Memorandum

Date: May 12, 2016

To: Brad Stoneman, Teslin Environmental Services

From: Tyler Gale, Hydrogeologist, ERM
Allyson Longmuir, Project Manager, ERM

Cc: Yaming Chen, Principal Consultant, Discipline Manager - Hydrogeology, ERM;

Subject: **Hydrogeologic Testing and Interpretations for the Teslin Sawmill Land Treatment Facility – Revised with Consideration of Regulatory Review**

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1. INTRODUCTION AND BACKGROUND

This memorandum documents work conducted by ERM to support the Deslin Development Corporation (DDC) in fulfilling the requirements of a hydrogeologic assessment for the Teslin Sawmill Land Treatment Facility (the LTF).

The LTF is situated in the Teslin Tlingit Council Capital Works Yard, near Teslin, Yukon Territory (Figure 1). The facility spans a rectangular area of approximately 40 m by 50 m. One meter high embankments bound the perimeter, and a geomembrane liner covers the floor and inner embankment walls. The design capacity is 4,500 m^3 of soil.

Under the Yukon Contaminates Sites Regulation (YCSR 2002), a hydrogeologic assessment must be undertaken for a land treatment facility with a capacity greater than 3,000 m^3. Specific requirements of the hydrogeologic assessment include the following:

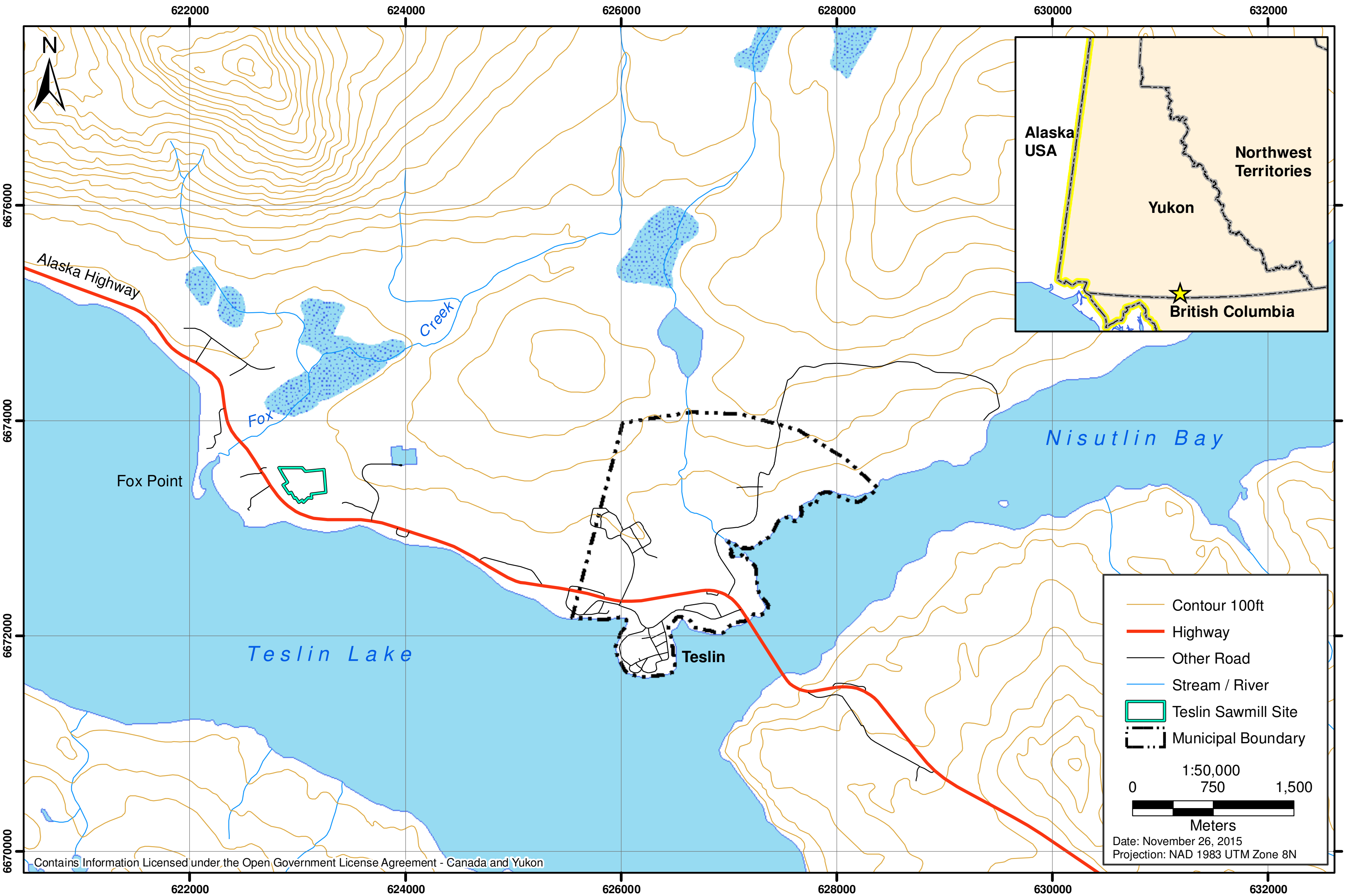
- the direction and rate of groundwater flow;
- identifying potential receiving environments;
- an estimate of travel times along contaminant transport pathways;
- formulation of the assessment based on a minimum of one monitoring well up-gradient of the facility and two down-gradient; and
- wells to be sited appropriately for regular monitoring of potential groundwater contamination.

Components of the work in fulfillment of the hydrogeologic assessment requirements have been conducted by Chilkoot Geological Engineering Inc. (Chilkoot), and the reports documenting this work have been included as appendices to this memorandum. The work conducted by Chilkoot includes:

- Supervision of the drilling of three boreholes and installation of three monitoring wells in May 2014 (Appendix A);

Figure 1
Location of Teslin Sawmill Land Treatment Facility

ERM



- groundwater level measurements at the three existing wells in September 2014 (Appendix B); and
- Supervision of drilling of a fourth borehole and installation of a monitoring well in October 2015 (Appendix C).

The work conducted by ERM in support of the hydrogeolgic assessment includes the following:

- Coordination of a high-accuracy GPS spatial survey of well collar locations;
- Groundwater level measurements and single well response testing at monitoring wells in October 2015; and
- A desktop study to characterize the groundwater flow regime.

1.1 Rationale for the Use of Relatively Long Well Screens

A letter from Yukon Environment (Yukon Environment 2016) instructed that the revised hydrogeological assessment include rationale for the use of relatively long screens completed over different hydrostratigraphic units. This section has been included in fulfilment of this requirement.

The relatively long well screens serve as appropriate screening tools to establish the groundwater levels and groundwater quality at the LTF. They would not serve as appropriate tools for the purpose of characterizing the groundwater contamination in greater details, or measuring vertical hydraulic gradients over the depth of investigation. Vertical hydraulic gradients are not included in the linear formulas used for the calculation of groundwater flow velocity and travel time to the receiving environment, and are therefore not required to fulfil the requirements of the hydrogeological assessment as described in the guidelines (Environment Yukon 2015).

The well logs show only one geological material (glacial till) being identified in the saturated section of the screen intervals. The composition of the glacial till is dominated with silts, and slug tests have indicated relatively low hydraulic conductivity (from 6e-8 m/sec to 8e-7 m/sec). The information indicates that the glacial till can be considered as one hydrostratigraphic unit from the hydrogeological conceptualization and contaminant migration point of view. Therefore, the potential of cross-contamination within the silts-dominated low permeable glacial till in the longer screen intervals (as a single hydrostratigraphic unit) would not be expected.

The Land Treatment Facility Guidelines (Environment Yukon 2015) specify that adaptive management must be initiated if hydrocarbons are detected in the groundwater down-gradient of the facility. Longer well screens may dilute contamination more than shorter well screens (in the event that the plume is narrow); however, shorter well screens present a greater likelihood of not intersecting the contaminated groundwater at all. Therefore longer well screens serve as a more effective screening tool leading to the initiation of adaptive management. Adaptive management at this site could include the installation of shorter well screens to provide improved confidence in the magnitude of contamination, if hydrocarbons were indeed detected at a well down-gradient of the LTF.

2. OCTOBER 2015 TESTING AND MEASUREMENTS

2.1 Monitoring Well Location Survey

The location of each of four monitoring wells near the LTF was surveyed using a real-time kinematic GPS system with centimeter accuracy (Table 1; Figure 2). Coordinates were measured using the NAD 83 horizontal datum, and the CGVD 28 vertical datum. The accuracy of this survey method is appropriate for determining groundwater elevations.

2.2 Groundwater Levels

An electric water level tape was used to measure groundwater levels at each of four wells near the LTF on October 5, 2015 (Table 1). Two of four wells were found to be dry.

2.3 Single Well Response Tests

Single well response tests were performed in BH1-14 and BH2-14 on October 5 and 6, 2015. A pressure transducer was deployed in each well, and a barometric logger was deployed next to BH2-14. A bailer was used to withdraw water to initiate tests. Tests were allowed to proceed overnight, and the pressure transducers were recovered the following morning.

Recoveries to the initial water level took several hours in each well. The early time responses were influenced by borehole storage. Late-time responses were skewed to some extent by natural variation in the groundwater level, likely because the water table was rising in response to recent heavy rainfall.

Log-linear sections of the recovery plot were used to estimate hydraulic conductivity for each well, as shown in the attached single well response test analysis reports (Appendix D). Analyses were conducted using the method of Bouwer and Rice (1976), as groundwater levels were within the screened intervals of the wells.

A vertical anisotropy ratio of 1 ($K_h/K_z = 1$) and a well radius of 0.075 m were used in both analysis. The vertical anisotropy ratio has not been evaluated with field data. The well radius corresponds with the width of the auger flytes, and assumes a sand pack fills the space between the well casing and the borehole wall.

A hydraulic conductivity of 6×10^{-8} m/s was estimated for BH1-14. The well screen at BH1-14 intersected glacial till below the water table during the test. An aquifer thickness of 5.3 m was used in the analysis, corresponding with the interval of till extending from the water table to the bottom of the borehole (partially penetrating well).

A hydraulic conductivity of 8×10^{-7} m/s was estimated for BH2-14. The well screen at BH2-14 intersects glacial till characterised with more sand. An aquifer thickness of 1.4 m was used in the analysis, corresponding with the interval of till extending from the water table to the bottom of the borehole (partially penetrating well).

