve and rates monitored using a digital flow meter. Water temperature and field water quality parameters were monitored through the duration of the pumping test program.

Water from the test was discharged to ground approximately 100 m to the east of KFN-M. Given the thick permafrost and low-permeability layers overlying the aquifer tested, Tetra Tech EBA considers it is very unlikely that the discharge had any hydraulic effect on the well response.

3.3.2.2 Step Rate Pumping Test

As it was inferred that KFN-M was completed in the same aquifer as KFN-N and the aquifer characteristics (aquifer thickness, water quality and estimated yield) would be almost identical, Tetra Tech EBA decided that a step rate pump test was not necessary at KFN-M.

3.3.2.3 Constant Rate Pumping Test

A constant rate pumping test was conducted from October 27 to 28, 2015 after the well had recovered to approximately 88% of the pre-development water level. Based on the step and constant rate tests conducted at KFN-N and the estimated yield at KFN-M during airlifting and development, Tetra Tech EBA determined that the well could be pumped at 2.2 L/sec (35 US gpm) for the constant rate test.

The constant rate pump test ran for a 24 hour period and the maximum drawdown during this test from the static water level (1.5 m bg) was 39.78 m. At the completion of the constant rate test, the pump was switched off and recovery of the water level monitored via the installed logger until November 1, 2015.

3.3.3 Water Sample Collection

One sample was collected from KFN-M by Tetra Tech EBA on October 28, 2015 at the completion of the 24 hour constant rate pumping test. This sample was analyzed for a drinking water package, extractable petroleum hydrocarbons, trihalomethanes, haloacetic acids, radio-nuclides and bacteriological analysis.

Samples were collected in laboratory supplied sample bottles in accordance with laboratory sampling protocols. All samples were transported to Whitehorse by Tetra Tech EBA personnel then shipped on ice either by air cargo to ALS Environmental, an accredited ISO/IEC 17025 testing laboratory located in Burnaby, B.C. or to the Environmental Health laboratory in Whitehorse (where microbiological analysis) was conducted.

4.0 WELL DISINFECTION (KFN-M AND KFN-N)

At the completion of the pumping test program, both KFN-M and KFN-N were disinfected to remove potential bacteriological contamination that can cause the water supply to be unsafe for human consumption and/or cause blockage on or near the well screen.

The disinfection program was conducted by Midnight Sun in early November, 2015 in general accordance with Tetra Tech EBA specifications. Tetra Tech EBA was not on site for the disinfection program.

Both wells were disinfected with a 200 parts per million (ppm) chlorine solution. Approximately 2.4 standing well volumes (600 US gal) of the chlorine solution was added to each well. 70% of the solution (420 US gal) was added to the top of the well and the remaining 30% (180 US gal) was added just above the screen level via a tremie pipe. Each well was then left to stand left overnight. After a minimum of 12 hours, each well was purged to a holding tank.

To avoid discharge to ground of water with elevated chlorine concentrations, purge water in the holding tank was tested prior to discharge using chlorine test strips. Where chlorine concentrations exceeded 10 ppm, a neutralizer was added to lower the chlorine concentration. MSD estimated that the first 200 US gal removed from each well was above 10 ppm and required treatment. After this volume was removed the chlorine concentration remained below 10 ppm and further neutralization was not required prior to discharge. As per the specifications, the wells

were pumped until the chlorine concentration was non-detectable and a minimum of 6 standing volumes was removed from each well.

Tetra Tech EBA note that both KFN-M and KFN-N will need to be disinfected again via a similar method following installation of the pump and associated pipework and prior to being brought online for potable water supply.

Following disinfection of both wells, freeze protection measures (foam) was installed into both KFN-M and KFN-N. As the water level in both well was below ground level, foam was bundled together using wire and then hung from a secure point on the well head.

5.0 HYDRAULIC TESTING RESULTS (KFN-M AND KFN-N)

5.1 Hydraulic Testing Results KFN-M

5.1.1 Pumping Test Results

Water levels were recorded in KFN-M and observation well KFN-N during the 24 hour constant rate test. Observed drawdown and recovery in KFN-M during the pumping test program is shown in Figures 4a and 4b. The maximum drawdown observed in KFN-M during the constant rate pumping test was 39.76 m below the initial static water level (1.5 m bg) / 35.83 m below the post development recovered water level (5.43 m bg). As shown in Figure 4a, the water level continued to fall throughout the pumping test, although the rate of drawdown slowed throughout the test. The groundwater level recovered 99 percent of drawdown within after 5 days of recovery, at which time the logger and pump were removed from the well. KFN-N showed a strong and rapid response to the pumping of KFN-M with approximately 30 m of drawdown observed in this well during the constant rate pumping test at KFN-M.

Tetra Tech EBA notes that while a logger was placed in KFN-N to analyze response during the pumping test, a malfunction/issue with data collection resulted in the loss of a significant portion of the data. We consider the data collected from the pumping well (KFN-M) sufficient for interpretation and analysis of the aquifer properties presented below.

The drawdown data during the pumping test were analyzed using the Cooper-Jacob Straight-Line Time-Drawdown and Theis recovery Methods (e.g., Fetter 2001). Both interpretation methods were applied using the software AquiferTest (by WHI, v3.5), which was used to analyze the pumping test data (see Appendix E).

The results of the pumping test are presented in Table 5-1. The observed hydraulic conductivity of about 2.81×10^{-6} m/s is typical for conductive gravelly sand deposits as encountered in the KFN-M well.

Table 5-1: Pumping Test Results - KFN-M

Well ID	Analysis Method	Transmissivity (m ² /s)	Hydraulic Conductivity ¹ (m/s)
KFN-M	Cooper- Jacob Time Drawdown	1.4×10^{-5}	3.5×10^{-6}
	Theis Recovery	8.6×10^{-6}	2.1×10^{-6}
	Mean	1.1×10^{-5}	2.8×10^{-6}

¹Assumes an aquifer thickness of 4.0 m

5.1.2 Well Capacity

The safe yield of a well is determined by the available drawdown above the pump intake, the capacity of the screen installed in the well, and the transmissivity of the aquifer around the well screen.

To calculate the safe yield of the wells, the 100-day specific capacity was multiplied by the safe available drawdown. The 100-day specific capacity of the well (at a given pumping rate) is based on the projection of the observed drawdown at the end of the constant rate pumping test extrapolated to 100 days as shown on Figure 4b. This conservatively assumes that the well would be continuously pumped at the same rate for 100-days with no recharge to the aquifer. The safe available drawdown of a well is determined by applying a safety factor of 70% to the physical available drawdown after an allowance has been made for seasonal fluctuations in static water level. This method is outlined in the BC Ministry of Environment guidance document titled *Evaluating Long-term Well Capacity for a Certificate of Public Convenience and Necessity* (1999).

The safe yield of a well screen is based on the maximum recommended screen entrance velocity of 0.03 m/s (0.1 ft/s). Table 5-2 details the safe yield calculations for KFN-M.

Table 5-2: Summary of Safe Yield Calculations (KFN-M)

WELL PARAMETER	VALUE	UNIT	KEY
Constant Rate Pumping Test Discharge Rate	2.2	L/s	a
Projected 100-Day Drawdown	90	m	b
Projected 100-Day Specific Capacity	0.024	L/s/m	c=a/b
Lowest Expected Seasonal Water Table (1.5 m below static)	3	m bg	d
Recommended Depth of Pump Intake	52.14	m bg	e
Available Drawdown	49.14	m	f = e-d
Safety Factor	70	%	g
Safe Available Drawdown	34.40	m	h = f x g
Safe Yield Based on Constant Rate Pumping Test			
Theoretical Sustainable Yield	0.83	L/s	i = c x h
Theoretical Sustainable Yield	13.2	USgpm	
Check for Screen Entrance Velocity			
Recommended Maximum Screen Entrance Velocity	0.03	m/s	
Intake Area (m ²) of:			
<ul style="list-style-type: none"> ▪ 0.39 m (1.4 ft) of 25-slot screen ▪ 1.2 m (4 ft) of 18-slot screen ▪ 1.2 m (4ft) of 20-slot screen 	0.050	m/s	j
	0.117	m/s	
	0.134	m/s	
Maximum Screen Entrance Velocity at Safe Estimated Sustainable Yield	0.003	m/s	(i/1000/j)
Check: Less than recommended maximum velocity	YES		

Tetra Tech EBA conservatively estimates the long-term theoretical sustainable yield of KFN-M to be 0.83 L/s (13.2 US gpm) which is limited by available drawdown in the well. At this pumping rate, the screen entrance velocity of the smallest slot size screen (18-slot) would be less than the recommended maximum screen entrance velocity of 0.03 m/s. These calculations assume that the pump inlet would be installed 1.5 m above the top of the aquifer (base of permafrost) to maximize the available drawdown without drawing the water level below the top of the aquifer or into the screened interval.

The short-term (hourly) capacity of the well will depend on the exact depth of pump intake installation and the fluctuations in static water level. The maximum pumping rate from KFN-N is expected to be approximately 2.5 L/s (40 US gpm) for short periods during WTP operation. Well screen entrance velocity pumping at this flow rate would

be 0.009 m/s which is below the maximum allowable entrance velocity of 0.03 m/s. Based on observations made during the pumping test program and calculations using drawdown data from the pumping tests, this short term cyclic pumping schedule at 2.5 L/s (40 US gpm) is sustainable and is not expected to result in drawdown to the pump inlet (assuming the pump inlet is placed at 52.14 m bg).

5.2 Hydraulic Testing Results KFN-N

5.2.1 Pumping Test Results

Water levels were recorded in KFN-N during the step and constant rate tests. Observed drawdown and recovery in the well during the pumping test program is shown in Figures 5a and 5b. The maximum drawdown observed in KFN-N during the constant rate pumping test was 45.23 m below the initial static water level (1.5 m bg)/ 42.68 m below the post step rate test recovered water level (5.03 m bg). As shown in Figure 5b, the water level continued to fall throughout the constant rate pumping test, although the rate of drawdown slowed throughout the test. The groundwater level recovered 86 percent of drawdown within 20.5 hours after the pump was shut off, at which time the logger and pump were removed from the well.

The drawdown data during the pumping test were analyzed using the Cooper- Jacob Time Drawdown and Theis Recovery Methods (e.g., Fetter 2001). Both interpretation methods were applied using the software AquiferTest (by WHI, v3.5), which was used to analyze the pumping test data (see Appendix E) and results confirmed through manual calculations.

The results of the pumping test are presented in Table 5-3. The observed hydraulic conductivity of about 3.1×10^{-6} m/s is typical for conductive gravelly sand deposits as encountered in the KFN-N well.

Table 5-3: Pumping Test Results - KFN-N

Well ID	Analysis Method	Transmissivity (m ² /s)	Hydraulic Conductivity ¹ (m/s)
KFN-N	Cooper- Jacob Time Drawdown	1.39×10^{-5}	3.23×10^{-6}
	Theis Recovery	1.27×10^{-5}	2.96×10^{-6}
	Mean	1.33×10^{-5}	3.10×10^{-6}

¹Assumes an aquifer thickness of 4.3 m

5.2.2 Well Capacity

To calculate the safe yield of the KFN-N, the 100-day specific capacity was multiplied by the safe available drawdown. The projection of the observed drawdown at the end of the constant rate pumping test extrapolated to 100 days as shown on Figure 5c. Table 5-4 details the safe yield calculations for KFN-N.

Table 5-4: Summary of Safe Yield Calculations (KFN-N)

WELL PARAMETER	VALUE	UNIT	KEY
Constant Rate Pumping Test Discharge Rate	2.5	L/s	a
Projected 100-Day Drawdown	106	m	b
Projected 100-Day Specific Capacity	0.024	L/s/m	c=a/b
Lowest Expected Seasonal Water Table (1.5 m below static)	3	m bg	d
Recommended Depth of Pump Intake	52.14	m bg	e

Table 5-4: Summary of Safe Yield Calculations (KFN-N)

Available Drawdown	49.14	m	$f = e - d$
Safety Factor	70	%	g
Safe Available Drawdown	34.40	m	$h = f \times g$
Safe Yield Based on Constant Rate Pumping Test			
Theoretical Sustainable Yield	0.83	L/s	$i = c \times h$
Theoretical Sustainable Yield	13.2	USgpm	
Check for Screen Entrance Velocity			
Recommended Maximum Screen Entrance Velocity	0.03	m/s	
Intake Area (m ²) of:			
▪ 0.39 m (1.4 ft) of 18-slot screen	0.038	m/s	
▪ 1.2 m (4 ft) of 20-slot screen	0.134	m/s	j
▪ 1.2 m (4ft) of 25-slot screen	0.155	m/s	
Maximum Screen Entrance Velocity at Safe Estimated Sustainable Yield (25 slot screen)	0.003	m/s	(i/1000/j)
Check: Less than recommended maximum velocity	YES		

Tetra Tech EBA conservatively estimates the long-term theoretical sustainable yield of KFN-N to be 0.83 L/s (13.2 US gpm) which is limited by available drawdown in the well. At this pumping rate the screen entrance velocity of the smallest slot size screen (18-slot) would be less than the recommended maximum screen entrance velocity of 0.03 m/s. These calculations assume that the pump inlet would be installed 1.5 m above the top of the aquifer (base of permafrost) to maximize the available drawdown without drawing the water level below the top of the aquifer or into the screened interval.

The short-term (hourly) capacity of the well will depend on the exact depth of pump intake installation and the fluctuations in static water level. The maximum pumping rate from KFN-N is expected to be approximately 2.5 L/s (40 US gpm) for short periods (4 hrs or less). Well screen entrance velocity pumping at this flow rate would be 0.009 m/s which is below the maximum allowable entrance velocity of 0.03 m/s. Based on observations made during the pumping test program and calculations using drawdown data from the pumping tests, this short term cyclic pumping schedule at 2.5 L/s (40 US gpm) is sustainable and is not expected to result in drawdown to the pump inlet (assuming the pump inlet is placed at 52.14 m bg).

Tetra Tech EBA note KFN-M and KFN-N are screened in the same aquifer and are hydraulically connected, with KFN-N showing rapid response when KFN-M is pumped. These two wells are not intended to be standalone wells and are not intended to be pumped simultaneously at the safe sustainable yield. The second well is meant for mechanical redundancy rather than supplemental supply. When in operation, the two wells are to be pumped cyclically to allow one well to rest and recover while the first well pumps. Each well should be used at least once daily to minimize water stagnation, and also to provide a rest and recovery for the other well.

6.0 RESULTS OF LABORATORY ANALYSIS,

6.1 KFN-K and KFN-L

Table 1, attached, presents groundwater analytical results from the samples collected on August 12, 13 and 28, 2015 and compares the results against Guidelines for Canadian Drinking Water Quality (GCDWQ) Maximum Allowable Concentrations (MAC) and Aesthetic Objectives (AO). Laboratory analytical reports are provided in

Appendix F. Tetra Tech EBA notes that while results for the testing of the monitoring well (KFN-MW15-01) and Administration Building appear in the laboratory reports, these results are not included in the results provided in Table 1. These results are to be further discussed in a separate Tetra Tech EBA report.

Analytical Results, KFN-K

Based on the analytical results, the following key points are noted in regards to the water chemistry of KFN-K:

- The water chemistry of samples collected in 2015 is generally similar to that of samples collected in 2012.
- Total Arsenic was reported at a concentration just above the GCDWQ MAC in the August 28 sampling event and at concentrations slightly below the guideline value in two samples collected on August 12 and 13. These are similar to concentrations reported in 2012 that were slightly above the GCDWQ MAC.
- Samples collected from KFN-K on August 12 and 13 reported detectable concentrations of toluene, a volatile organic substance that is not generally expected to be found in deep artesian groundwater wells. Tetra Tech EBA queried the result with the analytical laboratory who confirmed the analytical result as correct. While the concentration was below the GCDWQ AO (there is no guideline for MAC), the detection raised concerns about the source of the toluene, in particular potential contamination of the aquifer the well is completed in. Tetra Tech EBA revisited the site on August 28, 2015 and resampled the well. This sample returned a toluene concentration below the detection limit, and no detection of any other parameters that are usually associated with toluene.
- While the origin of the toluene detected in the samples collected on August 12 and 13, 2015 is not known, the non-detection in the re-sample indicates toluene may not actually be present in groundwater. Tetra Tech EBA consider that the original detection may be due to contamination of the samples during the sampling, transport or analysis process.

Analytical Results, KFN-L

Based on the analytical results, the following key points are noted in regards to the water chemistry of KFN-L:

- Total arsenic decreased approximately one order of magnitude from 2012 to 2015. Given the variation in concentrations, Tetra Tech EBA recommends that total arsenic be re-tested to provide further data for the design of the geo-exchange system.
- The iron concentration increased over one order of magnitude from the August 13 to August 28, 2015 monitoring events. This increase is considered likely due to corrosion of the steel casing. Given the variation in concentrations, Tetra Tech EBA recommends that total iron be re-tested to provide further data for the design of the geo-exchange system.
- A sample was sent to Water Systems Engineering, Inc. (WSEI) for a well profile analysis to identify fouling and corrosion issues with potential impacts on the operation of the well. The WSEI report is included in Appendix F and should be read in full and taken into consideration for potential use of this well. A summary of WSEI's interpretations and recommendations are provided below:
 - The results suggest chemical and biological congestion within the well, which can result in an increased potential for fouling due to the accumulation of scale and biomass.
 - Corrosion of the well appears to be occurring which is mobilizing iron. Increased iron concentrations could impact well operation as well as influence the supplied exchange system.

- The sample indicates a need to purge the well. During regular operation, chemical and biological congestion is limited due to the “purging” that occurs, slowing the accumulation of downhole fouling mechanisms. When idle, microbial communities expand and generally take on a more dynamic level of growth. Similarly, ions and compounds can concentrate, forming scale and become more likely to remain in the well.
- Active use of the well is recommended. A disinfection effort may be necessary, depending on the operational response observed. If the well is not currently slated for regular use, periodic purging is advised to limit accumulation downhole.

6.2 KFN-M and KFN-N

Table 2, attached presents groundwater analytical results from the samples collected at the end of the pumping test program at both KFN-M and KFN-N and compares the results against GCDWQ. The laboratory reports and certificates are included as Appendix F. Tetra Tech EBA notes that analytical results from the sample collected from KFN-N on October 18, 2015 during well development have not been included in Table 2. These results may have been influenced by aeration and agitation of sediments during the development process and may not be representative of actual groundwater to be supplied by the system. The samples collected post pumping test are considered the most representative for system design.

Based on the water analytical results, the following key points are noted in regards to the water chemistry of KFN-M and KFN-N:

- To evaluate the quality of the analysis Tetra Tech EBA calculated the ion balance (i.e., the balance between sum of anion and cation equivalent charges) of each water sample. Typically, an ion balance of within $\pm 10\%$ is considered satisfactory. The calculated ion balances of KFN-M and KFN-N were both within $\pm 5\%$, suggesting that analytical errors are within acceptable limits and all major cations and anions present in the sample water were analyzed.
- The water from both KFN-M and KFN-N can be classified as being hard and can be characterized as magnesium-sodium-calcium-bicarbonate-sulphate (Mg-Na-Ca-HCO₃-SO₄) type water.
- Analytical results were compared against the GCDWQ MAC and Aesthetic Objective values. Exceedances of the guideline values are detailed in Table 6-1.

Table 6-1: Exceedances of GCDWQ Values, KFN-M and KFN-N (October 2015)

Location	Parameter	Guideline – AO ¹ (ug/L)	Guideline – MAC ² (ug/L)	Value (ug/L)
KFN-M	Manganese (Total)	50	No Guideline Value	65.0
KFN-N				72.6

¹ Guidelines for Canadian Drinking Water Quality - Aesthetic Objective

² Guidelines for Canadian Drinking Water Quality - Maximum Allowable Concentration

As shown in Table 6-1, the total manganese concentration exceeded the GCDWQ Aesthetic Objective at both KFN-M and KFN-N. All other parameters analyzed reported results below the GCDWQ at the dates of sample collection.

- A bacteriological sample was taken from KFN-N on October 23, 2015 and submitted to ALS Environmental for analysis. This sample showed no presence of total coliforms or E.coli on the date sampled. A bacteriological sample was also collected from KFN-M on October 28, 2015 and submitted to Yukon Environmental Health

Services for analysis. Sample results showed no presence of total coliforms or E.coli on the date sampled. Bacteriological analysis results are provided in Appendix F.

- Extractable Petroleum Hydrocarbon (EPH₁₀₋₁₉ and EPH₁₉₋₃₂) analysis was conducted on the sample collected from KFN-M (EPH in groundwater can indicate impact from diesel or petroleum). Both EPH fractions were reported as non-detect.
- Gross alpha and gross beta radiochemistry results were below the GCDWQ Maximum Allowable Concentration at both KFN-M and KFN-N.
- Trihalomethane and haloacetic acid were both reported at concentrations below relevant guideline values. Tetra Tech EBA notes that given both wells were completed in the same aquifer and in such close proximity to each other, this comparatively expensive analysis was only required at one of the wells. This analysis was conducted on the sample collected from KFN-M. Results are reported in Table 2 and in laboratory reports provided in Appendix F.

7.0 TEMPERATURE GRADIENT PROFILING RESULTS (KFN-K AND KFN-L)

To obtain further data on permafrost conditions and temperature profiles in KFN-K and KFN-L, both wells were thawed and temperature loggers placed in KFN-L.

Well Thawing

Table 7-1 details field observations of the depths that ice was encountered and the depth of ice breakthrough (when free flowing artesian conditions observed) in both wells.

Table 7-1: Well Thawing Details (KFN-K and KFN-L)

Well ID	Top of Ice (m bg)	Base of Ice (m bg)*	Notes
KFN-L	19.25	48	Difference in top of ice elevation between KFN-L and KFN-K checked and confirmed.
KFN-K	9.68	48	

* Approximate depths based on estimates from KFN staff conducting thawing.

The data presented in Table 7-1 indicates permafrost extends from approximately 10 m to 48 m bg at the location of KFN-K which is in general accordance with expected depths. Tetra Tech EBA notes that the difference in the top of ice elevation measured at KFN-K and KFN-L was checked and confirmed. Staff from KFN advised that both wells were shut-in in late 2012 and neither well has been opened or purged since. The cause of the difference in the distance to the top of ice in both wells is not known and additional investigation would be required to determine (if deemed necessary).

Temperature Logging

Stabilized temperature logger data from KFN-L is detailed in Table 7-2.

Table 7-2: Stabilized Temperature Data, KFN-L (August 2015)

Approximate Depth (mbg)	Period Logger Installed	Stabilized Temperature (°C)*
100	15 days	1.79
177	15 days	5.83
352	15 days	14.9

*Average temperature for 12 hours prior to removal

The stabilized temperatures show a general linear increase in temperature with depth of approximately 0.05 °C/m.

The stabilized temperature at 352 m bg is similar to the water temperature recorded during the long-term pumping test conducted in 2012 (15.9°C). The slight difference in temperature may be due to the fact that the logger was placed about 30 m above the well screen and aquifer that KFN-L targets. Given the linear increase in temperature with depth, the current temperature at the well screen would be expected to be similar to that measured in discharge water in 2012.

8.0 GROUNDWATER UNDER THE DIRECT INFLUENCE (GUDI) ASSESSMENT (KFN-M AND KFN-N)

Well water or groundwater under the direct influence of surface water (GUDI) refers to groundwater sources that have a direct hydraulic connection to surface water sources and are therefore vulnerable to contamination by surface water organisms. The implication of a well being classified GUDI means that the well water source requires water treatment equivalent to that required for surface water sources.

Tetra Tech EBA conducted a Phase 1 Initial GUDI Screening and determined that both KFN-M and KFN-N can be considered **non-GUDI** according to the guidelines outlined in YG (2006). The following criteria were considered in the Phase 1 Initial GUDI Screening:

- The aquifer is confined and overlain by approximately 50 m of thick permafrost and approximately 54 m of till, which alternates between low permeability silt and higher permeability silt, sand and gravel layers;
- The aquifer is confined with the static water level at the time of drilling approximately 1.5 m bg (52 m above the top of the aquifer). The upward gradient and the thick low-permeability units and permafrost provide significant protection of the aquifer against potential contamination from surface sources;
- The well is located more than 60 m away from any permanent surface water bodies. Tetra Tech EBA notes that this criteria should be reviewed following the commissioning of the wells, installation of pitless units and associated water conveyance pipework. If following this work, water ponding is observed in the vicinity of the well heads, the site drainage should be improved to eliminate any standing water in the vicinity of either well.
- The well was constructed in accordance with the Guidelines for Water Well Construction published by the Canadian Ground Water Association, including a sanitary surface seal to a depth of 6 m bg; and
- The water quality does not indicate any evidence for influence by surface water.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are based on the information presented in this hydrogeological work program report:

KFN-K

- The water chemistry of samples collected in 2015 is generally similar to that of samples collected in 2012.
- Samples collected from KFN-K on August 12 and 13, 2015 reported detectable concentrations of toluene, a volatile organic substance that is not generally expected to be found in deep artesian groundwater wells. Toluene was not detected when the well was re-sampled and re-analysed approximately 2 weeks later.
- Permafrost extends from approximately 10 m to 48 m bg at the location of KFN-K which is in general accordance with expected depths.

KFN-L

- The water chemistry of samples collected in 2015 is generally comparable to that of samples collected in 2012 although arsenic and iron showed considerable variation between sample rounds. These parameters require further analysis to confirm concentrations prior to the design of the geo-exchange system.
- There is potential chemical and biological congestion within the well, possibly resulting in an increased potential for fouling due to the accumulation of scale and biomass. Additionally, mobilization of iron appears to be occurring, likely due to corrosion of the well. These two observations indicate that the well requires more regular purging to slow the accumulation of downhole fouling mechanisms.
- Permafrost extends from approximately 19 m to 48 m bg at the location of KFN-K which is in general accordance with expected depths. The reason for the variation in the top of ice elevation between KFN-K and KFN-L is not known and additional investigation would be required to determine (if deemed necessary).
- The stabilized temperatures show a general linear increase in temperature with depth between 100 m and 352 m bg. The stabilized temperature at 352 m bg is similar to the water temperature recorded during the long term pumping test conducted in 2012 (15.9°C).

KFN-M

- In October 2015, groundwater supply well KFN-M was drilled for KFN in Burwash Landing, Yukon to a depth of 57.30 m bg, and a screen was set from 54.25 to 57.30 m bg within a confined, gravel and sand aquifer.
- The well was completed as a permanent supply well in accordance with Tetra Tech EBA well specifications and requirements of KFN and YG.
- The well was constructed in accordance with the Public Drinking Water Regulations and the Canadian Groundwater Association's Guidelines for Water Well Construction (Tetra Tech EBA notes that while the Canadian Groundwater Association is currently defunct, the Guidelines for Water Well Construction are still considered to be best practice guidance for a well of this nature and have not been superseded by more recent or relevant guidelines).
- Pumping test results from the well indicate an aquifer transmissivity in the order of 1.12×10^{-5} m²/s (0.97 m²/day).

- The long-term theoretical sustainable yield of KFN-M is 0.83 L/s (13.2 US gpm) which exceeds the anticipated 20 year average daily demand.
- The concentration of dissolved and total manganese in the well water slightly exceeded the GCDWQ AO on the date sampled (October 28, 2015).
- The pH of the well water was equal to the upper limit of the GCDWQ AO on the date sampled.
- Bacteriological analysis indicated no total coliforms or E.coli on October 28, 2015.
- The well is non-GUDI based on Phase 1 initial GUDI screening.

KFN-N

- In October 2015, groundwater supply well KFN-N was drilled for KFN in Burwash Landing, Yukon to a depth of 57.76 m bg, and a screen was set from 54.71 to 57.76 m bg within a confined, gravel and sand aquifer.
- The well was completed as a permanent supply well in accordance with the well specifications and requirements of KFN and YG.
- The well was constructed in accordance with the Public Drinking Water Regulations and the Canadian Groundwater Association's Guidelines for Water Well Construction (Tetra Tech EBA notes that while the Canadian Groundwater Association is currently defunct, the Guidelines for Water Well Construction are still considered to be best practice guidance for a well of this nature and have not been superseded by more recent or relevant guidelines).
- Pumping test results from the well indicate an aquifer transmissivity in the order of $1.33 \times 10^{-5} \text{ m}^2/\text{s}$ (1.15 m²/day).
- The long-term theoretical sustainable yield of KFN-M is 0.83 L/s (13.2 US gpm) which exceeds the anticipated 20 year average daily demand.
- The concentration total manganese in the well water slightly exceeded the GCDWQ AO on the date sampled (October 23, 2015).
- Bacteriological analysis indicated no total coliforms or E.coli on October 23, 2015.
- The well is non-GUDI based on Phase 1 initial GUDI screening.

KFN-M and KFN-N are screened in the same aquifer and are hydraulically connected, with both wells showing rapid response when the other well is pumped. Tetra Tech EBA note that these two wells are not intended to be pumped simultaneously at the safe sustainable yield. The second well is meant for mechanical redundancy. When in operation, the two wells are to be pumped cyclically.

10.0 RECOMMENDATIONS

KFN-K

- The datalogger remaining in KFN-K should be removed and returned to Tetra Tech EBA at KFN's earliest convenience so the data can be downloaded and interpreted.
- Each time KFN-K is thawed, wellhead freeze protection measures should be reinstalled following the completion of work.

KFN-L

- Given the variation in arsenic and iron concentrations between monitoring events in 2012 and 2015, Tetra Tech EBA recommends that these parameters be re-tested to provide further data for the design of the geo-exchange system.
- Each time KFN-K is thawed, wellhead freeze protection measures should be reinstalled following the completion of work.

KFN-M

Proper well commissioning, operation and maintenance are fundamental to ensuring a reliable potable water source. Recommendations pertinent to the commissioning, operation and maintenance of KFN-M as a potable water supply are presented below:

- The pump should be installed with the pump intake at a depth of about 52.14 m bg (positioned about 1.5 m above the top of the aquifer). The pump should be able to pump at the maximum instantaneous yield, overcoming a head of 52 m plus pipe friction losses and possible additional elevation gain.
- The average daily pump rate should not exceed a rate of 0.83 L/s (13.2 US gpm), however the well can be pumped at rates up to 40 US gpm for short durations (up to 4 hours).
- The well should be disinfected prior to commissioning.
- To collect further information on the static groundwater elevation, the well should be thawed in summer of 2016 and the recovering water level monitored daily for a minimum of one week.
- During use, routine water quality testing of KFN-M should be conducted in accordance with the guidelines for Public Drinking Water Regulations to ensure that all health-based parameters meet the drinking water guidelines.
- Any alterations to the well or work conducted to tie into the WTP should be in compliance with the Public Drinking Water Regulations and the Canadian Groundwater Association's Guidelines for Water Well Construction (CGWA 1995).
- Freeze protection (e.g., heat trace) should be installed from surface to the base of the permafrost (53.6 m bg).

KFN-N

Proper well commissioning, operation and maintenance are fundamental to ensuring a reliable potable water source. Recommendations pertinent to the commissioning, operation and maintenance of KFN-N as a potable water supply are presented below:

- The pump should be installed with the pump intake at a depth of about 52.14 m bg (positioned about 1.5 m above the top of the aquifer). The pump should be able to pump at the maximum instantaneous yield, overcoming a head of 52 m plus pipe friction losses and possible additional elevation gain.
- The average daily pump rate should not exceed a rate of 0.83 L/s (13.2 US gpm), however the well can be pumped at rates up to 40 US gpm for short durations (up to 4 hours).
- The well should be disinfected prior to commissioning.

- To collect further information on the static groundwater elevation, the well should be thawed in summer of 2016 and the recovering water level monitored daily for a minimum of one week.
- During use, routine water quality testing of KFN-N should be conducted in accordance with the guidelines for Public Drinking Water Regulations to ensure that all health-based parameters meet the drinking water guidelines.
- Any alterations to the well or work conducted to tie into the WTP should be in compliance with the Public Drinking Water Regulations and the Canadian Groundwater Association's Guidelines for Water Well Construction (CGWA 1995).
- Freeze protection (e.g., heat trace) should be installed from surface to the base of the permafrost (53.6 m bg).
- KFN-M and KFN-N are screened in the same aquifer and are hydraulically connected, with both wells showing rapid response when the other well is pumped. Tetra Tech EBA note that these two wells are not intended to be pumped simultaneously at the safe sustainable yield. When in operation, the KFN-M and KFN-N are to be pumped cyclically to allow one well to rest and recover while the first well pumps. Tetra Tech EBA recommend that each well should be used at least once daily to minimize water stagnation, and also to provide a rest and recovery for the other well.

11.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Yukon Government their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Yukon Government, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated Tetra Tech EBA's General Conditions which are provided in Appendix A of this report.

12.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
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- Fetter, C.W. (2001) Applied Hydrogeology. 4th Ed., Prentice-Hall Inc., Upper Saddle River, New Jersey.
- Government of Yukon, Health and Social Services (2007) Guidelines for Part I – Large Public Drinking Water Systems.
- Government of Yukon, Health and Social Services. (2006) Assessment Guideline for Well Water or Groundwater Under the Direct Influence of Surface Water (GUDI).