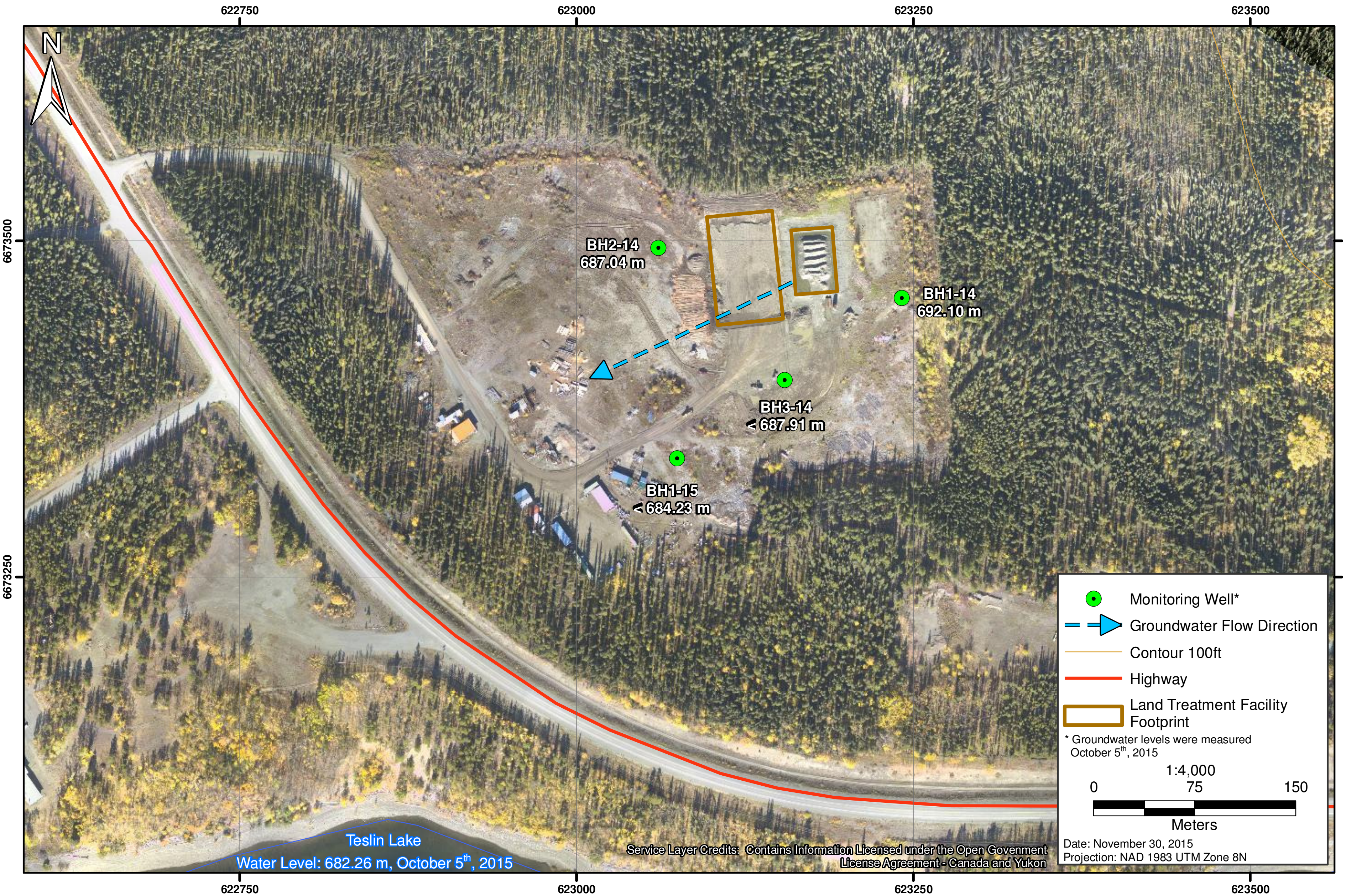
Table 1. Summary of Monitoring Well Construction Details and Groundwater Level Measurements

Well ID	Collar Location			Screened Interval		Water Elevations (m) [A]			
	Northing (m) [C]	Easting (m) [C]	Elevation (m) [A,B]	Top (m) [D]	Bottom (m) [D]	26-May-14	29-Sep-14	3-Oct-14	5-Oct-15
BH1-14	6673457.9	623241.5	700.00	5.67	11.77	690.20	694.54	694.95	692.10
BH2-14	6673495.2	623061.1	697.59	6.24	10.81	< 686.78	689.68	689.87	687.04
BH3-14	6673396.9	623154.4	698.51	4.50	10.6	< 687.91	< 687.91	< 687.91	< 687.91
BH1-15	6673338.3	623074.7	698.40	9.54	14.11	-	-	-	< 684.25

[A] *Referenced to Canadian Geodetic Vertical Datum (1928)*
[B] *Elevation measured at top of standpipe*
[C] *Referenced to North American Datum (1983)*
[D] *Referenced to top of standpipe*
"<" *indicates well was dry, water level below bottom of standpipe*

Figure 2

Monitoring Wells and Groundwater Levels at the Teslin Sawmill Land Treatment Facility



3. CHARACTERISATION OF GROUNDWATER FLOW REGIME

3.1 Groundwater Flow Direction

The groundwater flow records obtained at the four wells near the LTF (Table 1) indicate that groundwater flows westward to south-southwestward towards Teslin Lake (Figure 2). The absence of water in two of four wells has been used as an indicator in the determination of the groundwater flow direction.

Local topography may influence the groundwater flow direction down-gradient of the wells at the LTF. The flow direction may curve southward, shortening the flow pathway between the LTF and the lake relative to a sustained linear flow direction as indicated in Figure 2.

3.2 Hydraulic Gradient

The hydraulic gradient between the LTF and Teslin Lake has been calculated for the purpose of estimating the groundwater flow velocity (Section 3.3) and the travel time along the transport pathway (Section 3.4). Calculations were performed using equation 1.

$$i_h = \Delta h \div d \qquad (1)$$

Where,

- i_h is the horizontal hydraulic gradient,
- d is distance (between the LTF and Teslin Lake), and
- Δh is the difference in hydraulic head between the LTF and Teslin Lake

The true hydraulic gradient along the flow pathway between the LTF and Teslin Lake varies in time and space. Groundwater and Lake elevations vary differently in response to seasonal climate trends, thus resulting in hydraulic gradients that vary seasonally. Hydraulic conductivity varies along the transport pathway, and the hydraulic gradient will consequently vary. The calculated hydraulic gradients should therefore be regarded as estimates.

The estimated hydraulic gradient between BH1-14 and Teslin Lake on October 5, 2015 was 0.023, as calculated using equation 1. Input values include a distance of 430 m between the LTF and Teslin Lake, and a hydraulic head difference of 9.84 m. The water elevation in Teslin Lake was obtained from historical records for the Water Survey of Canada hydrometric station in Teslin (Water Survey of Canada 2015) and is shown on Figure 2.

3.3 Groundwater Flow Velocity

A range of potential linear groundwater flow velocities (also often referred to as seepage velocity) were calculated using equation 2.

$$V_s = \frac{1}{n_e} K i_h \qquad (2)$$

where,

- V_s is linear groundwater flow (seepage) velocity,
- n_e is effective porosity
- K is hydraulic conductivity
- i_h is horizontal hydraulic gradient

The groundwater flow velocity is heavily dependent on the hydraulic conductivity of the geologic material through-which the groundwater flows. Four different geologic materials were identified in the boreholes (Appendix A and C), including the following:

- Surficial materials characterised as silty sands with organics and woody debris;
- Glaciolacustrine silts and clays with stringers of fine sand;
- Galcial tills characterised as well graded silts and sands; and
- Well-graded glaciofluvial sand.

The single well response tests at BH1-14 and BH2-14 provide two measurements of the hydraulic conductivity of the glacial till: 6×10^{-8} m/s and 8×10^{-7} m/s. A flow velocity of 8 mm/day would correspond with the following:

- a bulk hydraulic conductivity of 8×10^{-7} m/s (highest estimate of two conservatively adopted)
- an effective porosity of 0.2 assumed, as would be applicable for soils with large proportions of silt (Morris & Johnson 1967); and
- a hydraulic gradient of 0.023 (estimated in Section 3.2).

A hydraulic conductivity of 5×10^{-4} m/s would be at the upper end of the range expected for a well-graded glaciofluvial sand with a non-trivial silt content (measured silt proportions of 20% at BH3-14 and 17% at BH1-15; Domenico & Schwartz 1990). This value would correspond with a flow velocity of 3 m/day, given an effective porosity of 0.3 for a material dominated by sand (Morris & Johnson 1967), and hydraulic gradient of 0.023.

A layer of well-graded sand was identified in BH3-14 and BH1-15. This sand deposit has been above the water table in the two wells to-date. However, the possibility of this sand extending into the saturated zone elsewhere cannot be ruled out. If present in the saturated zone, this sand would behave as a preferential flow pathway with groundwater flow velocities higher than the adjacent till and glaciolacustrine sediments. The possibility of this sand deposit extending into the saturated zone should be carefully considered if adaptive management becomes necessary.

3.4 Receiving Environments

Groundwater travelling beneath the LTF is interpreted to discharge into Teslin Lake. The flow direction indicated by the wells near the LTF suggest a discharge point a few hundred metres southeast of the mouth of Fox Creek. The distance from the LTF to Telsin Lake along the interpreted flow pathway is approximately 670 m.

Recognizing the possibility that groundwater flow curves southward down-gradient of the site (discussed in Section 3.1), it cannot be refuted that groundwater may travel along a pathway that approaches the shortest distance between the LTF and Teslin Lake (430 m). A distance of 430 m has been conservatively adopted in calculations of hydraulic gradient, seepage velocity, and travel time.

Fox Creek passes to the north and northwest of the LTF at a distance of 470 m and greater. The measured groundwater elevations do not suggest that Fox Creek would receive groundwater traveling beneath the LTF. The dry measurement at MW1-15, where the bottom of standpipe elevation is 684.23 m, provides a strong indication that flow does not trend to the north or northwest leaving the LTF.

Vapours of volatile compounds (e.g., BTEX compounds) emanating from a hydrocarbons plume are released upward into the surficial environment through the unsaturated zone. Industrial buildings on the Capital works Yard are 180 to 250 m down-gradient of the LTF, and the development of a large hydrocarbons plume would present the potential for vapour accumulation in the enclosed spaces of these buildings. A cluster of homes and the Teslin Tlingit Cultural Centre are 580 to 730 m down-gradient, and the possibility for volatile hydrocarbons to be sustained in a plume to such distances is judged to be very remote given the susceptibility of hydrocarbons to biodegradation.

3.5 Travel Time along Transport Pathway

Two travel times between the LTF and Teslin Lake have been calculated: one assuming flow occurs exclusively in the characterized glacial till, and one assuming the observed well graded sand occur in the saturated zone.

Key sources of uncertainty in the calculation of groundwater travel times include the following:

- the heterogeneous nature of hydraulic conductivity;
- the transient nature of the groundwater system (e.g., seasonal variation in groundwater levels); and
- variability in the direction of groundwater flow along its pathway to the receiving environment that is not captured in the site investigation.

The travel time along the groundwater transport pathway has been calculated using equation 3.

$$t = d \div V_s \qquad (3)$$

Where,

- t is travel time,
- d is distance, and
- V_s is linear groundwater flow (seepage) velocity.

Equation 3 provides travel time for groundwater, and does not provide a meaningful estimate of travel time for the dissolved organics that would leach from the LTF. Transport of organics in groundwater is subject to retardation caused by sorption, and to biodegradation. Retardation would increase the travel time for dissolved hydrocarbons entrained in the groundwater. Biodegradation would likely result in a hydrocarbon plume that attains a steady state with a front that does not reach Teslin Lake.

The approach used to calculate groundwater travel time also does not account for vertical flow through the unsaturated zone beneath the LTF. Water accumulating in the LTF would seep downward through a leak in the geomembrane liner, and through the glaciolacustine fines and glacial till underlying the liner in the unsaturated zone.

Case 1: Groundwater Flow Exclusively Through Glacial Till

A groundwater travel time of approximate 150 years is estimated for groundwater flow exclusively through the characterised glacial till, as calculated using equation 3. This travel time was calculated using a seepage velocity of 8 mm/day (Section 3.3), and a distance of 430 m between the LTF and Teslin Lake (Section 3.4).

Case 2: Groundwater Flow through Well-Graded Sand

A groundwater travel time of approximate 140 days is estimated for groundwater flow through the well-graded sand, as calculated using equation 3. This travel time was calculated using a seepage velocity of 3 m/day (Section 3.3), and a distance of 430 m between the LTF and Teslin Lake (Section 3.4).

4. SUMMARY

The groundwater flow regime at the Teslin Land Treatment Facility is interpreted to have the following attributes:

- groundwater flows westward to south-southwestward towards Teslin Lake;
- the site investigation indicates that a glacial till is the primary geological material through-which the groundwater flows in the saturated zone; however, the possibility that well-graded sands with greater hydraulic conductivity are present in locations where drilling has not confirmed the geological materials cannot be ruled out;
- the groundwater flow velocity around the Capital Works Yard containing the LTF is estimated to be 8 mm/day through the glacial till;
- Teslin Lake is the receiving surface water body for groundwater sourced beneath the LTF; and
- the travel time for groundwater along the flow pathway from the LTF to Teslin Lake is estimated to be 150 years through the glacial till, and may be as little as 140 days if the well graded glaciofluvial sands are present and continuous beneath the water table (e.g. below the bottom of the existing borehole depths).

These interpretations are based on field data collected from four boreholes with monitoring wells near the LTF, a review of terrain imagery and topographic data, and hydrometric data for Teslin Lake. The field dataset includes drilling of four boreholes, installation of four monitoring wells, groundwater level measurements in each well, and single well response tests in two wells.

Two of four wells have been dry during each groundwater level monitoring event. The absence of water in these wells has been used in the determination of the groundwater flow direction.

The calculated flow velocity and travel time do not consider the natural attenuation mechanisms affecting hydrocarbons dissolved in groundwater. A hydrocarbon plume would likely attain a steady-state prior to arriving at Teslin Lake due to natural attenuation. The flow velocity and travel time also assume a leak in the geomembrane liner beneath the LTF, and do not account for vertical flow through the low-permeability materials forming the LTF foundation.

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— Appendix A —

Hydrological Assessment, Sawmill Land Treatment Facility, Teslin, Yukon – 2014
Prepared by Chilkoot Geological Engineers Ltd, June 2014

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Hydrological Assessment
Sawmill Land Treatment Facility
Teslin, Yukon – 2014

Prepared For: **Teslin Tlingit Council**

Date : **June 25, 2014**

Project No: **200-002-14**

TABLE OF CONTENTS

Hydrological Assessment

Sawmill Land Treatment Facility

Teslin, Yukon – 2014

APPENDICES

1.0 INTRODUCTION

Chilkoot Geological Engineers Ltd. was retained by the *Teslin Tlingit Council (TTC)*, to conduct a hydrological assessment at the Sawmill Land Treatment Facility (LTF) located in Teslin, Yukon. The location of the facility has been denoted in Figure 1.

The purpose of conducting the assessment was to satisfy the minimum standards set forth by *YG –Department of Environment – (CSR 5 – LTF Guidelines)* as an expansion to the LTF is anticipated. At present, the facility is comprised of a single containment cell which contains approximately 3000 m^3 of hydrocarbon impacted soils.

In brief, our hydrological assessment involved the installation of three (3) groundwater monitoring wells to allow for long-term monitoring of the facility to depths of approximately ten (10) meters. In addition, during the well installations, our firm retained soil samples and a single groundwater sample, to allow for additional site characterization through laboratory work programs.

Authorization to proceed with the work was granted on May 22nd, 2014 by Mr.Adam Grinde, *TTC* – Director of Capital. The work was conducted in accordance with our May 5th, 2014 proposal. The drilling component of the field work was conducted on May 25th and 26th, 2014. While the laboratory work program is currently ongoing, our findings herein have been presented to facilitate the permitting process as our assessment did not reveal the presence of any potential liabilities which would prohibit an expansion to the facility.

The outstanding laboratory results, which will assist in soil classification of three samples, will be forwarded upon receipt as an Addendum, to verify the findings of the previous studies.

A detailed description of our hydrological assessment methodology has been provided below.

2.0 METHODOLOGY

The methodology was comprised of the following components;

2.1 Literature Review

A literature review was conducted prior to the field work program to better evaluate the regional conditions. In brief, the following sources of information were reviewed;

Previous Chilkoot Reports

Our July 20, 2013 Soil Characterization letter and August 22, 2013 Geotechnical Evaluation (submitted to *TTC* prior to construction of the existing LTF), were reviewed to provide a background as to the regional soil deposits that may be encountered.

> In brief, laboratory work conducted during the soil characterization letter, characterized the underlying regional soils as ‘CL’ (clay) soils in accordance with the *Unified Soil Classification System* (USCS). The permeability for these soils, which appeared prevalent throughout the region, were estimated to be in the order of 10^{-6} cm/s to 10^{-8} cm/s. The hydrometer analysis noted that the soils contained between 18.9 and 53.6 percent clay. The permeability of the soils were expected to be lower in regions where higher clay contents and very stiff soils are encountered.

Surficial Geology

The soil conditions in the region of the proposed Land Treatment Facility are predominately comprised of morainal (glacial till) deposits.

> The *Surficial Geology of Teslin, Yukon Territory, Map 1891A* (compiled by *S.R.Morison and R.W.Klassen, 1997, 1:125,*000 *Scale*), suggests that the soils in the region of the proposed facility consist of a morainal blanket which is comprised of lodgment and ablation till (which measures between 1-30 meters

thick). The morphological expression is described as gently irregular to strongly irregular bedrock controlled topography blanketed by till.

2.2 Field Work Program

The field work program was comprised of a site reconnaissance, sub-surface utility locates and drilling program.

Site Reconnaissance

A site reconnaissance was conducted by the undersigned and a TTC representative (Mr.Grinde) on May 22nd, 2014, to note relevant site features and assess potential borehole locations.

Sub-surface Utility Locates

Sub-surface utilities were located prior to drilling by contacting *Northwestel, Yukon Electric Company Ltd.,* personnel in order to verify that the proposed borehole locations were clear of potential underground hazards. In general, there were no subsurface utilities located in the region near where the boreholes were advanced. The exception to this was an underground electrical line which was located between a power pole and the some of the sawmill components located west of the LTF region. The public utilities (phone and power) were located along the Alaska Highway right-of-way.

Drilling Program

The drilling program was conducted under *Chilkoot* supervision on May 25th and May 26th, 2014 by *Donjek Services* utilizing a CME-750 drill mounted on an FN-60 Nodwell.

The program was comprised of advancing three (3) boreholes in order to obtain soil samples and characterize the subsurface conditions to an average depth of 11.79 meters (but ranged between 10.97 and 12.19 meters).

The boreholes were advanced utilizing 150 mm Ø solid-stem continuous flight augers at the approximate locations noted on Figure 3. While the use of 200 mm Ø hollow-stem augers was not required, as borehole collapse was of concern, the work involved additional effort to allow for installation of the monitoring wells.

Soil Logs

During the borehole drilling, field soil logs were maintained by the undersigned to record the stratigraphy of the soils that were encountered. This information was utilized to compile the Soil Logs which have been enclosed in Appendix A. An outline of the *USCS* soil classification system that was utilized has also been included.

The soil logs were compiled utilizing a combination of field notes, visual observations and results of laboratory analysis. These observations were supplemented by utilizing a *Humboldt Manufacturing Ltd*. pocket penetrometer which was utilized on cohesive (fine-grained) soils to provide relative estimates (in kg/cm^2) of the materials unconfined compressive strength. The pocket penetrometer test results have been noted on the individual borehole soil logs.

Borehole Survey

Following completion of the drilling, the elevations of the boreholes were surveyed relative to the top of a concrete slab located at the center of the facility utilizing a (*Leica LR Rugby*) laser level. The top of the concrete slab was given an arbitrary elevation of 100.00 meters. The borehole elevations have been noted on the soil logs. While hand held GPS was utilized to record the borehole locations, they were plotted on Figure 3 relative to prominent site features for ease of presentation.

Sampling Program

During the drilling program, soil (grab) samples were retained at regular (~ 1 meter) intervals, to allow for subsequent laboratory analysis.

Once the soil samples were retained, they were described on the field soil logs by the undersigned. The samples were subsequently sealed in air-tight plastic bags and numbered consecutively in order to allow for laboratory analysis.

> Where samples were chosen for chemical analysis, they were sealed in air-tight glass jars and were refrigerated in accordance with standard environmental sampling and storage practices.

Upon completion of the field work, the retained samples were transported to our Whitehorse laboratory facilities (or else forwarded to our laboratory sub-consultants in the Vancouver area) to allow for more detailed examination and analysis as described in Section 2.3, below.

In all, a total of forty-six (46) samples episodes were conducted during the drilling program.

Monitoring Well Installations

Monitoring wells were installed at each of the three borehole locations (BH 1-14 through BH 3-14) as noted in Figure 3, to an average depth of 10.19 meters below the existing ground surface. The well locations were positioned following onsite discussions with *TTC* to accommodate anticipated facility operations and future LTF expansions.