TABLES

Table 1	Groundwater Analytical Results (KFN-K and KFN-L)
Table 2	Groundwater Analytical Results (KFN-M and KFN-N)

Table 1: Groundwater Analytical Results (KFN-K and KFN-L)

Parameter	Unit	Canadian Drinking Water ¹	KFN-K					KFN-L		
			18-Jul-2012 Burwash	24-Aug-2012 KFN-K	12-Aug-2015 KFN-K #1	13-Aug-2015 KFN-K #2	28-Aug-2015 KFN-K	23-Aug-2012 KFN-L	13-Aug-2015 KFN-L	28-Aug-2015 KFN-L
Physical Parameters										
pH	pH Units	6.5-8.5	8.15	8.10	7.98	8.04	-	7.50	8.28	-
Electrical Conductivity (EC)	µS/cm	-	412	403	-	-	-	1060	-	-
Chloride (Cl)	µg/L	250,000 ²	940	1260	760	750	-	8820	4240	-
Alkalinity (Bicarbonate)	µg/L	-	245,000	242,000	-	-	-	651,000	-	-
Alkalinity (Carbonate)	µg/L	-	<6000	<6000	-	-	-	<6000	-	-
Alkalinity (Hydroxide)	µg/L	-	<5000	<5000	-	-	-	<5000	-	-
Alkalinity (total as CaCO ₃)	µg/L	-	201,000	198,000	-	-	-	534,000	-	-
Bromide	µg/L	-	-	-	<20	<20	-	-	<20	-
Colour	TCU	15 ²	10	6	-	-	-	29	-	-
Fluoride (F)	µg/L	1500	320	380	330	320	-	<100	270	-
Sulphate (SO ₄)	µg/L	500,000 ²	35,300	36,400	35,400	35,500	-	110,000	52,100	-
Total Dissolved Solids (TDS)	µg/L	500,000 ²	271,000	264,000	190,000	240,000	-	725,000	-	-
Total Solids	µg/L	-	-	-	<5000	<3000	-	-	522,000	-
Hardness as CaCO ₃	µg/L	-	158,000	150,000	159,000	161,000	-	406,000	324,000	-
Hardness as CaCO ₃	µg/L	-	-	-	161,000	159,000	-	-	325,000	-
Orthophosphate (as P)	µg/L	-	-	-	25	24	-	-	-	-
Salinity	g/L	-	-	-	0.0932	0.0906	-	-	0.279	-
Turbidity	NTU	0.3 ³	1.1	<0.1	0.61	0.28	-	4.2	-	-
Nutrients										
Ammonia	µg/L	-	-	-	-	-	-	-	390	-
Total Kjeldahl Nitrogen (TKN)	µg/L	-	-	-	-	-	-	-	690	-
Nitrate (as N)	µg/L	10,000	<10	<10	<10	<10	-	<100	<10	-
Nitrite (as N)	µg/L	1000	170	60	80	80	-	<100	<10	-
Total Nitrogen	µg/L	-	-	-	-	-	-	-	690	-
Organics										
Total Organic Carbon (TOC)	µg/L	-	1000	1100	1000	<500	-	1100	-	-
Dissolved Metals										
Aluminum	µg/L	100 ⁴	-	-	<5	<5	-	-	<5	-
Antimony	µg/L	6	-	-	<0.2	<0.2	-	-	<0.2	-
Arsenic	µg/L	10	-	-	9.6	9.6	-	-	5.2	-
Barium	µg/L	1000	-	-	37	37	-	-	66	-
Beryllium	µg/L	-	-	-	<0.04	<0.04	-	-	<0.04	-
Bismuth	µg/L	-	-	-	<1	<1	-	-	<1	-
Boron	µg/L	5000	-	-	422	419	-	-	420	-
Cadmium	µg/L	5	-	-	<0.01	<0.01	-	-	<0.01	-
Calcium	µg/L	-	-	-	18,500	18,000	-	-	18,300	-
Chromium	µg/L	50	-	-	<0.4	<0.4	-	-	<0.4	-
Cobalt	µg/L	-	-	-	<0.02	<0.02	-	-	0.03	-
Copper	µg/L	1000 ²	-	-	<1	<1	-	-	<1	-
Iron	µg/L	300 ²	-	-	82	172	-	-	77	-
Lead	µg/L	10	-	-	<0.1	0.2	-	-	<0.1	-
Lithium	µg/L	-	-	-	2	1	-	-	68	-
Magnesium	µg/L	-	-	-	28,000	27,600	-	-	67,800	-
Manganese	µg/L	50 ²	-	-	32.1	33.2	-	-	23.0	-
Mercury	µg/L	1	-	-	<0.01	<0.01	-	-	<0.01	-
Molybdenum	µg/L	-	-	-	10.38	10.62	-	-	8.48	-
Nickel	µg/L	-	-	-	<1	<1	-	-	<1	-
Potassium	µg/L	-	-	-	4200	4200	-	-	4200	-
Selenium	µg/L	50	-	-	<0.6	<0.6	-	-	<0.6	-
Silicon	µg/L	-	-	-	11,000	10,900	-	-	11,900	-
Silver	µg/L	-	-	-	<0.01	<0.01	-	-	<0.01	-
Sodium	µg/L	200,000 ²	-	-	36,900	35,900	-	-	111,000	-
Strontium	µg/L	-	-	-	256	259	-	-	528	-
Sulphur	µg/L	-	-	-	12,300	12,200	-	-	17,700	-
Tellurium	µg/L	-	-	-	<0.1	<0.1	-	-	<0.1	-
Thallium	µg/L	-	-	-	<0.01	<0.01	-	-	<0.01	-
Thorium	µg/L	-	-	-	<0.4	<0.4	-	-	<0.4	-
Tin	µg/L	-	-	-	<0.1	0.1	-	-	0.8	-
Titanium	µg/L	-	-	-	<0.40	<0.40	-	-	<0.4	-
Uranium	µg/L	20	-	-	<0.4	<0.4	-	-	<0.40	-
Vanadium	µg/L	-	-	-	<0.10	<0.10	-	-	<0.10	-
Zinc	µg/L	5000 ²	-	-	2.27	10.55	-	-	1.77	-
Zirconium	µg/L	-	-	-	<0.1	<0.1	-	-	<0.1	-
Total Metals										
Aluminum	µg/L	100 ⁴	<5	<5	<5	<5	-	<5	15	-
Antimony	µg/L	6	<0.2	<0.2	<0.2	<0.2	-	<0.2	<0.2	-
Arsenic	µg/L	10	12.1	11.8	9.0	8.9	10.2	75	4.8	6.22
Barium	µg/L	1000	37	36	37	39	-	47	71	-
Beryllium	µg/L	-	-	-	<0.04	<0.04	-	-	<0.04	-
Bismuth	µg/L	-	-	-	<1.0	<1.0	-	-	<1.0	-
Boron	µg/L	5000	501	525	410	420	-	530	401	-
Cadmium	µg/L	5	<0.07	<0.07	<0.01	<0.01	-	<0.07	<0.01	-
Calcium	µg/L	-	18,900	17,600	17,900	18,100	-	55,500	18,100	-
Chromium	µg/L	50	1.5	1.9	<0.4	<0.4	-	7	<0.4	-
Cobalt	µg/L	-	-	-	0.0206	<0.0200	-	-	0.0492	-
Copper	µg/L	1000 ²	<1	<1	<1	<1	-	<1	<1	-
Iron	µg/L	300 ²	277	32	<10	44	52	557	728	11,200
Lead	µg/L	10	<0.1	<0.1	<0.1	0.9	-	<0.1	0.1	-
Lithium	µg/L	-	-	-	1	1	-	-	69	-
Magnesium	µg/L	-	27,000	25,800	27,700	28,100	-	64,900	67,700	-
Manganese	µg/L	50 ²	32	26	26.8	29.5	-	29	20.5	-
Mercury	µg/L	1	<0.01	<0.01	<0.010	<0.010	-	<0.01	<0.010	-
Molybdenum	µg/L	-	-	-	11	11.3	-	-	9.0	-
Nickel	µg/L	-	-	-	<1	<1	-	-	<1	-
Potassium	µg/L	-	4300	3700	4140	4220	-	3500	4060	-
Selenium	µg/L	50	<0.6	<0.6	<0.6	<0.6	-	<0.6	<0.6	-
Silicon	µg/L	-	10,600	10,200	11,100	11,300	-	26,200	12,100	-
Silver	µg/L	-	-	-	<0.01	<0.01	-	-	<0.01	-
Sodium	µg/L	200,000 ²	34,700	32,600	36,000	37,100	-	90,300	112,000	-
Strontium	µg/L	-	-	-	269	271	-	-	544	-
Sulphur	µg/L	-	-	-	12,200	12,600	-	-	17,900	-
Thallium	µg/L	-	-	-	<0.01	<0.01	-	-	<0.01	-
Thorium	µg/L	-	-	-	<0.40	<0.40	-	-	<0.40	-
Tin	µg/L	-	-	-	<0.1	<0.1	-	-	<0.1	-
Titanium	µg/L	-	-	-	1.8	2.3	-	-	2.2	-
Uranium	µg/L	20	<0.5	<0.5	<0.4	<0.4	-	<0.5	<0.4	-
Vanadium	µg/L	-	0.6	0.6	<0.1	<0.1	-	2.5	<0.1	-
Zinc	µg/L	5000 ²	<1	43	4	4	-	393	42	-
Zirconium	µg/L	-	-	-	<0.1	<0.1	-	-	<0.1	-
BTEX & MTBE										
Benzene	µg/L	5	-	-	<0.5	<0.5	<0.50	-	-	<0.50
Toluene	µg/L	24 ²	-	-	0.8	9.1	<0.50	-	-	<0.50
Ethylbenzene	µg/L	1.6 ²	-	-	<0.5	<0.5	<0.50	-	-	<0.50
Xylenes (m & p)	µg/L	-	-	-	-	-	<0.50	-	-	<0.50
Xylene (o)	µg/L	-	-	-	-	-	<0.50	-	-	<0.50
Xylenes Total	µg/L	20 ²	-	-	<0.5	<0.5	<0.75	-	-	<0.75
Styrene	µg/L	-	-	-	<0.5	<0.5	-	-	-	-
MTBE	µg/L	15 ²	-	-	<0.5	<0.5	<0.50	-	-	<0.50
Laboratory Identification Number			884123-1	890749-1	1088469-1	1088469-2	L1665626-5	890749-2	1088469-3	L1665626-3

Notes:

- ¹ Health Canada Federal-Provincial-Territorial Committee on Drinking Water (October 2014). Guidelines for Canadian Drinking Water Quality Summary Table
- ² Aesthetic Objective
- ³ Treatment limit for conventional and direct filtration
- ⁴ Operational guideline for conventional treatment
- BOLD** - Greater than CDWQG Guideline
- N/A - Not applicable
- "-" No applicable guideline or not analyzed

Table 1: Groundwater Analytical Results (KFN-K and KFN-L)

Parameter	Unit	Canadian Drinking Water ¹	KFN-K					KFN-L		
			18-Jul-2012 Burwash	24-Aug-2012 KFN-K	12-Aug-2015 KFN-K #1	13-Aug-2015 KFN-K #2	28-Aug-2015 KFN-K	23-Aug-2012 KFN-L	13-Aug-2015 KFN-L	28-Aug-2015 KFN-L
Hydrocarbons										
EPH ₁₀₋₁₉	µg/L	-	-	-	<100	<100	-	-	-	-
EPH ₁₉₋₃₂	µg/L	-	-	-	<100	<100	-	-	-	-
LEPH	µg/L	-	-	-	<100	<100	-	-	-	-
HEPH	µg/L	-	-	-	<100	<100	-	-	-	-
Volatile Hydrocarbons (VH ₆₋₁₀)	µg/L	-	-	-	<50	<50	-	-	-	-
VPH ₆₋₁₀	µg/L	-	-	-	<50	<50	-	-	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene	µg/L	-	-	-	<0.1	<0.1	-	-	-	-
Acenaphthylene	µg/L	-	-	-	<0.1	<0.1	-	-	-	-
Anthracene	µg/L	-	-	-	<0.1	<0.1	-	-	-	-
Acridine	µg/L	-	-	-	<0.05	<0.05	-	-	-	-
Benz(a)anthracene	µg/L	-	-	-	<0.01	<0.01	-	-	-	-
Benzo(a) pyrene	µg/L	0.01	-	-	<0.01	<0.01	-	-	-	-
Benzo(b)fluoranthene	µg/L	-	-	-	<0.01	<0.01	-	-	-	-
Benzo(g,h,i)perylene	µg/L	-	-	-	<0.1	<0.1	-	-	-	-
Benzo(k)fluoranthene	µg/L	-	-	-	<0.02	<0.02	-	-	-	-
Chrysene	µg/L	-	-	-	<0.1	<0.1	-	-	-	-
Dibenz(a,h)anthracene	µg/L	-	-	-	<0.01	<0.01	-	-	-	-
Fluoranthene	µg/L	-	-	-	<0.1	<0.1	-	-	-	-
Fluorene	µg/L	-	-	-	<0.1	<0.1	-	-	-	-
Indeno(1,2,3-c,d)pyrene	µg/L	-	-	-	<0.1	<0.1	-	-	-	-
Naphthalene	µg/L	-	-	-	<0.1	<0.1	-	-	-	-
Phenanthrene	µg/L	-	-	-	<0.1	<0.1	-	-	-	-
Pyrene	µg/L	-	-	-	<0.02	<0.02	-	-	-	-
Quinoline	µg/L	-	-	-	<0.34	<0.34	-	-	-	-
Volatile Organic Compounds (VOCs)										
1,1,1-trichloroethane	µg/L	-	-	-	<1	<1	-	-	-	-
1,1,2,2-tetrachloroethane	µg/L	-	-	-	<1	<1	-	-	-	-
1,1,2-trichloroethane	µg/L	-	-	-	<1	<1	-	-	-	-
1,1-dichloroethane	µg/L	-	-	-	<1	<1	-	-	-	-
1,1-dichloroethene	µg/L	14	-	-	<1	<1	-	-	-	-
1,2-dichlorobenzene	µg/L	3 ²	-	-	<1	<1	-	-	-	-
1,2-dichloroethane	µg/L	5	-	-	<1	<1	-	-	-	-
1,2-Dichloroethene [cis]	µg/L	-	-	-	<1	<1	-	-	-	-
1,2-Dichloroethene [trans]	µg/L	-	-	-	<1	<1	-	-	-	-
1,2-dichloropropane	µg/L	-	-	-	<1	<1	-	-	-	-
1,3-dichlorobenzene	µg/L	-	-	-	<1	<1	-	-	-	-
1,3-Dichloropropene(cis)	µg/L	-	-	-	<1	<1	-	-	-	-
1,3-Dichloropropene(trans)	µg/L	-	-	-	<1	<1	-	-	-	-
1,4-dichlorobenzene	µg/L	1 ²	-	-	<1	<1	-	-	-	-
2-Chloroethylvinyl ether	µg/L	-	-	-	<1	<1	-	-	-	-
Bromodichloromethane	µg/L	16	-	-	<1	<1	-	-	-	-
Bromoform	µg/L	-	-	-	<1	<1	-	-	-	-
Bromomethane	µg/L	-	-	-	<10	<10	-	-	-	-
Carbon tetrachloride	µg/L	2	-	-	<1	<1	-	-	-	-
Chlorobenzene	µg/L	30 ²	-	-	<1	<1	-	-	-	-
Chloroethane	µg/L	-	-	-	<10	<10	-	-	-	-
Chloroform	µg/L	-	-	-	<1	<1	-	-	-	-
Chloromethane	µg/L	-	-	-	<10	<10	-	-	-	-
Dibromochloromethane	µg/L	-	-	-	<1	<1	-	-	-	-
Dichloromethane	µg/L	50	-	-	<5	<5	-	-	-	-
Tetrachloroethene	µg/L	30	-	-	<1	<1	-	-	-	-
Trichloroethene	µg/L	5	-	-	<1	<1	-	-	-	-
Trichlorofluoromethane	µg/L	-	-	-	<1	<1	-	-	-	-
Vinyl chloride	µg/L	2	-	-	<2	<2	-	-	-	-
Laboratory Identification Number			884123-1	890749-1	1088469-1	1088469-2	L1665626-5	890749-2	1088469-3	L1665626-3

Notes:

¹ Health Canada Federal-Provincial-Territorial Committee on Drinking Water (October 2014). Guidelines for Canadian Drinking Water Quality Summary Table

² Aesthetic Objective

³ Treatment limit for conventional and direct filtration

⁴ Operational guideline for conventional treatment

BOLD - Greater than CDWQG Guideline

N/A - Not applicable

"-" No applicable guideline or not analyzed

Table 2: Groundwater Analytical Results (KFN-M and KFN-N)

Parameter	Unit	Canadian Drinking Water ¹	KFN-M	KFN-N
			28-Oct-2015	24-Oct-2015
			KFN-M	KFN-N
Physical Parameters				
pH	pH Units	6.5-8.5	8.50	8.39
Electrical Conductivity (EC)	µS/cm	-	380	406
Chloride (Cl)	µg/L	250,000 ²	850	910
Alkalinity (total as CaCO ₃)	µg/L	-	173,000	178,000
Anions Total	meq/L	-	-	4.35
Cations Total	meq/L	-	-	4.38
Colour	TCU	15 ²	6.9	7.5
Fluoride (F)	µg/L	1500	304	293
Sulphate (SO ₄)	µg/L	500,000 ²	36,200	35,700
Total Dissolved Solids (TDS)	µg/L	500,000 ²	235,000	226,000
Hardness as CaCO ₃	µg/L	-	138,000	137,000
Turbidity	NTU	0.3 ³	0.42	0.48
Ionic Balance	%	-	-	0.4
Nutrients				
Ammonia	µg/L	-	235	-
Nitrate (as N)	µg/L	10,000	<5.0	<5.0
Nitrite (as N)	µg/L	1000	<1.0	<1.0
Dissolved Metals				
Aluminum	µg/L	100 ⁴	<5.0	-
Antimony	µg/L	6	<0.50	-
Arsenic	µg/L	10	5.78	-
Barium	µg/L	1000	39	-
Beryllium	µg/L	-	<1.0	-
Boron	µg/L	5000	450	-
Cadmium	µg/L	5	0.0051	-
Calcium	µg/L	-	23,300	-
Chromium	µg/L	50	<1.0	-
Cobalt	µg/L	-	<0.30	-
Copper	µg/L	1000 ²	2.6	-
Iron	µg/L	300 ²	43	-
Lead	µg/L	10	<0.50	-
Lithium	µg/L	-	<1.0	-
Magnesium	µg/L	-	19,500	-
Manganese	µg/L	50 ²	64.8	-
Mercury	µg/L	1	<0.0050	-
Molybdenum	µg/L	-	13.0	-
Nickel	µg/L	-	<1.0	-
Potassium	µg/L	-	4400	-
Selenium	µg/L	50	1.19	-
Silver	µg/L	-	<0.020	-
Sodium	µg/L	200,000 ²	35,300	-
Thallium	µg/L	-	<0.20	-
Tin	µg/L	-	<0.50	-
Titanium	µg/L	-	<10	-
Uranium	µg/L	20	0.53	-
Vanadium	µg/L	-	5.73	-
Zinc	µg/L	5000 ²	<5.0	-
Total Metals				
Aluminum	µg/L	100 ⁴	6.5	11
Antimony	µg/L	6	<0.50	<0.50
Arsenic	µg/L	10	5.97	6.40
Barium	µg/L	1000	40	37
Beryllium	µg/L	-	<1.0	-
Boron	µg/L	5000	460	490
Cadmium	µg/L	5	<0.0050	<0.20
Calcium	µg/L	-	23,100	23,800
Chromium	µg/L	50	<1.0	<2.0
Cobalt	µg/L	-	<0.30	-
Copper	µg/L	1000 ²	4.4	2.8
Iron	µg/L	300 ²	68	103
Lead	µg/L	10	<0.50	<0.50
Lithium	µg/L	-	1.3	-
Magnesium	µg/L	-	19,300	18,800
Manganese	µg/L	50 ²	65.0	72.6
Mercury	µg/L	1	<0.0050	<0.20
Molybdenum	µg/L	-	14.2	-
Nickel	µg/L	-	<1.0	-
Potassium	µg/L	-	4400	3540
Selenium	µg/L	50	1.16	<1.0
Silver	µg/L	-	<0.020	-
Sodium	µg/L	200,000 ²	35,900	35,400
Thallium	µg/L	-	<0.20	-
Tin	µg/L	-	<0.50	-
Titanium	µg/L	-	<10	-
Uranium	µg/L	20	0.58	0.18
Vanadium	µg/L	-	5.79	-
Zinc	µg/L	5000 ²	<5.0	<50
Chlorine				
Chlorine, Amount Dosed	µg/L	-	5280	-
Chlorine, Amount Achieved	µg/L	-	3500	-
Chlorine Demand	µg/L	-	1780	-
Haloacetic Acids				
Bromochloroacetic Acid	mg/L	-	<0.001	-
Dibromoacetic Acid	mg/L	-	<0.001	-
Monobromoacetic Acid	mg/L	-	<0.001	-
Radiological Parameters				
gross alpha	Bq/L	0.5	<0.19	<0.26
gross beta	Bq/L	1	0.17 ± 0.03	0.22 ± 0.04
Biological				
Total Coliforms	MPN/100mL	None per 100 mL	Absent ⁵	<1
E. Coli	MPN/100mL	None per 100 mL	Absent ⁵	<1
Hydrocarbons				
EPH ₁₀₋₁₉	µg/L	-	<250	-
EPH ₁₉₋₃₂	µg/L	-	<250	-
Volatile Organic Compounds (VOCs)				
Bromodichloromethane	µg/L	-	2.87	-
Bromoform	µg/L	-	<0.50	-
Chloroacetic acid	µg/L	-	<5.0	-
Chloroform	µg/L	-	31.5	-
Dibromochloromethane	µg/L	-	<0.50	-
Dichloroacetic acid	µg/L	-	2.2	-
Trichloroacetic acid	µg/L	-	4.2	-
Trihalomethanes	µg/L	100	34.4	-
Laboratory Identification Number			L1694980-1	L1693357-1/36446

Notes:

¹ Health Canada Federal-Provincial-Territorial Committee on Drinking Water (October 2014). Guidelines for Canadian Drinking Water Quality Summary Table

² Aesthetic Objective

³ Treatment limit for conventional and direct filtration

⁴ Operational guideline for conventional treatment

⁵ Analysis conducted by Yukon Environmental Health Services

BOLD - Greater than CDWQG Guideline

N/A - Not applicable

"-" No applicable guideline or not analyzed

FIGURES

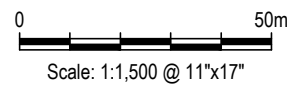
Figure 1	Site Plan
Figure 2	Well Log - KFN-N
Figure 3	Well Log - KFN-M
Figure 4a	KFN-M Constant Rate Pumping Test and Recovery (35 US gpm)
Figure 4b	100-day Drawdown (KFN-M)
Figure 5a	Step Rate Pumping Test (KFN-N)
Figure 5b	KFN-N Constant Rate Pumping Test and Recovery (40 US gpm)
Figure 5c	100-day Drawdown (KFN-N)

Q:\Whitehorse\Data\2015 Hydrogeo Work Program\ENH2003136-02 Fig. 1 - R0.dwg [FIGURE 1] December 23, 2015 - 9:01:00 am (BY: BUCHAN, CAMERON)



LEGEND

- - WATER SUPPLY WELL
- - EXISTING GEOTECHNICAL INVESTIGATION BOREHOLE



CLIENT



**2015 HYDROGEOLOGICAL WORK PROGRAM
BURWASH LANDING, YT**

SITE PLAN



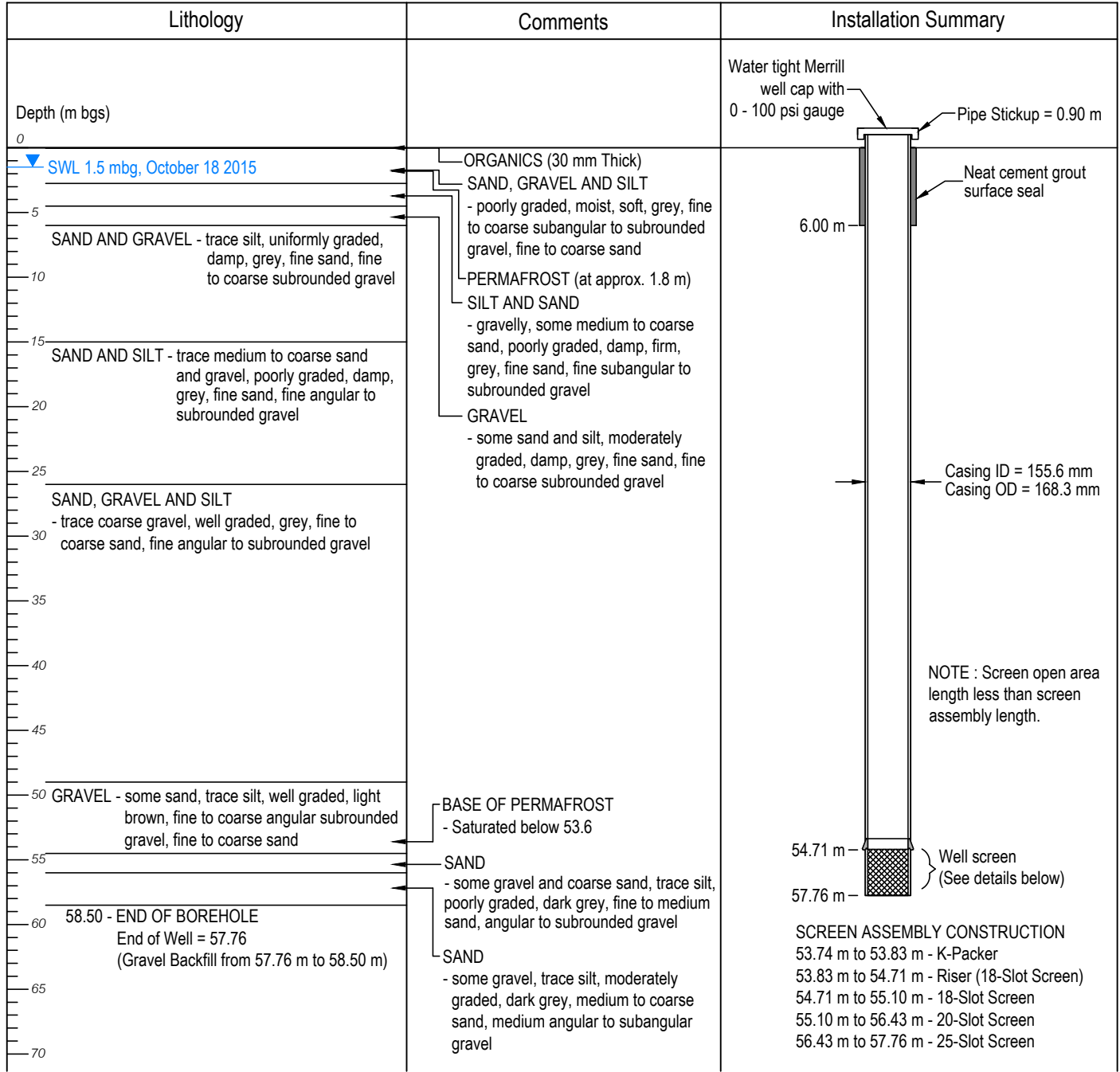
PROJECT NO. ENVH2003136-02	DWN CB	CKD AJS	REV 0
OFFICE EBA-WHSE	DATE December 14, 2015		

Figure 1

BOREHOLE LOG

PROJECT NAME: 2015 Hydrogeological Work Program
 LOCATION: Burwash Landing, Yukon
 DRILLER: Midnight Sun Drilling
 DRILL TYPE: Truck Mounted
 DRILL DATE: October 16 to 19, 2015

BOREHOLE NO.: KFN-N
 PROJECT NO.: ENVH2003136-02
 COMPLETION DEPTH: 57.76 m
 UTM (NAD83, ZONE 7): 6803686 N;
 607987 E



Q:\Whitehorse\Data\0201\Drawings\Burwash\ENVH2003136-01 Water Treatment Plant Design\02 - 2015 Hydrogeo Work Program\ENVH2003136-02 Fig.2-3-R0.dwg [FIGURE 2] December 24, 2015 - 8:48:51 am (BY: BUCHAN, CAMERON)



2015 HYDROGEOLOGICAL WORK PROGRAM BURWASH LANDING, YUKON

WELL LOG - KFN-N



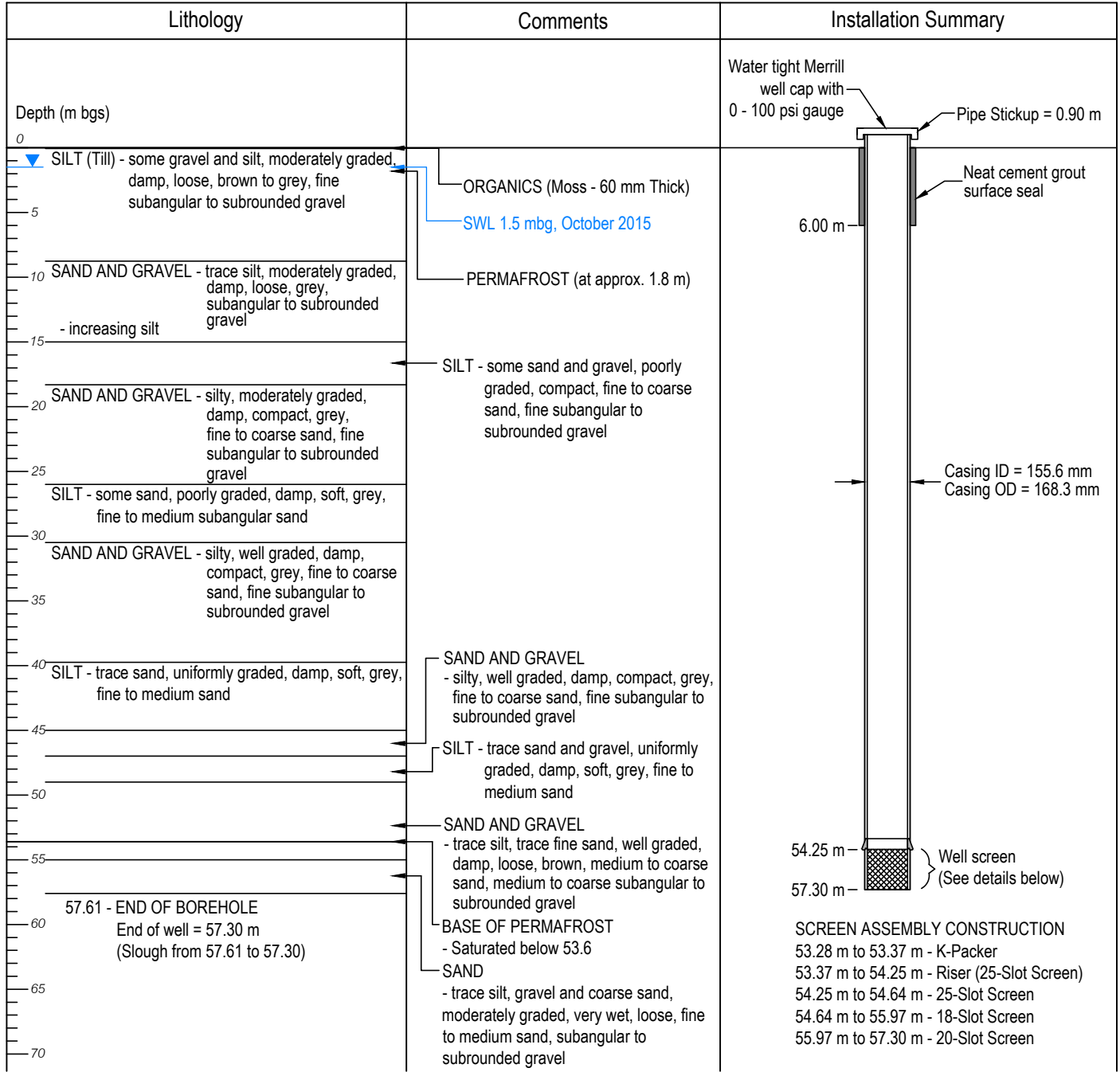
PROJECT NO. ENVH2003136-02	DWN CB	CKD AJS	REV 0
OFFICE EBA-WHSE	DATE December 14, 2015		

Figure 2

BOREHOLE LOG

PROJECT NAME: 2015 Hydrogeological Work Program
 LOCATION: Burwash Landing, Yukon
 DRILLER: Midnight Sun Drilling
 DRILL TYPE: Truck Mounted
 DRILL DATE: October 22 to 24, 2015

BOREHOLE NO.: KFN-M
 PROJECT NO.: ENVH2003136-02
 COMPLETION DEPTH: 57.30 m
 UTM (NAD83, ZONE 7): 6803686 N;
 607987 E



Q:\Whitehorse\Data\0201drawings\Burwash\ENVH2003136-01 Water Treatment Plant Design\02 - 2015 Hydrogeo Work Program\ENVH2003136-02 Fig.2-3-R0.dwg [FIGURE 3] December 23, 2015 - 9:01:46 am (BY: BUCHAN, CAMERON)