The monitoring wells were comprised of solid 2” diameter ABS pipe overlying screened 2” diameter ABS pipe. The screened portions of the pipe were covered with a ‘silt sock’ to increase the overall longevity of the wells. The annular space (between the well pipe and the native soils) was backfilled with silica sand to an elevation of 0.3 meters above the joint between the solid and screened sections of pipe. Bentonite pellets were subsequently placed at this elevation to serve as a 300 mm thick plug to prevent downward migration of surfaces waters. Above this, select auger cuttings were placed until within 0.5 meters of the ground surface. A second bentonite plug was placed at this elevation along with concrete to seal the annular space and install lockable steel casings, respectively.

The lengths of the solid and screened portions of the individual wells varied as follows;

Well	***Solid Length (m)***	***Screened Length (m)***	***Total Length (m)***	***Installed length below ground surface (m)***	***Ground Surface Elevation (m)***	***Top of pipe Elevation (m)***	***Base Elevation of Well (m)***
BH 1-14	5.67	6.10	11.77	10.81	101.87	102.83	91.06
BH 2-14	6.24	4.57	10.81	9.87	99.24	100.17	89.36
BH 3-14	2.42	6.10	10.60	9.90	100.02	100.72	90.12

The screened portions of the monitoring wells were installed in order to target the lower portions of the glaciolacustrine deposits, which were considered the most likely sub-strata to yield groundwater.

Borehole Termination

The boreholes were terminated at an average depth of 11.78 meters but ranged between 10.97 and 12.19 meters.

Following completion of the solid-stem drilling, the boreholes were left open for approximately 10 minutes in order to assess the sidewall stability and potential seepage over the course of time. In brief, there was no observable amount of groundwater seepage.

The three borehole locations noted collapse as follows;

Borehole	Depth of Termination (m)	Depth of Collapse (m)
BH 1-14	12.19	10.97
BH 2-14	10.97	7.10
BH 3-14	12.19	9.50

Photographs

Photographs of the field work, soil samples and site conditions were maintained to document the work. A selection of these photos has been provided in Appendix C.

Groundwater Sampling Program

A single groundwater sample was retained from BH 1-14 on May 26th, 2014. While a purging program (to flush a number of well volumes from the well) was considered, as the recharge rate was noted to be extremely slow, purging was not conducted and the sample was instead retained from the water located near the base of the well.

The well was measured immediately before and after sampling. Subsequent measurements conducted 1 hour after sampling did not note any recharge of the well.

BH 2-14 and BH 3-14, were noted to be dry on May 27th, 2014.

2.3 Laboratory Work Program

Both physical and chemical laboratory work programs were conducted on the retained samples to better characterize the soils that were encountered.

Physical Laboratory Analysis

The physical laboratory analysis was conducted in order to characterize the index properties and conditions of the retained soil samples. The analysis was initiated on June 2nd, 2014 by our firm and sub-consultant *Golder Associates Ltd.* (Burnaby, BC) as follows;

Description	***ASTM Analysis***	***Quantity***	***Laboratory***
Moisture Content	D 2216-92	46	*Chilkoot Engineers*
Grain Size Distribution	D 422-633	10	*Chilkoot Engineers*
Hydrometer Analysis	D 422	3	*Golder Associates*
Atterberg Limit Analysis	D 4318-10	3	*Golder Associates*

The results of the moisture analysis have been denoted as 'MC' (⦿ - Symbol) on the 'Laboratory Results' column on the Soil Logs enclosed in Appendix A.

The Grain Size Distribution Analysis was conducted in order to assist in soil classification utilizing the *Unified Soils Classification System*. The results of the analysis have been summarized on the Soil Logs with the percent composition of fines (silt & clay), sand and gravel denoted on the Soil Logs with the symbols - ▲, ● & ■, respectively.

Three of the glaciolacustrine samples (No.9, No.22 and No.36) were chosen to undergo hydrometer and limit analysis to assess the clay contents and characterize the soils utilizing the USCS, respectively. While the results of the hydrometer and Atterberg limit analysis have not yet been received from our sub-consultant *Golder Associates Ltd.*, we have for reference purposes included the results obtained during our July 20, 2013 Soil Characterization letter, which also analyzed the glaciolacustrine deposits.

Summary of Hydrometer and Limit Analysis – July 20, 2013

Test Pit	Sample Number	Sample Depth	Golder Associates Ltd.						
			Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Sand (%)	Silt (%)	Clay (%)	USCS
1-13	1A	1.5	27	32	20	0.1	81	18.9	CL
2-13	2A	1.5	32	46	24	0.2	46.2	53.6	CL
3-13	3A	1.5	29	36	22	0.4	68.0	31.6	CL

Note: Sand, Silt and Clay content noted % passing the respective grain sizes from extrapolation of *Golder Associates Ltd.* hydrometer results.

The individual sample results for the hydrometer and limit analysis will be forwarded as an Addendum upon receipt.

Chemical Laboratory Analysis

The chemical laboratory analysis was conducted by our sub-consultant *EXOVA* at their Surrey, B.C., laboratory facilities between June 2th and June 9th, 2014. The purpose of the analysis was to assess the degree of potential hydrocarbon contamination relative to *Yukon Government - Department of Environment - Contaminated Site Regulation* (YG – CSR).

The chemical analysis was comprised of an assessment of;

Extractable Petroleum Hydrocarbons (EPHw10-19 & EPHw19-32)

1 water samples (BH 1-14)

Extractable Petroleum Hydrocarbons (EPHs10-19 & EPHs19-32)

3 soil samples (Sample 9, 16 & 36)

The *EXOVA* results of the chemical analysis have been attached in Appendix B.

3.0 SITE CONDITIONS

3.1 Site Description

The Land Treatment Facility is located at a former Sawmill in Teslin, Yukon, as illustrated in Figure 1. The intended Land Treatment Unit (LTU) component of the facility is to be situated within the eastern half of the centrally cleared region as noted in Figure 3. This area of the facility is located approximately 500 meters south-east of Fox Creek and 400 meters north-west of Teslin Lake, at its closest point.

With the exception of an administrative office and outdoor storage areas located on the western periphery, the majority of the industrial site is essentially dormant.

During historical development, the central portions of the site were cleared and grubbed. The grubbing piles were pushed to the northern, eastern and southern peripheries of the site. Visual inspection of the grubbing piles noted that they appeared to be well consolidated and were in the order of 2-3 meters in height.

Central portions of the site (located within the limits of the grubbing piles), were comprised of low gradient (<1%) undulating terrain (as denoted in Figure 2). The elevation differences in this region were noted to be in the order of 3 meters. Regionally, higher elevations were noted north-east and east of the site.

The site survey generally noted local area drainage flowed towards the north-west, as illustrated in Figure 2.

A brief review of the 1:50,000 scale topographical maps noted regional drainage towards the west (Teslin Lake) and north-west (Fox Creek).

3.2 Geomorphic Setting

The *Surficial Geology of Teslin, Yukon Territory* (*Map 1891A*) suggests that the soils in the region of the proposed facility are dominated by a morainal blanket which is comprised of lodgment and ablation (glacial) till that measure up to 30 meters thick. From our assessment, it is apparent that these soils are overlain with fine grained glaciolacustrine soils which on measure ~ 5.4 meters thick.

3.3 Subsurface Conditions

Detailed descriptions of the soil stratigraphy that was encountered have been provided on the Soil Logs attached in Appendix A.

Soil Stratigraphy

In general, similar subsurface conditions were encountered in each of the boreholes.

The local soil stratigraphy is comprised of;

surficial deposits, overlying

glaciolacustrine deposits, overlying

morainal (till) deposits.

In addition, glaciofluvial deposits were encountered below the till at the location of BH 3-14.

A description of each of the respective soil units has been provided below.

Surficial Soils - Soil Unit 1

The surficial soils were comprised of a 50-100 mm thick layer of moist organics and organic silt which overlay damp to moist silty sand deposits which on average, measured 0.8 meters thick. These soils generally contained up to some rootlets. In addition to these soils, the surficial soils harbor remnant debris such as sawdust piles/fill, wood chips, logs and other similar types of waste materials associated with historical sawmill facilities.

The relative density of the organic and sandy soils was noted to be soft/loose, respectively.

The average moisture content of the silty sand was noted to be on average 18.9 %, indicating generally damp to moist conditions.

Glaciolacustrine Deposits - Soil Unit 2

The glaciolacustrine deposits were encountered below the surficial soil deposits at each of the borehole locations at an average depth of 0.8 meters. These soils were comprised of predominately inorganic clays which contained varying amounts of silt and were of low to medium (intermediate) plasticity. The soil unit also contained thin seams of fine sand and the odd pebble. There was no indication of cobbles (and/or boulders) within these soils.

The soil unit measured on average 5.40 meters thick (but ranged between 4.38 meters (BH 3-14) and 6.01 meters (BH 1-14)).

The consistency of the clays varied. In general, the upper 1.3 meters of the soil unit was noted to be firm to stiff. Pocket penetrometer readings were generally >3.0 kg/cm^2 in BH 2-14 and BH 3-14. The central portions of the soil unit were comprised of interbedded firm to soft zones which measured on average, 300-500 mm thick. The lower 1.1 meters of the deposit was noted to be very soft with pocket penetrometer readings of 0.

The average moisture content of the glaciolacustrine deposits was noted to be 31.2 % indicating generally moist conditions (but ranged between 17.4 and 43.9 %). Although lower moisture contents, which ranged between 17.4 % (Sample No.9) and

20.2 % (Sample No.36), were noted in the very soft, lower zones of the deposit, these soils were noted to be wet. The lower moisture contents suggest that the lower zones of the deposit contains higher amounts of sand and gravel as was noted in Sample No.9.

The upper stiff zone was noted to be grey-brown in color. The remainder of the deposit was generally grey although a blue-grey zone was noted near the base of the deposit in BH 1-14 (Sample No.9).

Morainal (Till) Deposits - Soil Unit 3

Grey till deposits were encountered at all borehole locations below the glaciolacustrine soils at depths of 6.7 meters (BH 1-14 and BH 2-14) and 5.2 meters (BH 3-14), below the existing ground surface.

These soils were generally comprised of silty gravelly sand to gravelly silty sand and contained trace amounts of fractured rock particles in size to 35 mm. The odd rounded cobble in size to 100 mm was also encountered. While none were noted, the tills may also contain boulder sized materials as is typical with the geomorphology.

BH 1-14 and BH 2-14, encountered 5.50 meters and 4.26 meters of till respectively, until the boreholes were terminated within the soil unit. By comparison, the thickness of the till in BH 3-14 was considerably thinner, as it measured 0.31 meters thick.

The till soil unit was noted to be dense and refusal was encountered in BH 2-14 at a depth of 10.97 meters below the ground surface.

The average moisture content of the till was 7.7 % (with a standard deviation of 2.3 %) indicating generally damp conditions.

While the deposit was predominately grey in color, the upper realm of the deposit contained orange-brown streaks of oxidation, suggesting the presence of potentially seasonal groundwater.

Glaciofluvial Deposits - Soil Unit 4

Brown glaciofluvial deposits were encountered below the till in BH 3-14. These soils were generally comprised of silty gravelly sands to gravelly silty sands. The odd cobble and possible boulder was also noted within the deposit.

The relative density of the glaciofluvial deposits was generally noted to be loose.

The average moisture content was 4.7 % (with a standard deviation of 1.1 %) indicating generally damp conditions.

Groundwater

During drilling, free groundwater was not encountered in any of the three boreholes which were advanced. However, the base of the glaciolacustrine unit was noted to be wet in all three boreholes indicating the possibility of potential seepage zones. These potential seepage zones were encountered at depths of 6.10, 5.29 and 3.80 meters in BH 1-14 to BH 3-14, respectively.

The monitoring wells were measured approximately 24 hours following installation to assess the presence of groundwater at the three locations. While BH 2-14 and BH 3-14 noted dry conditions, BH 1-14 noted the presence of groundwater at a depth of 8.84 meters below the existing ground surface. While this depth equates to an elevation of 93.03 meters (within the till deposits), it is likely that the groundwater had not yet stabilized as the rate of recharge was noted to be extremely slow. As such, it is likely that following long-term stabilization of groundwater regime, the static elevation of the groundwater would equate to that near 95.7 meters (within the base of the glaciolacustrine deposits) at the well location.

The groundwater vector would likely range between the south and west, towards Teslin Lake. Given the presence of Fox Creek located approximately 500 meters north of the site, it is possible that the groundwater direction may be dominated by a more westerly vector.

Permafrost

There was no evidence of permanently frozen soils in any of the boreholes which were advanced.

Bedrock

Although the till deposits contained trace amounts of fractured rock, there was no indication of bedrock in any of the boreholes that were advanced.

4.0 DISCUSSIONS

The minimum requirements set forth by *YG – Department of Environment – CSR 5* - is to have a minimum of three wells installed around the LTF (one up-gradient, two down-gradient) to ensure that contaminants do not migrate from the facility to nearby environments. In addition, the *YG* guidelines required that the;

- Direction and rate of groundwater flow be identified,
- Receiving environments be identified,
- Travel times for potential pathways be assessed, and
- Groundwater regime be characterized through well installations.

As such, we have addressed each of these requirements as follows;

Groundwater Flow

Direct confirmation of the groundwater flow was not possible as groundwater was only encountered one of the three monitoring wells. However, based upon topographical assessment, the direction of groundwater flow in the region of the facility would likely be towards Teslin Lake. As such, the groundwater vector may range from the south to the west in the region of the facility.

The rate of groundwater flow would be extremely slow given that estimates of the soils hydraulic conductivity would be in the order of 10^{-6} cm/s to 10^{-8} cm/s. While higher rates may occur in the preferential pathways identified at the base of the glaciolacustrine deposit (in the order of 10^{-3} cm/s), the potential that contaminants would reach this zone would be extremely remote.

Contaminant Migration

The travel time through the glaciolacustrine soils would be greater than 100 years if preferential pathways are not utilized. Assuming contaminants reach the preferential pathways (which may exist in the lower realms of the glaciolacustrine deposits), the travel time to Teslin Lake would be in the order of 5-10 years (assuming higher rates of conductivity in the order of 10^{-3} cm/s are encountered).

Receiving Environments

The closest possible accepting environment would be Teslin Lake located 400 meters to the south-west and Fox Creek located 500 meters to the north-west.

Groundwater Regime

The well monitoring episode which was conducted on May 26th and May 27th, noted dry well conditions in the (assumed) down-gradient wells, BH 2-14 and BH 3-14. Groundwater was only encountered in the (assumed) up-gradient well, BH 1-14, near an elevation of 93.0 meter. This groundwater elevation however, is not likely representative of the static conditions as the groundwater regime would not have stabilized adequately following the drilling operations given the extremely low recharge rates and so this should be considered when viewing the information presented herein. Seasonal fluctuations will affect the groundwater elevations and gradient and so this should also be considered during future site assessments.

The presence of orange-brown oxidation streaks within the upper 300 mm of the till deposits and the wet zones noted at the base of the glaciolacustrine deposits, suggest that the groundwater at the site will be encountered in preferential pathways located within these zones. The dense nature of the underlying till deposits and low moisture contents suggest that the till is impermeable.

As the results of the chemical analysis of the groundwater sample for BH 1-14 and the three soil samples (# 9, # 16 and # 36), did not register any notable amounts of hydrocarbons, if future groundwater contamination is encountered, then it can be assumed that the contaminant would have migrated to wells from other parts of the facility.

5.0 RECOMMENDATIONS

The frequency of future monitoring episodes of the groundwater elevation(s) and sampling of the well(s) should be as per the Land Treatment Facility Permit issued by *YG – Department of Environment*.

In general, monitoring of the groundwater elevations (and rates of recharge) should be conducted at a frequency of four times per year (or more) to characterize seasonal groundwater fluctuations. Sampling of the groundwater to allow for hydrocarbon analysis would not likely be beneficial in the near future given the extremely low permeability and thickness of the underlying fine grained glaciolacustrine deposits. However, if there is reason to believe that a liner from a treatment cell has been compromised, then intermittent monitoring of the well(s) should be conducted to verify that the groundwater has not been impacted.

If groundwater is however encountered within either of the two down-gradient wells (BH 2-14 or BH 3-14), then groundwater samples should be retained and analyzed to establish a baseline which will allow for a comparison of future samples.

6.0 CONCLUSIONS

The well installation program was successful at installing three (3) peripheral wells which will allow for the retention of groundwater samples and monitoring of the groundwater regime at the facility. Any potential groundwater is likely concentrated within preferential pathways located at the base of the glaciolacustrine deposits and upper realms of the till.

Relative to *YG – Department of Environment* guidelines, the site is an ideal location for the land treatment facility as the hydraulic conductivity of the underlying glaciolacustrine and dense till deposits are extremely low. These soils would be considered impermeable and as such, any leakage which might occur from the facility (or future cells), would likely manifest as surface flow or else be restricted to the upper realms of the firm to stiff glaciolacustrine deposits. Transport mechanisms would restrict any potential migration to nearby regions immediately adjacent to the cell(s).

Contaminant travel times to the closest accepting environment of Teslin Lake or Fox Creek would likely be greater than 100 years. As such, if a contaminant breach occurs at the facility, it is unlikely that any contamination will migrate outside the limits of the facility, as natural attenuation over this time period would have remediated any potential contaminant concern.

7.0 LIMITATIONS

This report is intended for the sole use of the *TTC*. No portion of this report may be used as a separate entity; it is intended to be read in its entirety. Any use of this report by a third party is the responsibility of such third party.

Our assessment reflects our best judgment of the environmental site conditions at the subject property in light of the information available to our firm at the time of report preparation. Our assessment is based upon the subsurface conditions encountered at the sample locations, current analytical techniques and environmental standards and generally accepted engineering practices.

It is important to emphasize that the samples were obtained through random sampling. Due to the geomorphological nature of the deposits encountered, interpolations of subsurface conditions between the well/sample locations have not been made or been implied.

Our assessment was limited due to the scope-of-work that was undertaken. While this limitation precludes us from providing a warranty, our firm provided our best professional judgment of potential/actual environmental liabilities that may be associated with the subject property based upon the retained information.

Should any newly found environmental or subsurface conditions become apparent, our firm should be notified immediately such that we can confirm the suitability of our recommendations. If required, our firm may alter or modify our findings at such time.

8.0 CLOSURE

Thank you for providing our firm with the opportunity to conduct the above noted assessment.

We trust that the information we have provided will be suitable for your purposes, however, if you should have any questions or concerns, please feel free to contact the undersigned at your convenience.

Respectfully Submitted,

CHILKOOT GEOLOGICAL ENGINEERS LTD.

PROFESSIONAL #1277 YUKON TARES DHARA TERRITORY ENGINEER

PERMIT TO PRACTICE
Signature
Date June 25, 2014
PERMIT NUMBER: PP025
Association of Professional Engineers of Yukon

Tares Dhara, P.Eng.
Senior Geotechnical Engineer

TD/td

Land Treatment Facility, Teslin, Yukon – 2014

FIGURE 1 – Site Location

Based map modified from Google Earth

Compiled September 14, 2013 by T.Dhara

CHILKOOT GEOLOGICAL ENGINEERS LTD.

Proposed Land Treatment Facility, Teslin, Yukon – 2014

FIGURE 2 –Local Elevations & Area Drainage (Prior to Aug. 2013 LTF Installation)

Based map modified from Google Earth

Compiled June 12, 2014 by T.Dhara

Land Treatment Facility - Teslin, Yukon – 2014

FIGURE 3 – Borehole Locations

Not to Scale

Compiled June 13, 2014 by T.Dhara

CHILKOOT GEOLOGICAL ENGINEERS LTD.
5B Bennett Road, Whitehorse, Yukon

HYDROLOGICAL ASSESSMENT
SAWMILL LAND TREATMENT FACILITY
TESLIN, YUKON

TABLE I - SUMMARY OF SOIL STRATIGRAPHY

STRATA	Units	BOREHOLE			Average
		BH 1-14	BH 2-14	BH 3-14	
SURFICIAL DEPOSITS	Elevation (m)	101.87	99.23	100.02	100.37
	Thickness (m)	0.70	0.90	0.80	0.80
GLACIOLACUSTRINE DEPOSITS	Elevation (m)	101.17	98.33	99.22	99.57
	Thickness (m)	6.01	5.80	4.38	5.40
SEEPAGE ZONE	Elevation (m)	95.77	93.94	96.22	95.31
	Thickness (m)	0.61	1.41	1.38	1.13
TILL DEPOSITS	Elevation (m)	95.16	92.53	94.84	94.18
	Depth (m)	6.71	6.70	5.18	6.20
	Thickness (m)	5.50	4.26	0.31	3.36
GLACIOFLUVIAL DEPOSITS	Elevation (m)	NA	NA	94.53	94.53
	Thickness (m)	NA	NA	6.70	6.70
GROUNDWATER	Elevation (m)	93.03	NA	NA	93.03
	Depth (m)	8.84	NA	NA	8.84
BOREHOLE TERMINATION	Elevation (m)	89.68	88.27	87.83	88.59
	Depth (m)	12.19	10.97	12.19	11.78

Note - Elevation refers to the top of the deposit or interface.