CLIENT



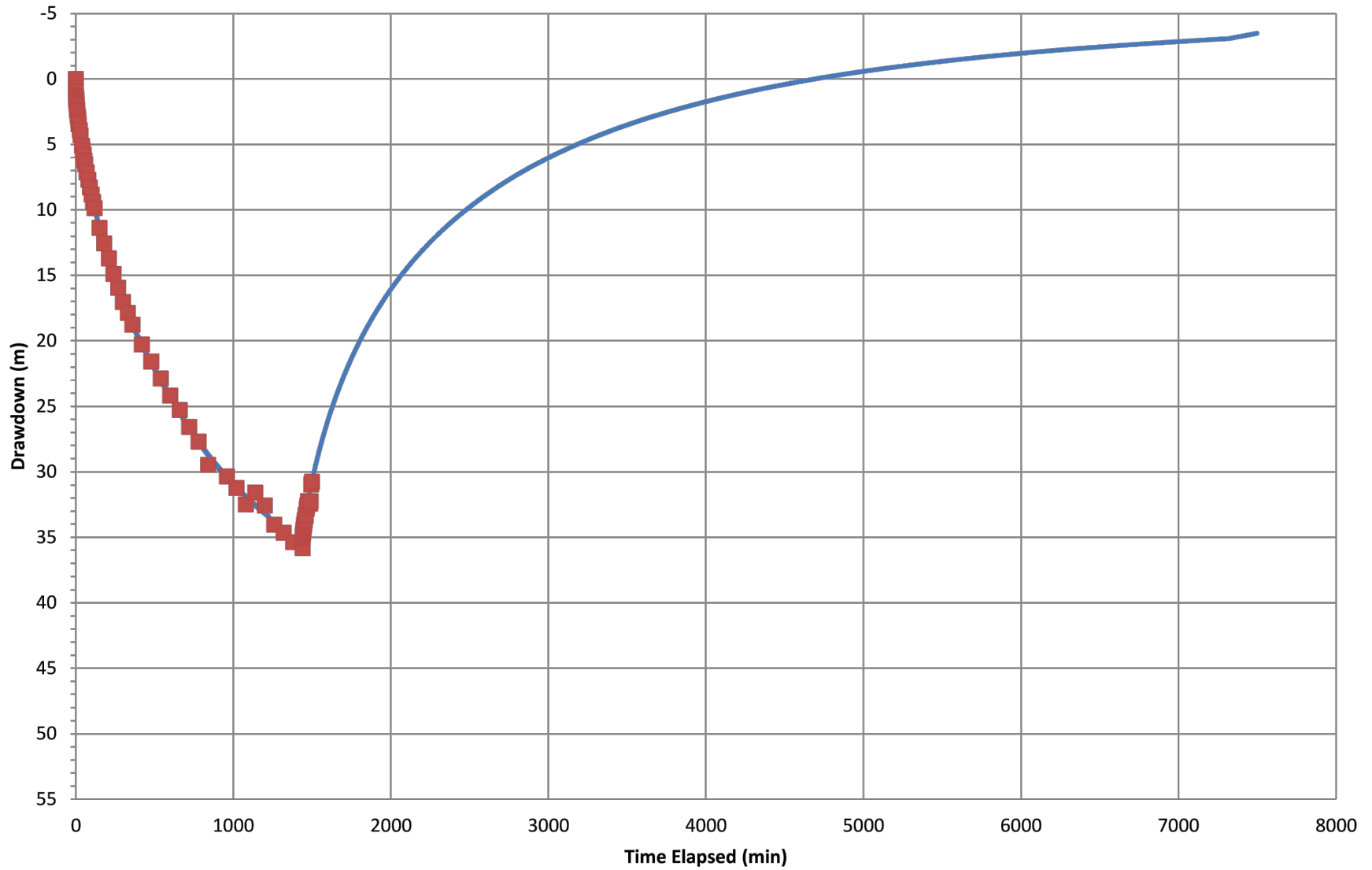
2015 HYDROGEOLOGICAL WORK PROGRAM BURWASH LANDING, YUKON

WELL LOG - KFN-M



PROJECT NO. ENVH2003136-02	DWN CB	CKD AJS	REV 0
OFFICE EBA-WHSE	DATE December 14, 2015		

Figure 3



LEGEND

- KFN-M Levellogger Data
- KFN-M Manual Data

CLIENT



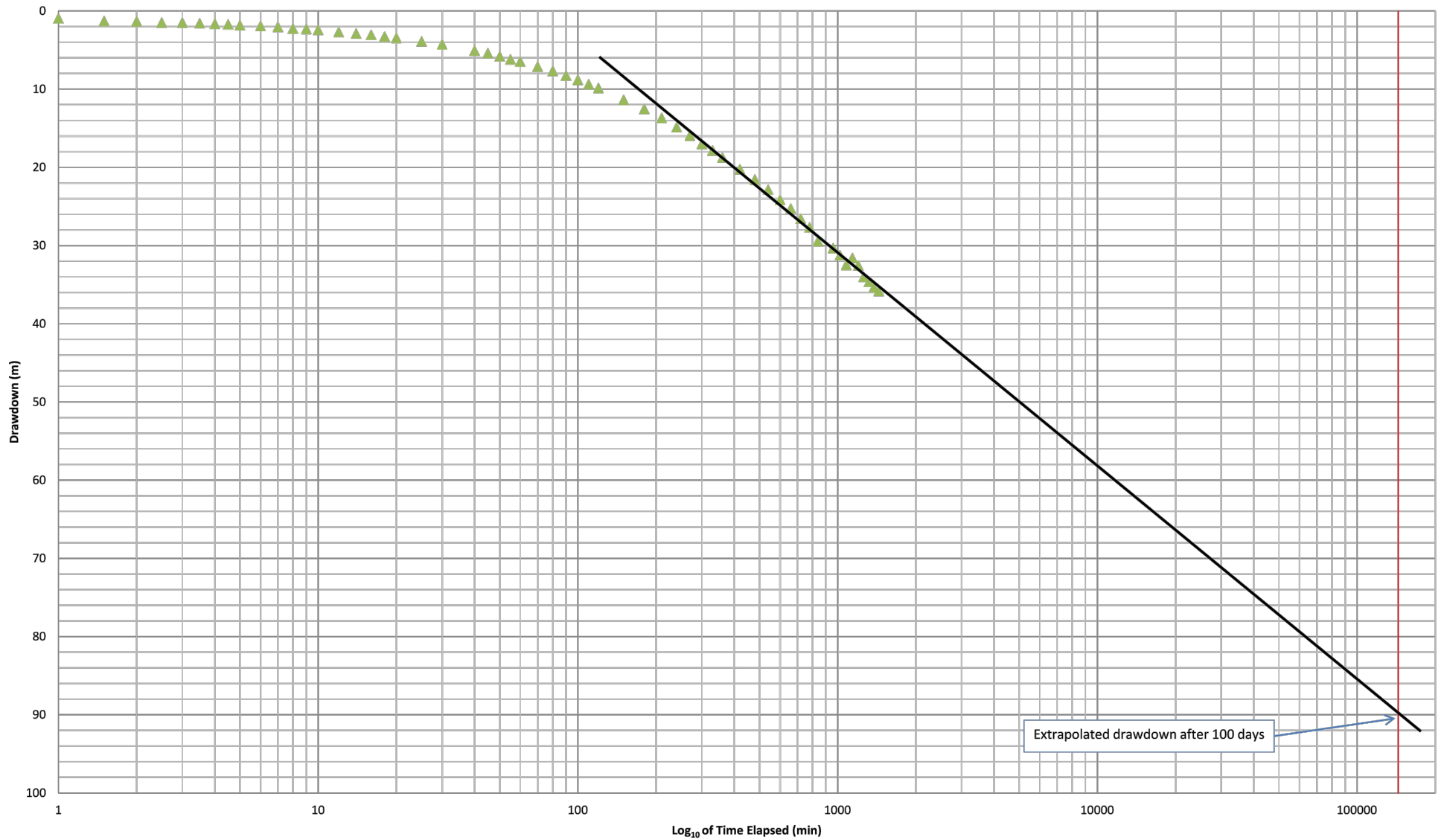
**2015 HYDROGEOLOGICAL WORK PROGRAM
BURWASH LANDING, YUKON**

**KFN-M CONSTANT RATE PUMPING TEST
AND RECOVERY (35 USgpm)**



PROJECT NO. ENVH2O03136-02	DWN CB	CKD AJS	REV 0
OFFICE EBA-WHSE	DATE December 14, 2015		

Figure 4a



LEGEND

▲ - KFN-M MANUAL DATA

CLIENT



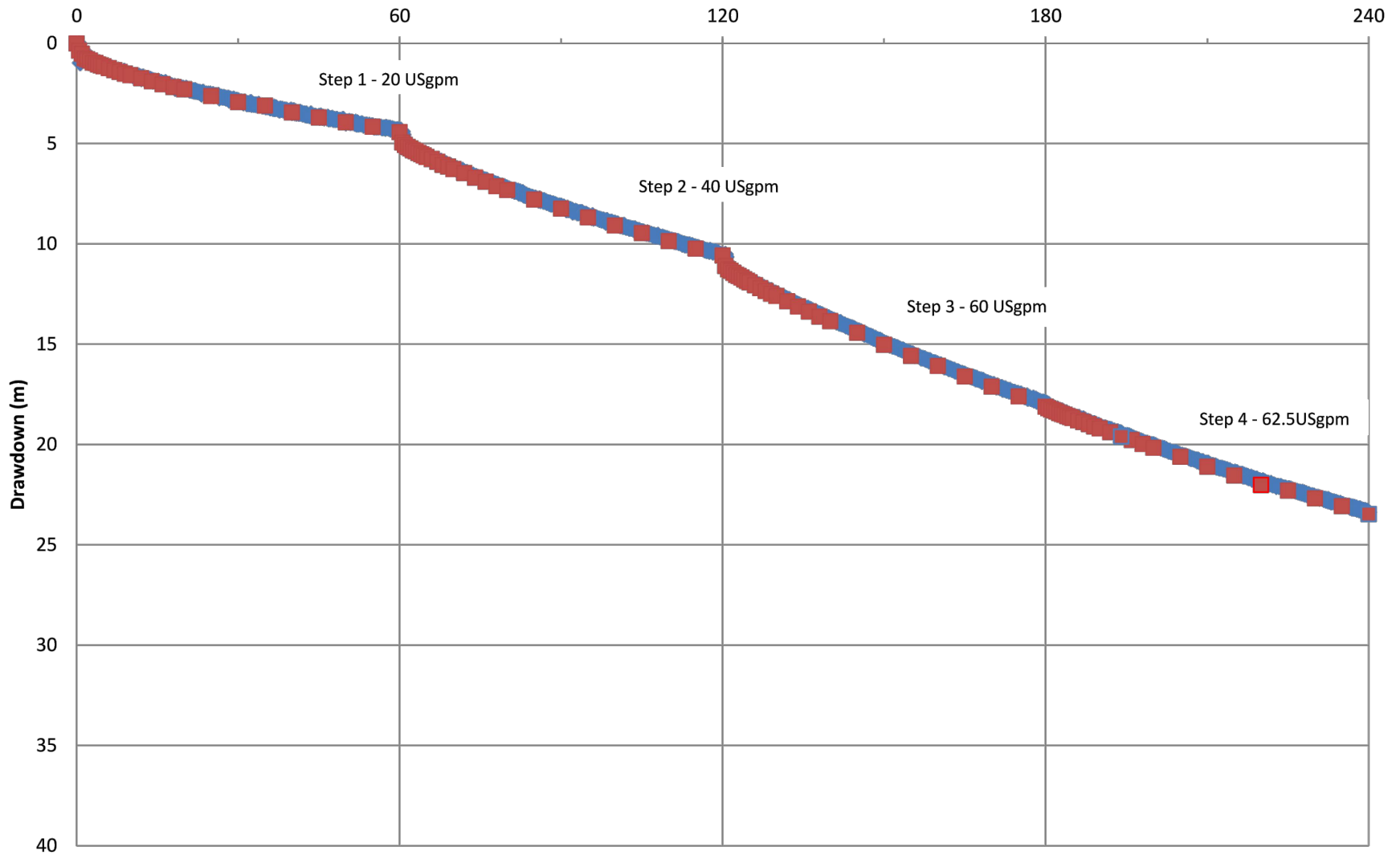
**2015 HYDROGEOLOGICAL WORK PROGRAM
BURWASH LANDING, YUKON**

**100-DAY DRAWDOWN
(KFN-M)**



PROJECT NO. ENVH2O03136-02	DWN CB	CKD AJS	REV 0
OFFICE EBA-WHSE	DATE December 14, 2015		

Figure 4b



LEGEND

- ◆ KFN-N Levellogger
- KFN-N Manual Data

CLIENT



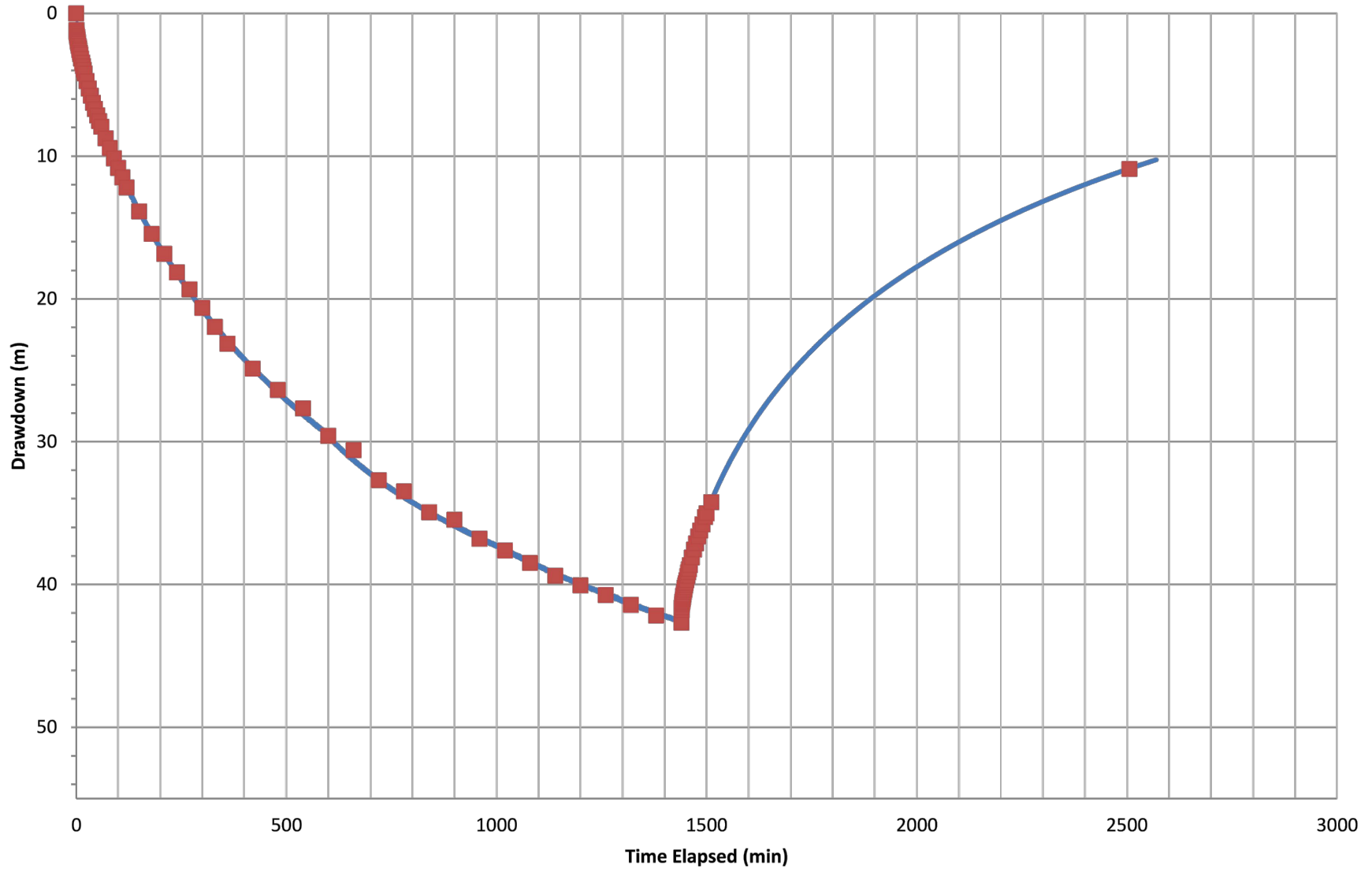
**2015 HYDROGEOLOGICAL WORK PROGRAM
BURWASH LANDING, YUKON**

**STEP RATE PUMPING TEST
(KFN-N)**



PROJECT NO. ENVH2O03136-02	DWN CB	CKD AJS	REV 0
OFFICE EBA-WHSE	DATE December 14, 2015		

Figure 5a



LEGEND

- KFN-N Levellogger Data
- KFN-N Manual Data

CLIENT



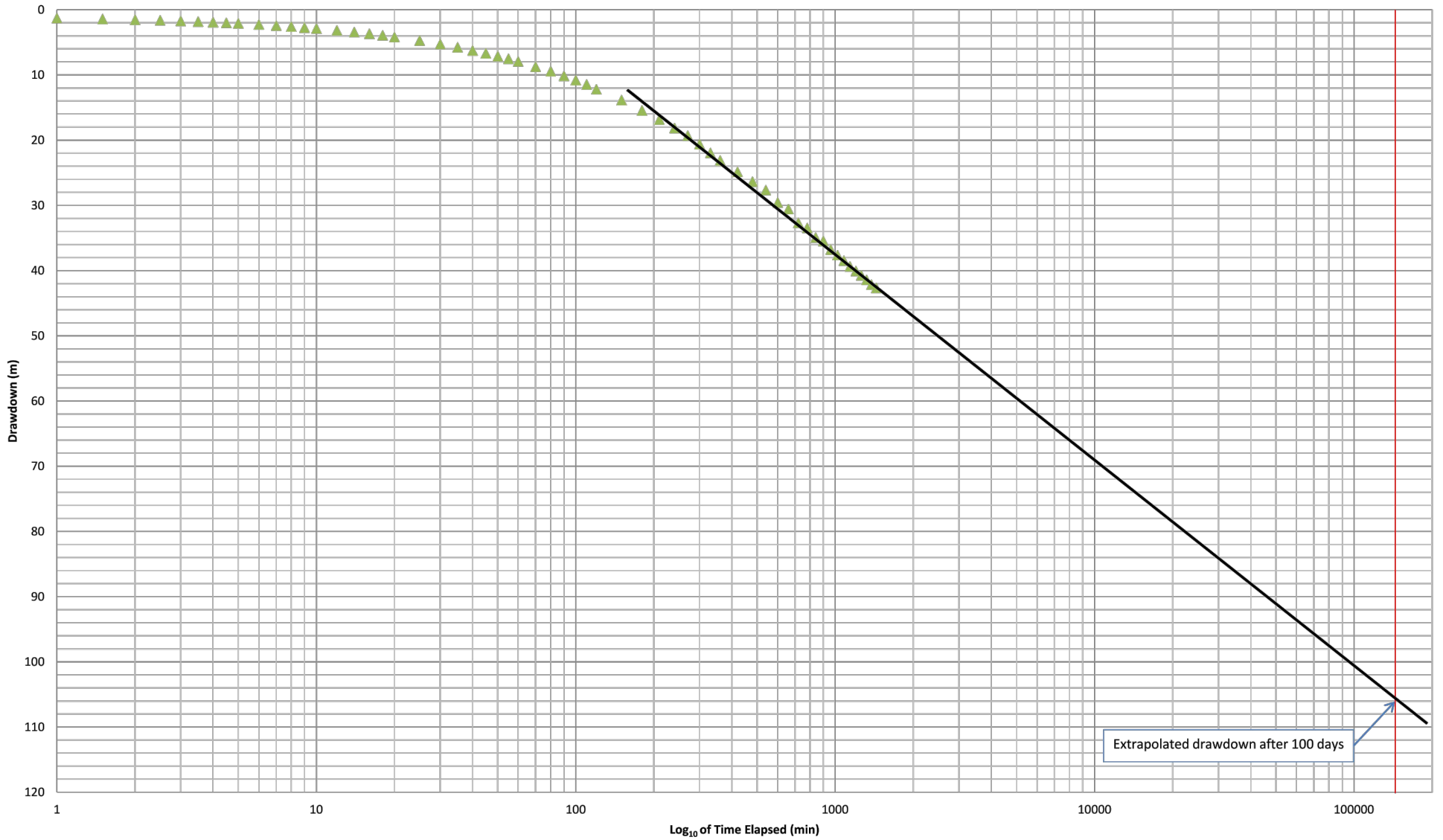
**2015 HYDROGEOLOGICAL WORK PROGRAM
BURWASH LANDING, YUKON**

**KFN-N CONSTANT RATE PUMPING TEST
AND RECOVERY (40 USgpm)**



PROJECT NO. ENVH2O03136-02	DWN CB	CKD AJS	REV 0
OFFICE EBA-WHSE	DATE December 14, 2015		

Figure 5b



LEGEND

▲ - KFN-N MANUAL DATA

CLIENT



**2015 HYDROGEOLOGICAL WORK PROGRAM
BURWASH LANDING, YUKON**

**100-DAY DRAWDOWN
(KFN-N)**



PROJECT NO. ENVH2O03136-02	DWN CB	CKD AJS	REV 0
OFFICE EBA-WHSE	DATE December 14, 2015		

Figure 5c

APPENDIX A

TETRA TECH EBA GENERAL CONDITIONS

GENERAL CONDITIONS

GEOENVIRONMENTAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of Tetra Tech EBA's client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA's Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

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2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. The Client warrants that Tetra Tech EBA's instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by Tetra Tech EBA in its reasonably exercised discretion.

4.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

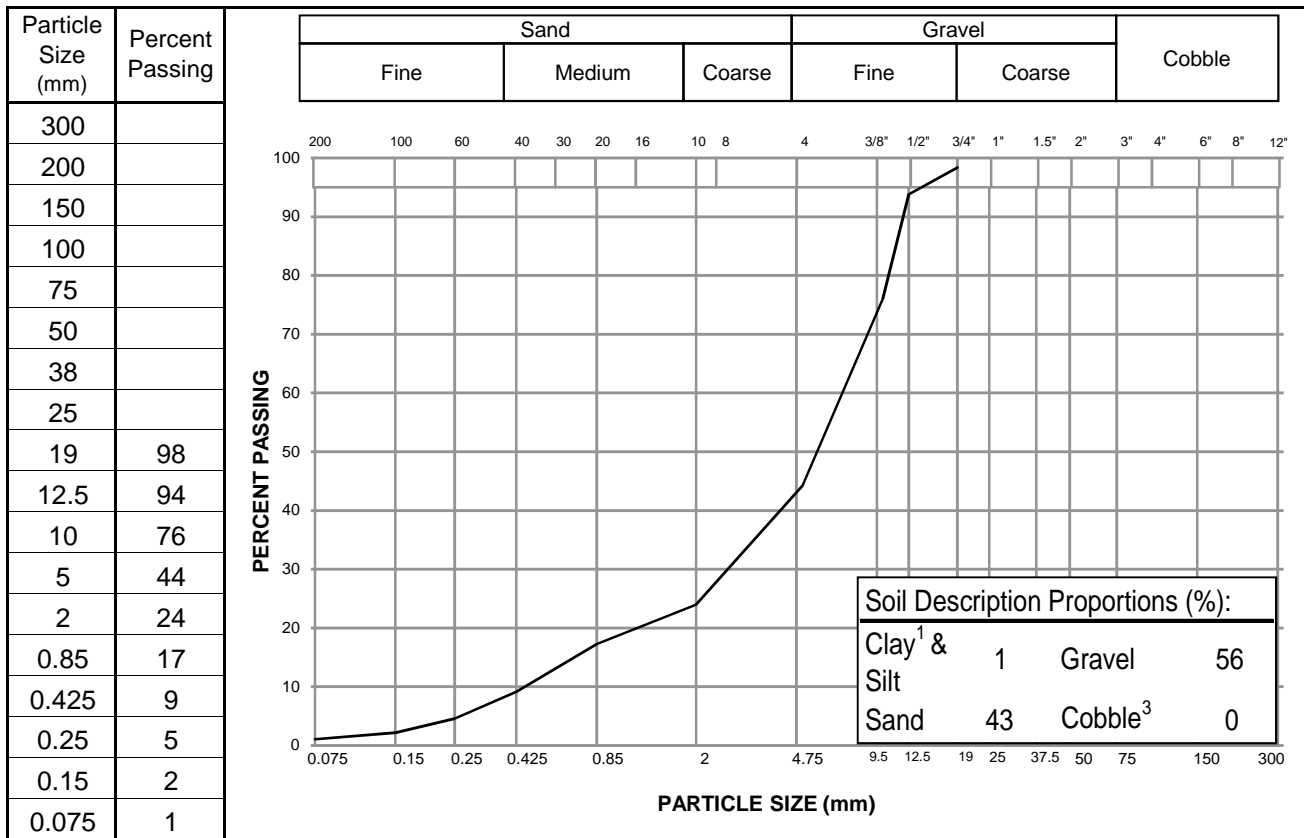
APPENDIX B

PARTICLE SIZE DISTRIBUTION RESULTS (KFN-M AND KFN-N)

PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	KFN Well Installation	Sample No.:	1
Project No.:	ENVH2O03136	Material Type:	
Site:	Burwash Landing	Sample Loc.:	KFN-M
Client:	Yukon Government	Sample Depth:	176 ft
Client Rep.:	Nick Rodger	Sampling Method:	Air Rotary - off cyclone
Date Tested:	25/10/15	By:	AJS
		Date sampled:	24/10/15
Soil Description ² :	SAND and GRAVEL	Sampled By:	AJS
		USC Classification:	Cu: 16.0 Cc: 2.4
Moisture Content:	#DIV/0!		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to EBA description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: AJS

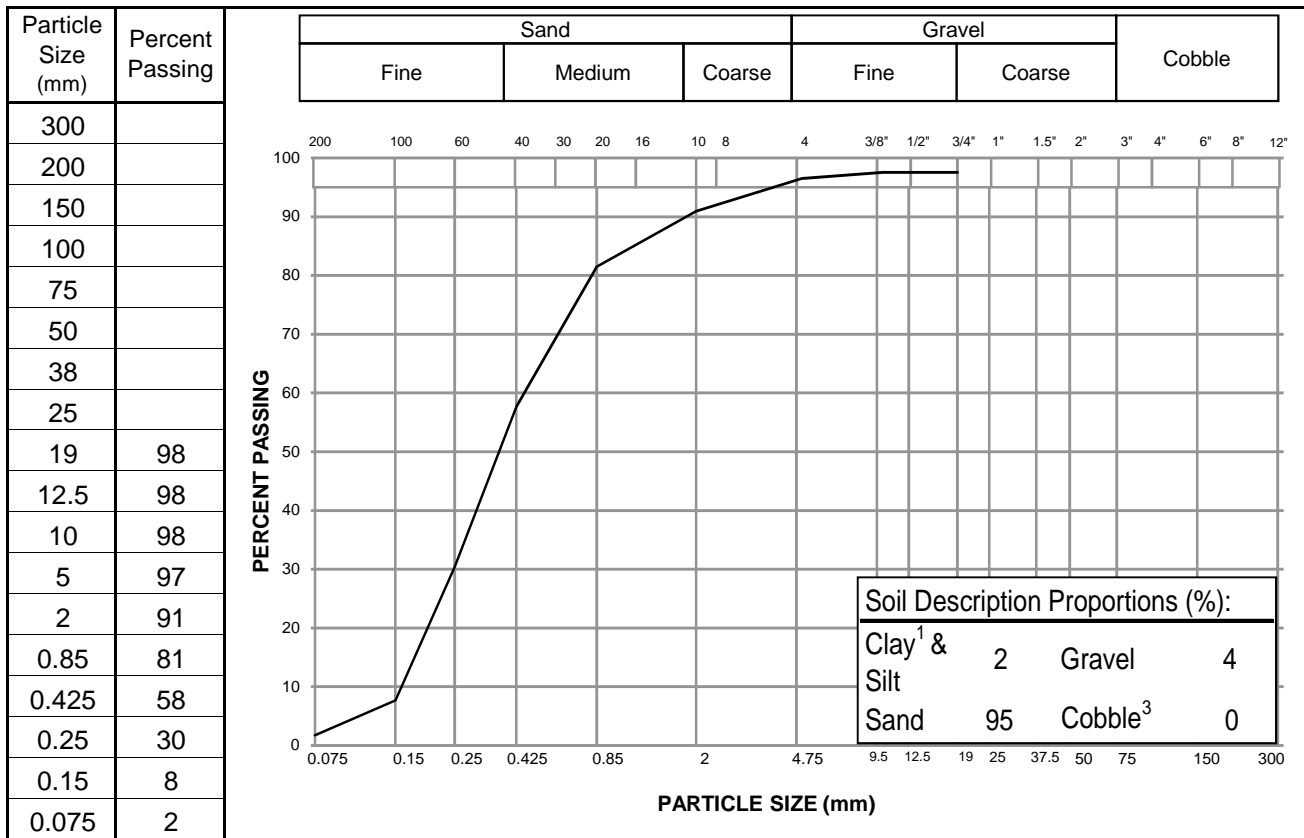
Data presented hereon is for the sole use of the stipulated client. EBA Engineering Consultants Ltd. operating as EBA A Tetra Tech Company is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.



PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	KFN Well Installation	Sample No.:	1
Project No.:	ENVH2O03136	Material Type:	
Site:	Burwash Landing	Sample Loc.:	KFN-M
Client:	Yukon Government	Sample Depth:	182 ft
Client Rep.:	Nick Rodger	Sampling Method:	Air Rotary - off cyclone
Date Tested:	25/10/15	By:	AJS
		Date sampled:	24/10/15
Soil Description ² :	Fine to coarse SAND	Sampled By:	AJS
		USC Classification:	Cu: 2.9 Cc: 0.8
Moisture Content:	#DIV/0!		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to EBA description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: AJS

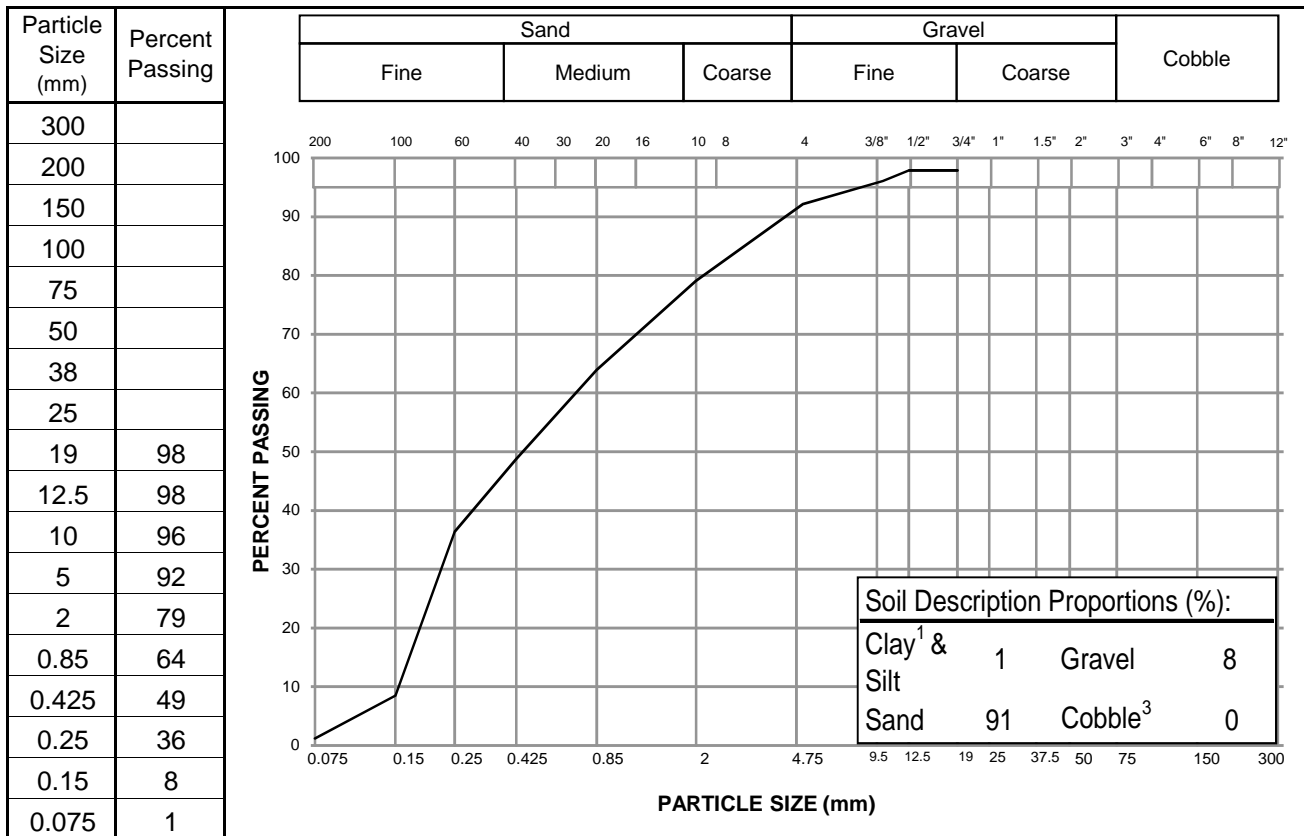
Data presented hereon is for the sole use of the stipulated client. EBA Engineering Consultants Ltd. operating as EBA A Tetra Tech Company is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.



PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	KFN Well Installation	Sample No.:	1
Project No.:	ENVH2O03136	Material Type:	
Site:	Burwash Landing	Sample Loc.:	KFN-M
Client:	Yukon Government	Sample Depth:	188 ft
Client Rep.:	Nick Rodger	Sampling Method:	Air Rotary - off cyclone
Date Tested:	25/10/15	By:	AJS
		Date sampled:	24/10/15
Soil Description ² :	SAND, trace gravel	Sampled By:	AJS
		USC Classification:	Cu: 4.8 Cc: 0.4
Moisture Content:	#DIV/0!		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to EBA description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: AJS

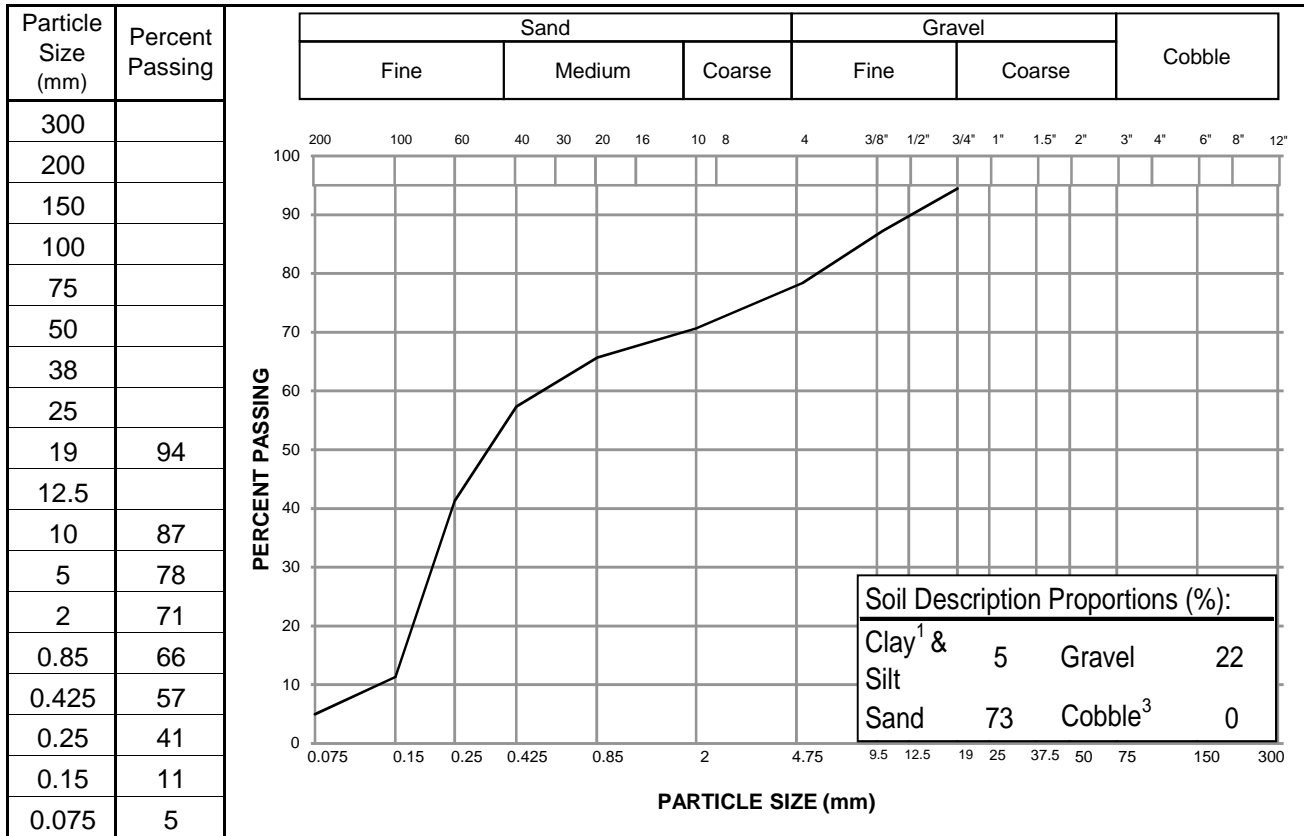
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PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	KFN Well Installation	Sample No.:	2
Project No.:	ENVH2O03136	Material Type:	
Site:	Burwash Landing	Sample Loc.:	KFN-N
Client:	Yukon Government	Sample Depth:	54.9 m / 180 ft
Client Rep.:	Nick Rodger	Sampling Method:	Air Rotary - off cyclone
Date Tested:	17/10/15	By:	AJS
		Date sampled:	17/10/15
Soil Description ² :	Gravelly SAND	Sampled By:	AJS
		USC Classification:	Cu: 4.2 Cc: 0.6
Moisture Content:	#DIV/0!		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to EBA description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: AJS

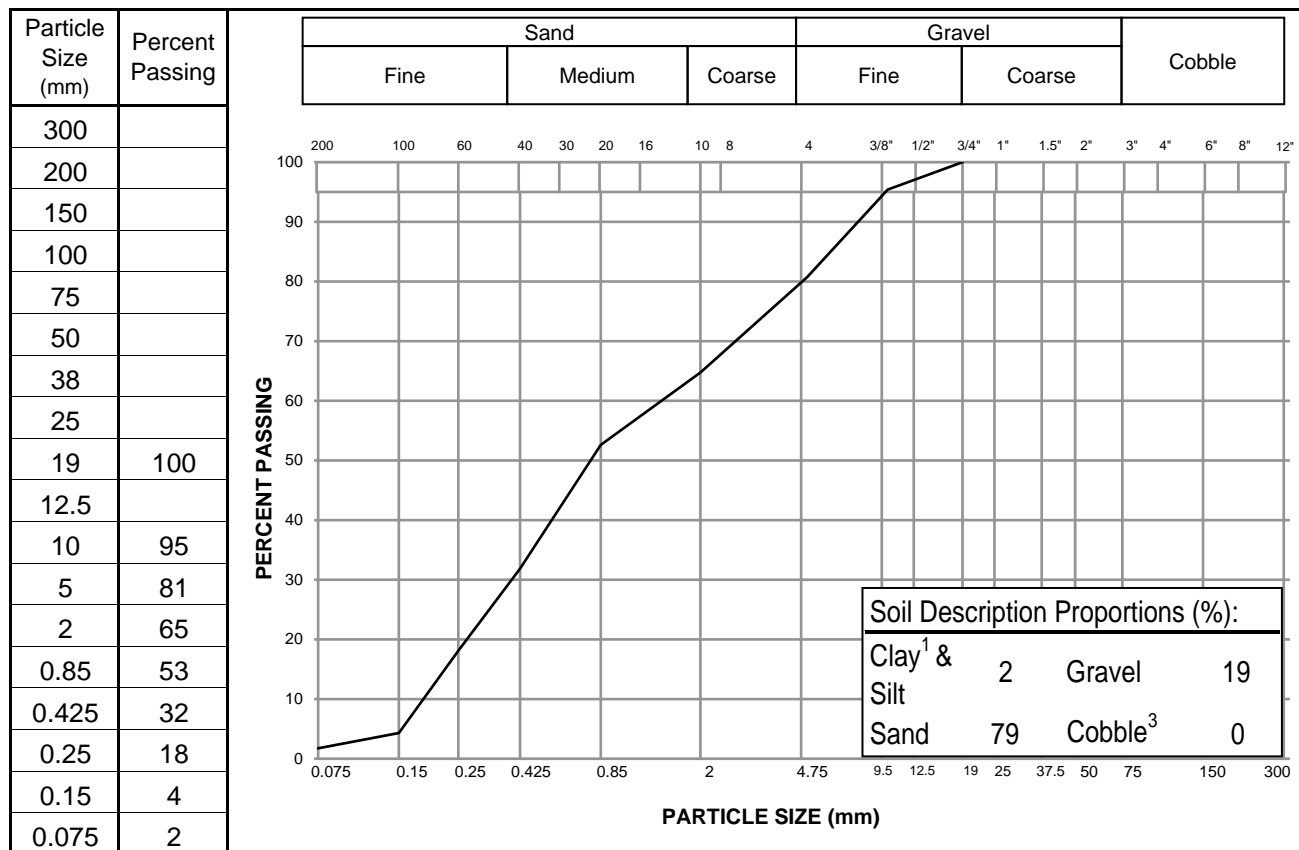
Data presented hereon is for the sole use of the stipulated client. EBA Engineering Consultants Ltd. operating as EBA A Tetra Tech Company is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.



PARTICLE SIZE ANALYSIS REPORT

ASTM D422, C136 & C117

Project:	KFN Well Installation	Sample No.:	2
Project No.:	ENVH2O03136	Material Type:	
Site:	Burwash Landing	Sample Loc.:	KFN-N
Client:	Yukon Government	Sample Depth:	57.3 m / 188 ft
Client Rep.:	Nick Rodger	Sampling Method:	Air Rotary - off cyclone
Date Tested:	17/10/15	By:	AJS
		Date sampled:	17/10/15
Soil Description ² :	Gravelly SAND	Sampled By:	AJS
		USC Classification:	Cu: 8.1 Cc: 0.5
Moisture Content:	#DIV/0!		



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
² The description is visually based & subject to EBA description protocols
³ If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: AJS

Data presented hereon is for the sole use of the stipulated client. EBA Engineering Consultants Ltd. operating as EBA A Tetra Tech Company is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.



APPENDIX C

DRILLER'S LOGS RESULTS (KFN-M AND KFN-N)

Well ID: To be assigned by Dept. Of Environment

Metric Imperial

INSTRUCTIONS FOR COMPLETING THE FORM

1. Additional information is provided at the bottom of this form on page 2.
2. Question can be directed to Water Resources at 867 667-3171.
3. All well construction measurements shall be reported to 0.1 m or 0.3 ft.
4. Please print clearly in blue or black ink.
5. Completion and submission of this form is the responsibility of the drilling contractor.
6. Please specify metric or imperial units for all measurements.