Prepared by T.Dhara - June 18, 2014

APPENDIX A

Borehole Soil Logs

NOTES ON SOIL LOGS

Soil Description

The soil is named after its principal component and modified by other components as follows;

Percent of Component	Modifier
> 15 %	XXX - ey
11% to 15%	some XXX
5% to 10%	trace XXX

Examples;

SILT	SAND	GRAVEL	Description
6	32	62	Sandy Gravel trace Silt
55	6	39	Gravelly Silt trace Sand
43	36	21	Silty Gravelly Sand

Note: In the cases where the coarse fraction (sand & gravel) comprise > 50% of the sample, then the larger component of the coarse fraction becomes the principal component.

Undrained Shear Strength of Cohesive Soils

Consistency	Undrained Shear Strength	
	p.s.f	kN/m^2
Very Soft	< 375	<20
Soft	375-750	20-40
Firm	750-1500	40-75
Stiff	1500-3000	75-150
Very Stiff	3000-6000	150-300
Hard	>6000	<300

Relative Density (Qualitative Classification)

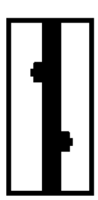
Cohesive Soils

Very Soft	- Exudes between fingers when squeezed by hand
Soft	- Moulded by light finger pressure
Firm	- Moulded by strong finger pressure
Stiff	- Cannot be moulded by fingers – Can be indented by thumb
Very Stiff	- Can only be indented by thumbnail
Hard	- Cannot be indented by thumbnail

Granular Soils

Very Loose	- Considerable sidewall sloughage noted
Loose	- Some sidewall sloughage noted – Easy digging
Compact/ Medium-Dense	- Unimpeded excavation – little to no sidewall sloughage
Dense	- Considerable effort required during excavation – Stable vertical sidewalls
Very Dense	- Extreme difficulty in excavation

Soil Log - Sample Type

Symbol	Test Pitting	Drilling
	**Grab Sample** Retained from excavation sidewall or base	**Auger Sample** Retained from Auger flighting
	**Bucket Sample** Retained from leading edge of excavator bucket	**Split-Spoon Sample** Retained from Split-Spoon Sampler tube

Relative Moisture

Described as - *dry*, *damp*, *moist*, *wet* or *saturated* - relative to the principal soil matrix.

For example, a moisture content of 10 percent may be classified as '*moist*' for a coarse grained soil (sand or gravel) but '*damp*' for a fine grained (silt) soil.

The moisture content is recorded as a percentage (%) of the weight of water within the soil sample relative to the dry weight of the sample.

Recovery

Refers to the (linear) amount of sample retained after driving the Split Spoon (SPT) sampler tube 18 inches.

Recorded as a percentage (i.e. 12 inch sample/18 drive = 66 %)

N-Value

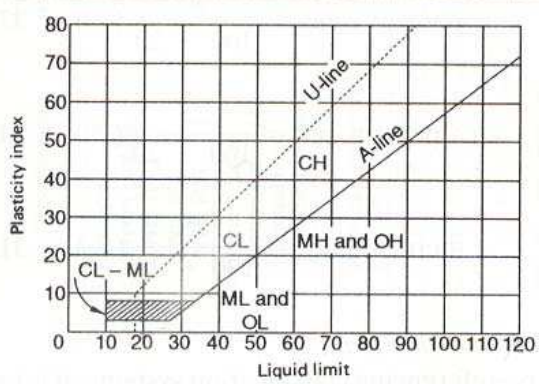
Refers to the total number of blows required to drive the Split Spoon sampler tube the final 12 inches of the 18 inch drive.

Relative Density based upon SPT 'N' Value

Non-cohesive (Granular) Soil		**Cohesive (Clayey) Soils**	
Relative Density	**Blows per Foot (N-value)**	**Consistency**	**Blows per Foot (N-value)**
Very Loose	< 5	*Very Soft*	0 to 2
Loose	5 to 9	*Soft*	3 to 4
Compact	10 to 29	*Firm*	5 to 8
Dense	30 to 50	*Stiff*	9 to 15
Very Dense	> 50	*Very Stiff*	16 to 30
		Hard	> 30

Unified Soil Classification System
(ASTM Designation D-2487)

Major division			Group Symbols	Typical Names		Classification Criteria
Coarse-grained soils More than 50% retained on No. 200 sieve	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines: Less than 5% Pass No. 200 sieve GW, GP, SW, SP; More than 12% Pass No. 200 sieve GM, GC, SM, SC; 5% to 12% Pass No. 200 sieve Borderline classification requiring use of dual symbols	$C_u = D_{60}/D_{10}$ Greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits plot above "A" line and plasticity index greater than 7
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines		$C_u = D_{60}/D_{10}$ Greater than 6; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW
		Sands with fines	SM	Silty sands, sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4
			SC	Clayey sands, sand-clay mixtures		Atterberg limits plot above "A" line and plasticity index greater than 7
Fine-grained soils 50% or more passes No. 200 sieve	Silts and Clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands		Check plasticity chart
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	Silts and Clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity		
Highly organic soils			Pt	Peat, muck and other highly organic soils		Fibrous organic matter; will char, burn, or glow



Note: U-line represents approximate upper limit of LL and PI combinations for natural soils

Plasticity chart for the classification of fine-grained soils. Tests made on fraction finer than No. 40 sieve.

Unified Soil Classification System

Figure 18. UNIFIED SOIL CLASSIFICATION SYSTEM

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BOREHOLE LOG

Client : Teslin Tlingit Council
Location : Sawmill Land Treatment Facility
Project : Hydrological Assessment - Well Installations
Chilkoot Project No. : 200-002-14

Date Drilled: May 25, 2014
Elevation : 101.87 meters
Depth of BH: 12.19 meters
Instrumentation: Well to 91.06 m

BOREHOLE **1-14**
Sheet 1 of 2

Depth (m)	Relative Density	Stratigraphic Description	Relative Moisture	Sample Number	Temperature (degrees C)	Recovery %	Penetrometer (Kg/cm2)	SPT 'N'	Laboratory Results (%)	USCS/NRC	Elev. (m)
0.05	Loose	ORGANICS - rootlets and organic silt, black	Moist							ORG	101.82
0.05–0.70	Loose	SILTY SAND with some rootlets - poorly graded, fine grained, brown	Moist	1	NA	NA	NA	NA	Gravel 2.5, MC 14.2, Fines 37.4, Sand 60.1	SM	101.17
0.70–1.70	Firm	SILTY CLAY - low plasticity, odd silty sand inclusions in size to 10 mm, grey-brown - as above	Damp	2	NA	NA	1.5	NA	MC 38.9	CL-ML	100.17
1.70–2.30	Soft	- as above	Damp	3	NA	NA	0.5	NA	MC 29.7	CL-ML	99.57
2.30–3.10	Soft	CLAY some SILT - low to medium plasticity, grey	Moist	4	NA	NA	0.5	NA	MC 34.2	CL	98.77
3.10–3.80	Firm	- as above	Moist	5	NA	NA	1.25	NA	MC 35.0	CL	98.07
3.80–4.90	Soft	- as above	Moist	6	NA	NA	0.5	NA	MC 31.5	CL	96.97
4.90–6.10	Very Soft	- as above	Moist	7	NA	NA	0.0	NA	MC 35.7	CL	
		- as above		8	NA	NA	0.0	NA	MC 38.0	CL	95.77
6.10–6.71	Very Soft	CLAYEY SILT some SAND trace GRAVEL - non-plastic, blue-grey - possible seepage zone (Hydrometer and Limit Analysis)	Wet	9	NA	NA	0.0	NA	MC 17.4	CL-ML	95.16
6.71–	Loose		Damp							ML	

Drilled By : Donjek Services
Drill Type : CME 750 (FN60)
Drill Method : 150 mm Solid Stem
Bit Type : Fish Tail

Water Level(s): During Drilling; After Drilling; At End of Drilling

Logged By : T.Dhara, P.Eng. Date : May 25, 2014
Data Entry By : T.Dhara, P.Eng. Date : June 3-6, 2014
Reviewed By: TD Date : June 11, 2014

CHILKOOT GEOLOGICAL ENGINEERS LTD.

5B Bennett Road, Whitehorse, Yukon
(867) 335-2085 chilkoot@northwestel.net

BOREHOLE LOG

Client : Teslin Tlingit Council
Location : Sawmill Land Treatment Facility
Project : Hydrological Assessment - Well Installations
Chilkoot Project No. : 200-002-14

Date Drilled: May 25, 2014
Elevation : 101.87 meters
Depth of BH: 12.19 meters
Instrumentation: Well to 91.06 m

BOREHOLE **1-14**

Depth (m)	Relative Density	Stratigraphic Description	Relative Moisture	Sample Number	Temperature (degrees C)	Recovery %	Penetrometer (kg/cm2)	SPT N	MC (%)	Gravel (%)	Sand (%)	Fines (%)	USCS/NRC
(continued) – 7.6	Loose (continued)	(Hydrocarbon Analysis)	Damp (continued)	10	NA	NA	NA	NA	5.4				
– 8.5		TILL - SANDY GRAVELLY SILT - poorly graded, fine to medium grained, grey											
		- as above		11	NA	NA	NA	NA	6.2	19.8	33.2	47.1	ML
8.5 – 9.20		- as above but with odd fractured rock in size to 35 mm and odd cobble in size to 100 mm		12	NA	NA	NA	NA	9.7				
9.20 – 12.19	Loose	TILL - SILTY GRAVELLY SAND - poorly graded, fine to medium grained, grey	Damp										SM
		- as above		13	NA	NA	NA	NA	7.7				
		- as above		14	NA	NA	NA	NA	6.3	23.5	41.3	35.2	

USCS/NRC column notes: 8.0 ML; 9.0; 10.0; SM; Caved To 10.97; 12.0

Elevation markers (Symbol column): 93.87, 93.47, 92.67, 91.77, 90.07, 89.88

End of Borehole
No groundwater encountered during drilling.
Groundwater noted May 26, 2014 at 93.03
Borehole terminated at 12.19 m. below the existing ground surface.

Drilled By : Donjek Services
Drill Type : CME 750 (FN60)
Drill Method : 150 mm Solid Stem
Bit Type : Fish Tail

Water Level(s): During Drilling; After Drilling; At End of Drilling

Logged By : T.Dhara, P.Eng.
Date : May 25, 2014

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Date : June 11, 2014

CHILKOOT GEOLOGICAL ENGINEERS LTD.