WELL LOCATION AND OWNER'S INFORMATION

A1 Well Name: Optional (i.e. City Well No. 2)

A2 Drilled For: First Name Last Name

Company / Department / Organization

Kluane First Nations

A3 Street Address of Well Location:

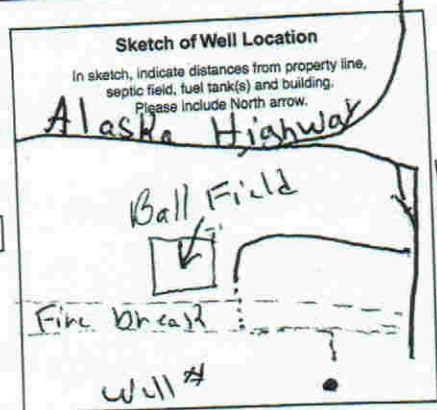
A4 Town / Village / Area / Lot #:

A5 UTM Coordinates (using handheld GPS): NAD 8 3 Zone 07

607986 Easting 6903706 Northing

A6 Elevation of Top of Casing: 2601 m / ft ASL

A7 Accuracy of GPS: 20 ft. +/- m / ft



RFN OFFICE

A8 Purpose of Wells

- Domestic Test Well Irrigation Environmental (Quality)
 Commercial Municipal Observation - Water Level Other (please identify use)
 Industrial Agricultural Public/Recreational

LOG OF OVERBURDEN AND BEDROCK MATERIALS (All depths are below ground surface, circle appropriate units, use descriptors provided)

EXAMPLE ONLY	Depth (m / ft) B2 From B3 To	B4 General Colour <small>(brown, gray, green, black, redish, beige, olive, yellowish)</small>	B5 Most Common Material <small>CLAY, SILT, SAND, GRAVEL, COBBLES, BOULDERS, BEDROCK</small>	B6 Secondary Materials <small>"trace" <10% (i.e. SILT trace gravel) "some" 10-20% (i.e. SAND some gravel) "silty / sandy / gravelly" 20-30% (i.e. silty SAND) "and sand" or "and gravel" 35-50%</small>		B7 General Description <small>MOISTURE: dry / moist / saturated (wet) HARDNESS: soft / hard / very hard</small>
				trace gravel	some silt	
	0 2	Brown	Peat			Soft
	2 3	Yellow	Silt			Very Hard
	3 35	Coar	Till			Hard Frozen
	35 45	Coar	Till			Hard Frozen
	45 115	Coar	Till			Hard Frozen
	115 160	Coar/Brown	Gravel			Hard Frozen
	160 176	Brown	Coar			Loose - Water
	176 178	Brown	Coar			Loose - Water
	178 180	Coar	Sand Fine			Loose - Water
	180 188	Coar	Sand-Med-fine			Loose - Water
	188 190	Coar	Coar			Loose - Water
	190 190	Brown	Till			Very Hard

B8 Permafrost Encountered: NO YES If yes, indicated depth (m / ft): from 2 to 176

WELL CONSTRUCTION (Continues on Page 2)

Date Well Completed 20151019
Y Y Y Y M M D D

Example:
2005 01 31

- C1 Drilling Method Air Rotary (Conventional) Dug Other (please specify)
 Reverse Air Rotary Cable Tool
 Mud Rotary Auger (Hollow / Solid Stem)

C2 Well Type: In what geological material is the water producing zone located?
 OVERBURDEN BEDROCK

Casing (depth below ground surface, please circle appropriate units)

C3 Outside Diameter 106 (cm / in)
 Plastic Steel Other
 C4 Casing Material Steel Plastic Other
 C5 Casing Wall Thickness 2.50 (cm / in)
 C6 Casing Depth to: 190 (m / ft)

C7 Other Comments Regarding Casing:

Surface / Environmental Seal (depth below ground surface, please circle appropriate units)

C8 Seal Material Type: Cement (i.e. Bentonite)
 C9 Diameter of Seal: 2" (cm / in)
 C10 Seal Depth from: 20-0 (m / ft)
 C11 Seal Depth to: 0 (m / ft)
 C12 Volume Placed: _____ (m³ / ft³)

Gravel Pack (depth below ground surface, please circle appropriate units)

C13 Gravel Pack: NO If yes, indicated depth (m / ft): _____
 YES from: _____ to: _____ Indicate diameter of material: _____ (mm / inches) Material type: _____ (i.e. silica)

Well Screen Information (depth below ground surface, please circle appropriate units)

C14 Outside Diameter: 67 (cm / in)
 C15 Screen Material: Stainless Steel Steel Plastic N/A Other: _____
 C16 Screen Type: Continuous Wire Wrap Louver Screen Perforated Slotted Open Hole
 C17 Depth from: Screen 1: 188.5 (m / ft) Screen 2: 194 (m / ft) Screen 3: 179.5 (m / ft)
 C18 Depth to: Screen 1: 184 (m / ft) Screen 2: 179.5 (m / ft) Screen 3: 175 (m / ft)
 Slot Size / Perforation Dia: Screen 1: 0.025 Thou. / mm / inches 0.25
 Screen 2: 0.020 Thou. / mm / inches
 Screen 3: 0.018 Thou. / mm / inches
 C19 Screen Comments: _____

WELL DEVELOPMENT AND STATUS

D1 Well Developed by: Surge Block Water Jetting Air Jetting / Air Lifting Bailing Pumping Other: _____
 D2 Well Head Completion: Well House Pitless Adaptor Well Pit (NOT PERMITTED) None (well not completed)
 D3 Well Head Stick-up (above ground surface): _____ (m / ft) (Use negative if below grade)
 D4 Static Water Level (below top of casing): _____ (m / ft) (Use negative if below grade)
 D5 Well Yield Estimate: _____ (Lps / gpm)
 D6 Final Well Status: Water Supply (in use) Stand by (Back-up) Observation Not in use Deepened Other: _____
 Abandoned Dry Poor Quality Insufficient Yield Artesian conditions
 D7 Well Abandonment Status: Was the well properly decommissioned with bentonite grout? YES NO
 If YES, indicate Date: _____
 D8 Method Used to Estimate Well Yield: Air Lifting Bailing Pumping Test (If test conducted, complete Pumping Test Record)
 Y Y Y Y M M D D

PUMPING TEST RECORD AND GROUNDWATER QUALITY

(All depths below ground, circle appropriate units)

E1 Pumping Test Information

Pumping Test Start Date: 20151022
 Static Water Level (SWL): 5 (m / ft)
 Pump Intake Set at: 166 (m / ft)
 Duration of pumping: 24 hrs _____ min
 Final Water Level (FWL) at end of Pumping Test: _____ (m / ft)

RECOMMENDATIONS

Recomm. Pump Depth: 160 (m / ft)
 Recomm. Pumping Rate: 40 (Lps / gpm)
 If flowing, provide rate: _____ (Lps / gpm)

F1 Well Water Level Drawdown/Recovery DATA

Drawdown		Recovery	
Time (min)	Water Level (m / ft)	Time (min)	Water Level (m / ft)
0 (SWL)		0 (FWL)	
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

G1 GROUNDWATER QUALITY

Field Data
 Date Measurements Taken: _____
 Electrical Conductivity: _____ uS
 pH: _____
 Temperature: _____ °C

Turbidity/Sand Content

Clear
 Slightly turbid/cloudy
 Moderately turbid/cloudy
 Turbid/cloudy
 Trace sand present
 No sand present

Groundwater Type

Salty
 Sulphur / Egg Odour
 Organic Taste / Odour
 Metallic Taste
 Other: _____

Well Disinfection

Was the well disinfected upon completion of the pump installation? YES NO

Briefly describe method of well disinfection.

Injected 600 Gal. 200 PPM Chlorine

Bacteria Testing

Was a sample taken? YES NO If yes, indicate the name of the laboratory.
 Date Sample Taken: _____
 Y Y Y Y M M D D

Chemical Analysis of Water

Was a sample taken? YES NO If yes, indicate the name of the laboratory.
 Date Sample Taken: _____
 Y Y Y Y M M D D

WELL CONTRACTOR

H1 Name of Contractor / Drilling Company: Midnight Sun Drilling
 H2 Name of Driller(s): Carl MacKenzie
 H3 Address of Driller: Box 1515 DeWasa Circle Y.T. 10P1G0
 Signature of Primary Driller: _____
 Date Submitted to Dept. Of Environment: _____

CONSULTANT (If applicable)

I1 Company Name: Tetra Tech.
 I2 Company Address: _____
 I3 Report Reference: _____
 I4 Report Date: _____
 Y Y Y Y M M D D

ADDITIONAL INSTRUCTIONS

Upon completing this form, please mail or fax it to:

Water Resources Section (V-310),
 Department of Environment,
 Government of Yukon Box 2703,
 Whitehorse, Yukon, Canada Y1A 2C8

Please feel free to contact us at:
 Phone: (867) 667-3171, Toll free (in Yukon): (1-800) 661-0408, local 3171
 Fax: (867) 667-3195 E-mail: Water.Resources@gov.yk.ca

Personal information contained on this form is collected under the authority of the Access to Information and Protection of Privacy (ATIP) Act, Section 29 (c) and will be used to compile a public database of well and ground water information. For further information contact the Manager of Hydrology, Water Resources at (867) 667-3223, toll free within Yukon, 1-800-661-0408 Ext 3223.

I have read the above clause and understand the purpose for collection of personal information.

Signature of Well Owner

WATER WELL DRILLERS FORM

Well ID:

To be assigned by Dept. Of Environment

Metric Imperial

INSTRUCTIONS FOR COMPLETING THE FORM

1. Additional information is provided at the bottom of this form on page 2.
2. Question can be directed to Water Resources at 867 667-3171.
3. All well construction measurements shall be reported to 0.1 m or 0.3 ft.
4. Please print clearly in blue or black ink.
5. Completion and submission of this form is the responsibility of the drilling contractor.
6. Please specify metric or imperial units for all measurements.

WELL LOCATION AND OWNER'S INFORMATION

A1 Well Name: Optional (i.e. City Well No. 2)

A2 Drilled For: First Name Last Name Company / Department / Organization **Kluane First Nations**

A3 Street Address of Well Location:

A4 Town / Village / Area / Lot #:

A5 UTM Coordinates (using handheld GPS): NAD 8 | 3 Zone 07

607971 E 6803713
Easting Northing

A6 Elevation of Top of Casing: 2634 m / ft ASL

A7 Accuracy of GPS: 4.2 +/- m (ft)

Sketch of Well Location
In sketch, indicate distances from property line, septic field, fuel tank(s) and building. Please include North arrow.

A8 Purpose of Wells

- Domestic Test Well Irrigation Environmental (Quality)
 Commercial Municipal Observation - Water Level Other (please identify use)
 Industrial Agricultural Public/Recreational

LOG OF OVERBURDEN AND BEDROCK MATERIALS (All depths are below ground surface, circle appropriate units, use descriptors provided)

EXAMPLE ONLY

(brown, grey, green, black, redish, beige, olive, yellowish) **brown**
CLAY, SILT, SAND, GRAVEL, COBBLES, SOULDERS, BEDROCK **SAND**
"trace" <10% (i.e. SILT trace gravel) "some" 10-20% (i.e. SAND some gravel) "silty / sandy / gravelly" 20-30% (i.e. silty SAND) "and sand" or "and gravel" 35-50% **trace gravel some silt**
MOISTURE: dry / moist / saturated (wet) HARDNESS: soft / hard / very hard **soft and saturated**

Depth (m / ft)		B4 General Colour	B5 Most Common Material	B6 Secondary Materials	B7 General Description
B2 From	B3 To				
0	2	Brown	Peat	Silt.	Soft
2	4	Blown	Silt		Dense
4	80	Grey	Silt.	Clay	Dense
80	105	Grey	Fill	Cobbles - Gravel	Hard
105	108	Clear	Ice		Soft
108	160	Grey	Fill	Gravel	Hard
160	175	Grey	Gravel	Ice, Sand	Hard
175	180	Grey	Cobble	Sand	High Production
180	189	Grey	Sand	Cobble	High Production
189	190	Grey	Till	Gravel	Very Hard

B8 Permafrost Encountered: NO YES If yes, indicated depth (m / ft): from: to:

WELL CONSTRUCTION (Continues on Page 2)

Date Well Completed **20151025**
Y Y Y Y M M D D

Example: 2005 01 31

C1 Drilling Method Air Rotary (Conventional) Dug Other (please specify)
 Reverse Air Rotary Cable Tool
 Mud Rotary Auger (Hollow / Solid Stem)

C2 Well Type: In what geological material is the water producing zone located?
 OVERBURDEN BEDROCK

Casing (depth below ground surface, please circle appropriate units)

C3 Outside Diameter 6.65 (cm) (in)
 C4 Casing Material Steel Plastic Other
 C5 Casing Wall Thickness 2.50 (cm) (in)
 C6 Casing Depth to: 179 (m) (ft)

C7 Other Comments Regarding Casing:

Surface / Environmental Seal (depth below ground surface, please circle appropriate units)

C8 Seal Material Type: Concrete (i.e. Bentonite)
 C9 Diameter of Seal: 21 (cm / in)
 C10 Seal Depth from: 0 20 (m / ft)
 C11 Seal Depth to: _____ (m / ft)
 C12 Volume Placed: 18 bags (m³ / ft³)

Gravel Pack (depth below ground surface, please circle appropriate units)

C13 Gravel Pack: NO If yes, indicated depth (m / ft): _____
 YES from: _____ to: _____ Indicate diameter of material: _____ (mm / inches) Material type: _____ (i.e. silica)

Well Screen Information (depth below ground surface, please circle appropriate units)

C14 Outside Diameter: 55 (cm / in)
 C15 Screen Material: Stainless Steel Steel Plastic N/A Other: _____
 C16 Screen Type: Continuous Wire Wrap Louver Screen Perforated Slotted Open Hole
 C17 Depth from: Screen 1: 185 (m / ft) Screen 2: 181 (m / ft) Screen 3: 177 (m / ft)
 C18 Depth to: 189 (m / ft) 185 (m / ft) 181 (m / ft)
 Slot Size / Perforation Dia: 25 Thou. / mm / inches 20 Thou. / mm / inches 18 Thou. / mm / inches
 C19 Screen Comments: _____

WELL DEVELOPMENT AND STATUS

D1 Well Developed by: Surge Block Water Jetting Air Jetting / Air Lifting Bailing Pumping Other: _____
 D2 Well Head Completion: Well House Pitless Adaptor Well Pit (NOT PERMITTED) None (well not completed)
 D3 Well Head Stick-up (above ground surface): 32 (m / ft) (Use negative if below grade)
 D4 Static Water Level (below top of casing): 6 (m / ft) (Use negative if below grade)
 D5 Well Yield Estimate: 40 (Lps / gpm)
 D6 Final Well Status: Water Supply (in use) Stand by (Back-up) Observation Not in use Deepened Other: _____
 Abandoned Dry Poor Quality Insufficient Yield Artesian conditions
 D7 Well Abandonment Status: Was the well properly decommissioned with bentonite grout? YES NO
 If YES, Indicate Date: _____
 D8 Method Used to Estimate Well Yield: Air Lifting Bailing Pumping Test (If test conducted, complete Pumping Test Record)
 Y Y Y Y M M D D

PUMPING TEST RECORD AND GROUNDWATER QUALITY

(All depths below ground, circle appropriate units)

E1 Pumping Test Information

Pumping Test Start Date: 20151627
 Static Water Level (SWL): _____ (m / ft)
 Pump Intake Set at: 166 (m / ft)
 Duration of pumping: 24 hrs _____ min
 Final Water Level (FWL) at end of Pumping Test: _____ (m / ft)

RECOMMENDATIONS

Recomm. Pump Depth: 160 (m / ft)
 Recomm. Pumping Rate: 40 (Lps / gpm)
 If flowing, provide rate: _____ (Lps / gpm)

F1 Well Water Level Drawdown/Recovery DATA

Drawdown		Recovery	
Time (min)	Water Level (m / ft)	Time (min)	Water Level (m / ft)
0 (SWL)		0 (FWL)	
1		1	
2		2	
3		3	
4		4	
5		5	
10		10	
15		15	
20		20	
25		25	
30		30	
40		40	
50		50	
60		60	

G1 GROUNDWATER QUALITY

Field Data
 Date Measurements Taken: _____
 Electrical Conductivity: _____ uS
 pH: _____
 Temperature: _____ °C

Turbidity/Sand Content
 Clear
 Slightly turbid/cloudy
 Moderately turbid/cloudy
 Turbid/cloudy
 Trace sand present
 No sand present

Bacteria Testing

Was a sample taken? YES NO If yes, indicate the name of the laboratory.
 Date Sample Taken: _____
 Y Y Y Y M M D D

Chemical Analysis of Water

Was a sample taken? YES NO If yes, indicate the name of the laboratory.
 Date Sample Taken: _____
 Y Y Y Y M M D D

Well Disinfection

Was the well disinfected upon completion of the pump installation? YES NO
 Briefly describe method of well disinfection:
600 Gal - 200 PPM Chlorine water

WELL CONTRACTOR

H1 Name of Contractor / Drilling Company: Midnight Sun Drilling
 H2 Name of Driller(s): Carl MacRae
 H3 Address of Driller: Box 1515 Dawson City

 Signature of Primary Driller

CONSULTANT (if applicable)

I 1 Company Name: _____
 I 2 Company Address: _____
 I 3 Report Reference: _____
 I 4 Report Date: _____
 Y Y Y Y M M D D

ADDITIONAL INSTRUCTIONS

Upon completing this form, please mail or fax it to:
 Water Resources Section (V-310), Department of Environment, Government of Yukon Box 2703, Whitehorse, Yukon, Canada Y1A 2C8
 Please feel free to contact us at:
 Phone: (867) 667-3171, Toll free (in Yukon): (1-800) 661-0408, local 3171
 Fax: (867) 667-3195 E-mail: Water.Resources@gov.yk.ca

Personal information contained on this form is collected under the authority of the Access to Information and Protection of Privacy (ATIP) Act, Section 29 (c) and will be used to compile a public database of well and ground water information. For further information contact the Manager of Hydrology, Water Resources at (867) 667-3223, toll free within Yukon 1-800-661-0408 Ext 3223.

I have read the above clause and understand the purpose for collection of personal information. _____
 Signature of Well Owner

APPENDIX D

MANUAL PUMPING TEST DATA (KFN-M AND KFN-N)

KFN-M - 24 hr Constant Rate Test (Manual Data)

Elapsed Time (m)	Elapsed Time (s)	Depth to water (m)	Drawdown (m)	Flow Rate (USgpm)	Flow Rate (m3/s)	Test Step
0	0	6.43	0	35	0.0022	35 Usgpm Long Term Pumping Test
0.5	30	7.09	0.66	35	0.0022	
1	60	7.39	0.96	35	0.0022	
1.5	90	7.72	1.29	35	0.0022	
2	120	7.77	1.34	35	0.0022	
2.5	150	7.93	1.50	35	0.0022	
3	180	7.93	1.50	35	0.0022	
3.5	210	8.02	1.59	35	0.0022	
4	240	8.10	1.67	35	0.0022	
4.5	270	8.16	1.73	35	0.0022	
5	300	8.28	1.85	35	0.0022	
6	360	8.38	1.95	35	0.0022	
7	420	8.49	2.06	35	0.0022	
8	480	8.71	2.28	35	0.0022	
9	540	8.76	2.33	35	0.0022	
10	600	8.87	2.44	35	0.0022	
12	720	9.13	2.70	35	0.0022	
14	840	9.35	2.92	35	0.0022	
16	960	9.50	3.07	35	0.0022	
18	1080	9.71	3.28	35	0.0022	
20	1200	9.89	3.46	35	0.0022	
25	1500	10.34	3.91	35	0.0022	
30	1800	10.73	4.30	35	0.0022	
35	2100	-		35	0.0022	
40	2400	11.53	5.10	35	0.0022	
45	2700	11.86	5.43	35	0.0022	
50	3000	12.23	5.80	35	0.0022	
55	3300	12.65	6.22	35	0.0022	
60	3600	12.94	6.51	35	0.0022	
70	4200	13.56	7.13	35	0.0022	
80	4800	14.12	7.69	35	0.0022	
90	5400	14.71	8.28	35	0.0022	
100	6000	15.26	8.83	35	0.0022	
110	6600	15.82	9.39	35	0.0022	
120	7200	16.30	9.87	35	0.0022	
150	9000	17.80	11.37	35	0.0022	
180	10800	18.98	12.55	35	0.0022	
210	12600	20.13	13.70	35	0.0022	
240	14400	21.32	14.89	35	0.0022	
270	16200	22.37	15.94	35	0.0022	
300	18000	23.46	17.03	35	0.0022	
330	19800	24.30	17.87	35	0.0022	
360	21600	25.20	18.77	35	0.0022	
420	25200	26.70	20.27	35	0.0022	
480	28800	28.00	21.57	35	0.0022	
540	32400	29.30	22.87	35	0.0022	
600	36000	30.60	24.17	35	0.0022	
660	39600	31.72	25.29	35	0.0022	

KFN-M - 24 hr Constant Rate Test (Manual Data)

Elapsed Time (m)	Elapsed Time (s)	Depth to water (m)	Drawdown (m)	Flow Rate (USgpm)	Flow Rate (m3/s)	Test Step
720	43200	33.00	26.57	35	0.0022	
780	46800	34.12	27.69	35	0.0022	
840	50400	35.90	29.47	35	0.0022	
900	54000	-		35	0.0022	
960	57600	36.77	30.34	35	0.0022	
1020	61200	37.67	31.24	35	0.0022	
1080	64800	38.93	32.50	35	0.0022	
1140	68400	38.02	31.59	35	0.0022	
1200	72000	39.00	32.57	35	0.0022	
1260	75600	40.46	34.03	35	0.0022	
1320	79200	41.08	34.65	35	0.0022	
1380	82800	41.80	35.37	35	0.0022	
1440	86400	42.26	35.83	35	0.0022	
1440.5	86430	41.58	35.15	0	Recovery	
1441	86460	41.40	34.97			
1441.5	86490	41.30	34.87			
1442	86520	41.23	34.80			
1442.5	86550	41.17	34.74			
1443	86580	41.11	34.68			
1443.5	86610	41.04	34.61			
1444	86640	41.01	34.58			
1444.5	86670	40.97	34.54			
1445	86700	40.91	34.48			
1446	86760	40.81	34.38			
1447	86820	40.72	34.29			
1448	86880	40.63	34.20			
1449	86940	40.54	34.11			
1450	87000	40.46	34.03			
1452	87120	40.29	33.86			
1454	87240	40.13	33.70			
1458	87480	39.83	33.40			
1460	87600	39.70	33.27			
1466	87960	39.25	32.82			
1470	88200	39.00	32.57			
1475	88500	38.66	32.23			
1488	89280	38.87	32.44			
1491	89460	38.68	32.25			
1495	89700	37.40	30.97			
1500	90000	37.19	30.76			

KFN-N Step Rate Test - Manual Data

Time Elapsed (min)	Time Elapsed (s)	Depth to Water (mbTOC)	Drawdown (m)	Flow Rate (USgpm)	Flow Rate (m3/s)	Pumping Step
0	0	4.56	0	20	0.0013	Step 1 - 20 USgpm
0.5	30	4.92	0.36	20	0.0013	
1	60	5.08	0.52	20	0.0013	
1.5	90	5.3	0.74	20	0.0013	
2	120	5.36	0.8	20	0.0013	
2.5	150	5.42	0.86	20	0.0013	
3	180	5.52	0.96	20	0.0013	
3.5	210	5.53	0.97	20	0.0013	
4	240	5.61	1.05	20	0.0013	
4.5	270	5.66	1.1	20	0.0013	
5	300	5.71	1.15	20	0.0013	
6	360	5.8	1.24	20	0.0013	
7	420	5.9	1.34	20	0.0013	
8	480	5.98	1.42	20	0.0013	
9	540	6.07	1.51	20	0.0013	
10	600	6.15	1.59	20	0.0013	
12	720	6.3	1.74	20	0.0013	
14	840	6.45	1.89	20	0.0013	
16	960	6.6	2.04	20	0.0013	
18	1080	6.74	2.18	20	0.0013	
20	1200	6.85	2.29	20	0.0013	
25	1500	7.19	2.63	20	0.0013	
30	1800	7.49	2.93	20	0.0013	
35	2100	7.66	3.1	20	0.0013	
40	2400	8	3.44	20	0.0013	
45	2700	8.25	3.69	20	0.0013	
50	3000	8.49	3.93	20	0.0013	
55	3300	8.72	4.16	20	0.0013	
60	3600	8.98	4.42	20	0.0013	
60.5	3630	9.5	4.94	40	0.0025	
61	3660	9.62	5.06	40	0.0025	
61.5	3690	9.72	5.16	40	0.0025	
62	3720	9.8	5.24	40	0.0025	
62.5	3750	9.88	5.32	40	0.0025	
63	3780	9.94	5.38	40	0.0025	
63.5	3810	10.02	5.46	40	0.0025	
64	3840	10.09	5.53	40	0.0025	
64.5	3870	10.15	5.59	40	0.0025	
65	3900	10.22	5.66	40	0.0025	
66	3960	10.32	5.76	40	0.0025	
67	4020	10.46	5.9	40	0.0025	
68	4080	10.61	6.05	40	0.0025	
69	4140	10.7	6.14	40	0.0025	
70	4200	10.82	6.26	40	0.0025	
72	4320	11.03	6.47	40	0.0025	
74	4440	11.25	6.69	40	0.0025	
76	4560	11.45	6.89	40	0.0025	
78	4680	11.68	7.12	40	0.0025	

KFN-N Step Rate Test - Manual Data

Time Elapsed (min)	Time Elapsed (s)	Depth to Water (mbTOC)	Drawdown (m)	Flow Rate (USgpm)	Flow Rate (m3/s)	Pumping Step	
80	4800	11.87	7.31	40	0.0025		
85	5100	12.35	7.79	40	0.0025		
90	5400	12.8	8.24	40	0.0025		
95	5700	13.24	8.68	40	0.0025		
100	6000	13.63	9.07	40	0.0025		
105	6300	14.01	9.45	40	0.0025		
110	6600	14.42	9.86	40	0.0025		
115	6900	14.79	10.23	40	0.0025		
120	7200	15.13	10.57	40	0.0025		
120.5	7230	15.65	11.09	60	0.0038		Step 3 - 60 USgpm
121	7260	15.82	11.26	60	0.0038		
121.5	7290	15.89	11.33	60	0.0038		
122	7320	16	11.44	60	0.0038		
122.5	7350	16.09	11.53	60	0.0038		
123	7380	16.16	11.6	60	0.0038		
123.5	7410	16.23	11.67	60	0.0038		
124	7440	16.32	11.76	60	0.0038		
124.5	7470	16.4	11.84	60	0.0038		
125	7500	16.47	11.91	60	0.0038		
126	7560	16.61	12.05	60	0.0038		
127	7620	16.76	12.2	60	0.0038		
128	7680	16.9	12.34	60	0.0038		
129	7740	17.04	12.48	60	0.0038		
130	7800	17.15	12.59	60	0.0038		
132	7920	17.41	12.85	60	0.0038		
134	8040	17.68	13.12	60	0.0038		
136	8160	17.93	13.37	60	0.0038		
138	8280	18.18	13.62	60	0.0038		
140	8400	18.4	13.84	60	0.0038		
145	8700	18.98	14.42	60	0.0038		
150	9000	19.58	15.02	60	0.0038		
155	9300	20.13	15.57	60	0.0038		
160	9600	20.64	16.08	60	0.0038		
165	9900	21.16	16.6	60	0.0038		
170	10200	21.67	17.11	60	0.0038		
175	10500	22.16	17.6	60	0.0038		
180	10800	22.67	18.11	60	0.0038		
180.5	10830	22.74	18.18	62.5	0.0039		
181	10860	22.81	18.25	62.5	0.0039		
181.5	10890	22.86	18.3	62.5	0.0039		
182	10920	22.91	18.35	62.5	0.0039		
182.5	10950	22.98	18.42	62.5	0.0039		
183	10980	23.03	18.47	62.5	0.0039		
183.5	11010	23.07	18.51	62.5	0.0039		
184	11040	23.13	18.57	62.5	0.0039		
184.5	11070	23.19	18.63	62.5	0.0039		
185	11100	23.24	18.68	62.5	0.0039		
186	11160	23.35	18.79	62.5	0.0039		

KFN-N Step Rate Test - Manual Data

Time Elapsed (min)	Time Elapsed (s)	Depth to Water (mbTOC)	Drawdown (m)	Flow Rate (USgpm)	Flow Rate (m3/s)	Pumping Step
187	11220	23.43	18.87	62.5	0.0039	Step 4 - 62.5 USgpm
188	11280	23.54	18.98	62.5	0.0039	
189	11340	23.65	19.09	62.5	0.0039	
190	11400	23.75	19.19	62.5	0.0039	
192	11520	23.94	19.38	62.5	0.0039	
194	11640	24.15	19.59	62	0.0039	
196	11760	24.33	19.77	61.8	0.0039	
198	11880	24.52	19.96	61.8	0.0039	
200	12000	24.71	20.15	61.8	0.0039	
205	12300	25.17	20.61	61.5	0.0039	
210	12600	25.65	21.09	61.4	0.0039	
215	12900	26.1	21.54	61.4	0.0039	
220	13200	26.56	22	61.3	0.0039	
225	13500	26.85	22.29	59.9	0.0038	
230	13800	27.24	22.68	59.9	0.0038	
235	14100	27.63	23.07	59.9	0.0038	
240	14400	28.02	23.46	59.9	0.0038	
240.5	14430	26.48	21.92	0	Recovery	
241	14460	26.17	21.61			
241.5	14490	26.03	21.47			
242	14520	25.89	21.33			
242.5	14550	25.74	21.18			
243	14580	25.61	21.05			
243.5	14610	25.47	20.91			
244	14640	25.37	20.81			
244.5	14670	23.32	18.76			
245	14700	25.22	20.66			
246	14760	24.99	20.43			
247	14820	24.84	20.28			
248	14880	24.66	20.1			
249	14940	24.52	19.96			
250	15000	24.39	19.83			
252	15120	24.07	19.51			
255	15300	23.75	19.19			
256	15360	23.61	19.05			
258	15480	23.4	18.84			
260	15600	23.13	18.57			
265	15900	22.65	18.09			
270	16200	22.23	17.67			
480	28800	14.17	9.61			
1382	82920	6.50	1.94			
1502	90120	6.15	1.59			

KFN-N - 24 hr Constant Rate Test (Manual Data)

Elapsed Time (m)	Elapsed Time (s)	Depth to water (m)	Drawdown (m)	Flow Rate (USgpm)	Flow Rate (m3/s)	Test Step
0	0	5.03	0	40	0.0025	40 Usgpm Long Term Pumping Test
0.5	30	6.20	1.17	40	0.0025	
1	60	6.33	1.30	40	0.0025	
1.5	90	6.46	1.43	40	0.0025	
2	120	6.58	1.55	40	0.0025	
2.5	150	6.67	1.64	40	0.0025	
3	180	6.77	1.74	40	0.0025	
3.5	210	6.87	1.84	40	0.0025	
4	240	6.96	1.93	40	0.0025	
4.5	270	7.05	2.02	40	0.0025	
5	300	7.14	2.11	40	0.0025	
6	360	7.31	2.28	40	0.0025	
7	420	7.47	2.44	40	0.0025	
8	480	7.62	2.59	40	0.0025	
9	540	7.79	2.76	40	0.0025	
10	600	7.91	2.88	40	0.0025	
12	720	8.20	3.17	40	0.0025	
14	840	8.48	3.45	40	0.0025	
16	960	8.72	3.69	40	0.0025	
18	1080	8.97	3.94	40	0.0025	
20	1200	9.23	4.20	40	0.0025	
25	1500	9.77	4.74	40	0.0025	
30	1800	10.30	5.27	40	0.0025	
35	2100	10.80	5.77	40	0.0025	
40	2400	11.30	6.27	40	0.0025	
45	2700	11.72	6.69	40	0.0025	
50	3000	12.17	7.14	40	0.0025	
55	3300	12.57	7.54	40	0.0025	
60	3600	12.97	7.94	40	0.0025	
70	4200	13.78	8.75	40	0.0025	
80	4800	14.46	9.43	40	0.0025	
90	5400	15.18	10.15	40	0.0025	
100	6000	15.85	10.82	40	0.0025	
110	6600	16.51	11.48	40	0.0025	
120	7200	17.23	12.20	40	0.0025	
150	9000	18.90	13.87	40	0.0025	
180	10800	20.48	15.45	40	0.0025	
210	12600	21.88	16.85	40	0.0025	
240	14400	23.17	18.14	40	0.0025	
270	16200	24.36	19.33	40	0.0025	
300	18000	25.66	20.63	40	0.0025	
330	19800	27.00	21.97	40	0.0025	
360	21600	28.16	23.13	40	0.0025	
420	25200	29.92	24.89	40	0.0025	
480	28800	31.40	26.37	40	0.0025	
540	32400	32.70	27.67	40	0.0025	
600	36000	34.61	29.58	40	0.0025	
660	39600	35.62	30.59	40	0.0025	

KFN-N - 24 hr Constant Rate Test (Manual Data)

Elapsed Time (m)	Elapsed Time (s)	Depth to water (m)	Drawdown (m)	Flow Rate (USgpm)	Flow Rate (m3/s)	Test Step
720	43200	37.72	32.69	40	0.0025	
780	46800	38.51	33.48	40	0.0025	
840	50400	39.97	34.94	40	0.0025	
900	54000	40.50	35.47	40	0.0025	
960	57600	41.82	36.79	40	0.0025	
1020	61200	42.65	37.62	40	0.0025	
1080	64800	43.52	38.49	40	0.0025	
1140	68400	44.41	39.38	40	0.0025	
1200	72000	45.10	40.07	40	0.0025	
1260	75600	45.77	40.74	40	0.0025	
1320	79200	46.46	41.43	40	0.0025	
1380	82800	47.20	42.17	40	0.0025	
1440	86400	47.71	42.68	40	0.0025	
1440.5	86430	46.84	41.81	0		
1441	86460	46.65	41.62			
1441.5	86490	46.44	41.41			
1442	86520	46.32	41.29			
1442.5	86550	46.21	41.18			
1443	86580	46.10	41.07			
1443.5	86610	46.00	40.97			
1444	86640	45.90	40.87			
1444.5	86670	45.81	40.78			
1445	86700	45.74	40.71			
1446	86760	45.56	40.53			
1447	86820	45.40	40.37			
1448	86880	45.25	40.22			
1449	86940	45.10	40.07			
1450	87000	44.94	39.91			
1452	87120	44.72	39.69			
1454	87240	44.43	39.40			
1456	87360	44.18	39.15			
1458	87480	43.96	38.93			
1460	87600	43.67	38.64			
1465	87900	43.13	38.10			
1470	88200	42.59	37.56			
1475	88500	42.15	37.12			
1480	88800	41.66	36.63			
1485	89100	41.25	36.22			
1490	89400	40.83	35.80			
1496.5	89790	40.30	35.27			
1500	90000	40.04	35.01			
1511	90660	39.26	34.23			
2506	150360	15.93	10.90			

APPENDIX E

PUMPING TEST ANALYSIS (KFN-M AND KFN-N)

Pumping Test Analysis Report

Project: Burwash WTP - KFN-M

Number: ENVH2O03136-02

Client: YG

Location: Burwash Landing, Yukon

Pumping Test: Pumping Test 1

Pumping Well: KFN-M

Test Conducted by:

Test Date: 11/23/2015

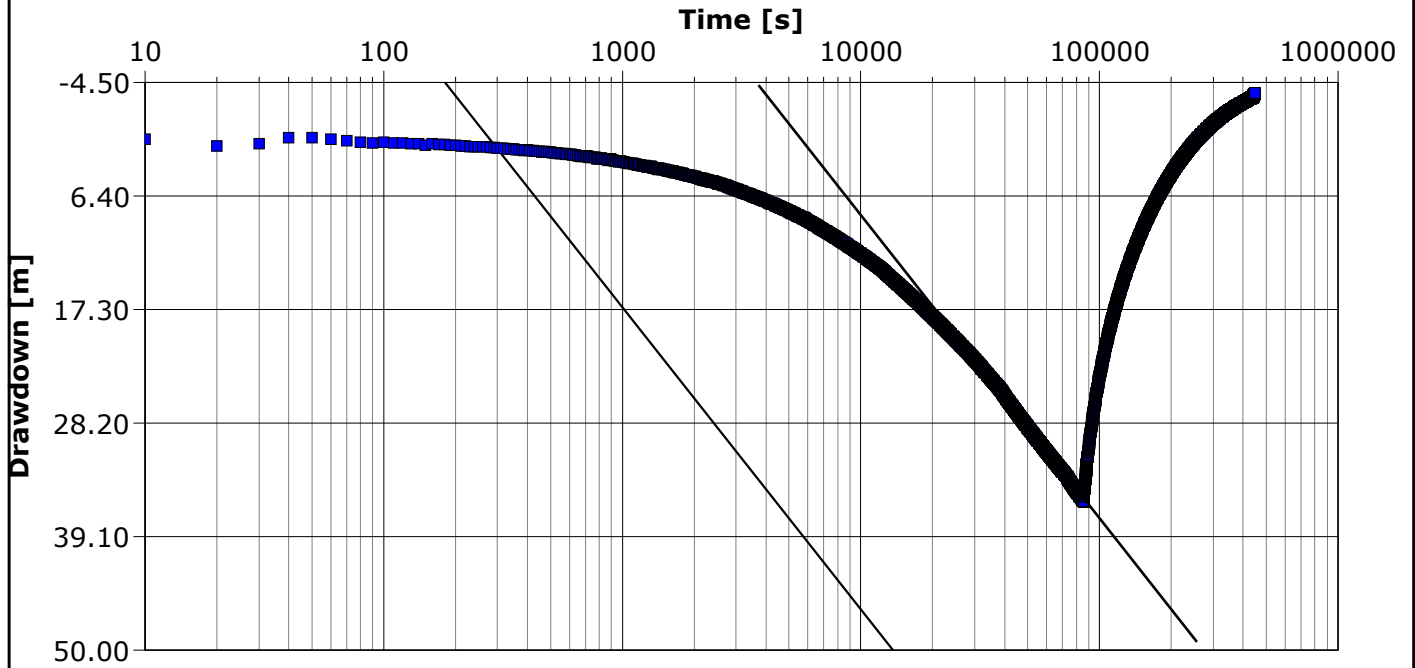
Analysis Performed by: AJS

New analysis 1

Analysis Date: 11/23/2015

Aquifer Thickness: 4.00 m

Discharge: variable, average rate 2.2 [l/s]



Calculation using COOPER & JACOB

Observation Well	Transmissivity [m ² /s]	Hydraulic Conductivity [m/s]	Storage coefficient	Radial Distance to PW [m]
KFN-M	1.39×10^{-5}	3.47×10^{-6}	5.00×10^{-1}	0.13

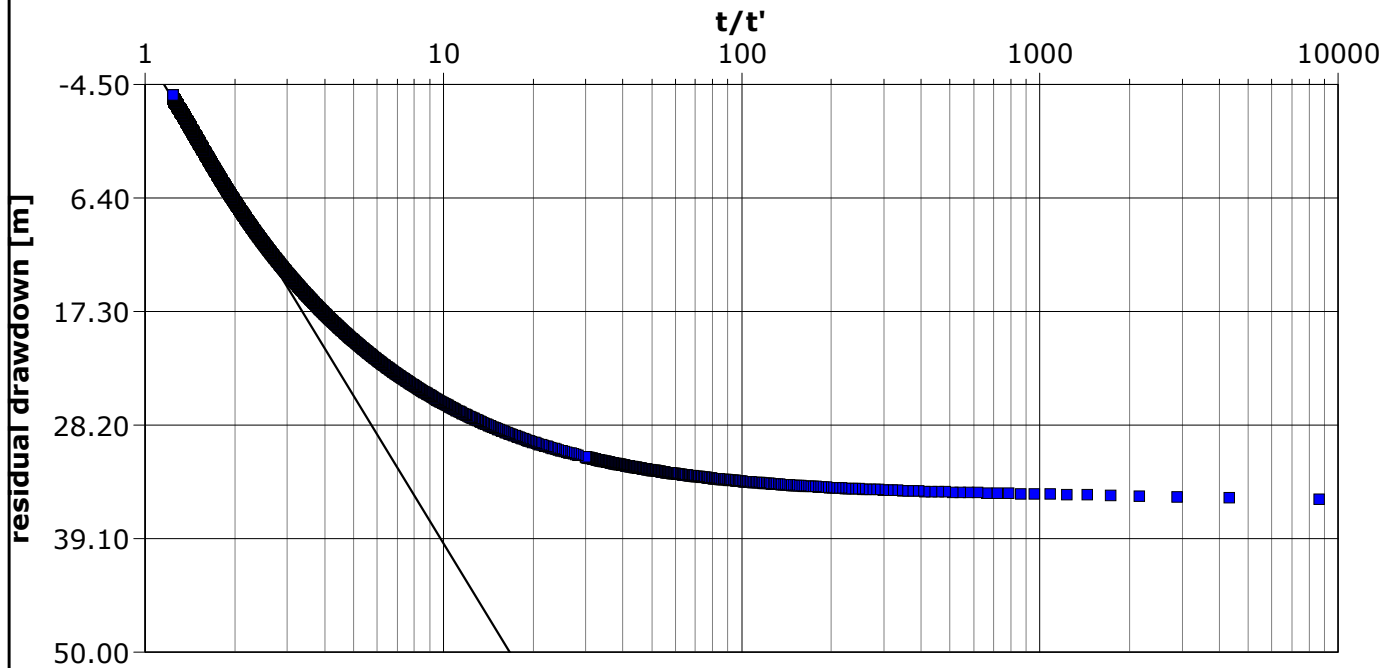
Pumping Test Analysis Report

Project: Burwash WTP - KFN-M

Number: ENVH2O03136-02

Client: YG

Location: Burwash Landing, Yukon	Pumping Test: Pumping Test 1	Pumping Well: KFN-M
Test Conducted by:		Test Date: 11/23/2015
Analysis Performed by: AJS	New analysis 1	Analysis Date: 11/23/2015
Aquifer Thickness: 4.00 m	Discharge: variable, average rate 2.2 [l/s]	



Calculation using THEIS & JACOB

Observation Well	Transmissivity [m ² /s]	Hydraulic Conductivity [m/s]	Radial Distance to PW [m]
KFN-M	8.56×10^{-6}	2.14×10^{-6}	0.13

Pumping Test Analysis Report

Project: Burwash WTP - KFN-N

Number: ENVH2O03136-02

Client: YG

Location: Burwash Landing, Yukon

Pumping Test: Pumping Test 1

Pumping Well: KFN-N

Test Conducted by: AJS

Test Date: 10/22/2015

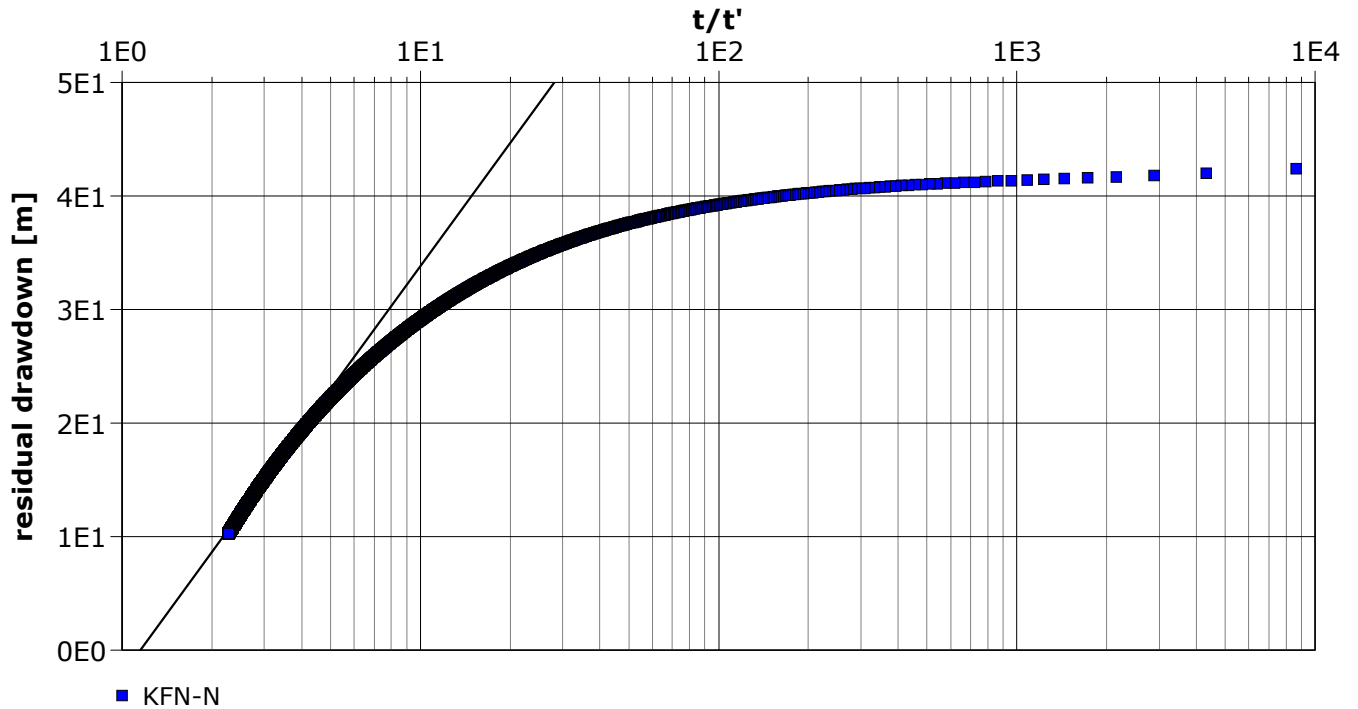
Analysis Performed by:

New analysis 1

Analysis Date: 11/23/2015

Aquifer Thickness: 4.30 m

Discharge: variable, average rate 2.5 [l/s]



Calculation using THEIS & JACOB

Observation Well	Transmissivity [m ² /s]	Hydraulic Conductivity [m/s]	Radial Distance to PW [m]
KFN-N	1.27×10^{-5}	2.95×10^{-6}	0.13

Pumping Test Analysis Report

Project: Burwash WTP - KFN-N

Number: ENVH2O03136-02

Client: YG

Location: Burwash Landing, Yukon

Pumping Test: Pumping Test 1

Pumping Well: KFN-N

Test Conducted by: AJS

Test Date: 10/22/2015

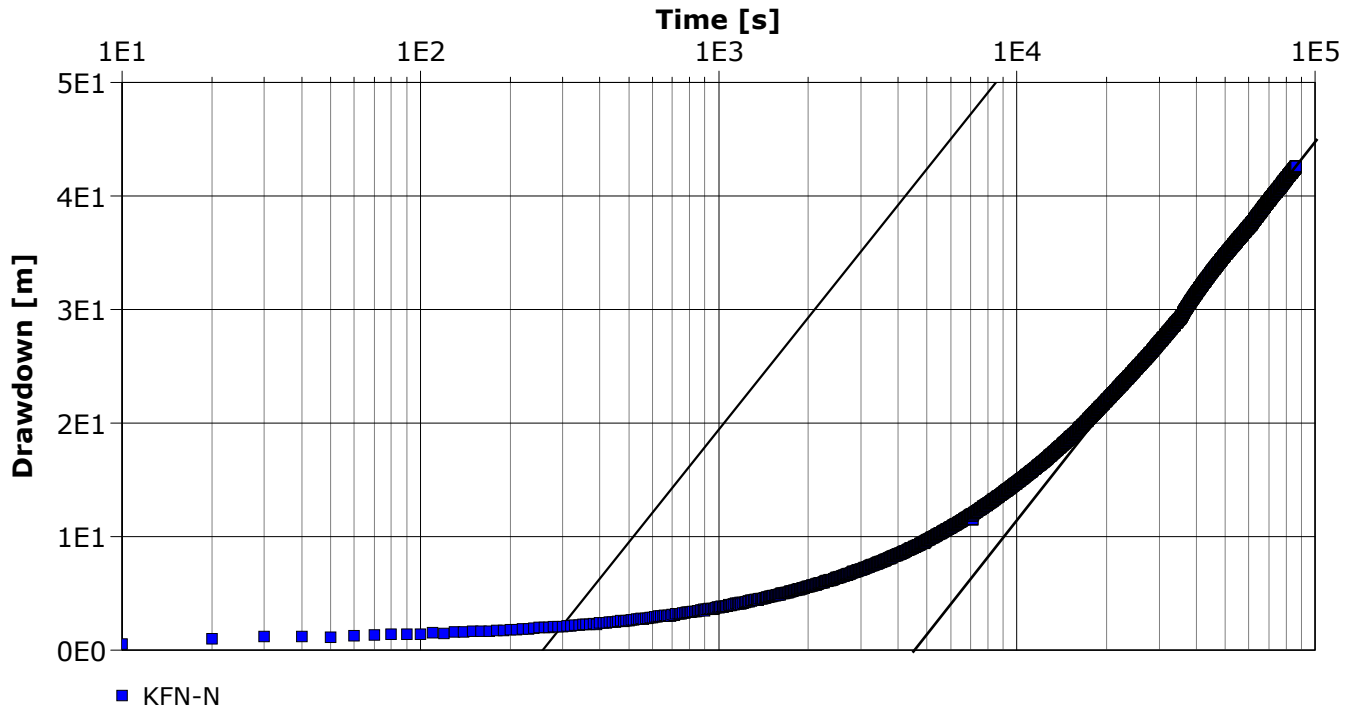
Analysis Performed by:

New analysis 1

Analysis Date: 11/23/2015

Aquifer Thickness: 4.30 m

Discharge: variable, average rate 2.5 [l/s]



Calculation using COOPER & JACOB

Observation Well	Transmissivity [m ² /s]	Hydraulic Conductivity [m/s]	Storage coefficient	Radial Distance to PW [m]
KFN-N	1.39×10^{-5}	3.23×10^{-6}	5.00×10^{-1}	0.13

APPENDIX F

ANALYTICAL LABORATORY RESULTS



Tetra Tech EBA Inc.
ATTN: Adam Seeley
61 Wasson Place
Whitehorse YT Y1A 0H7

Date Received: 28-OCT-15
Report Date: 24-NOV-15 15:18 (MT)
Version: FINAL

Client Phone: 867-668-3068

Certificate of Analysis

Lab Work Order #: L1694980
Project P.O. #: NOT SUBMITTED
Job Reference: ENVH2O03136-02
C of C Numbers: 10-266888
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID	L1694980-1 Drinking W 28-OCT-15 10:00 KFN-M	L1694980-2 Ground W 28-OCT-15 09:30 KFN-MW15-01	L1694980-3 Ground W 28-OCT-15 12:30 KFN-MW15-02		
Grouping	Analyte				
WATER					
Physical Tests	Colour, True (CU)	6.9			
	Conductivity (uS/cm)	380			
	Hardness (as CaCO3) (ug/L)	138000	1300000	2170000	
	pH (pH)	8.50	8.04	7.43	
	Total Dissolved Solids (ug/L)	235000	1710000	3080000	
	Turbidity (NTU)	0.42			
Anions and Nutrients	Alkalinity, Total (as CaCO3) (ug/L)	173000			
	Ammonia, Total (as N) (ug/L)	235	229	37.5	
	Chloride (Cl) (ug/L)	850	44300	54700	
	Fluoride (F) (ug/L)	304			
	Nitrate (as N) (ug/L)	<5.0			
	Nitrite (as N) (ug/L)	<1.0			
	Total Kjeldahl Nitrogen (ug/L)		4100	4880	
	Sulfate (SO4) (ug/L)	36200	772000	1300000	
Organic / Inorganic Carbon	Total Organic Carbon (ug/L)		107000	123000	
Total Metals	Aluminum (Al)-Total (ug/L)	<10			
	Antimony (Sb)-Total (ug/L)	<0.50			
	Arsenic (As)-Total (ug/L)	5.97			
	Barium (Ba)-Total (ug/L)	40			
	Beryllium (Be)-Total (ug/L)	<1.0			
	Boron (B)-Total (ug/L)	460			
	Cadmium (Cd)-Total (ug/L)	<0.20			
	Calcium (Ca)-Total (ug/L)	23100			
	Chromium (Cr)-Total (ug/L)	<2.0			
	Cobalt (Co)-Total (ug/L)	<0.30			
	Copper (Cu)-Total (ug/L)	4.4			
	Iron (Fe)-Total (ug/L)	68			
	Lead (Pb)-Total (ug/L)	<0.50			
	Lithium (Li)-Total (ug/L)	1.3			
	Magnesium (Mg)-Total (ug/L)	19300			
	Manganese (Mn)-Total (ug/L)	65.0			
	Mercury (Hg)-Total (ug/L)	<0.0050			
	Molybdenum (Mo)-Total (ug/L)	14.2			
	Nickel (Ni)-Total (ug/L)	<1.0			
	Potassium (K)-Total (ug/L)	4400			
	Selenium (Se)-Total (ug/L)	1.2			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID				
	L1694980-1 Drinking W 28-OCT-15 10:00 KFN-M	L1694980-2 Ground W 28-OCT-15 09:30 KFN-MW15-01	L1694980-3 Ground W 28-OCT-15 12:30 KFN-MW15-02		
Grouping	Analyte				
WATER					
Total Metals	Silver (Ag)-Total (ug/L)	<0.020			
	Sodium (Na)-Total (ug/L)	35900			
	Thallium (Tl)-Total (ug/L)	<0.20			
	Tin (Sn)-Total (ug/L)	<0.50			
	Titanium (Ti)-Total (ug/L)	<10			
	Uranium (U)-Total (ug/L)	0.58			
	Vanadium (V)-Total (ug/L)	5.79			
	Zinc (Zn)-Total (ug/L)	<50			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	LAB	LAB	
	Dissolved Metals Filtration Location	FIELD	FIELD	LAB	
	Aluminum (Al)-Dissolved (ug/L)	<5.0	<10	36	
	Antimony (Sb)-Dissolved (ug/L)	<0.50	0.66	1.13	
	Arsenic (As)-Dissolved (ug/L)	5.78	2.0	2.2	
	Barium (Ba)-Dissolved (ug/L)	39	34	44	
	Beryllium (Be)-Dissolved (ug/L)	<1.0			
	Boron (B)-Dissolved (ug/L)	450	260	200	
	Cadmium (Cd)-Dissolved (ug/L)	0.0051	0.064	0.091	
	Calcium (Ca)-Dissolved (ug/L)	23300	177000	318000	
	Chromium (Cr)-Dissolved (ug/L)	<1.0	<1.0	1.0	
	Cobalt (Co)-Dissolved (ug/L)	<0.30	3.25	1.13	
	Copper (Cu)-Dissolved (ug/L)	2.6	6.3	19.4	
	Iron (Fe)-Dissolved (ug/L)	43	<30	<30	
	Lead (Pb)-Dissolved (ug/L)	<0.50	<1.0	<1.0	
	Lithium (Li)-Dissolved (ug/L)	<1.0			
	Magnesium (Mg)-Dissolved (ug/L)	19500	208000	333000	
	Manganese (Mn)-Dissolved (ug/L)	64.8			
	Mercury (Hg)-Dissolved (ug/L)	<0.0050	<0.20	<0.20	
	Molybdenum (Mo)-Dissolved (ug/L)	13.0	4.6	3.9	
	Nickel (Ni)-Dissolved (ug/L)	<1.0	14.6	21.5	
	Potassium (K)-Dissolved (ug/L)	4400			
	Selenium (Se)-Dissolved (ug/L)	1.19	1.8	1.2	
	Silver (Ag)-Dissolved (ug/L)	<0.020	<0.050	<0.050	
	Sodium (Na)-Dissolved (ug/L)	35300	73800	91400	
	Thallium (Tl)-Dissolved (ug/L)	<0.20	<0.20	<0.20	
	Tin (Sn)-Dissolved (ug/L)	<0.50			
	Titanium (Ti)-Dissolved (ug/L)	<10	<50	<50	
	Uranium (U)-Dissolved (ug/L)	0.53	15.8	32.2	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1694980-1	L1694980-2	L1694980-3		
		Description	Drinking W	Ground W	Ground W		
		Sampled Date	28-OCT-15	28-OCT-15	28-OCT-15		
		Sampled Time	10:00	09:30	12:30		
		Client ID	KFN-M	KFN-MW15-01	KFN-MW15-02		
Grouping	Analyte						
WATER							
Dissolved Metals	Vanadium (V)-Dissolved (ug/L)	5.73					
	Zinc (Zn)-Dissolved (ug/L)	<5.0	<5.0	5.1			
Aggregate Organics	COD (ug/L)		297000	319000			
	Volatile Organic Compounds						
	Benzene (ug/L)		<0.50	<0.50			
	Bromodichloromethane (ug/L)		<1.0	<1.0			
	Bromoform (ug/L)		<1.0	<1.0			
	Carbon Tetrachloride (ug/L)		<0.50	<0.50			
	Chlorobenzene (ug/L)		<1.0	<1.0			
	Dibromochloromethane (ug/L)		<1.0	<1.0			
	Chloroethane (ug/L)		<1.0	<1.0			
	Chloroform (ug/L)		<1.0	<1.0			
	Chloromethane (ug/L)		<5.0	<5.0			
	1,2-Dichlorobenzene (ug/L)		<0.70	<0.70			
	1,3-Dichlorobenzene (ug/L)		<1.0	<1.0			
	1,4-Dichlorobenzene (ug/L)		<1.0	<1.0			
	1,1-Dichloroethane (ug/L)		<1.0	<1.0			
	1,2-Dichloroethane (ug/L)		<1.0	<1.0			
	1,1-Dichloroethylene (ug/L)		<1.0	<1.0			
	cis-1,2-Dichloroethylene (ug/L)		<1.0	<1.0			
	trans-1,2-Dichloroethylene (ug/L)		<1.0	<1.0			
	1,3-Dichloropropene (cis & trans) (ug/L)		<1.4	<1.4			
	Dichloromethane (ug/L)		<5.0	<5.0			
	1,2-Dichloropropane (ug/L)		<1.0	<1.0			
	cis-1,3-Dichloropropylene (ug/L)		<1.0	<1.0			
	trans-1,3-Dichloropropylene (ug/L)		<1.0	<1.0			
	Ethylbenzene (ug/L)		<0.50	<0.50			
	Methyl t-butyl ether (MTBE) (ug/L)		<0.50	<0.50			
	Styrene (ug/L)		<0.50	<0.50			
	1,1,1,2-Tetrachloroethane (ug/L)		<1.0	<1.0			
	1,1,2,2-Tetrachloroethane (ug/L)		<1.0	<1.0			
	Tetrachloroethylene (ug/L)		<1.0	<1.0			
	Toluene (ug/L)		<0.50	<0.50			
	1,1,1-Trichloroethane (ug/L)		<1.0	<1.0			
	1,1,2-Trichloroethane (ug/L)		<1.0	<1.0			
	Trichloroethylene (ug/L)		<1.0	<1.0			
	Trichlorofluoromethane (ug/L)		<1.0	<1.0			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID	L1694980-1 Drinking W 28-OCT-15 10:00 KFN-M	L1694980-2 Ground W 28-OCT-15 09:30 KFN-MW15-01	L1694980-3 Ground W 28-OCT-15 12:30 KFN-MW15-02		
Grouping	Analyte				
WATER					
Volatile Organic Compounds	Vinyl Chloride (ug/L)		<1.0	<1.0	
	ortho-Xylene (ug/L)		<0.50	<0.50	
	meta- & para-Xylene (ug/L)		<0.50	<0.50	
	Xylenes (ug/L)		<0.75	<0.75	
	Surrogate: 4-Bromofluorobenzene (SS) (%)		88.3	86.9	
	Surrogate: 1,4-Difluorobenzene (SS) (%)		96.9	98.6	
Hydrocarbons	EPH10-19 (ug/L)	<250	<250	<250	
	EPH19-32 (ug/L)	<250	<250	<250	
	LEPH (ug/L)		<250	<250	
	HEPH (ug/L)		<250	<250	
	Volatile Hydrocarbons (VH6-10) (ug/L)		<100	<100	
	VPH (C6-C10) (ug/L)		<100	<100	
	Surrogate: 2-Bromobenzotrifluoride (%)	105.2	101.1	101.4	
	Surrogate: 3,4-Dichlorotoluene (SS) (%)		75.5	71.2	
Polycyclic Aromatic Hydrocarbons	Acenaphthene (ug/L)		<0.050	<0.050	
	Acenaphthylene (ug/L)		<0.050	<0.050	
	Acridine (ug/L)		<0.10	<0.050	
	Anthracene (ug/L)		<0.050	<0.050	
	Benz(a)anthracene (ug/L)		<0.050	<0.050	
	Benzo(a)pyrene (ug/L)		<0.010	<0.010	
	Benzo(b)fluoranthene (ug/L)		<0.050	<0.050	
	Benzo(g,h,i)perylene (ug/L)		<0.050	<0.050	
	Benzo(k)fluoranthene (ug/L)		<0.050	<0.050	
	Chrysene (ug/L)		<0.050	<0.050	
	Dibenz(a,h)anthracene (ug/L)		<0.050	<0.050	
	Fluoranthene (ug/L)		<0.050	<0.050	
	Fluorene (ug/L)		<0.050	<0.050	
	Indeno(1,2,3-c,d)pyrene (ug/L)		<0.050	<0.050	
	Naphthalene (ug/L)		<0.050	<0.050	
	Phenanthrene (ug/L)		<0.050	<0.050	
	Pyrene (ug/L)		<0.050	<0.050	
	Quinoline (ug/L)		<0.050	<0.050	
	Surrogate: Acridine d9 (%)		56.1	65.1	
	Surrogate: Chrysene d12 (%)		72.9	77.2	
Surrogate: Naphthalene d8 (%)		88.3	85.1		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	Description	Sampled Date	Sampled Time	Client ID				
L1694980-1	Drinking W	28-OCT-15	10:00	KFN-M				
L1694980-2	Ground W	28-OCT-15	09:30	KFN-MW15-01				
L1694980-3	Ground W	28-OCT-15	12:30	KFN-MW15-02				
Grouping	Analyte							
WATER								
Polycyclic Aromatic Hydrocarbons	Surrogate: Phenanthrene d10 (%)				85.8	86.8		
Trihalomethanes	Total THMs (ug/L)			34.4				
Formation Potential Trihalomethanes	Bromoform (ug/L)			<0.50				
	Bromodichloromethane (ug/L)			2.87				
	Chloroform (ug/L)			31.5				
	Chlorodibromomethane (ug/L)			<0.50				
	Surrogate: 4-Bromofluorobenzene (SS) (%)			85.3				
	Surrogate: 1,4-Difluorobenzene (SS) (%)			98.0				
Haloacetic Acids	Bromochloroacetic Acid (ug/L)			<1.0				
	Dibromoacetic Acid (ug/L)			<1.0				
	Dichloroacetic Acid (ug/L)			2.2				
	Monobromoacetic Acid (ug/L)			<1.0				
	Monochloroacetic Acid (ug/L)			<5.0				
	Trichloroacetic Acid (ug/L)			4.2				
	Surrogate: 2,3-Dibromopropionic Acid (SS) (%)			100.6				
Formation Potential Haloacetic Acids	Chlorine, Amount Dosed (ug/L)			5280				
	Chlorine, Amount Achieved (ug/L)			3500				
	Chlorine, Demand (ug/L)			1780				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Nitrite (as N)	DLDS	L1694980-1
Duplicate	Nitrite (as N)	DLDS	L1694980-1
Duplicate	Nitrate (as N)	DLDS	L1694980-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1694980-1, -2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1694980-1, -2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1694980-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1694980-1, -2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1694980-1, -2
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1694980-1, -2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1694980-1, -2
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1694980-1, -2
Matrix Spike	Boron (B)-Dissolved	MS-B	L1694980-1, -2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1694980-1, -2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1694980-1, -2
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1694980-1, -2
Matrix Spike	Sulfate (SO4)	MS-B	L1694980-1, -2, -3
Matrix Spike	Selenium (Se)-Dissolved	MS-B	L1694980-3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1694980-3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1694980-3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
SURR-ND	Surrogate recovery marginally exceeded ALS DQO. Reported non-detect results for associated samples were deemed to be unaffected.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-COL-VA	Water	Alkalinity by Colourimetric (Automated)	EPA 310.2
This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310B TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND
This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength
This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
EPH-ME-FID-VA	Water	EPH in Water	BC Lab Manual
EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.			
F-IC-N-WR	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			

Reference Information

HAA-FP-ECD-WP	Water	HAA Formation Potential	APHA 5710B (modified)
<p>The HAA formation potential procedure is used to determine the potential for water sources or water treatment processes to form HAAs. HAA concentration is determined using liquid-liquid extraction, capillary column, GC/electron capture techniques.</p>			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
<p>Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO₃ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.</p>			
HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)
<p>Water samples are filtered (0.45 µm), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.</p>			
HG-DIS-CVAFS-VA	Water	Dissolved Hg in Water by CVAFS LOR=50ppt	APHA 3030B/EPA 1631E (mod)
<p>This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).</p>			
HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)
<p>Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.</p>			
LEPH/HEPH-CALC-VA	Water	LEPHs and HEPHs	BC MOE LABORATORY MANUAL (2005)
<p>Light and Heavy Extractable Petroleum Hydrocarbons in water. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 20, 1999).</p>			
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)
<p>Water samples are filtered (0.45 µm), preserved with nitric acid, and analyzed by CRC ICPMS.</p>			
<p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p>			
MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B
<p>This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).</p>			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
<p>Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.</p>			
<p>Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.</p>			
MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B
<p>This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).</p>			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	APHA 4500 NH3-NITROGEN (AMMONIA)
<p>This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.</p>			
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
<p>This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.</p>			
NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)
<p>Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.</p>			
NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PAH-ME-MS-VA Water PAHs in Water EPA 3511/8270D (mod)

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

THM-FORM-HS-WP Water THM Formation Potential APHA 5710B (modified)

The THM formation potential procedure is used to determine the potential for water sources or water treatment processes to form THMs. THM concentration is determined using head space techniques.

THM-SUM-CALC-WP Water Total Trihalomethanes (THMs) CALCULATION

Total Trihalomethanes (THMs) represents the sum of bromodichloromethane, bromoform, chlorodibromomethane and chloroform. For the purpose of calculation, results less than the detection limit (DL) are treated as zero.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

VH-HSFID-VA Water VH in Water by Headspace GCFID B.C. MIN. OF ENV. LAB. MAN. (2009)

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Compounds eluting between n-hexane and n-decane are measured and summed together using flame-ionization detection.

VH-SURR-FID-VA Water VH Surrogates for Waters B.C. MIN. OF ENV. LAB. MAN. (2009)

VOC-HSMS-VA Water VOCs in water by Headspace GCMS EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-HSMS-VA Water BTEX/MTBE/Styrene by Headspace GCMS EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA Water VOC7 and/or VOC Surrogates for Waters EPA8260B, 5021

VPH-CALC-VA Water VPH is VH minus select aromatics BC MOE LABORATORY MANUAL (2005)

These results are determined according to the British Columbia Ministry of Environment Analytical Method for Contaminated Sites "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water". The concentrations of specific Monocyclic Aromatic Hydrocarbons (Benzene, Toluene,

Reference Information

Ethylbenzene, Xylenes and, in solids, Styrene) are subtracted from the collective concentration of Volatile Hydrocarbons (VH) that elute between n-hexane (nC6) and n-decane (nC10).

XYLENES-CALC-VA Water Sum of Xylene Isomer Concentrations CALCULATION
Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-266888

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

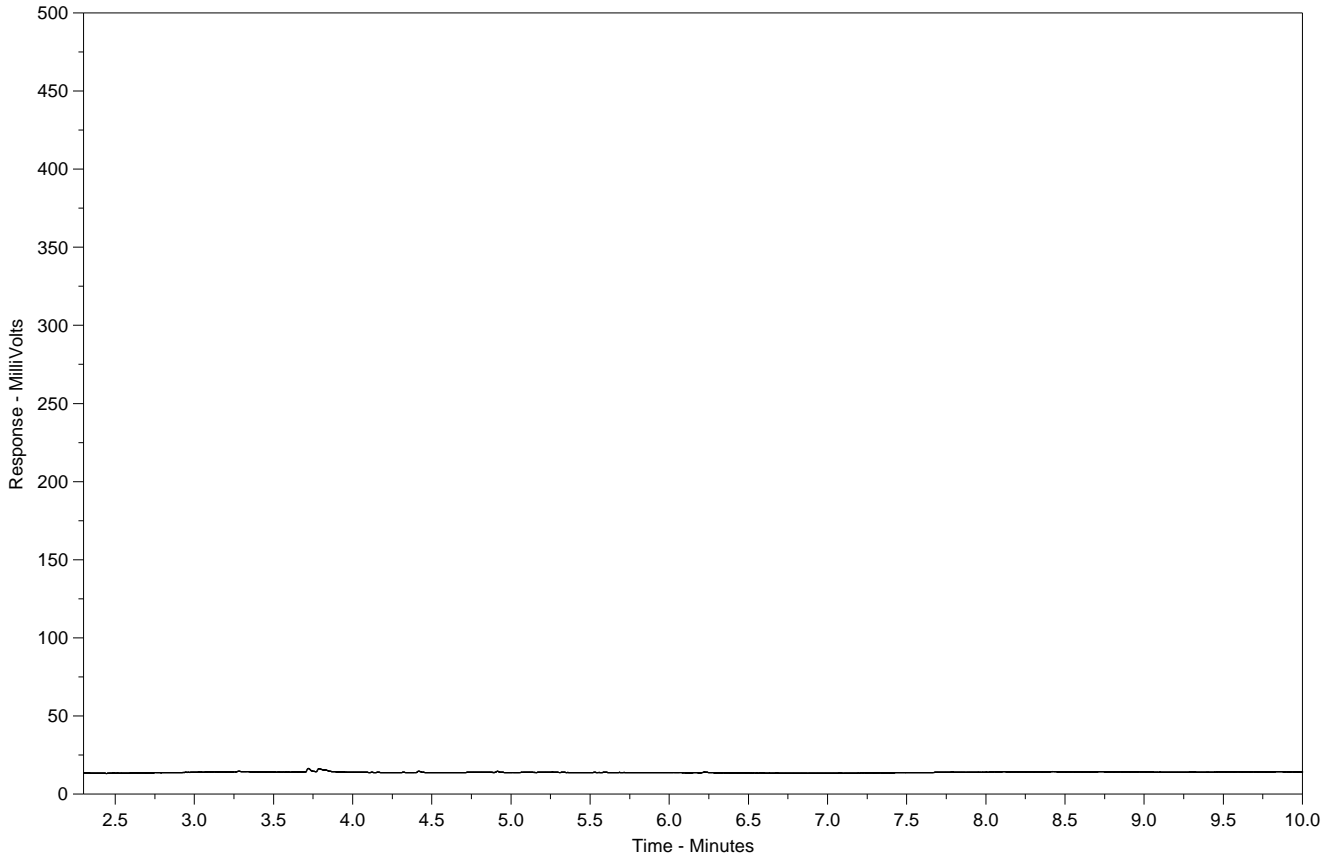
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Hydrocarbon Distribution Report



ALS Sample ID: L1694980-1
 Client Sample ID: KFN-M



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline → ← Diesel / Jet Fuels → ← Motor Oils / Lube Oils / Grease →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

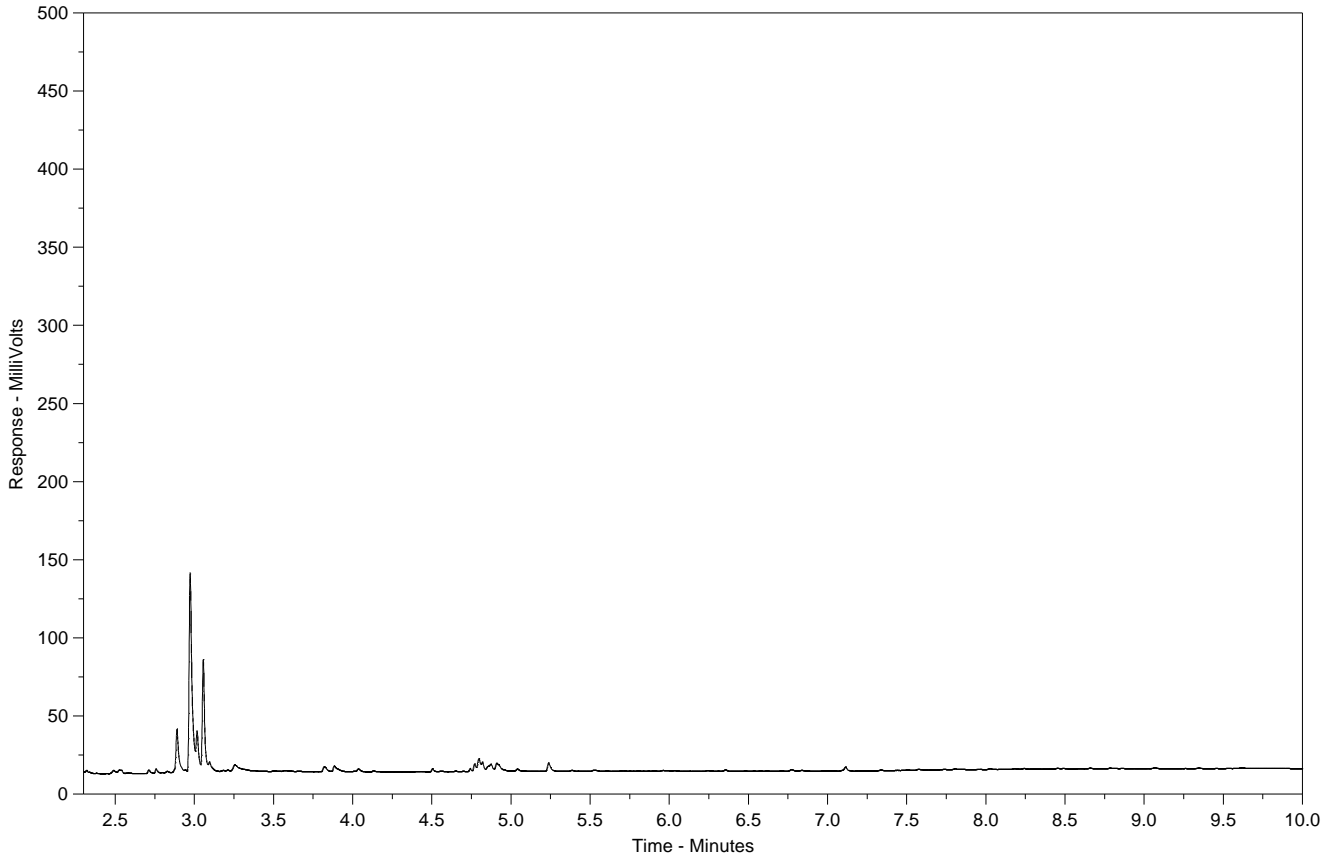
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report



ALS Sample ID: L1694980-2
Client Sample ID: KFN-MW15-01



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →		← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

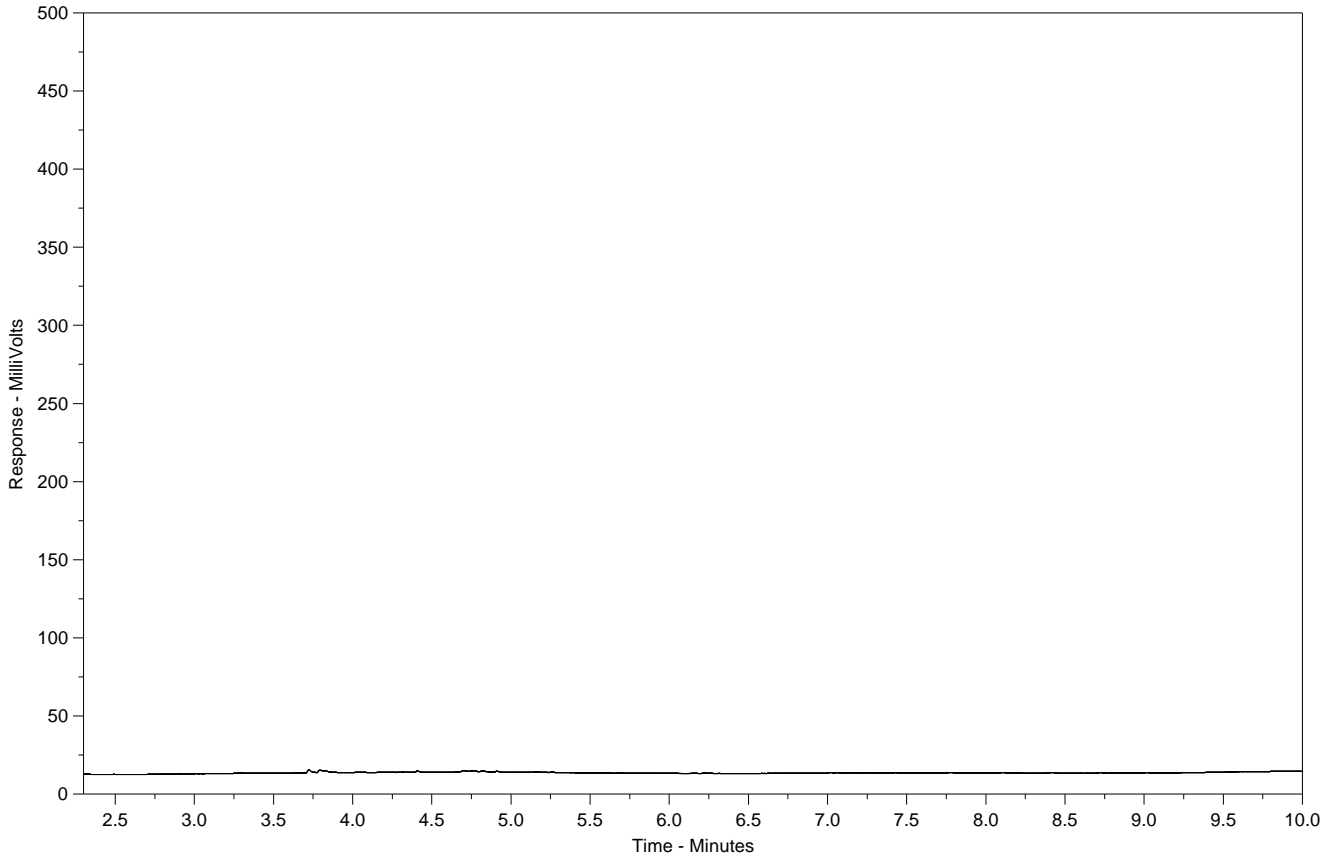
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report



ALS Sample ID: L1694980-3
Client Sample ID: KFN-MW15-02



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →		
← Diesel / Jet Fuels →		
← Motor Oils / Lube Oils / Grease →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.