5B Bennett Road, Whitehorse, Yukon
(867) 335-2085 chilkoot@northwestel.net

BOREHOLE LOG

Client : Teslin Tlingit Council
Location : Sawmill Land Treatment Facility
Project : Hydrological Assessment - Well Installations
Chilkoot Project No. : 200-002-14

Date Drilled: May 25-26, 2014
Elevation : 99.24 meters
Depth of BH: 10.97 meters
Instrumentation: Well to 89.36 m

BOREHOLE

2-14

Sheet 1 of 2

Depth (m)	Relative Density	Stratigraphic Description	Relative Moisture	USCS/NRC
0.00–0.05	Soft	ORGANICS - rootlets and organic silt, black	Moist	ORG
0.05–0.5	Loose	SILTY SAND with some rootlets - poorly graded, fine grained, brown	Moist	SM
0.5–0.91	Loose	as above but no rootlets	Moist	SM
0.91–1.50	Stiff	SILTY CLAY - low plasticity, grey-brown (Hydrocarbon Analysis)	Damp	CL-ML
1.50–2.27	Stiff	CLAY some SILT - odd sandy silt inclusion in size to 10 mm, low to medium plasticity, grey - as above	Moist	CL
2.27–3.90	Firm	- as above; - as above	Moist	CL
3.90–5.26	Soft	- as above; - as above	Moist	CL
5.26–6.71	Very Soft	- as above (Hydrometer and Limit Analysis)	Wet	CL
6.71–7.00	Firm	TILL - SANDY SILT odd GRAVEL in size	Damp	ML

Field Sample

Number	Temperature (degrees C)	Recovery %	Penetrometer (kg/cm2)	SPT 'N'
15	NA	NA	NA	NA
16	NA	NA	3.5-4.0	NA
17	NA	NA	2.0	NA
18	NA	NA	1.5	NA
19	NA	NA	1.25	NA
20	NA	NA	0.5	NA
21	NA	NA	0.25	NA
22	NA	NA	0.0	NA
23	NA	NA	NA	NA

Laboratory Results (%)

▲ - FINES ● - SAND ■ - GRAVEL PL ⊢ MC ⊙ ⊣ LL

Sample	MC	Gravel	Sand	Fines
15	[illegible]			
16	26.8			
17	43.9			
18	31.1			
19	35.3			
20	32.7			
21	38.0			
22	33.6			
23	14.0	2.1	41.4	56.5

Elev. (m) marks: 99.24, 99.19, 99.0, 98.74, 98.5, 98.33, 98.0, 97.74, 97.5, 97.34, 97.0, 96.64, 96.5, 96.0, 95.74, 95.5, 95.34, 95.0, 94.5, 94.24, 94.0, 93.75, 93.5, 93.0, 92.53, 92.5, 92.24

Drilled By : Donjek Services
Drill Type : CME 750 (FN60)
Drill Method : 150 mm Solid Stem
Bit Type : Fish Tail

Water Level(s): During Drilling; After Drilling; At End of Drilling

Logged By : T.Dhara, P.Eng.
Date : May 25-26, 2014

Data Entry By : T.Dhara, P.Eng.
Date : June 3-6, 2014

Reviewed By: TD
Date : June 11, 2014

CHILKOOT GEOLOGICAL ENGINEERS LTD.

5B Bennett Road, Whitehorse, Yukon
(867) 335-2085 chilkoot@northwestel.net

BOREHOLE LOG

Client : Teslin Tlingit Council
Location : Sawmill Land Treatment Facility
Project : Hydrological Assessment - Well Installations
Chilkoot Project No. : 200-002-14

Date Drilled: May 25-26, 2014
Elevation : 99.24 meters
Depth of BH: 10.97 meters
Instrumentation: Well to 89.36 m

BOREHOLE **2-14**
Sheet 2 of 2

Depth (m)	Relative Density	Stratigraphic Description	Relative Moisture	Type	Number	Temperature (degrees C)	Recovery %	Penetrometer (kg/cm2)	SPT 'N'	MC	Gravel	Fines	Sand	USCS/NRC
to 7.59	Loose	to 20 mm - non-plastic, grey with orange-brown streaks of oxidation	Damp		24	NA	NA	NA	NA	7.8	17.2	30.6	52.2	Caved To 7.10
7.59		TILL - SILTY GRAVELLY SAND - fine to medium grained, poorly graded, grey												
		- as above but with fracture rock in size to 35 mm			25	NA	NA	NA	NA	8.7	15.6	40.3	44.1	8.0 SM
					26	NA	NA	NA	NA	4.7				9.0
9.14	Dense	- as above but grey-brown - hard drilling beyond 9.14 meters	Damp		27	NA	NA	NA	NA	7.3				
					28	NA	NA	NA	NA	7.7				10.0 SM
10.97		- as above - very hard drilling - Refusal at 10.97 meters			29	NA	NA	NA	NA	6.8	27.0	35.4	37.7	

End of Borehole
No groundwater encountered.
Borehole terminated at 10.97 m. below the existing ground surface.

Symbol column elevations: 92.0, 91.62, 91.5, 91.0, 90.5, 90.1, 90.0, 89.5, 89.0, 88.49, 88.5, 88.27, 88.0, 87.5, 87.0, 86.5, 86.0, 85.5

Drilled By : Donjek Services
Drill Type : CME 750 (FN60)
Drill Method : 150 mm Solid Stem
Bit Type : Fish Tail

Water Level(s): During Drilling; After Drilling; At End of Drilling

Logged By : T.Dhara, P.Eng. Date : May 25-26, 2014
Data Entry By : T.Dhara, P.Eng. Date : June 3-6, 2014
Reviewed By: Date : June 11, 2014

CHILKOOT GEOLOGICAL ENGINEERS LTD.

5B Bennett Road, Whitehorse, Yukon
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BOREHOLE LOG

Client : Teslin Tlingit Council
Location : Sawmill Land Treatment Facility
Project : Hydrological Assessment - Well Installations
Chilkoot Project No. : 200-002-14

Date Drilled: May 26, 2014
Elevation : 100.02 meters
Depth of BH: 12.19 meters
Instrumentation: Well to 90.12 m

BOREHOLE **3-14**
Sheet 1 of 2

Depth (m)	Relative Density	Stratigraphic Description	Relative Moisture	Number	Temperature (degrees C)	Recovery %	Penetrometer (kg/cm2)	SPT 'N'	Laboratory Results (%)	USCS/NRC	Elev. (m)
0.10	soft	ORGANICS - rootlets and organic silt, black	moist	30	NA	NA	NA	NA	MC 21.1	ORG	100.02 – 99.92
0.10–0.80	Loose	SILTY SAND with some rootlets - poorly graded, fine grained, brown	damp							SM	99.92 – 99.22
0.80–1.50	stiff	SILTY CLAY - low plasticity, grey-brown (Hydrometer and Limits Analysis)	damp	31	NA	NA	3.5	NA	MC 25.8	CL-ML	99.22 – 98.52
1.50	firm	CLAY some SILT - low to medium plasticity, grey	moist							CL	98.5
		- as above		32	NA	NA	1.5	NA	MC 31.6		98.02 / 98.0 – 97.72
	soft	- as above	moist	33	NA	NA	0.75	NA	MC 29.8		97.57
		- as above		34	NA	NA	0.25	NA	MC 29.9		96.52 / 96.5 – 96.22
– 4.70	very soft	- interbedded zones of fine sand	wet	35	NA	NA	0.0	NA	MC 28.3		95.32
4.70–5.18	soft	SILTY CLAY - low plasticity, grey (Hydrometer Analysis)	moist	36	NA	NA	0.5-0.75	NA	MC 20.2	CL-ML	94.84
5.18–5.49	hard	TILL - GRAVELLY SILTY SAND - fine to medium grained, poorly graded, grey - traces of orange-brown oxidation streaks	damp	37	NA	NA	NA	NA	MC 6.4; Fines 22.3; Gravel 25.8; Sand 51.9	SM	94.53 / 94.5
5.5	loose	GLACIOFLUVIAL DEPOSITS - GRAVELLY SILTY SAND - fine to medium grained - brown	damp	38	NA	NA	NA	NA	MC 3.9; Fines 19.5; Gravel 22.2; Sand 58.2	SM	
– 7.0		- as above		39	NA	NA	NA	NA	MC 3.0		93.52 / 93.5; 94.53

Drilled By : Donjek Services
Drill Type : CME 750 (FN60)
Drill Method : 150 mm Solid Stem
Bit Type : Fish Tail

Water Level(s): During Drilling; After Drilling; At End of Drilling

Logged By : T.Dhara, P.Eng.
Date : May 26, 2014

Data Entry By : T.Dhara, P.Eng.
Date : June 3-6, 2014

Reviewed By:
Date : June 11, 2014

CHILKOOT GEOLOGICAL ENGINEERS LTD.

5B Bennett Road, Whitehorse, Yukon
(867) 335-2085 chilkoot@northwestel.net

BOREHOLE LOG

Client : Teslin Tlingit Council
Location : Sawmill Land Treatment Facility
Project : Hydrological Assessment - Well Installations
Chilkoot Project No. : 200-002-14

Date Drilled: May 26, 2014
Elevation : 100.02 meters
Depth of BH: 12.19 meters
Instrumentation: Well to 90.12 m

BOREHOLE **3-14**

Stratigraphic Description (Relative Density / Relative Moisture)	Type	Number	Temperature (degrees C)	Recovery %	Penetrometer (kg/cm2)	SPT 'N'	Laboratory Results (%)
loose (continued) GLACIOFLUVIAL DEPOSITS - GRAVELLY SILTY SAND - fine to medium grained - brown; damp (continued)	X	40	NA	NA	NA	NA	MC 4.5
- as above - odd cobble and possible boulder	X	41	NA	NA	NA	NA	MC 3.5
- as above	X	42	NA	NA	NA	NA	MC 6.8
- as above	X	43	NA	NA	NA	NA	MC 5.3
loose GLACIOFLUVIAL DEPOSITS - SILTY GRAVELLY SAND - fine to medium grained, poorly graded, brown; damp	X	44	NA	NA	NA	NA	MC 4.5; Fines 19.6; Gravel 25.5; Sand 54.8
- as above	X	45	NA	NA	NA	NA	MC 5.3
- as above	X	46	NA	NA	NA	NA	MC 5.0

End of Borehole
No groundwater encountered.
Borehole terminated at 12.19 m. below the existing ground surface.