Health and Social Services
Santé et Affaires sociales
Environmental Health Services
Service d'hygiène du milieu

BACTERIOLOGICAL ANALYSIS OF DRINKING WATER
ANALYSE BACTÉRIOLOGIQUE DE L'EAU POTABLE

#2 Hospital Road, Whitehorse, Yukon Y1A 3H8
phone : (867) 667-8391 fax : (867) 667-8322
Toll free: 1-800-661-0408 ext.8391

2 Hospital Road, Whitehorse (Yukon) Y1A 3H8
Tél. : 867-667-8391 Téléc. : 867-667-8322
Sans frais au Yukon : 1-800-661-0408, poste 8391

Contact information - Coordonnées de la personne ressource

Contact Person / Personne ressource: Kristen Rame Phone / Téléphone: 667-9225
Mailing address / Adresse postale: Tetra Tech EBA Fax / Télécopieur:
61 Wason Place Postal code / Code postal:
First Nation, Municipal or Business Name / Nom de la Première nation, de la municipalité ou de l'entreprise: Kluane First Nation
Agent / Agent: Tetra Tech EBA Fax / Télécopieur:

Sampling Location - Lieu de la prise d'échantillon

Municipal Address / Adresse municipale: Burwash Well KFN-M Subdivision / Lotissement: Burwash
Legal Description Lot / Désignation officielle Lot: _____ Quad / Quadrilatère: _____ Plan no. / Plan n°: _____
Other information (e.g. Location, Business / Building Name) / Autres renseignements (ex.: emplacement, nom de l'entreprise, nom de l'édifice): KFN-M

Sample Collection / Prélèvement de l'échantillon

Sample Collected By / Échantillon prélevé par: Kristen Rame Date / Date: 15/10/28 Time / Heure: 10:00 am
Sampling Site (e.g., kitchen tap) / Point d'échantillonnage (ex.: robinet de cuisine): Sampling port
Is this a Resample from a Previous Test? / Est-ce un deuxième échantillon d'un test antérieur? Yes / Oui No / Non Previous Sample Number / Numéro de l'échantillon précédent: _____

Sample Supply / Source d'approvisionnement en eau

Public Supply / Municipal - par canalisation Bulk Water Distributor / Municipal - par camion Business / Privé - entreprise Private Residence / Privé - résidence

Sample Source / Provenance de l'échantillon

Dug Well / Puits creusé Driven Well / Puits tubulaire Drilled Well / Puits foré à la sondeuse Depth of Well / Profondeur du puits: 160'
 Water Holding Tank / Réservoir d'eau Other (explain) / Autre (précisez): _____

Water Treatment / Traitement de l'eau

Is the Water Chlorinated? / L'eau contient-elle du chlore? Yes / Oui No / Non Free Available Chlorine / Chlore libre disponible: _____ ppm / mg/L
Other Treatment Systems (e.g., UV, softener, filter) / Autre dispositif de traitement (ex.: désinfection aux rayons UV, adoucisseur d'eau, filtre): NO

For Laboratory Use Only / À l'usage du laboratoire seulement

Receipt of Sample / Réception de l'échantillon: Date / Date: 15-10-28 Time / Heure: 3:50 pm By / Par: SS
Condition of Sample / État de l'échantillon: Satisfactory / Satisfaisant Unsatisfactory / Non satisfaisant Details / Précisez: 36°C
Incubation: Date / Date: 15-10-28 Time / Heure: 4:00 pm By / Par: SS Incubator / Incubateur: 2
Analysis Completed / Analyse terminée: Date / Date: 15-10-29 Time / Heure: 4:15 pm By / Par: SS

Results (See Reverse Side for Interpretation) per 100 ml
Résultats (Voir au verso l'interprétation des résultats)

Total Coliforms/Coliformes totaux
 Present / Présence Absent / Absence

E. coli/E. coli
 Present / Présence Absent / Absence

Comments / Commentaires

Report Authorized By / Rapport autorisé par: [Signature] Position / Poste: WLT Date / Date: 15-10-29

Distribution: White - Chain of Custody / Blanc - Chaîne de possession Yellow - Lab Copy / Jaune - Laboratoire Pink - Client Copy / Rose - Client

SRC Group # 2015-12613

Nov 20, 2015

Tetra Tech EBA
14940-123 Avenue
Edmonton, AB T5V 1B4
Attn: KRISTEN RANGE

Date Samples Received: Nov-13-2015

Client P.O.:

This is a final report.

Organics results have been authorized by Pat Moser, Supervisor

Inorganics and ICP results have been authorized by Keith Gipman, Supervisor

Radiochemistry results have been authorized by Vicky Snook, Supervisor

SLOWPOKE-2 results have been authorized by Dave Chorney

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as

- * Standard Methods for the Examination of Water and Wastewater APHA AWWA WEF
- * Environment Canada
- * US EPA
- * CANMET

* The results reported relate only to the test samples as provided by the client.

* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

SRC Group # 2015-12613

Nov 20, 2015

Tetra Tech EBA
14940-123 Avenue
Edmonton, AB T5V 1B4
Attn: KRISTEN RANGE

Date Samples Received: Nov-13-2015

Client P.O.:

38851 10/28/2015 10:00 KFN-M *WATER*

Analyte	Units	38851
Radiochemistry		
Gross alpha	Bq/L	<0.19
Gross beta	Bq/L	0.17±0.03

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.



Tetra Tech EBA Inc.
ATTN: Ryan Martin
61 Wasson Place
Whitehorse YT Y1A 0H7

Date Received: 26-OCT-15
Report Date: 04-NOV-15 13:30 (MT)
Version: FINAL

Client Phone: 867-668-3068

Certificate of Analysis

Lab Work Order #: L1693357
Project P.O. #: NOT SUBMITTED
Job Reference: ENVH2003136-04
C of C Numbers: 10-266890
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1693357-1	Water	24-OCT-15	16:00	KFN-N
Grouping	Analyte					
WATER						
Physical Tests	Colour, True (CU)		7.5			
	Conductivity (uS/cm)		406			
	Hardness (as CaCO3) (ug/L)		137000			
	pH (pH)		8.39			
	Total Dissolved Solids (ug/L)		226000			
	Turbidity (NTU)		0.48			
Anions and Nutrients	Alkalinity, Total (as CaCO3) (ug/L)		178000			
	Chloride (Cl) (ug/L)		910			
	Fluoride (F) (ug/L)		293			
	Nitrate (as N) (ug/L)		<5.0			
	Nitrite (as N) (ug/L)		<1.0			
	Sulfate (SO4) (ug/L)		35700			
	Anion Sum (meq/L)		4.35			
	Cation Sum (meq/L)		4.38			
	Cation - Anion Balance (%)		0.4			
Bacteriological Tests	E. coli (MPN/100mL)		<1	PEHR		
	Coliform Bacteria - Total (MPN/100mL)		<1	PEHR		
Total Metals	Aluminum (Al)-Total (ug/L)		11			
	Antimony (Sb)-Total (ug/L)		<0.50			
	Arsenic (As)-Total (ug/L)		6.40			
	Barium (Ba)-Total (ug/L)		37			
	Boron (B)-Total (ug/L)		490			
	Cadmium (Cd)-Total (ug/L)		<0.20			
	Calcium (Ca)-Total (ug/L)		23800			
	Chromium (Cr)-Total (ug/L)		<2.0			
	Copper (Cu)-Total (ug/L)		2.8			
	Iron (Fe)-Total (ug/L)		103			
	Lead (Pb)-Total (ug/L)		<0.50			
	Magnesium (Mg)-Total (ug/L)		18800			
	Manganese (Mn)-Total (ug/L)		72.6			
	Mercury (Hg)-Total (ug/L)		<0.20			
	Potassium (K)-Total (ug/L)		3540			
	Selenium (Se)-Total (ug/L)		<1.0			
	Sodium (Na)-Total (ug/L)		35400			
	Uranium (U)-Total (ug/L)		0.18			
	Zinc (Zn)-Total (ug/L)		<50			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Calcium (Ca)-Total	MS-B	L1693357-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-COL-VA	Water	Alkalinity by Colourimetric (Automated)	EPA 310.2
This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.			
CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength
This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
ECOLI-COLI-BCDW-VA	Water	E.coli by Colilert	APHA METHOD 9223
This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.			
EPH-ME-FID-VA	Water	EPH in Water	BC Lab Manual
EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.			
F-IC-N-WR	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-TOT-CVAFS-VA	Water	Total Hg in Water by CVAFS LOR=50ppt	EPA 1631E (mod)
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
IONBALANCE-VA	Water	Ion Balance Calculation	APHA 1030E
Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero. Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance is calculated as: Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]			
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.			
MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TCOLI-COLI-BCDW-VA Water Total coliform by Colilert APHA METHOD 9223

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is quantified by a statistical estimation of bacteria density (most probable number).

TDS-CALC-VA Water TDS (Calculated) APHA 1030E (20TH EDITION)

This analysis is carried out using procedures adapted from APHA 1030E "Checking Correctness of Analyses".

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-266890

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

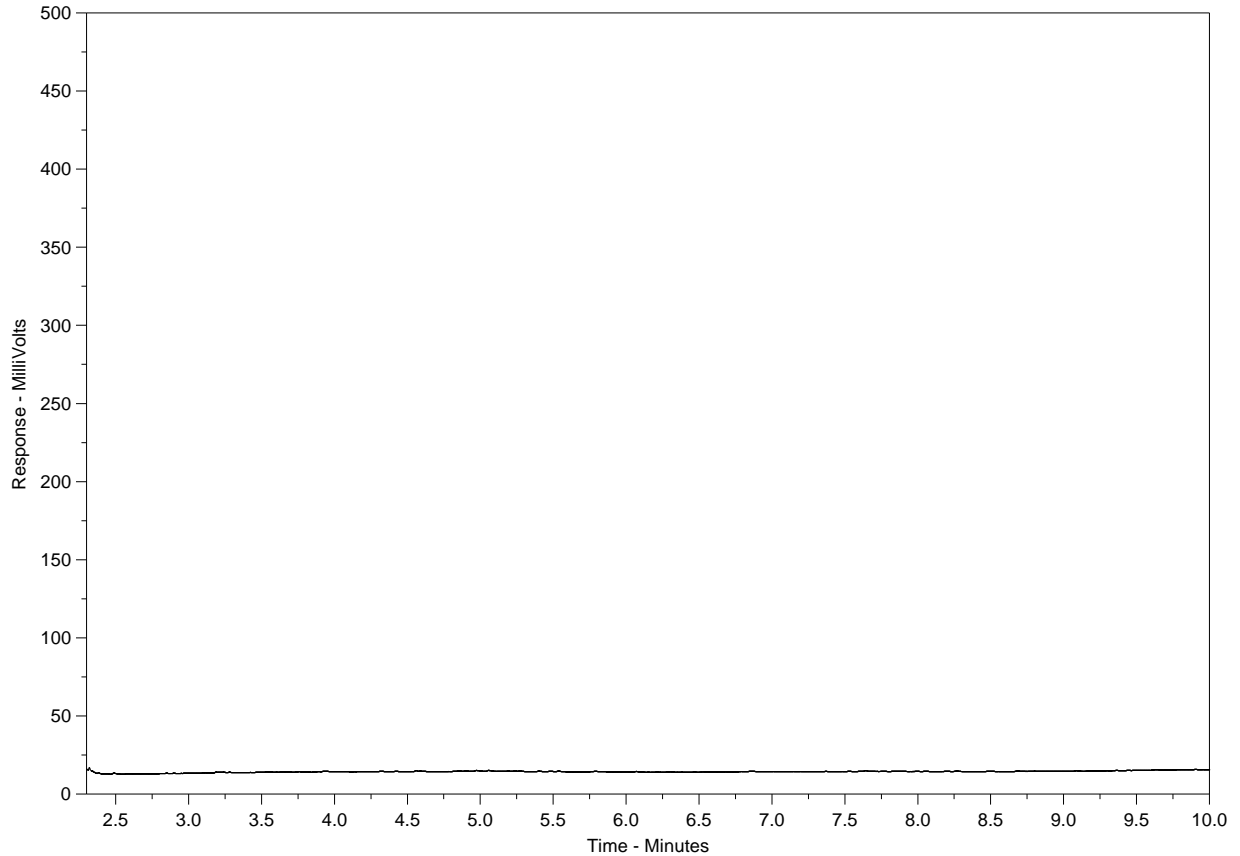
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

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Hydrocarbon Distribution Report



ALS Sample ID: L1693357-1
Client Sample ID: KFN-N



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Diesel / Jet Fuels →	← Motor Oils / Lube Oils / Grease →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

SRC Group # 2015-11910

Nov 06, 2015

Tetra Tech EBA
61 Wasson Place
Whitehorse, Yukon Y1A 0H7
Attn: Ryan Martin

Date Samples Received: Oct-29-2015

Client P.O.: ENVH2O03136-02

This is a final report.

Organics results have been authorized by Pat Moser, Supervisor

Inorganics and ICP results have been authorized by Keith Gipman, Supervisor

Radiochemistry results have been authorized by Vicky Snook, Supervisor

SLOWPOKE-2 results have been authorized by Dave Chorney

* Test methods and data are validated by the laboratory's Quality Assurance Program.

* Routine methods follow recognized procedures from sources such as

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- * Environment Canada
- * US EPA
- * CANMET

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* Samples will be kept for 30 days after the final report is sent. Please contact the lab if you have any special requirements.

* Additional information is available upon request.

SRC Group # 2015-11910

Nov 06, 2015

Tetra Tech EBA
61 Wasson Place
Whitehorse, Yukon Y1A 0H7
Attn: Ryan Martin

Date Samples Received: Oct-29-2015

Client P.O.: ENVH2O03136-02

36446 10/24/2015 KFN-N *WATER*

Analyte	Units	36446
Radiochemistry		
Gross alpha	Bq/L	<0.26
Gross beta	Bq/L	0.22±0.04

Symbol of "<" means "less than". This indicates that it was not detected at level stated above.



Date: September 4, 2015

Lab Report No. 20274

Adam Seeley
Tetra Tech EBA, Inc
61 Wasson PL
Whitehorse, YT Y1A OH7, Canada

Project Description: Kluane First Nation, Well KFN-L; Samples dated 8/13/15
Complete Profile; P.O. #ENVH2003136

Test Description:

The Complete Well Profile analysis is designed for comparative analysis of two samples, typically one static and one pumping sample. The Complete Well Profile utilizes a series of inorganic chemical and microbiological tests to identify fouling and corrosion issues with potential impacts on the operation of the sampled well. The tests include a number of inorganic chemical parameters such as pH, total dissolved solids/conductivity, hardness, alkalinity, oxidation reduction potential (ORP), bicarbonate, carbonates, silica, sodium, potassium, chloride, iron, manganese, phosphate, nitrate, sulfate, and total organic carbon (TOC). Biological assessment is designed to quantify the total bacterial population, identify two dominant populations of bacteria, assess anaerobic conditions, and identify the presence of iron related bacteria and sulfate reducing organisms. Also included are tests for Adenosine triphosphate (ATP), heterotrophic plate count (HPC), total coliform and E. coli coliform, and a microscopic evaluation.

Testing Procedures:

All laboratory testing procedures are performed according to the guidelines set forth in *Standard Methods for the Examination of Water and Wastewater* as established by the American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF). Corrosion analyses are performed in accordance with the guidelines as set forth by the National Association of Corrosion Engineers (NACE). In general, these methods are approved by both the Environmental Protection Agency (EPA) and AWWA for the reporting of water and/or wastewater data.

Sample collection and shipment is the responsibility of the customer, performed according to protocol and procedures defined by the laboratory in advance of the sampling event with regards to the specific project and nature of the problem.

Disclaimer:

The data and interpretations presented are based on an evaluation of the samples and submitted data. Conclusions reached in this report are based upon the data available at the time of submittal and the accuracy of the report depends upon the validity of information submitted. Any recommendations presented are based on laboratory and field evaluations of similar fouling occurrences within potable water systems. Further investigative efforts, such as efficiency testing, site inspection, video survey, or other evaluation methods may offer additional insight into the system's condition and the degree of fouling present.

Client: Tetra Tech EBA, Inc

Date: September 4, 2015

Lab Report No. 20274

Re: Kluane First Nation, Well KFN-L; Samples dated 8/13/15
 Complete Profile; P.O. #ENVH2003136

ND - Not Detected NA - Not Applicable *as CaCO ₃	KFN-L mg/l	Detection Limits
pH Value	8.50	NA
Phenolphthalein Alkalinity*	40	4 mg/l
Total Alkalinity*	516	4 mg/l
Hydroxide Alkalinity	ND	4 mg/l
Carbonate Alkalinity	80	4 mg/l
Bicarbonate Alkalinity	436	4 mg/l
Total Dissolved Solids	672	1.0 mg/l
Conductivity (µm or µS/cm)	934	NA
ORP (mV)	173.5	NA
Langelier Saturation Index (at 16°C)	+ 0.86	NA
Total Hardness*	300	4 mg/l
Carbonate Hardness	300	4 mg/l
Non Carbonate Hardness	ND	4 mg/l
Calcium*	52	4 mg/l
Magnesium*	248	4 mg/l
Sodium (as Na)	101.00	0.02 mg/l
Potassium (as K)	3.60	0.1 mg/l
Phosphate (as PO ₄)	0.27	0.06 mg/l
Chlorides (as Cl)	10.8	2 mg/l
Nitrate (Nitrogen)	ND	0.3 mg/l
Chlorine (as Cl)	ND	0.02 mg/l
Dissolved Iron (as Fe ²⁺)	ND	0.02 mg/l
Suspended Iron (as Fe ³⁺)	0.46	0.02 mg/l
Iron Total (as Fe)	0.46	0.02 mg/l
Iron (resuspended)	0.71	0.02 mg/l
Copper (as Cu)	ND	0.04 mg/l
Manganese (as Mn)	ND	0.1 mg/l
Sulfate (as SO ₄)	44	2 mg/l
Silica (as SiO ₂)	26.1	1.0 mg/l
Tannin/Lignin	0.3	0.1 mg/l
Total Organic Carbon (C)	1.4	0.0 mg/l

Biological Analysis:

	KFN-L	Detection Limit
Plate Count (colonies/ml)	>1,500	NA
Anaerobic Growth (%)	<10	NA
Sulfate Reducing Bacteria	Negative	NA
Fe/Mn Oxidizing Bact	Negative	NA
ATP (cells per ml) Initial	2.0 Million	NA
ATP (cells per ml) 24 Hour	1.8 Million	NA
Bacterial Identification	<i>Pseudomonas stutzeri</i>	NA
Bacterial Identification	<i>Ralstonia insidiosa</i>	NA

Microscopic Evaluation:

KFN-L: Moderate to heavy visible bacterial activity, low crystalline debris, low iron oxide with low iron oxide entrained biomass.

Observations:

The sample exhibited an elevated, slightly alkaline pH and elevated levels of total dissolved solids (TDS) and conductivity. A moderately oxidative oxidation reduction potential (ORP) was recorded for the sample. Total alkalinity for the sample was high, as were hardness levels. A positive Langelier Saturation Index (LSI) was calculated for the sample. A positive LSI indicates that the water is supersaturated with respect to calcium carbonate (CaCO₃) and scale forming may occur.

Elevated ion concentrations identified during testing included magnesium, sodium, and potassium. Iron, as evaluated in multiple forms, shows some concentrating occurring within the well, likely the result of corrosion of iron bearing components within the well. Resuspended iron, which accounts for both chemical and biological mobilization of iron, was present.

Total organic carbon (TOC) is reported as the amount of carbon bound in an organic compound. In water testing, TOC is often used as a non-specific indicator of water quality as well as the potential for bacterial stimulation and propagation. TOC was present in the sample and at a considered elevated for an active well and sufficient to act as stimulants for biofouling. A second indicator of organic influence, tannins and lignins, were present in a minor concentration. Tannin and Lignin are organic compounds similar to humic substances, generally reflecting more complex organic compounds such as those found in soils.

Biological testing of the water samples reported a large, active microbial population. Adenosine triphosphate (ATP) testing reported a very large bacterial population that decreased slightly over a twenty-four hour observation period, yet remained high. Heterotrophic plate growth, as a measure of growth activity, was excessive as well, overwhelming the test plate. The heterotrophic plate growth results paralleled observations of the level of visible bacteria activity noted during microscopic evaluation. Anaerobic growth, as a percentage of the total population, was limited to less than ten percent. Testing for sulfate reducing bacteria presence was

negative. Testing for the presence of iron and manganese oxidizing bacteria was negative as well.

Microscopic evaluation of the water samples noted moderate to heavy visible biological activity and a low amount of biomass present. A low occurrence of iron oxide and crystalline debris were reported.

Dominant bacteria identified from the samples included multiple forms of slime forming bacteria. *Pseudomonas stutzeri* is a gram-negative, rod-shaped soil bacterium that is highly motile. As a member of the genus *Pseudomonas*, it is a prolific slime former; however it's known to produce a particularly dense, almost leathery form of biomass. It is also considered a denitrifying bacterium.

Ralstonia insidiosa is a gram negative, environmental bacterium commonly found in wet environments such as soils, rivers, and lakes. It has been observed in heavier biofilm accumulations in plastic water pipes, and in areas with high concentrations of metals. It is an oligotrophic organism, making it capable of surviving in areas with a very low concentration of nutrients.

Interpretations:

Submitted information indicates that the well supplies a geothermal exchange unit and that currently, no permanent pump is installed in the well. Additionally, the sample was collected after the well had thawed following a period of being frozen, and was purged for two to three well volumes.

The sample suggests chemical and biological congestion within the well. In addition to an increased potential for fouling due to the accumulation of scale and biomass, the sample suggests that some corrosion is occurring. Although not overly aggressive, the corrosion is mobilizing iron into the well which could impact well operation as well as influence the supplied exchange system.

Recommendations:

As a means of evaluating the current condition of the well, the sample indicates a need to purge the well. Generally, during regular operation, the concentration of ions and biology is limited due to the "purging" that occurs. Through this regular use, the accumulation of fouling mechanisms downhole is slowed. When idle, microbial communities expand and generally take on a more dynamic level of growth. Similarly, ions and compounds can concentrate, forming scale and become more likely to remain in the well.

Active use of the well is recommended. A disinfection effort may be necessary, depending on the operational response observed. If the well is not currently slated for regular use, periodic purging is advised to limit accumulation downhole.

If you have any questions regarding the analyses, interpretations, or the recommendations presented, please contact our office.

Michael Schnieders, PG, PH-GW
Hydrogeologist

Report Transmission Cover Page

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Contact & Affiliation	Address	Delivery Commitments
Adam Seeley	61 Wasson Place	On [Lot Verification] send
Tetra Tech EBA Inc - Edmonton	Whitehorse, Yukon Territory Y1A 0H7	(COA) by Email - Merge Reports
	Phone: (867) 668-3068	On [Report Approval] send
	Fax: (867) 668-4349	(COC, Test Report) by Email - Merge Reports
	Email: adam.seeley@tetrattech.com	On [Report Approval] send
		(Test Report) by Email - Multiple Reports By Agreement
		On [Report Approval] send
		(Test Report) by Email - Multiple Reports By Agreement
		On [Lot Creation] send
		(COR) by Email - Merge Reports

Notes To Clients:

- An appropriately preserved sample was not received for Ammonia analysis of sample 1088469-3. Analysis was performed on unpreserved sample.
- Analysis was performed on sample # 1088469-1 & 2 that exceeded the recommended holding time for turbidity analysis.
- pH analysis was performed past the recommended holding time of 15 minutes from sample collection.

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Analytical Report

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

	Reference Number	1088469-1	1088469-2		
	Sample Date	Aug 12, 2015	Aug 13, 2015		
	Sample Time	NA	NA		
	Sample Location				
	Sample Description	KFN-K / KFN-K #1	KFN-K / KFN-K #2		
	Matrix	Water	Water		
Analyte	Units	Results	Results	Results	Nominal Detection Limit
Mono-Aromatic Hydrocarbons - Water					
Benzene	ug/L	<0.5	<0.5		0.5
Ethylbenzene	ug/L	<0.5	<0.5		0.5
Methyl t-Butyl Ether	ug/L	<0.5	<0.5		0.5
Styrene	ug/L	<0.5	<0.5		0.5
Toluene	ug/L	0.8	9.1		0.5
Total Xylenes (m,p,o)	ug/L	<0.5	<0.5		0.5
Volatile Petroleum Hydrocarbons - Water					
VPHw (VHw6-10 minus BTEX)	ug/L	<50	<50		50
VHw6-10	ug/L	<50	<50		50
Extractable Petroleum Hydrocarbons - Water					
EPHw10-19	ug/L	<100	<100		100
EPHw19-32	ug/L	<100	<100		100
LEPHw	ug/L	<100	<100		100
HEPHw	ug/L	<100	<100		100
Polycyclic Aromatic Hydrocarbons - Water					
Acenaphthene	ug/L	<0.1	<0.1		0.1
Acenaphthylene	ug/L	<0.1	<0.1		0.1
Acridine	ug/L	<0.05	<0.05		0.05
Anthracene	ug/L	<0.1	<0.1		0.1
Benzo(a)anthracene	ug/L	<0.01	<0.01		0.01
Benzo(a)pyrene	ug/L	<0.01	<0.01		0.01
Benzo(b)fluoranthene	ug/L	<0.01	<0.01		0.01
Benzo(g,h,i)perylene	ug/L	<0.1	<0.1		0.1
Benzo(k)fluoranthene	ug/L	<0.02	<0.02		0.02
Chrysene	ug/L	<0.1	<0.1		0.1
Dibenzo(a,h)anthracene	ug/L	<0.01	<0.01		0.01
Fluoranthene	ug/L	<0.1	<0.1		0.1
Fluorene	ug/L	<0.1	<0.1		0.1
Indeno(1,2,3-c,d)pyrene	ug/L	<0.1	<0.1		0.1
Naphthalene	ug/L	<0.1	<0.1		0.1
Phenanthrene	ug/L	<0.1	<0.1		0.1
Pyrene	ug/L	<0.02	<0.02		0.02
Quinoline	ug/L	<0.34	<0.34		0.34
PAH - Water - Surrogate Recovery					
2-Fluorobiphenyl	PAH - Surrogate	%	106	114	50-130
p-Terphenyl-d14	PAH - Surrogate	%	81	108	60-130

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Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Analyte	Units	Reference Number		Results	Nominal Detection Limit
		1088469-1	1088469-2		
PAH - Water - Surrogate Recovery - Continued		Sample Date	Sample Time	Results	
Naphthalene-d8	PAH - Surrogate	Aug 12, 2015	NA	104	50-130
Quinoline-d7	PAH - Surrogate		NA	110	50-130
VOC Screen - Water		Sample Location	Sample Description	Results	
Bromodichloromethane	ug/L	KFN-K / KFN-K #1	KFN-K / KFN-K #2	<1	1
Bromoform	ug/L	Water	Water	<1	1
Bromomethane	ug/L			<10	10
Carbon Tetrachloride	ug/L			<1	1
Chlorobenzene	ug/L			<1	1
Chloroethane	ug/L			<10	10
2-Chloroethyl Vinyl Ether	ug/L			<1	1
Chloroform	ug/L			<1	1
Chloromethane	ug/L			<10	10
Dibromochloromethane	ug/L			<1	1
1,2-Dichlorobenzene	ug/L			<1	1
1,3-Dichlorobenzene	ug/L			<1	1
1,4-Dichlorobenzene	ug/L			<1	1
1,1-Dichloroethane	ug/L			<1	1
1,2-Dichloroethane	ug/L			<1	1
1,1-Dichloroethene	ug/L			<1	1
1,2-Dichloroethene(cis)	ug/L			<1	1
1,2-Dichloroethene(trans)	ug/L			<1	1
1,2-Dichloropropane	ug/L			<1	1
1,3-Dichloropropene(cis)	ug/L			<1	1
1,3-Dichloropropene(trans)	ug/L			<1	1
Methylene Chloride	ug/L			<5	5
Styrene	ug/L			<1	1
1,1,1,2-Tetrachloroethane	ug/L			<1	1
Tetrachloroethene	ug/L			<1	1
1,1,1-Trichloroethane	ug/L			<1	1
1,1,2-Trichloroethane	ug/L			<1	1
Trichloroethene	ug/L			<1	1
Trichlorofluoromethane	ug/L			<1	1
Vinyl Chloride	ug/L			<2	2
VOC - Water - Surrogate Recovery					
Dibromofluoromethane	EPA Surrogate	%		91	86-118
Toluene-d8	EPA Surrogate	%		102	85-115

Analytical Report

Bill To: Tetra Tech EBA Inc
 Report To: Tetra Tech EBA Inc
 61 Wasson Place
 Whitehorse, YT, Canada
 Y1A 0H7
 Attn: Adam Seeley
 Sampled By: Adam Seeley
 Company: TetraTech

Project:
 ID: ENVH2O 03136
 Name: Burwash WTP
 Location: Burwash, YT
 LSD:
 P.O.:
 Acct code:

Lot ID: **1088469**
 Control Number: A198353
 Date Received: Aug 17, 2015
 Date Reported: Aug 24, 2015
 Report Number: 2034858

	Reference Number	1088469-1	1088469-2		
	Sample Date	Aug 12, 2015	Aug 13, 2015		
	Sample Time	NA	NA		
	Sample Location				
	Sample Description	KFN-K / KFN-K #1	KFN-K / KFN-K #2		
	Matrix	Water	Water		
Analyte	Units	Results	Results	Results	Nominal Detection Limit
VOC - Water - Surrogate Recovery - Continued					
Bromofluorobenzene	EPA Surrogate	%	103	90	86-115

Analytical Report

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Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

		Reference Number	1088469-1	1088469-2	1088469-3	
		Sample Date	Aug 12, 2015	Aug 13, 2015	Aug 13, 2015	
		Sample Time	NA	NA	NA	
		Sample Location				
		Sample Description	KFN-K / KFN-K #1	KFN-K / KFN-K #2	KFN-L / KFN-L	
		Matrix	Water	Water	Water	
Analyte	Units	Results	Results	Results	Nominal Detection Limit	
Inorganic Nonmetallic Parameters						
Kjeldahl Nitrogen	Total	mg/L			0.69	0.07
Nitrogen	Total	mg/L			0.69	0.06
Organic Carbon	Total Nonpurgeable	mg/L	1	<0.5		0.5
Ammonia - N		mg/L			0.39	.01
Orthophosphate-P	Dissolved	mg/L	0.025	0.024		0.002
Metals Dissolved						
Mercury	Dissolved	ug/L	<0.01	<0.01	<0.01	0.01
Metals Total						
Calcium	Total	mg/L	17.9	18.1	18.1	0.05
Iron	Total	mg/L	<0.010	0.044	0.728	0.01
Magnesium	Total	mg/L	27.7	28.1	67.7	0.05
Manganese	Total	mg/L	0.0268	0.0295	0.0205	0.005
Potassium	Total	mg/L	4.14	4.22	4.06	0.1
Silicon	Total	mg/L	11.1	11.3	12.1	0.05
Sulfur	Total	mg/L	12.2	12.6	17.9	0.1
Sodium	Total	mg/L	36.0	37.1	112	0.02
Titanium	Total	mg/L	0.0018	0.0023	0.0022	0.001
Mercury	Total	ug/L	<0.010	<0.010	<0.010	0.01
Physical and Aggregate Properties						
Solids	Total Suspended	mg/L	<5	<3		3
Solids	Total Dissolved	mg/L	190	240	522	5
Turbidity		NTU	0.61	0.28		0.02
Routine Water						
pH	at 25 °C		7.98	8.04	8.28	
Calcium	Dissolved	mg/L	18.5	18.0	18.3	0.1
Magnesium	Dissolved	mg/L	28.0	27.6	67.8	0.1
Potassium	Dissolved	mg/L	4.2	4.2	4.2	0.1
Silicon	Dissolved	mg/L	11.0	10.9	11.9	0.05
Sodium	Dissolved	mg/L	36.9	35.9	111	0.1
Sulfur	Dissolved	mg/L	12.3	12.2	17.7	0.2
Bromide	Dissolved	mg/L	<0.02	<0.02	<0.02	0.02
Chloride	Dissolved	mg/L	0.76	0.75	4.24	0.05
Fluoride	Dissolved	mg/L	0.33	0.32	0.27	0.01
Nitrate - N	Dissolved	mg/L	<0.01	<0.01	<0.01	0.01
Nitrite - N	Dissolved	mg/L	0.08	0.08	<0.01	0.01
Sulfate (SO4)	Dissolved	mg/L	35.4	35.5	52.1	0.5

Analytical Report

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 Whitehorse, YT, Canada
 Y1A 0H7
 Attn: Adam Seeley
 Sampled By: Adam Seeley
 Company: TetraTech

Project:
 ID: ENVH2O 03136
 Name: Burwash WTP
 Location: Burwash, YT
 LSD:
 P.O.:
 Acct code:

Lot ID: **1088469**
 Control Number: A198353
 Date Received: Aug 17, 2015
 Date Reported: Aug 24, 2015
 Report Number: 2034858

		Reference Number	1088469-1	1088469-2	1088469-3	
		Sample Date	Aug 12, 2015	Aug 13, 2015	Aug 13, 2015	
		Sample Time	NA	NA	NA	
		Sample Location				
		Sample Description	KFN-K / KFN-K #1	KFN-K / KFN-K #2	KFN-L / KFN-L	
		Matrix	Water	Water	Water	
Analyte	Units	Results	Results	Results	Nominal Detection Limit	
Routine Water - Continued						
Hardness	as CaCO ₃	mg/L	161	159	325	5
Hardness	Total	mg CaCO ₃ /L	159	161	324	1
Salinity	Dissolved	g/L	0.0932	0.0906	0.279	0.0001
Trace Metals Dissolved						
Digestion	Dissolved		Field Filtered	Field Filtered	Field Filtered	
Aluminum	Dissolved	ug/L	<5	<5	<5	5
Antimony	Dissolved	ug/L	<0.2	<0.2	<0.2	0.2
Arsenic	Dissolved	ug/L	9.6	9.6	5.2	0.2
Barium	Dissolved	ug/L	37	37	66	1
Beryllium	Dissolved	ug/L	<0.04	<0.04	<0.04	0.04
Bismuth	Dissolved	ug/L	<1	<1	<1	1
Boron	Dissolved	ug/L	422	419	420	4
Cadmium	Dissolved	ug/L	<0.01	<0.01	<0.01	0.01
Chromium	Dissolved	ug/L	<0.4	<0.4	<0.4	0.4
Cobalt	Dissolved	ug/L	<0.02	<0.02	0.03	0.02
Copper	Dissolved	ug/L	<1	<1	<1	1
Iron	Dissolved	ug/L	82	172	77	5
Lead	Dissolved	ug/L	<0.1	0.2	<0.1	0.1
Lithium	Dissolved	ug/L	2	1	68	1
Manganese	Dissolved	ug/L	32.1	33.2	23.0	1
Molybdenum	Dissolved	ug/L	10.38	10.62	8.48	0.1
Nickel	Dissolved	ug/L	<1	<1	<1	1
Selenium	Dissolved	ug/L	<0.6	<0.6	<0.6	0.6
Silver	Dissolved	ug/L	<0.01	<0.01	<0.01	0.01
Strontium	Dissolved	ug/L	256	259	528	1.0
Tellurium	Dissolved	ug/L	<0.1	<0.1	<0.1	0.1
Thallium	Dissolved	ug/L	<0.01	<0.01	<0.01	0.01
Thorium	Dissolved	ug/L	<0.4	<0.4	<0.4	0.4
Tin	Dissolved	ug/L	<0.1	0.1	0.8	0.1
Titanium	Dissolved	ug/L	<0.4	<0.4	<0.4	0.4
Uranium	Dissolved	ug/L	<0.40	<0.40	<0.40	0.4
Vanadium	Dissolved	ug/L	<0.10	<0.10	<0.10	0.1
Zinc	Dissolved	ug/L	2.27	10.55	1.77	1
Zirconium	Dissolved	ug/L	<0.1	<0.1	<0.1	0.1
Trace Metals Total						
Aluminum	Total	ug/L	<5	<5	15	5

Analytical Report

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

	Reference Number	1088469-1	1088469-2	1088469-3		
	Sample Date	Aug 12, 2015	Aug 13, 2015	Aug 13, 2015		
	Sample Time	NA	NA	NA		
	Sample Location					
	Sample Description	KFN-K / KFN-K #1	KFN-K / KFN-K #2	KFN-L / KFN-L		
	Matrix	Water	Water	Water		
Analyte	Units	Results	Results	Results	Nominal Detection Limit	
Trace Metals Total - Continued						
Antimony	Total	ug/L	<0.2	<0.2	<0.2	0.2
Arsenic	Total	ug/L	9.0	8.9	4.8	0.2
Barium	Total	ug/L	37	39	71	1
Beryllium	Total	ug/L	<0.04	<0.04	<0.04	0.04
Bismuth	Total	ug/L	<1.0	<1.0	<1.0	1
Boron	Total	ug/L	410	420	401	5
Cadmium	Total	ug/L	<0.01	<0.01	<0.01	0.01
Chromium	Total	ug/L	<0.4	<0.4	<0.4	0.4
Cobalt	Total	ug/L	0.0206	<0.0200	0.0492	0.02
Copper	Total	ug/L	<1	<1	<1	1
Lead	Total	ug/L	<0.1	0.9	0.1	0.1
Lithium	Total	ug/L	1	1	69	1
Molybdenum	Total	ug/L	11.0	11.3	9.0	0.1
Nickel	Total	ug/L	<1	<1	<1	1
Selenium	Total	ug/L	<0.6	<0.6	<0.6	0.6
Silver	Total	ug/L	<0.01	<0.01	<0.01	0.01
Strontium	Total	ug/L	269	271	544	1.0
Thallium	Total	ug/L	<0.01	<0.01	<0.01	0.01
Thorium	Total	ug/L	<0.40	<0.40	<0.40	0.4
Tin	Total	ug/L	<0.1	<0.1	<0.1	0.1
Uranium	Total	ug/L	<0.4	<0.4	<0.4	0.4
Vanadium	Total	ug/L	<0.1	<0.1	<0.1	0.1
Zinc	Total	ug/L	4	4	42	1
Zirconium	Total	ug/L	<0.1	<0.1	<0.1	0.1
Mercury	Total	ug/L	<0.010	<0.010	<0.010	0.01

Analytical Report

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 Report To: Tetra Tech EBA Inc
 61 Wasson Place
 Whitehorse, YT, Canada
 Y1A 0H7
 Attn: Adam Seeley
 Sampled By: Adam Seeley
 Company: TetraTech

Project:
 ID: ENVH2O 03136
 Name: Burwash WTP
 Location: Burwash, YT
 LSD:
 P.O.:
 Acct code:

Lot ID: **1088469**
 Control Number: A198353
 Date Received: Aug 17, 2015
 Date Reported: Aug 24, 2015
 Report Number: 2034858

Reference Number 1088469-4
 Sample Date Aug 13, 2015
 Sample Time NA
 Sample Location
 Sample Description KFN-MW / KFN-MW
 Matrix Water

Analyte	Units	Results	Results	Results	Nominal Detection Limit
Metals Dissolved					
Mercury	Dissolved	ug/L	<0.01		0.01
Routine Water					
Calcium	Dissolved	mg/L	153		0.1
Magnesium	Dissolved	mg/L	170		0.1
Potassium	Dissolved	mg/L	15.2		0.1
Silicon	Dissolved	mg/L	4.86		0.05
Sodium	Dissolved	mg/L	63.7		0.1
Sulfur	Dissolved	mg/L	243		0.2
Hardness	as CaCO3	mg/L	1080		5
Salinity	Dissolved	g/L	0.161		0.0001
Trace Metals Dissolved					
Digestion	Dissolved		Field Filtered		
Aluminum	Dissolved	ug/L	<5		5
Antimony	Dissolved	ug/L	1.0		0.2
Arsenic	Dissolved	ug/L	1.2		0.2
Barium	Dissolved	ug/L	61		1
Beryllium	Dissolved	ug/L	<0.04		0.04
Bismuth	Dissolved	ug/L	<1		1
Boron	Dissolved	ug/L	297		4
Cadmium	Dissolved	ug/L	0.12		0.01
Chromium	Dissolved	ug/L	<0.4		0.4
Cobalt	Dissolved	ug/L	6.61		0.02
Copper	Dissolved	ug/L	11		1
Iron	Dissolved	ug/L	7		5
Lead	Dissolved	ug/L	<0.1		0.1
Lithium	Dissolved	ug/L	10		1
Manganese	Dissolved	ug/L	1190		1
Molybdenum	Dissolved	ug/L	13.57		0.1
Nickel	Dissolved	ug/L	18		1
Selenium	Dissolved	ug/L	0.6		0.6
Silver	Dissolved	ug/L	<0.01		0.01
Strontium	Dissolved	ug/L	706		1.0
Tellurium	Dissolved	ug/L	<0.1		0.1
Thallium	Dissolved	ug/L	<0.01		0.01
Thorium	Dissolved	ug/L	<0.4		0.4
Tin	Dissolved	ug/L	1.3		0.1

Analytical Report

Bill To: Tetra Tech EBA Inc
Report To: Tetra Tech EBA Inc
61 Wasson Place
Whitehorse, YT, Canada
Y1A 0H7
Attn: Adam Seeley
Sampled By: Adam Seeley
Company: TetraTech

Project:
ID: ENVH2O 03136
Name: Burwash WTP
Location: Burwash, YT
LSD:
P.O.:
Acct code:

Lot ID: **1088469**
Control Number: A198353
Date Received: Aug 17, 2015
Date Reported: Aug 24, 2015
Report Number: 2034858

Reference Number 1088469-4
Sample Date Aug 13, 2015
Sample Time NA
Sample Location
Sample Description KFN-MW / KFN-MW
Matrix Water

Analyte	Units	Results	Results	Results	Nominal Detection Limit
Trace Metals Dissolved - Continued					
Titanium	Dissolved	ug/L	1.5		0.4
Uranium	Dissolved	ug/L	3.23		0.4
Vanadium	Dissolved	ug/L	0.25		0.1
Zinc	Dissolved	ug/L	21.50		1
Zirconium	Dissolved	ug/L	0.8		0.1

Approved by: 
Mathieu Simoneau
Operations Manager

Data have been validated by Analytical Quality Control and Exova's Integrated Data Validation System (IDVS).

Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

Quality Control

Bill To: Tetra Tech EBA Inc
 Report To: Tetra Tech EBA Inc
 61 Wasson Place
 Whitehorse, YT, Canada
 Y1A 0H7
 Attn: Adam Seeley
 Sampled By: Adam Seeley
 Company: TetraTech

Project:
 ID: ENVH2O 03136
 Name: Burwash WTP
 Location: Burwash, YT
 LSD:
 P.O.:
 Acct code:

Lot ID: **1088469**
 Control Number: A198353
 Date Received: Aug 17, 2015
 Date Reported: Aug 24, 2015
 Report Number: 2034858

Inorganic Nonmetallic Parameters

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC	
Ammonium - N	ug/L	0	-110.00	10.00	yes	
Orthophosphate-P	mg/L	0.0004	-0.002	0.002	yes	
Phosphorus	mg/L	-0.0009	-0.003	0.003	yes	
Date Acquired: August 19, 2015						
Nitrogen	mg/L	0.02	-0.04	0.08	yes	
Organic Carbon	mg/L	-0.1313	-0.5	0.5	yes	
Date Acquired: August 20, 2015						
Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC	
Ammonium - N	ug/L	111.07	85	115	yes	
Orthophosphate-P	mg/L	92.90	90	110	yes	
Phosphorus	mg/L		90	110	yes	
Date Acquired: August 19, 2015						
Ammonium - N	ug/L	96.48	70	130	yes	
Orthophosphate-P	mg/L	96.00	90	110	yes	
Phosphorus	mg/L		80	120	yes	
Date Acquired: August 19, 2015						
Certified Reference Material	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Ammonium - N	mg/L	0.25	0.28	0.22	0.33	yes
Date Acquired: August 19, 2015						
Ammonia - N	mg/L	2.69	2.75	2.20	3.30	yes
Orthophosphate-P	mg/L	5.15	5.368	4.597	6.139	yes
Date Acquired: August 20, 2015						
Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Nitrogen	mg/L	0.25	0.21	10	0.06	yes
Organic Carbon	mg/L	<0.5	<0.5	10	1.0	yes
Date Acquired: August 20, 2015						
Ammonia - N	mg/L	<0.01	<0.01	20	50.00	yes
Date Acquired: August 19, 2015						
Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC	
Nitrogen	mg/L	117	103.74	137.28	yes	
Organic Carbon	mg/L	130	106.4	138.8	yes	
Date Acquired: August 20, 2015						
Nitrogen	mg/L	15.3	13.27	16.93	yes	
Organic Carbon	mg/L	14.9	12.8	17.2	yes	
Date Acquired: August 20, 2015						
Nitrogen	mg/L	1.25	0.89	1.25	yes	
Organic Carbon	mg/L	2.8	2.4	4.0	yes	
Date Acquired: August 20, 2015						
Phosphorus	mg/L	0.093	0.078	0.120	yes	
Date Acquired: August 19, 2015						

Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Inorganic Nonmetallic Parameters - Continued

Metals Dissolved

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC	
Mercury	ng/L	2.6	-9.99	9.99	yes	
Date Acquired: August 21, 2015						
Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC	
Mercury	ng/L	103.80	90	110	yes	
Date Acquired: August 21, 2015						
Certified Reference Material	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Mercury	ug/L	0.09	0.10	0.07	0.12	yes
Date Acquired: August 21, 2015						
Mercury	ug/L	0.11	0.10	0.07	0.12	yes
Date Acquired: August 21, 2015						
Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Mercury	ug/L	<0.01	<0.01	20	0.05	yes
Date Acquired: August 21, 2015						

Metals Total

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	-0.00101021	-0.10	0.10	yes
Iron	mg/L	0	-0.009	0.009	yes
Magnesium	mg/L	0.0128941	-0.10	0.10	yes
Manganese	mg/L	0	-0.0010	0.0010	yes
Potassium	mg/L	-0.0326931	-0.10	0.10	yes
Silicon	mg/L	0.00104229	-0.05	0.05	yes
Sodium	mg/L	-0.0151302	-0.02	0.02	yes
Date Acquired: August 18, 2015					
Mercury	ng/L	1.3	-9.990	9.990	yes
Date Acquired: August 21, 2015					
Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Mercury	ng/L	99.20	90	110	yes
Date Acquired: August 21, 2015					
Calcium	mg/L	102.35	90	110	yes
Iron	mg/L	106.40	90	110	yes
Magnesium	mg/L	104.74	90	110	yes
Manganese	mg/L	102.37	90	110	yes
Potassium	mg/L	102.42	90	110	yes
Silicon	mg/L	101.20	90	110	yes
Sodium	mg/L	104.17	90	110	yes
Titanium	mg/L	104.61	90	110	yes
Date Acquired: August 18, 2015					

Quality Control

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61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Metals Total - Continued

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	103.94	90	110	yes
Iron	mg/L	106.67	90	110	yes
Magnesium	mg/L	107.77	90	110	yes
Manganese	mg/L	102.10	90	110	yes
Potassium	mg/L	100.28	90	110	yes
Silicon	mg/L	102.96	90	110	yes
Sodium	mg/L	102.80	90	110	yes
Titanium	mg/L	106.33	90	110	yes

Date Acquired: August 18, 2015

Certified Reference Material	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Mercury	ug/L	0.099	0.097	0.073	0.121	yes

Date Acquired: August 21, 2015

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Calcium	mg/L	17.9	18.1	20	0.05	yes
Iron	mg/L	<0.010	<0.010	20	0.050	yes
Magnesium	mg/L	27.7	28.1	20	0.05	yes
Manganese	mg/L	0.0268	0.0279	20	0.0050	yes
Potassium	mg/L	4.14	4.20	20	0.10	yes
Silicon	mg/L	11.1	11.2	20	0.10	yes
Sodium	mg/L	36.0	36.3	20	0.10	yes

Date Acquired: August 18, 2015

Physical and Aggregate Properties

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Turbidity	NTU	0.02	-0.05	0.05	yes

Date Acquired: August 19, 2015

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Turbidity	NTU	100.00	50	150	yes
Date Acquired: August 19, 2015					
Turbidity	NTU	101.00	95	105	yes
Date Acquired: August 19, 2015					
Turbidity	NTU	97.80	95	105	yes
Date Acquired: August 19, 2015					
Turbidity	NTU	102.00	90	110	yes
Date Acquired: August 19, 2015					

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Solids	mg/L	<5	<5	30	10	yes
Turbidity	NTU	44	44	15	0.10	yes

Date Acquired: August 19, 2015

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
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Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Physical and Aggregate Properties -

Continued

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Turbidity	NTU	4.4	3.51	5.97	yes
Date Acquired:	August 19, 2015				
Solids	mg/L	400	291	591	yes
Date Acquired:	August 20, 2015				
Solids	mg/L	22	16	31	yes
Date Acquired:	August 20, 2015				
Solids	mg/L	<5	-5	5	yes
Date Acquired:	August 20, 2015				
Solids	mg/L	<3	-5	5	yes
Date Acquired:	August 20, 2015				

Routine Water

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	-0.00579026	-0.10	0.10	yes
Iron	mg/L	0.00222536	-0.005	0.005	yes
Magnesium	mg/L	0.00422555	-0.10	0.10	yes
Manganese	mg/L	0.000330148	-0.001	0.001	yes
Potassium	mg/L	-0.00385023	-0.1	0.1	yes
Silicon	mg/L	-0.00471336	-0.05	0.05	yes
Sodium	mg/L	-0.00757789	-0.1	0.1	yes
Date Acquired:	August 18, 2015				
Nitrate - N	mg/L	0	-0.01	0.01	yes
Nitrite - N	mg/L	0	-0.005	0.005	yes
Date Acquired:	August 20, 2015				
Bromide	mg/L	0	-0.10	0.10	yes
Chloride	mg/L	0.0535911	-0.20	0.20	yes
Fluoride	mg/L	0.021999	-0.10	0.10	yes
Nitrate - N	mg/L	0.00147619	-0.01	0.01	yes
Nitrite - N	mg/L	0.015874	-0.10	0.10	yes
Sulfate (SO4)	mg/L	0.104875	-0.99	0.99	yes
Date Acquired:	August 18, 2015				
Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	102.14	90	110	yes
Iron	mg/L	102.97	90	110	yes
Magnesium	mg/L	103.55	90	110	yes
Manganese	mg/L	102.52	90	110	yes
Potassium	mg/L	102.28	90	110	yes
Silicon	mg/L	99.88	90	110	yes
Sodium	mg/L	102.74	90	110	yes
Date Acquired:	August 18, 2015				

Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Routine Water - Continued

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC	
Bromide	mg/L	94.58	90	110	yes	
Chloride	mg/L	87.81	85	115	yes	
Fluoride	mg/L	94.00	85	115	yes	
Nitrate - N	mg/L	90.33	85	115	yes	
Sulfate (SO4)	mg/L	91.64	85	115	yes	
Date Acquired: August 18, 2015						
Bromide	mg/L	105.28	90	110	yes	
Chloride	mg/L	92.90	85	105	yes	
Fluoride	mg/L	100.63	89	109	yes	
Nitrate - N	mg/L	95.52	88	108	yes	
Nitrite - N	mg/L	98.44	90	118	yes	
Sulfate (SO4)	mg/L	95.00	90	110	yes	
Date Acquired: August 18, 2015						
Calcium	mg/L	102.96	90	110	yes	
Iron	mg/L	106.44	90	110	yes	
Magnesium	mg/L	106.09	90	110	yes	
Manganese	mg/L	106.01	90	110	yes	
Potassium	mg/L	102.58	90	110	yes	
Sodium	mg/L	100.82	90	110	yes	
Date Acquired: August 18, 2015						
Certified Reference Material	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Nitrite - N	mg/L	0.12	0.13	0.10	0.15	yes
Date Acquired: August 18, 2015						
Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Calcium	mg/L	18.5	18.3	30	1.00	yes
Iron	mg/L	0.082	0.085	30	0.060	yes
Magnesium	mg/L	28.0	28.0	30	1.00	yes
Manganese	mg/L	0.032	0.032	30	0.015	yes
Potassium	mg/L	4.2	4.3	30	1.0	yes
Silicon	mg/L	11.0	11.1	30	0.15	yes
Sodium	mg/L	36.9	37.3	30	1.0	yes
Sulfur	mg/L	12.3	12.4	30	3.0	yes
Date Acquired: August 18, 2015						
Hardness	mg CaCO3/L	159	161	20	1.000	yes
Date Acquired: August 18, 2015						
pH		6.60	6.56	10		yes
Electrical Conductivity	dS/m at 25 C	0.170	0.177	10	0.005	yes
Bromide	mg/L	<0.02	<0.02	20	0.50	yes
Chloride	mg/L	0.13	0.15	20	0.25	yes
Fluoride	mg/L	0.32	0.32	20	0.50	yes
Nitrate - N	mg/L	<0.01	<0.01	20	0.05	yes

Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Routine Water - Continued

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Nitrite - N	mg/L	0.08	0.08	20	0.50	yes
Sulfate (SO4)	mg/L	35.5	35.0	20	0.50	yes
Date Acquired: August 18, 2015						

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Chloride	mg/L	1.60	1.58	6	0.01	yes
Nitrate - N	mg/L	0.28	0.30	12	0.05	yes
Sulfate (SO4)	mg/L	4.59	4.78	6	0.01	yes
Date Acquired: August 18, 2015						

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
pH		9.36	9.17	10.81	yes
Electrical Conductivity	µS/cm at 25 C	192	165	243	yes
Date Acquired: August 18, 2015					
pH		4.01	3.88	4.12	yes
Date Acquired: August 18, 2015					
pH		7.94	7.88	8.12	yes
Date Acquired: August 18, 2015					
Electrical Conductivity	µS/cm at 25 C	1430	1323	1503	yes
Date Acquired: August 18, 2015					
Nitrate - N	mg/L	10.0	9.58	10.58	yes
Nitrite - N	mg/L	9.96	9.460	10.600	yes
Nitrate and Nitrite - N	mg/L	20.0	19.27	20.97	yes
Date Acquired: August 20, 2015					
Nitrate - N	mg/L	4.86	4.48	5.24	yes
Nitrite - N	mg/L	4.96	4.488	5.292	yes
Nitrate and Nitrite - N	mg/L	9.82	9.06	10.42	yes
Date Acquired: August 20, 2015					
Nitrate - N	mg/L	0.51	0.44	0.58	yes
Nitrite - N	mg/L	0.486	0.453	0.567	yes
Nitrate and Nitrite - N	mg/L	0.99	0.93	1.11	yes
Date Acquired: August 20, 2015					

Mono-Aromatic Hydrocarbons - Water

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Benzene	ng	0	-0.5	0.5	yes
Ethylbenzene	ng	0	-0.5	0.5	yes
Methyl t-Butyl Ether	ng	0	-0.5	0.5	yes
m,p-Xylene	ng	0	-0.5	0.5	yes
o-Xylene	ng	0	-0.5	0.5	yes
Styrene	ng	0	-0.5	0.5	yes
Toluene	ng	0	-0.5	0.5	yes

Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Mono-Aromatic Hydrocarbons - Water -

Continued

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Total Xylenes (m,p,o)	ng	0	-0.5	0.5	yes

Date Acquired: August 19, 2015

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Benzene	ng	92.37	75	125	yes
Ethylbenzene	ng	97.22	75	125	yes
Methyl t-Butyl Ether	ng	106.06	75	125	yes
m,p-Xylene	ng	96.51	75	125	yes
o-Xylene	ng	96.43	75	125	yes
Styrene	ng	96.34	75	125	yes
Toluene	ng	92.13	75	125	yes
Total Xylenes (m,p,o)	ng	96.48	75	125	yes

Date Acquired: August 19, 2015

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Benzene	ug/L	<0.5	<0.5	20	2.5	yes
Ethylbenzene	ug/L	<0.5	<0.5	20	2.5	yes
Methyl t-Butyl Ether	ug/L	<0.5	<0.5	20	2.5	yes
m,p-Xylene	ug/L	<0.5	<0.5	20	2.5	yes
o-Xylene	ug/L	<0.5	<0.5	20	2.5	yes
Styrene	ug/L	<0.5	<0.5	20	2.5	yes
Toluene	ug/L	<0.5	<0.5	20	2.5	yes
Total Xylenes (m,p,o)	ug/L	<0.5	<0.5	20	2.5	yes

Date Acquired: August 19, 2015

Matrix Spike	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Benzene	ug/L	83	75	125	yes
Ethylbenzene	ug/L	94	75	125	yes
Methyl t-Butyl Ether	ug/L	92	75	125	yes
m,p-Xylene	ug/L	98	75	125	yes
o-Xylene	ug/L	95	75	125	yes
Styrene	ug/L	94	75	125	yes
Toluene	ug/L	94	75	125	yes
Total Xylenes (m,p,o)	ug/L	97	75	125	yes

Date Acquired: August 19, 2015

Volatile Petroleum Hydrocarbons - Water

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
VPW (VHw6-10 minus)	ng	0	-50	50	yes
VHw6-10	ng	0	-50	50	yes

Date Acquired: August 19, 2015

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
VPW (VHw6-10 minus)	ug/L	<50	<50	20	100	yes

Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Volatile Petroleum Hydrocarbons - Water

- Continued

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
VHw6-10	ug/L	<50	<50	20	100	yes
Date Acquired: August 19, 2015						

Extractable Petroleum Hydrocarbons -

Water

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
EPHw10-19	ug/mL	0	-100	100	yes
EPHw19-32	ug/mL	0	-100	100	yes
Date Acquired: August 19, 2015					

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
EPHw10-19	ug/mL	96.44	85	115	yes
EPHw19-32	ug/mL	99.76	85	115	yes
Date Acquired: August 19, 2015					

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
EPHw10-19	ug/L	1820	1690	40	500	yes
EPHw19-32	ug/L	2040	1920	40	500	yes
Date Acquired: August 19, 2015						

Matrix Spike	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
EPHw10-19	ug/L	103	79	128	yes
EPHw19-32	ug/L	101	70	122	yes
Date Acquired: August 19, 2015					

Polycyclic Aromatic Hydrocarbons -

Water

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Acenaphthene	ng/mL	0	-0.1	0.1	yes
Acenaphthylene	ng/mL	0	-0.1	0.1	yes
Acridine	ng/mL	0	-0.05	0.05	yes
Anthracene	ng/mL	0	-0.1	0.1	yes
Benzo(a)anthracene	ng/mL	0	-0.01	0.01	yes
Benzo(a)pyrene	ng/mL	0	-0.01	0.01	yes
Benzo(b)fluoranthene	ng/mL	0	-0.01	0.01	yes
Benzo(g,h,i)perylene	ng/mL	0	-0.1	0.1	yes
Benzo(k)fluoranthene	ng/mL	0	-0.02	0.02	yes
Chrysene	ng/mL	0	-0.1	0.1	yes
Dibenzo(a,h)anthracene	ng/mL	0	-0.01	0.01	yes
Fluoranthene	ng/mL	0	-0.1	0.1	yes
Fluorene	ng/mL	0	-0.1	0.1	yes
Indeno(1,2,3-c,d)pyrene	ng/mL	0	-0.1	0.1	yes
Naphthalene	ng/mL	0	-0.1	0.1	yes

Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

**Polycyclic Aromatic Hydrocarbons -
 Water - Continued**

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Phenanthrene	ng/mL	0	-0.1	0.1	yes
Pyrene	ng/mL	0	-0.02	0.02	yes
Quinoline	ng/mL	0	-0.34	0.34	yes

Date Acquired: August 19, 2015

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Acenaphthene	ng/mL	106.17	80	120	yes
Acenaphthylene	ng/mL	110.02	80	120	yes
Acridine	ng/mL	107.15	80	120	yes
Anthracene	ng/mL	106.60	80	120	yes
Benzo(a)anthracene	ng/mL	99.33	80	120	yes
Benzo(a)pyrene	ng/mL	110.83	80	120	yes
Benzo(b)fluoranthene	ng/mL	106.04	80	120	yes
Benzo(g,h,i)perylene	ng/mL	90.11	80	120	yes
Benzo(k)fluoranthene	ng/mL	101.37	80	120	yes
Chrysene	ng/mL	91.86	80	120	yes
Dibenzo(a,h)anthracene	ng/mL	89.41	80	120	yes
Fluoranthene	ng/mL	104.04	80	120	yes
Fluorene	ng/mL	111.41	80	120	yes
Indeno(1,2,3-c,d)pyrene	ng/mL	89.43	80	120	yes
Naphthalene	ng/mL	103.61	80	120	yes
Phenanthrene	ng/mL	106.39	80	120	yes
Pyrene	ng/mL	101.19	80	120	yes
Quinoline	ng/mL	101.91	80	120	yes

Date Acquired: August 19, 2015

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Acenaphthene	ug/L	<0.1	<0.1	20	0.5	yes
Acenaphthylene	ug/L	0.1	0.1	20	0.5	yes
Acridine	ug/L	0.11	0.11	20	0.25	yes
Anthracene	ug/L	0.1	0.1	20	0.5	yes
Benzo(a)anthracene	ug/L	0.10	0.10	20	0.05	yes
Benzo(a)pyrene	ug/L	0.09	0.09	20	0.05	yes
Benzo(b)fluoranthene	ug/L	0.11	0.11	20	0.05	yes
Benzo(g,h,i)perylene	ug/L	<0.1	<0.1	20	0.5	yes
Benzo(k)fluoranthene	ug/L	0.11	0.11	20	0.10	yes
Chrysene	ug/L	0.1	0.1	20	0.5	yes
Dibenzo(a,h)anthracene	ug/L	0.10	0.10	20	0.05	yes
Fluoranthene	ug/L	<0.1	<0.1	20	0.5	yes
Fluorene	ug/L	<0.1	<0.1	20	0.5	yes
Indeno(1,2,3-c,d)pyrene	ug/L	<0.1	<0.1	20	0.5	yes
Naphthalene	ug/L	0.1	0.1	20	0.5	yes
Phenanthrene	ug/L	0.1	0.1	20	0.5	yes

Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Polycyclic Aromatic Hydrocarbons - Water - Continued

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Pyrene	ug/L	0.10	0.10	20	0.10	yes
Quinoline	ug/L	<0.34	<0.34	20	1.70	yes

Date Acquired: August 19, 2015

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Acenaphthene	ug/L	97.0	50.0	130.0	yes
Acenaphthylene	ug/L	109	50.0	130.0	yes
Acridine	ug/L	106	59.99	130.01	yes
Anthracene	ug/L	110	60.0	130.0	yes
Benzo(a)anthracene	ug/L	99.1	59.99	130.01	yes
Benzo(a)pyrene	ug/L	90.8	59.99	130.01	yes
Benzo(b)fluoranthene	ug/L	106	59.99	130.01	yes
Benzo(g,h,i)perylene	ug/L	91.0	60.0	130.0	yes
Benzo(k)fluoranthene	ug/L	112	59.99	130.01	yes
Chrysene	ug/L	101	60.0	130.0	yes
Dibenzo(a,h)anthracene	ug/L	104	59.99	130.01	yes
Fluoranthene	ug/L	96.2	60.0	130.0	yes
Fluorene	ug/L	90.9	50.0	130.0	yes
Indeno(1,2,3-c,d)pyrene	ug/L	97.5	60.0	130.0	yes
Naphthalene	ug/L	104	50.0	130.0	yes
Phenanthrene	ug/L	109	60.0	130.0	yes
Pyrene	ug/L	100	59.99	130.01	yes
Quinoline	ug/L	107	50.01	129.99	yes

Date Acquired: August 19, 2015

PAH - Water - Surrogate Recovery

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
2-Fluorobiphenyl	%	103.48	80	120	yes
p-Terphenyl-d14	%	90.19	80	120	yes
Naphthalene-d8	%	96.71	80	120	yes

Date Acquired: August 19, 2015

Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
2-Fluorobiphenyl	%	105	105	20	0	yes
p-Terphenyl-d14	%	94	94	20	0	yes
Naphthalene-d8	%	93	93	20	0	yes

Date Acquired: August 19, 2015

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
2-Fluorobiphenyl	%	105	50	130	yes
p-Terphenyl-d14	%	94	60	130	yes
Naphthalene-d8	%	93	50	130	yes

Date Acquired: August 19, 2015



Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

VOC Screen - Water

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Benzene	ng	0	-2	2	yes
Bromodichloromethane	ng	0	-2	2	yes
Bromoform	ng	0	-2	2	yes
Bromomethane	ng	0	-15	15	yes
Carbon Tetrachloride	ng	0	-2	2	yes
Chlorobenzene	ng	0	-2	2	yes
Chloroethane	ng	0	-15	15	yes
2-Chloroethyl Vinyl Ether	ng	0	-2	2	yes
Chloroform	ng	0	-2	2	yes
Chloromethane	ng	0	-15	15	yes
Dibromochloromethane	ng	0	-2	2	yes
1,2-Dichlorobenzene	ng	0	-2	2	yes
1,3-Dichlorobenzene	ng	0	-2	2	yes
1,4-Dichlorobenzene	ng	0	-2	2	yes
1,1-Dichloroethane	ng	0	-2	2	yes
1,2-Dichloroethane	ng	0	-2	2	yes
1,1-Dichloroethene	ng	0	-2	2	yes
1,2-Dichloroethene(cis)	ng	0	-2	2	yes
1,2-Dichloroethene(trans)	ng	0	-2	2	yes
1,2-Dichloropropane	ng	0	-2	2	yes
1,3-Dichloropropene(cis)	ng	0	-2	2	yes
1,3-Dichloropropene(trans)	ng	0	-2	2	yes
Ethylbenzene	ng	0	-2	2	yes
Methylene Chloride	ng	0	-15	15	yes
Styrene	ng	0	-2	2	yes
1,1,2,2-Tetrachloroethane	ng	0	-2	2	yes
Tetrachloroethene	ng	0	-2	2	yes
Toluene	ng	0	-2	2	yes
1,1,1-Trichloroethane	ng	0	-2	2	yes
1,1,2-Trichloroethane	ng	0	-2	2	yes
Trichloroethene	ng	0	-2	2	yes
Trichlorofluoromethane	ng	0	-2	2	yes
Vinyl Chloride	ng	0	-15	15	yes
Xylene-m&p	ng	0	0	0	yes
Xylene-o	ng	0	0	0	yes
Total Xylenes (m,p,o)	ng	0	-2	2	yes

Date Acquired: August 19, 2015

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Benzene	ng	107.81	80	120	yes
Bromodichloromethane	ng	95.74	80	120	yes
Bromoform	ng	89.54	80	120	yes
Bromomethane	ng	87.52	80	120	yes

Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

VOC Screen - Water - Continued

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Carbon Tetrachloride	ng	92.66	80	120	yes
Chlorobenzene	ng	94.98	80	120	yes
Chloroethane	ng	86.26	80	120	yes
2-Chloroethyl Vinyl Ether	ng	98.84	80	120	yes
Chloroform	ng	95.82	80	120	yes
Chloromethane	ng	101.52	80	120	yes
Dibromochloromethane	ng	88.96	80	120	yes
1,2-Dichlorobenzene	ng	94.06	80	120	yes
1,3-Dichlorobenzene	ng	94.78	80	120	yes
1,4-Dichlorobenzene	ng	89.30	80	120	yes
1,1-Dichloroethane	ng	96.84	80	120	yes
1,2-Dichloroethane	ng	96.54	80	120	yes
1,1-Dichloroethene	ng	91.86	80	120	yes
1,2-Dichloroethene(cis)	ng	95.92	80	120	yes
1,2-Dichloroethene(trans)	ng	93.50	80	120	yes
1,2-Dichloropropane	ng	105.46	80	120	yes
1,3-Dichloropropene(cis)	ng	97.24	80	120	yes
1,3-Dichloropropene(trans)	ng	93.62	80	120	yes
Ethylbenzene	ng	100.92	80	120	yes
Methylene Chloride	ng	82.10	80	120	yes
Styrene	ng	91.68	80	120	yes
1,1,2,2-Tetrachloroethane	ng	95.06	80	120	yes
Tetrachloroethene	ng	100.46	80	120	yes
Toluene	ng	103.13	80	120	yes
1,1,1-Trichloroethane	ng	93.10	80	120	yes
1,1,2-Trichloroethane	ng	102.04	80	120	yes
Trichloroethene	ng	96.00	80	120	yes
Trichlorofluoromethane	ng	92.92	80	120	yes
Vinyl Chloride	ng	91.12	80	120	yes
Xylene-m&p	ng	96.04	80	120	yes
Xylene-o	ng	96.50	80	120	yes
Total Xylenes (m,p,o)	ng	96.19	80	120	yes

Date Acquired: August 19, 2015

VOC - Water - Surrogate Recovery

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Dibromofluoromethane	%	95.36	85	115	yes
Toluene-d8	%	100.74	85	115	yes
Bromofluorobenzene	%	92.4	85	115	yes

Date Acquired: August 19, 2015

Trace Metals Dissolved



Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Trace Metals Dissolved

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Aluminum	ug/L	2.03093	-5	5	yes
Antimony	ug/L	0.00909683	-0.2	0.2	yes
Arsenic	ug/L	-0.00302915	-0.2	0.2	yes
Barium	ug/L	-0.0155347	-1	1	yes
Beryllium	ug/L	-0.00411358	-0.04	0.04	yes
Bismuth	ug/L	0.00454175	-1.0	1.0	yes
Boron	ug/L	-3.54075	-4	4	yes
Cadmium	ug/L	0.00248085	-0.01	0.01	yes
Chromium	ug/L	-0.130581	-0.4	0.4	yes
Cobalt	ug/L	0.0019733	-0.02	0.02	yes
Copper	ug/L	-0.0526513	-1	1	yes
Lead	ug/L	-0.0259317	-0.1	0.1	yes
Lithium	ug/L	-0.046371	-1	1	yes
Molybdenum	ug/L	0.013322	-0.10	0.10	yes
Nickel	ug/L	-0.0309905	-1	1	yes
Selenium	ug/L	0.00499669	-0.6	0.6	yes
Silver	ug/L	-5.34672e-005	-0.01	0.01	yes
Strontium	ug/L	0.0436525	-1	1	yes
Tellurium	ug/L	0.014314	-0.1	0.1	yes
Thallium	ug/L	0.0056573	-0.01	0.01	yes
Thorium	ug/L	0.0459307	-0.4	0.4	yes
Tin	ug/L	-0.0216322	-0.4	0.4	yes
Titanium	ug/L	-0.0100794	-0.1	0.1	yes
Uranium	ug/L	0.0038709	-0.40	0.40	yes
Vanadium	ug/L	0	-0.10	0.10	yes
Zinc	ug/L	0	-0.990	0.990	yes
Zirconium	ug/L	0.00568738	-0.1	0.1	yes

Date Acquired: August 18, 2015

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Titanium	mg/L	101.69	90	110	yes
Date Acquired: August 18, 2015					
Aluminum	ug/L	93.72	80	120	yes
Antimony	ug/L	90.64	90	110	yes
Arsenic	ug/L	91.76	90	110	yes
Barium	ug/L	96.06	90	110	yes
Beryllium	ug/L	101.44	90	110	yes
Boron	ug/L	79.41	70	130	yes
Cadmium	ug/L	96.15	90	110	yes
Chromium	ug/L	100.33	90	110	yes
Cobalt	ug/L	94.60	90	110	yes
Copper	ug/L	100.80	90	110	yes
Lead	ug/L	104.47	90	110	yes

Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Trace Metals Dissolved - Continued

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Lithium	ug/L	103.15	90	110	yes
Molybdenum	ug/L	90.76	90	110	yes
Nickel	ug/L	94.16	90	110	yes
Selenium	ug/L	95.82	90	110	yes
Silver	ug/L	106.16	90	110	yes
Strontium	ug/L	97.54	90	110	yes
Thorium	ug/L	102.74	90	110	yes
Tin	ug/L	91.72	90	110	yes
Titanium	ug/L	98.51	90	110	yes
Uranium	ug/L	106.61	90	110	yes
Vanadium	ug/L	95.76	90	110	yes
Zinc	ug/L	96.93	90	110	yes
Date Acquired: August 18, 2015					
Aluminum	ug/L	88.88	80	120	yes
Antimony	ug/L	94.85	90	110	yes
Arsenic	ug/L	91.22	90	110	yes
Barium	ug/L	90.20	90	110	yes
Beryllium	ug/L	99.10	90	110	yes
Boron	ug/L	94.58	80	120	yes
Cadmium	ug/L	99.17	90	110	yes
Chromium	ug/L	100.60	90	110	yes
Cobalt	ug/L	90.64	90	110	yes
Copper	ug/L	98.71	90	110	yes
Lead	ug/L	96.04	90	110	yes
Lithium	ug/L	100.33	90	110	yes
Molybdenum	ug/L	92.52	90	110	yes
Nickel	ug/L	93.08	90	110	yes
Selenium	ug/L	99.72	90	110	yes
Silver	ug/L	108.35	90	110	yes
Strontium	ug/L	95.10	90	110	yes
Thallium	ug/L	96.35	90	110	yes
Thorium	ug/L	96.78	86	122	yes
Tin	ug/L	95.48	90	110	yes
Titanium	mg/L	102.41	90	110	yes
Uranium	ug/L	97.46	90	110	yes
Vanadium	ug/L	91.03	90	110	yes
Zinc	ug/L	94.79	90	110	yes
Date Acquired: August 18, 2015					

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Aluminum	ug/L	<5	<5	20	20	yes
Antimony	ug/L	<0.2	<0.2	20	1.0	yes
Arsenic	ug/L	9.6	9.9	20	1.0	yes

Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Trace Metals Dissolved - Continued

Client Sample	Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Barium		ug/L	37	37	20	5	yes
Beryllium		ug/L	<0.04	<0.04	20	1.00	yes
Boron		ug/L	422	426	20	5	yes
Cadmium		ug/L	<0.01	<0.01	20	0.50	yes
Chromium		ug/L	<0.4	<0.4	20	5.0	yes
Cobalt		ug/L	<0.02	<0.02	20	0.50	yes
Copper		ug/L	<1	<1	20	5	yes
Lead		ug/L	<0.1	<0.1	20	0.5	yes
Lithium		ug/L	2	1	20	5	yes
Molybdenum		ug/L	10.38	10.49	20	0.50	yes
Nickel		ug/L	<1	<1	20	5	yes
Selenium		ug/L	<0.6	<0.6	20	0.5	yes
Silver		ug/L	<0.01	<0.01	20	0.50	yes
Strontium		ug/L	256	259	20	0	yes
Tellurium		ug/L	<0.1	<0.1	20	0.5	yes
Thallium		ug/L	<0.01	<0.01	20	0.10	yes
Thorium		ug/L	<0.4	<0.4	20	0.1	yes
Tin		ug/L	<0.1	<0.1	20	0.5	yes
Titanium		ug/L	<0.4	<0.4	20	0.5	yes
Uranium		ug/L	<0.40	<0.40	20	0.10	yes
Vanadium		ug/L	<0.10	<0.10	20	0.50	yes
Zinc		ug/L	2.27	2.34	20	5.000	yes
Zirconium		ug/L	<0.1	0.1	20	0.5	yes
Date Acquired:	August 18, 2015						
Titanium		mg/L	<0.010	<0.010	30	0.012	yes
Date Acquired:	August 18, 2015						

Trace Metals Total

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Aluminum	ug/L	1.33938	-5	5	yes
Antimony	ug/L	0.0239352	-0.2	0.2	yes
Arsenic	ug/L	0.00852126	-0.2	0.2	yes
Barium	ug/L	0.0210733	-1.0	1.0	yes
Beryllium	ug/L	0.00402049	-0.04	0.04	yes
Bismuth	ug/L	0.00364442	-1.0	1.0	yes
Boron	ug/L	-3.87276	-5	5	yes
Cadmium	ug/L	0.000457307	-0.01	0.01	yes
Chromium	ug/L	0	-0.4	0.4	yes
Cobalt	ug/L	0.0134521	-0.02010	0.02010	yes
Copper	ug/L	-0.0267787	-0.990	0.990	yes
Lead	ug/L	-0.013593	-0.099	0.099	yes
Lithium	ug/L	0.0147185	-1	1	yes



Quality Control

Bill To: Tetra Tech EBA Inc
 Report To: Tetra Tech EBA Inc
 61 Wasson Place
 Whitehorse, YT, Canada
 Y1A 0H7
 Attn: Adam Seeley
 Sampled By: Adam Seeley
 Company: TetraTech

Project:
 ID: ENVH2O 03136
 Name: Burwash WTP
 Location: Burwash, YT
 LSD:
 P.O.:
 Acct code:

Lot ID: **1088469**
 Control Number: A198353
 Date Received: Aug 17, 2015
 Date Reported: Aug 24, 2015
 Report Number: 2034858

Trace Metals Total - Continued

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Molybdenum	ug/L	0.0823209	-0.20	0.20	yes
Nickel	ug/L	0.345044	-1	1	yes
Selenium	ug/L	0.000150923	-0.6	0.6	yes
Silver	ug/L	0.00160249	-0.01	0.01	yes
Strontium	ug/L	-0.0148768	-1.0	1.0	yes
Tellurium	ug/L	0.00313391	-0.1	0.1	yes
Thallium	ug/L	0.00414193	-0.01	0.01	yes
Thorium	ug/L	0.180775	-0.40	0.40	yes
Tin	ug/L	0.013116	-0.1	0.1	yes
Titanium	ug/L	0.125797	-0.4	0.4	yes
Uranium	ug/L	0.00388448	-0.4	0.4	yes
Vanadium	ug/L	0.097619	-0.10	0.10	yes
Zinc	ug/L	-0.0171772	-1	1	yes
Zirconium	ug/L	0.0835612	-0.1	0.1	yes

Date Acquired: August 18, 2015

Mercury	ng/L	3.2	-9.990	9.990	yes
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Date Acquired: August 21, 2015

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Aluminum	ug/L	97.60	80	120	yes
Antimony	ug/L	95.42	90	110	yes
Arsenic	ug/L	92.56	90	110	yes
Barium	ug/L	99.32	90	110	yes
Beryllium	ug/L	97.60	90	110	yes
Boron	ug/L	79.00	70	130	yes
Cadmium	ug/L	103.16	90	110	yes
Chromium	ug/L	92.57	90	110	yes
Cobalt	ug/L	97.81	90	110	yes
Copper	ug/L	105.02	90	110	yes
Lead	ug/L	102.67	90	110	yes
Lithium	ug/L	102.63	90	110	yes
Molybdenum	ug/L	93.64	90	110	yes
Nickel	ug/L	92.58	90	110	yes
Selenium	ug/L	103.36	90	110	yes
Silver	ug/L	102.02	90	110	yes
Strontium	ug/L	97.65	90	110	yes
Thallium	ug/L	104.15	90	110	yes
Thorium	ug/L	94.53	90	110	yes
Tin	ug/L	92.66	90	110	yes
Titanium	ug/L	99.63	90	110	yes
Uranium	ug/L	103.92	90	110	yes
Vanadium	ug/L	95.58	90	110	yes
Zinc	ug/L	91.52	90	110	yes



Quality Control

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Trace Metals Total - Continued

Calibration Check	Units	% Recovery	Lower Limit	Upper Limit	Passed QC
Date Acquired: August 18, 2015					
Aluminum	ug/L	95.49	80	120	yes
Antimony	ug/L	95.16	90	110	yes
Arsenic	ug/L	93.33	90	110	yes
Barium	ug/L	94.39	90	110	yes
Beryllium	ug/L	98.40	90	110	yes
Boron	ug/L	91.46	80	120	yes
Cadmium	ug/L	102.69	90	110	yes
Chromium	ug/L	93.08	90	110	yes
Cobalt	ug/L	96.05	90	110	yes
Copper	ug/L	105.48	90	110	yes
Lead	ug/L	100.89	90	110	yes
Lithium	ug/L	97.93	90	110	yes
Molybdenum	ug/L	95.38	90	110	yes
Nickel	ug/L	91.48	90	110	yes
Selenium	ug/L	101.24	90	110	yes
Silver	ug/L	96.09	90	110	yes
Strontium	ug/L	99.46	90	110	yes
Thallium	ug/L	95.78	90	110	yes
Thorium	ug/L	98.23	90	110	yes
Tin	ug/L	93.06	90	110	yes
Titanium	ug/L	95.03	90	110	yes
Uranium	ug/L	97.93	90	110	yes
Vanadium	ug/L	95.00	90	110	yes
Zinc	ug/L	94.66	90	110	yes

Date Acquired: August 18, 2015

Certified Reference Material	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Mercury	ug/L	0.097	0.097	0.073	0.121	yes

Date Acquired: August 21, 2015

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Aluminum	ug/L	<5	<5	20	100	yes
Antimony	ug/L	<0.2	<0.2	20	2.0	yes
Arsenic	ug/L	9.0	9.0	20	2.0	yes
Barium	ug/L	37	39	20	10.0	yes
Beryllium	ug/L	<0.04	<0.04	20	0.40	yes
Boron	ug/L	410	425	20	40	yes
Cadmium	ug/L	<0.01	<0.01	20	0.10	yes
Chromium	ug/L	<0.4	0.4	20	6.0	yes
Cobalt	ug/L	0.0206	0.0245	20	0.20000	yes
Copper	ug/L	<1	<1	20	5.000	yes
Lead	ug/L	<0.1	<0.1	20	1.000	yes

Quality Control

Bill To: Tetra Tech EBA Inc
 Report To: Tetra Tech EBA Inc
 61 Wasson Place
 Whitehorse, YT, Canada
 Y1A 0H7
 Attn: Adam Seeley
 Sampled By: Adam Seeley
 Company: TetraTech

Project:
 ID: ENVH2O 03136
 Name: Burwash WTP
 Location: Burwash, YT
 LSD:
 P.O.:
 Acct code:

Lot ID: **1088469**
 Control Number: A198353
 Date Received: Aug 17, 2015
 Date Reported: Aug 24, 2015
 Report Number: 2034858

Trace Metals Total - Continued

Client Sample	Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Lithium		ug/L	1	1	20	10	yes
Molybdenum		ug/L	11.0	10.9	20	0.20	yes
Nickel		ug/L	<1	<1	20	10	yes
Selenium		ug/L	<0.6	<0.6	20	5.0	yes
Silver		ug/L	<0.01	<0.01	20	0.10	yes
Strontium		ug/L	269	277	20	10.0	yes
Tellurium		ug/L	<0.1	<0.1	20	0.5	yes
Thallium		ug/L	<0.01	<0.01	20	0.10	yes
Thorium		ug/L	<0.40	<0.40	20	1.00	yes
Tin		ug/L	<0.1	<0.1	20	1.0	yes
Titanium		ug/L	<0.4	<0.4	20	1.0	yes
Uranium		ug/L	<0.4	<0.4	20	1.0	yes
Vanadium		ug/L	<0.1	<0.1	20	0.40	yes
Zinc		ug/L	4	4	20	10	yes
Zirconium		ug/L	<0.1	0.2	20	1.0	yes
Date Acquired: August 18, 2015							
Mercury		ug/L	<0.010	<0.010	20	0.050	yes
Date Acquired: August 21, 2015							

Methodology and Notes

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

Method of Analysis

Method Name	Reference	Method	Date Analysis Started	Location
Alk, pH, EC, Turb in water (Surrey)	APHA	* pH - Electrometric Method, 4500-H+ B	18-Aug-15	Exova Surrey
Ammonia-N in Water (Surrey)	APHA	* Flow Injection Analysis, 4500-NH3 H	19-Aug-15	Exova Surrey
Anions by IEC in water (Surrey)	APHA	* Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	18-Aug-15	Exova Surrey
Anions by IEC in water (Surrey)	APHA	* Single-Column Ion Chromatography with Electronic Suppression, 4110 C	18-Aug-15	Exova Surrey
BTEX-VPH - Water (MS) (Surrey)	BCELM	* Volatile Hydrocarbons in Water by GC/FID, VH Water	19-Aug-15	Exova Surrey
Carbon Organic (Total) in water (TOC)	APHA	High-Temperature Combustion Method, 5310 B	20-Aug-15	Exova Edmonton
EPH - Water	BCELM	* Extractable Petroleum Hydrocarbons (EPH) in Water by GC/FID, EPH Water	19-Aug-15	Exova Surrey
Mercury Low Level (Dissolved) in water (Surrey)	EPA	* Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry, 245.7	21-Aug-15	Exova Surrey
Mercury Low Level (Total) in water (Surrey)	EPA	* Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry, 245.7	21-Aug-15	Exova Surrey
Metals SemiTrace (Dissolved) in water (Surrey)	US EPA	* Metals & Trace Elements by ICP-AES, 6010C	18-Aug-15	Exova Surrey
Metals SemiTrace (Total) in Water (Surrey)	US EPA	* Metals & Trace Elements by ICP-AES, 6010C	18-Aug-15	Exova Surrey
PAH - Water (Surrey)	BCELM	* Polycyclic Aromatic Hydrocarbons in Water by GC/MS - PBM, PAH Water	19-Aug-15	Exova Surrey
Phosphorus - orthophosphate by Smartchem (Surrey)	APHA	Ascorbic Acid Reduction Method, 4500-P E	20-Aug-15	Exova Surrey
Solids Dissolved (Total, Fixed and Volatile) - Surrey	APHA	* Total Dissolved Solids Dried at 180 C, 2540 C	20-Aug-15	Exova Surrey
Solids Suspended (Total, Fixed and Volatile) - Surrey	APHA	* Total Suspended Solids Dried at 103-105°C, 2540 D	20-Aug-15	Exova Surrey
Total and Kjeldahl Nitrogen (Total) in Water	ISO	* Water Quality - Determination of nitrogen, ISO/TR 11905-2	20-Aug-15	Exova Edmonton
Trace Metals (dissolved) in Water (Surrey)	US EPA	* Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	18-Aug-15	Exova Surrey
Trace Metals (Total) in Water (Surrey)	US EPA	* Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	18-Aug-15	Exova Surrey
Turbidity - Water (Surrey)	APHA	* Turbidity - Nephelometric Method, 2130 B	19-Aug-15	Exova Surrey
VOC - Water	US EPA	* Volatile Organic Compounds by GCMS / Purge and Trap for Aqueous Samples, 8260B/5030B	19-Aug-15	Exova Calgary

* Reference Method Modified

References

APHA	Standard Methods for the Examination of Water and Wastewater
B.C.M.O.E	B.C. Ministry of Environment

Methodology and Notes

Bill To: Tetra Tech EBA Inc	Project:	Lot ID: 1088469
Report To: Tetra Tech EBA Inc	ID: ENVH2O 03136	Control Number: A198353
61 Wasson Place	Name: Burwash WTP	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	Location: Burwash, YT	Date Reported: Aug 24, 2015
Y1A 0H7	LSD:	Report Number: 2034858
Attn: Adam Seeley	P.O.:	
Sampled By: Adam Seeley	Acct code:	
Company: TetraTech		

BCELM	B.C. Environmental Laboratory Manual
EPA	Environmental Protection Agency Test Methods - US
ISO	International Organization for Standardization
US EPA	US Environmental Protection Agency Test Methods

Comments:

- An appropriately preserved sample was not received for Ammonia analysis of sample 1088469-3. Analysis was performed on unpreserved sample.
- Analysis was performed on sample # 1088469-1 & 2 that exceeded the recommended holding time for turbidity analysis.
- pH analysis was performed past the recommended holding time of 15 minutes from sample collection.

Please direct any inquiries regarding this report to our Client Services group.

Results relate only to samples as submitted.

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Hydrocarbon Chromatogram

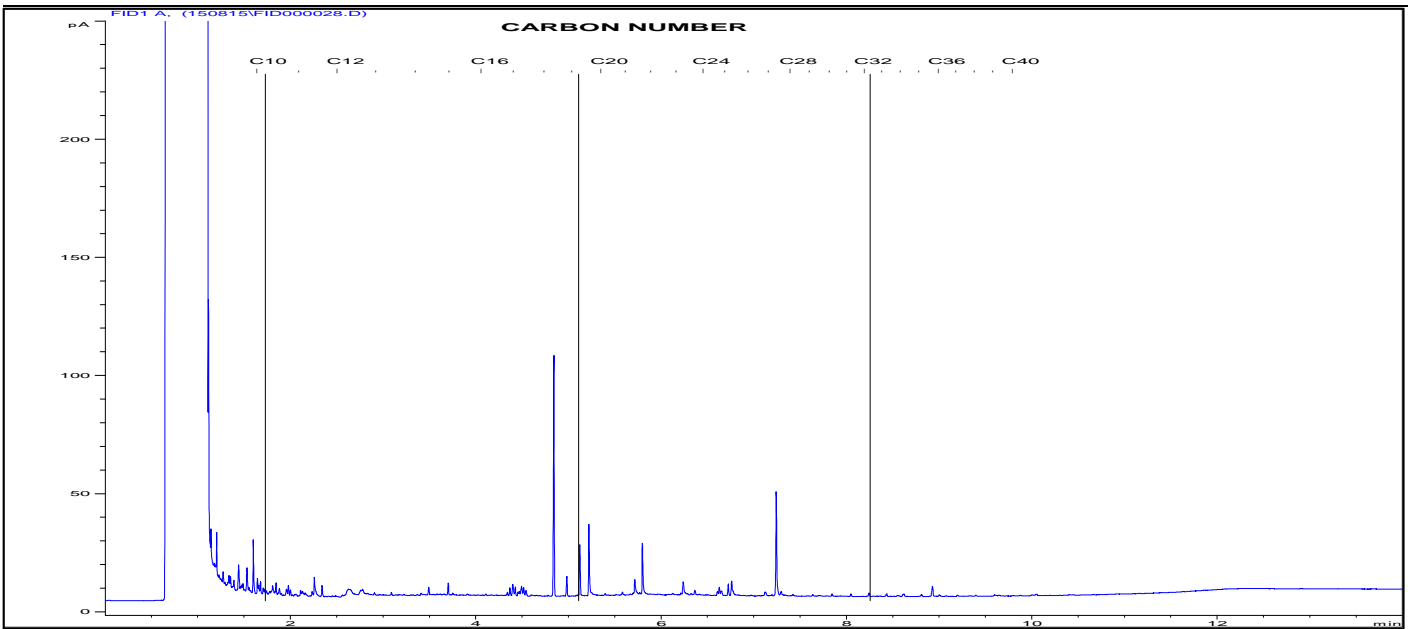
Bill To: Tetra Tech EBA Inc - Edmonton
 Report To: Tetra Tech EBA Inc - Edmonton
 61 Wasson Place
 Whitehorse, YT, Canada
 Y1A 0H7
 Attn: Adam Seeley
 Sampled by: Adam Seeley
 Company: TetraTech

Project ID: ENVH2O 03136
 Name: Burwash WTP
 Location: Burwash, YT
 LSD:
 P.O.:

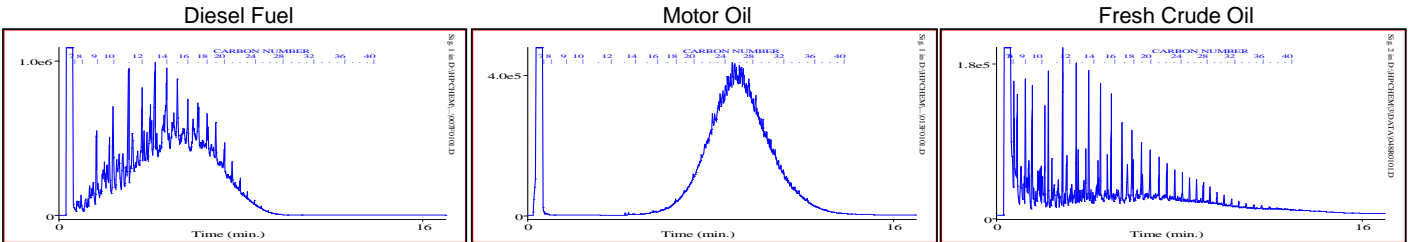
Lot ID: **1088469**
 Control Number: A198353
 Date Received: Aug 17, 2015
 Date Reported: Aug 21, 2015
 Report Number: 2034858

Exova Number: 1088469-1
 Sample Date: Aug 12, 2015

Sample Description: KFN-K KFN-K #1



TYPICAL PRODUCT CHROMATOGRAMS



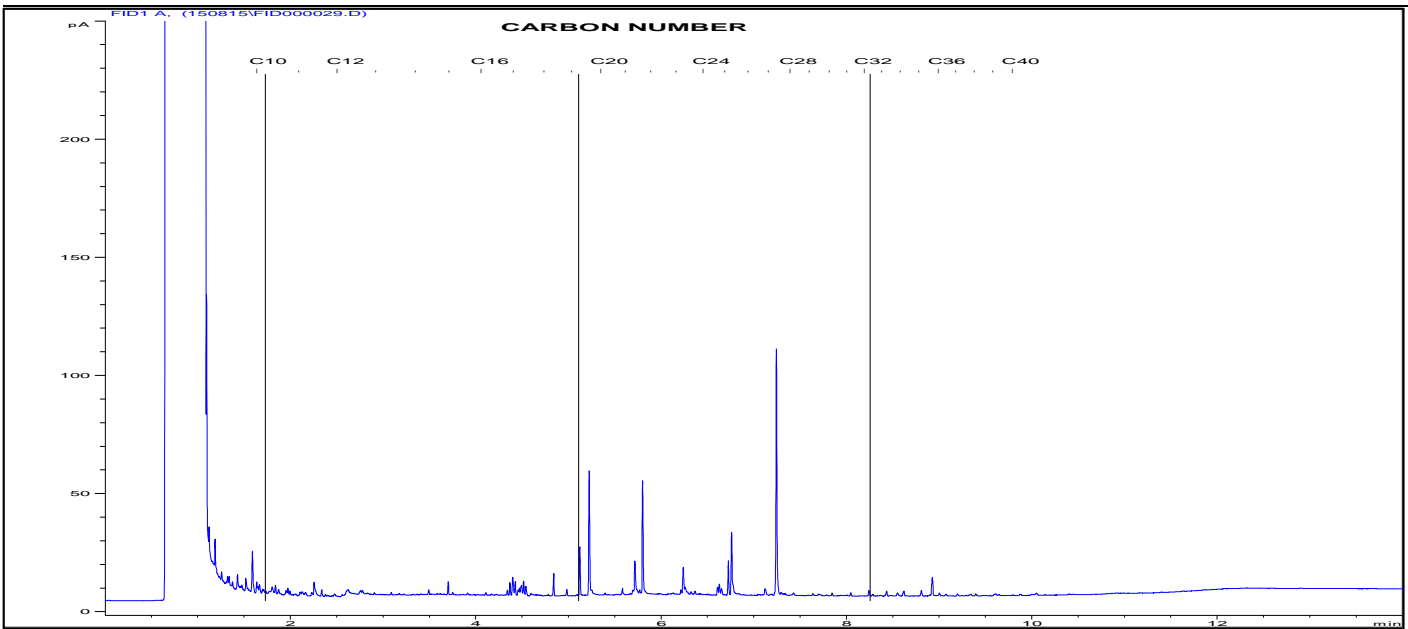
Product Carbon Number Ranges

Gasoline	C4-C12	Kerosene	C7-C16	Lubricating Oils	C20-C40
Varsol	C8-C12	Diesel	C8-C22	Crude Oils	C3-C60+

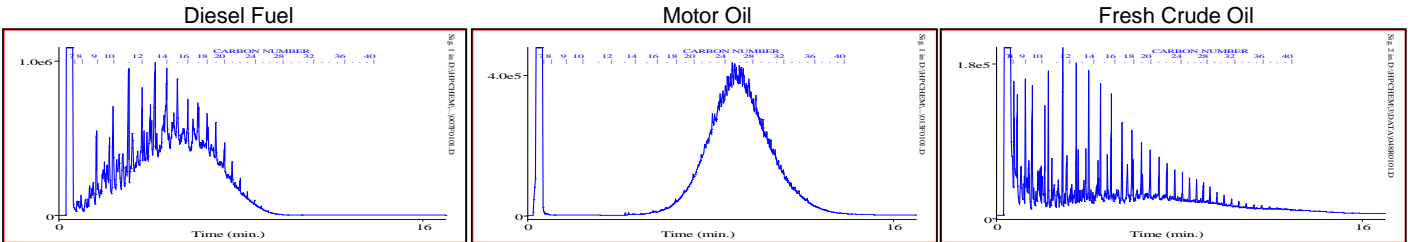
Hydrocarbon Chromatogram

Bill To: Tetra Tech EBA Inc - Edmonton	Project ID: ENVH2O 03136	Lot ID: 1088469
Report To: Tetra Tech EBA Inc - Edmonton	Name: Burwash WTP	Control Number: A198353
61 Wasson Place	Location: Burwash, YT	Date Received: Aug 17, 2015
Whitehorse, YT, Canada	LSD:	Date Reported: Aug 21, 2015
Y1A 0H7	P.O.:	Report Number: 2034858
Attn: Adam Seeley		
Sampled by: Adam Seeley		
Company: TetraTech		

Exova Number: 1088469-2 Sample Description: KFN-K KFN-K #2
 Sample Date: Aug 13, 2015



TYPICAL PRODUCT CHROMATOGRAMS



Product Carbon Number Ranges

Gasoline	C4-C12	Kerosene	C7-C16	Lubricating Oils	C20-C40
Varsol	C8-C12	Diesel	C8-C22	Crude Oils	C3-C60+



Tetra Tech EBA Inc.
ATTN: Ryan Martin
61 Wasson Place
Whitehorse YT Y1A 0H7

Date Received: 31-AUG-15
Report Date: 03-SEP-15 16:23 (MT)
Version: FINAL

Client Phone: 867-668-3068

Certificate of Analysis

Lab Work Order #: L1665626
Project P.O. #: NOT SUBMITTED
Job Reference: ENVH2003136-02
C of C Numbers: 14-469871
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1665626-3 Water 28-AUG-15 WS03	L1665626-5 Water 28-AUG-15 WS05	L1665626-6 Water 28-AUG-15 WS07	L1665626-7 Water 28-AUG-15 WS08
Grouping	Analyte				
WATER					
Physical Tests	pH (pH)			7.58	
	Total Dissolved Solids (ug/L)			1600000	
Anions and Nutrients	Ammonia, Total (as N) (ug/L)			284	
	Chloride (Cl) (ug/L)			77500	
	Total Kjeldahl Nitrogen (ug/L)			2430	
	Sulfate (SO4) (ug/L)			765000	
Organic / Inorganic Carbon	Total Organic Carbon (ug/L)			62500	
Total Metals	Arsenic (As)-Total (ug/L)	6.22	10.2		
	Iron (Fe)-Total (ug/L)	11200	52		
Aggregate Organics	COD (ug/L)			187000	
Volatile Organic Compounds	Benzene (ug/L)	<0.50	<0.50	<0.50	<0.50
	Bromodichloromethane (ug/L)			<1.0	
	Bromoform (ug/L)			<1.0	
	Carbon Tetrachloride (ug/L)			<0.50	
	Chlorobenzene (ug/L)			<1.0	
	Dibromochloromethane (ug/L)			<1.0	
	Chloroethane (ug/L)			<1.0	
	Chloroform (ug/L)			<1.0	
	Chloromethane (ug/L)			<5.0	
	1,2-Dichlorobenzene (ug/L)			<0.70	
	1,3-Dichlorobenzene (ug/L)			<1.0	
	1,4-Dichlorobenzene (ug/L)			<1.0	
	1,1-Dichloroethane (ug/L)			<1.0	
	1,2-Dichloroethane (ug/L)			<1.0	
	1,1-Dichloroethylene (ug/L)			<1.0	
	cis-1,2-Dichloroethylene (ug/L)			<1.0	
	trans-1,2-Dichloroethylene (ug/L)			<1.0	
	1,3-Dichloropropene (cis & trans) (ug/L)			<1.4	
	Dichloromethane (ug/L)			<5.0	
	1,2-Dichloropropane (ug/L)			<1.0	
	cis-1,3-Dichloropropylene (ug/L)			<1.0	
	trans-1,3-Dichloropropylene (ug/L)			<1.0	
	Ethylbenzene (ug/L)	<0.50	<0.50	<0.50	<0.50
	Methyl t-butyl ether (MTBE) (ug/L)	<0.50	<0.50	<0.50	<0.50
	Styrene (ug/L)			<0.50	

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1665626-3 Water 28-AUG-15 WS03	L1665626-5 Water 28-AUG-15 WS05	L1665626-6 Water 28-AUG-15 WS07	L1665626-7 Water 28-AUG-15 WS08
Grouping	Analyte				
WATER					
Volatile Organic Compounds	1,1,1,2-Tetrachloroethane (ug/L)			<1.0	
	1,1,2,2-Tetrachloroethane (ug/L)			<1.0	
	Tetrachloroethylene (ug/L)			<1.0	
	Toluene (ug/L)	<0.50	<0.50	<0.50	<0.50
	1,1,1-Trichloroethane (ug/L)			<1.0	
	1,1,2-Trichloroethane (ug/L)			<1.0	
	Trichloroethylene (ug/L)			<1.0	
	Trichlorofluoromethane (ug/L)			<1.0	
	Vinyl Chloride (ug/L)			<1.0	
	ortho-Xylene (ug/L)	<0.50	<0.50	<0.50	<0.50
	meta- & para-Xylene (ug/L)	<0.50	<0.50	<0.50	<0.50
	Xylenes (ug/L)	<0.75	<0.75	<0.75	<0.75
	Surrogate: 4-Bromofluorobenzene (SS) (%)	96.9	99.6	98.7	99.6
Surrogate: 1,4-Difluorobenzene (SS) (%)	99.9	100.9	100.6	100.1	
Hydrocarbons	EPH10-19 (ug/L)			155	
	EPH19-32 (ug/L)			557	
	LEPH (ug/L)			155	
	HEPH (ug/L)			557	
	Volatile Hydrocarbons (VH6-10) (ug/L)			<100	
	VPH (C6-C10) (ug/L)			<100	
	Surrogate: 2-Bromobenzotrifluoride (%)			88.2	
	Surrogate: 3,4-Dichlorotoluene (SS) (%)			94.1	
Polycyclic Aromatic Hydrocarbons	Acenaphthene (ug/L)			<0.010	
	Acenaphthylene (ug/L)			<0.010	
	Acridine (ug/L)			<0.010	
	Anthracene (ug/L)			<0.010	
	Benzo(a)anthracene (ug/L)			<0.010	
	Benzo(a)pyrene (ug/L)			<0.010	
	Benzo(b)fluoranthene (ug/L)			<0.010	
	Benzo(g,h,i)perylene (ug/L)			<0.010	
	Benzo(k)fluoranthene (ug/L)			<0.010	
	Chrysene (ug/L)			<0.010	
	Dibenz(a,h)anthracene (ug/L)			<0.010	
	Fluoranthene (ug/L)			<0.010	
	Fluorene (ug/L)			<0.010	
	Indeno(1,2,3-c,d)pyrene (ug/L)			<0.010	

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1665626-3 Water 28-AUG-15 WS03	L1665626-5 Water 28-AUG-15 WS05	L1665626-6 Water 28-AUG-15 WS07	L1665626-7 Water 28-AUG-15 WS08
Grouping	Analyte				
WATER					
Polycyclic Aromatic Hydrocarbons	Naphthalene (ug/L)			<0.050	
	Phenanthrene (ug/L)			<0.020	
	Pyrene (ug/L)			<0.010	
	Quinoline (ug/L)			<0.050	
	Surrogate: Acridine d9 (%)			93.3	
	Surrogate: Chrysene d12 (%)			76.8	
	Surrogate: Naphthalene d8 (%)			93.0	
	Surrogate: Phenanthrene d10 (%)			91.8	

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CARBONS-TOC-VA	Water	Total organic carbon by combustion This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".	APHA 5310B TOTAL ORGANIC CARBON (TOC)
CL-IC-N-WR	Water	Chloride in Water by IC Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	EPA 300.1 (mod)
COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.	APHA 5220 D. CHEMICAL OXYGEN DEMAND
EPH-L-ME-FID-VA	Water	EPH in Water (Low Level) EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.	BC Lab Manual
LEPH/HEPH-CALC-VA	Water	LEPHs and HEPHs Light and Heavy Extractable Petroleum Hydrocarbons in water. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 20, 1999).	BC MOE LABORATORY MANUAL (2005)
MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.	EPA 200.2/6020A (mod)
NH3-F-VA	Water	Ammonia in Water by Fluorescence This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.	APHA 4500 NH3-NITROGEN (AMMONIA)
NH3-F-VA	Water	Ammonia in Water by Fluorescence This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
PAH-ME-MS-VA	Water	PAHs in Water PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.	EPA 3511/8270D (mod)
PH-MAN-VA	Water	pH by Manual Meter This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode. It is recommended that this analysis be conducted in the field.	APHA 4500-H "pH Value"
PH-MAN-VA	Water	pH by Manual Meter This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode. It is recommended that this analysis be conducted in the field.	APHA 4500-H pH Value
SO4-IC-N-WR	Water	Sulfate in Water by IC Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	EPA 300.1 (mod)
TDS-VA	Water	Total Dissolved Solids by Gravimetric This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.	APHA 2540 C - GRAVIMETRIC
TKN-F-VA	Water	TKN in Water by Fluorescence This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.	APHA 4500-NORG D.
VH-HSFID-VA	Water	VH in Water by Headspace GCFID The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Compounds eluting between n-hexane and n-decane are measured and summed together using flame-ionization detection.	B.C. MIN. OF ENV. LAB. MAN. (2009)
VH-SURR-FID-VA	Water	VH Surrogates for Waters	B.C. MIN. OF ENV. LAB. MAN. (2009)

Reference Information

VOC-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5021
The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.			
VOC7-HSMS-VA	Water	BTEX/MTBE/Styrene by Headspace GCMS	EPA8260B, 5021
The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.			
VOC7/VOC-SURR-MS-VA	Water	VOC7 and/or VOC Surrogates for Waters	EPA8260B, 5021
VPH-CALC-VA	Water	VPH is VH minus select aromatics	BC MOE LABORATORY MANUAL (2005)
These results are determined according to the British Columbia Ministry of Environment Analytical Method for Contaminated Sites "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water". The concentrations of specific Monocyclic Aromatic Hydrocarbons (Benzene, Toluene, Ethylbenzene, Xylenes and, in solids, Styrene) are subtracted from the collective concentration of Volatile Hydrocarbons (VH) that elute between n-hexane (nC6) and n-decane (nC10).			
XYLENES-CALC-VA	Water	Sum of Xylene Isomer Concentrations	CALCULATION
Calculation of Total Xylenes			
Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

14-469871

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

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

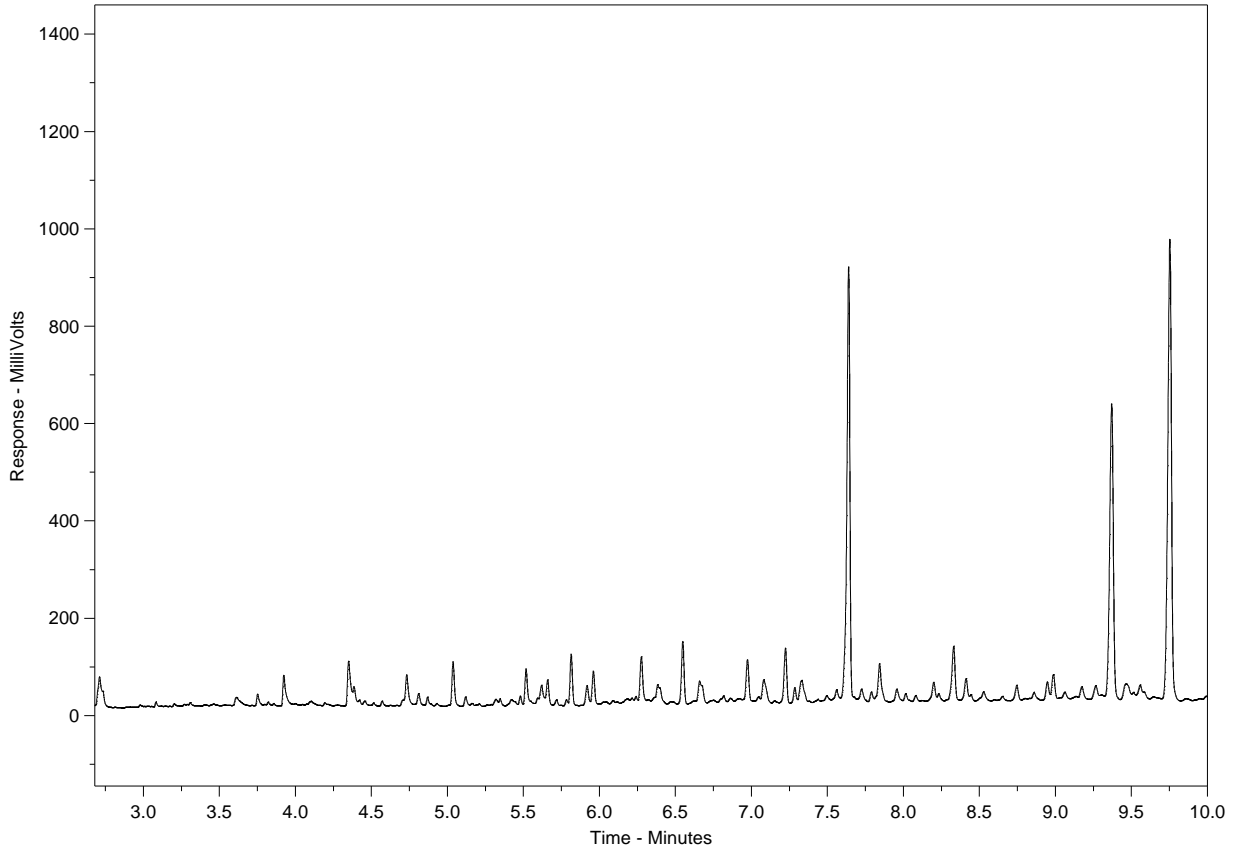
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Hydrocarbon Distribution Report



ALS Sample ID: L1665626-L-6
Client Sample ID: WS07



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →		← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