Elevation scale: 93.01 (continued), 92.5, 92.0, 91.5, 91.32, 91.0, 90.52, 90.5, 90.22, 90.0, 89.5, 89.0, 88.5, 88.02, 88.0, 87.83, 87.5, 87.0, 86.5
Depth scale (ft): 24.0 – 39.0; (m): 7.5 – 12.0, 12.19
USCS/NRC Depth (m): 8.0, 9.0, 9.50, 10.0, 11.0, 12.0 (GW/GM To 9.50)

Laboratory Results legend: ▲ - FINES ● - SAND ■ - GRAVEL; PL — MC — LL; 20 40 60 80

Drilled By : Donjek Services
Drill Type : CME 750 (FN60)
Drill Method : 150 mm Solid Stem
Bit Type : Fish Tail

Water Level(s): During Drilling; After Drilling; At End of Drilling

Logged By : T.Dhara, P.Eng. Date : May 26, 2014
Data Entry By : T.Dhara, P.Eng. Date : June 3-6, 2014
Reviewed By: TD Date : June 11, 2014

APPENDIX B

Results of Chemical Analysis

(EXOVA)

Exova
#104, 19575-55 A Ave.
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V3S 8P8, Canada

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W: www.exova.com

Report Transmission Cover Page

Bill To:	Chilkoot Geological Engineering	Project:		Lot ID:	**1005671**
Report To:	Chilkoot Geological Engineering	ID:	Client TTC	Control Number:	
	PO 31146	Name:	Project Sawmill. LTF Wells	Date Received:	Jun 2, 2014
	Whitehorse, YT, Canada	Location:		Date Reported:	Jun 9, 2014
	Y1A 5P7	LSD:		Report Number:	1921202
Attn:	Tares Dhara	P.O.:			
Sampled By:	T.D.	Acct code:			
Company:	Chilkoot				

Contact & Affiliation	Address	Delivery Commitments
Tares Dhara Chilkoot Geological Engineering	, PO 31146 Whitehorse, Yukon Territory Y1A 5P7 Phone: (867) 667-6671 Fax: (867) 667-6673 Email: chilkoot@northwestel.net	On [Lot Verification] send (COA) by Email - Multiple Reports By Agreement On [Report Approval] send (COC, Test Report) by Email - Merge Reports On [Lot Approval and Final Test Report Approval] send (Invoice) by Email - Multiple Reports By Agreement On [Lot Creation] send (COR) by Email - Multiple Reports By Agreement

Notes To Clients:

Exova
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W: www.exova.com

Exova

Analytical Report

Bill To:	Chilkoot Geological Engineering	Project:		Lot ID:	**1005671**
Report To:	Chilkoot Geological Engineering	ID:	Client TTC	Control Number:	
	PO 31146	Name:	Project Sawmill. LTF Wells	Date Received:	Jun 2, 2014
	Whitehorse, YT, Canada	Location:		Date Reported:	Jun 9, 2014
	Y1A 5P7	LSD:		Report Number:	1921202
Attn:	Tares Dhara	P.O.:			
Sampled By:	T.D.	Acct code:			
Company:	Chilkoot				

		Reference Number	1005671-1	1005671-2	1005671-3	
		Sample Date	May 26, 2014	May 26, 2014	May 26, 2014	
		Sample Time	NA	NA	NA	
		Sample Location				
		Sample Description	Project Sawmill. LTF Wells / BH1-14 Sample 9	Project Sawmill. LTF Wells / BH2-14 Sample 16	Project Sawmill. LTF Wells / BH3-14 Sample 36	
		Matrix	Soil	Soil	Soil	
Analyte		**Units**	**Results**	**Results**	**Results**	Nominal Detection Limit
Extractable Petroleum Hydrocarbons - Soil						
EPHs10-19	Dry Weight	ug/g	45	32	<20	20
EPHs19-32	Dry Weight	ug/g	<20	<20	<20	20
Soil % Moisture						
Moisture	Soil % Moisture	%	18.8	20.8	9.9	0.1

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Analytical Report

Bill To:	Chilkoot Geological Engineering	Project:		Lot ID:	**1005671**
Report To:	Chilkoot Geological Engineering	ID:	Client TTC	Control Number:	
	PO 31146	Name:	Project Sawmill. LTF Wells	Date Received:	Jun 2, 2014
	Whitehorse, YT, Canada	Location:		Date Reported:	Jun 9, 2014
	Y1A 5P7	LSD:		Report Number:	1921202
Attn:	Tares Dhara	P.O.:			
Sampled By:	T.D.	Acct code:			
Company:	Chilkoot				

Reference Number	1005671-4
Sample Date	May 26, 2014
Sample Time	NA
Sample Location	
Sample Description	Project Sawmill. LTF Wells / BH114
Matrix	Water

Analyte	Units	Results	Results	Results	Nominal Detection Limit
Extractable Petroleum Hydrocarbons - Water					
EPHw10-19	ug/L	<100			100
EPHw19-32	ug/L	<100			100

Approved by: Mathieu Simoneau

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.

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Methodology and Notes

Bill To:	Chilkoot Geological Engineering	Project:		Lot ID:	**1005671**
Report To:	Chilkoot Geological Engineering	ID:	Client TTC	Control Number:	
	PO 31146	Name:	Project Sawmill. LTF Wells	Date Received:	Jun 2, 2014
	Whitehorse, YT, Canada	Location:		Date Reported:	Jun 9, 2014
	Y1A 5P7	LSD:		Report Number:	1921202
Attn:	Tares Dhara	P.O.:			
Sampled By:	T.D.	Acct code:			
Company:	Chilkoot				

Method of Analysis

Method Name	Reference	Method	Date Analysis Started	Location
EPH - Soil	BCELM	* Extractable Petroleum Hydrocarbons (EPH) in Solids by GC/FID, EPH Solids	04-Jun-14	Exova Surrey
EPH - Water	BCELM	* Extractable Petroleum Hydrocarbons (EPH) in Water by GC/FID, EPH Water	06-Jun-14	Exova Surrey

** Reference Method Modified*

References

B.C.M.O.E — B.C. Ministry of Environment

Comments:

Data File C:\CHEM32\1\DATA\140605\FID000043.D
Sample Name: 1005620-1;8 mL

===

Acq. Operator : Reena Seq. Line : 43
Acq. Instrument : 6890N FID Location : Vial 30
Injection Date : 06-Jun-14, 01:07:55 Inj : 1
Inj Volume : 1 µl
Acq. Method : C:\CHEM32\1\METHODS\BCMESCAN.M
Last changed : 6/3/2014 8:38:47 AM by Huyen
Analysis Method : C:\Chem32\1\Methods\BCMERAW.M
Last changed : 2/12/2010 7:45:41 AM

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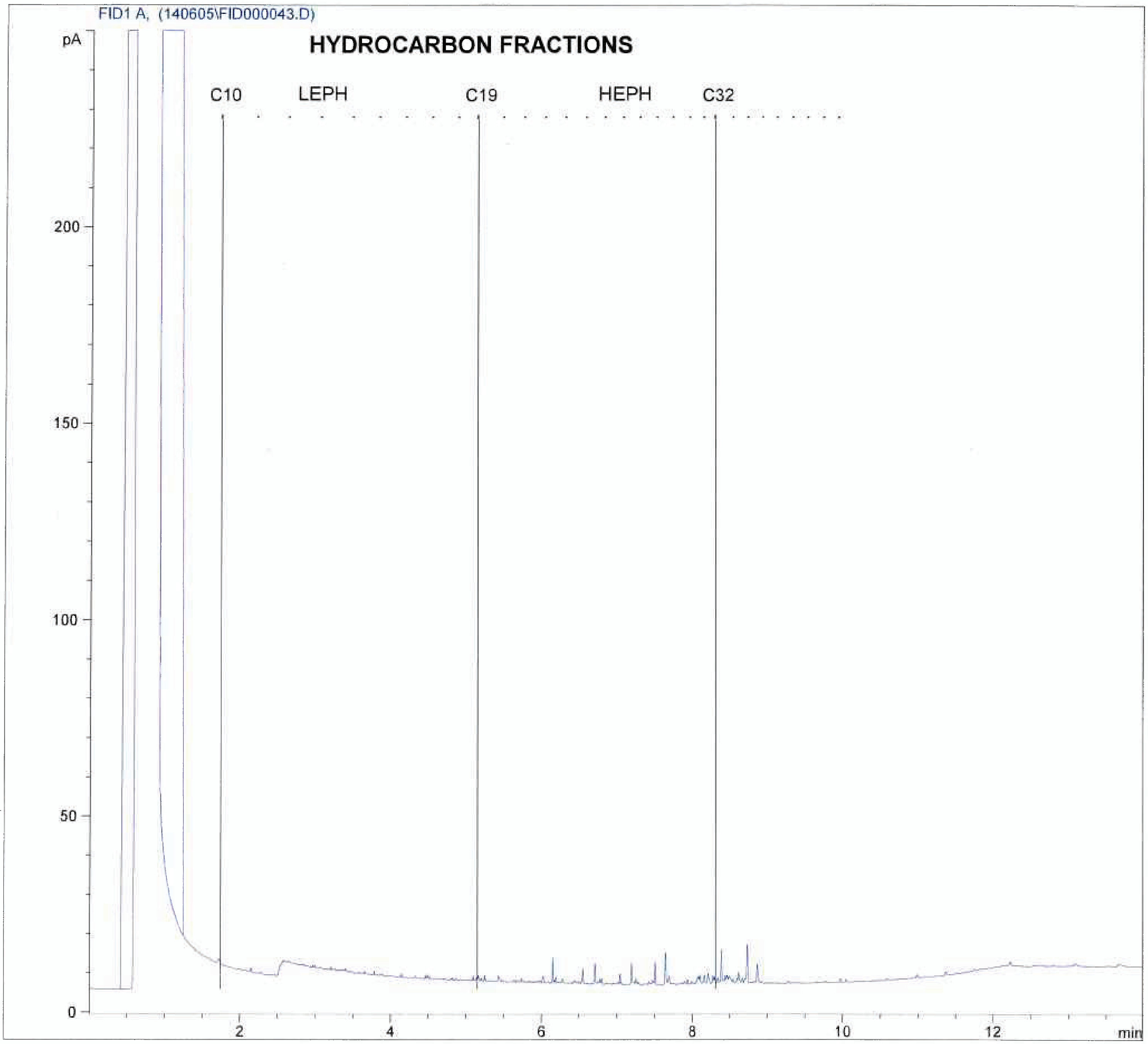

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Data File C:\CHEM32\1\DATA\140605\FID000044.D
Sample Name: 1005620-2;8 mL

===

Acq. Operator : Reena Seq. Line : 44
Acq. Instrument : 6890N FID Location : Vial 31
Injection Date : 06-Jun-14, 01:28:09 Inj : 1
Inj Volume : 1 µl
Acq. Method : C:\CHEM32\1\METHODS\BCMESCAN.M
Last changed : 6/3/2014 8:38:47 AM by Huyen
Analysis Method : C:\Chem32\1\Methods\BCMERAW.M
Last changed : 2/12/2010 7:45:41 AM

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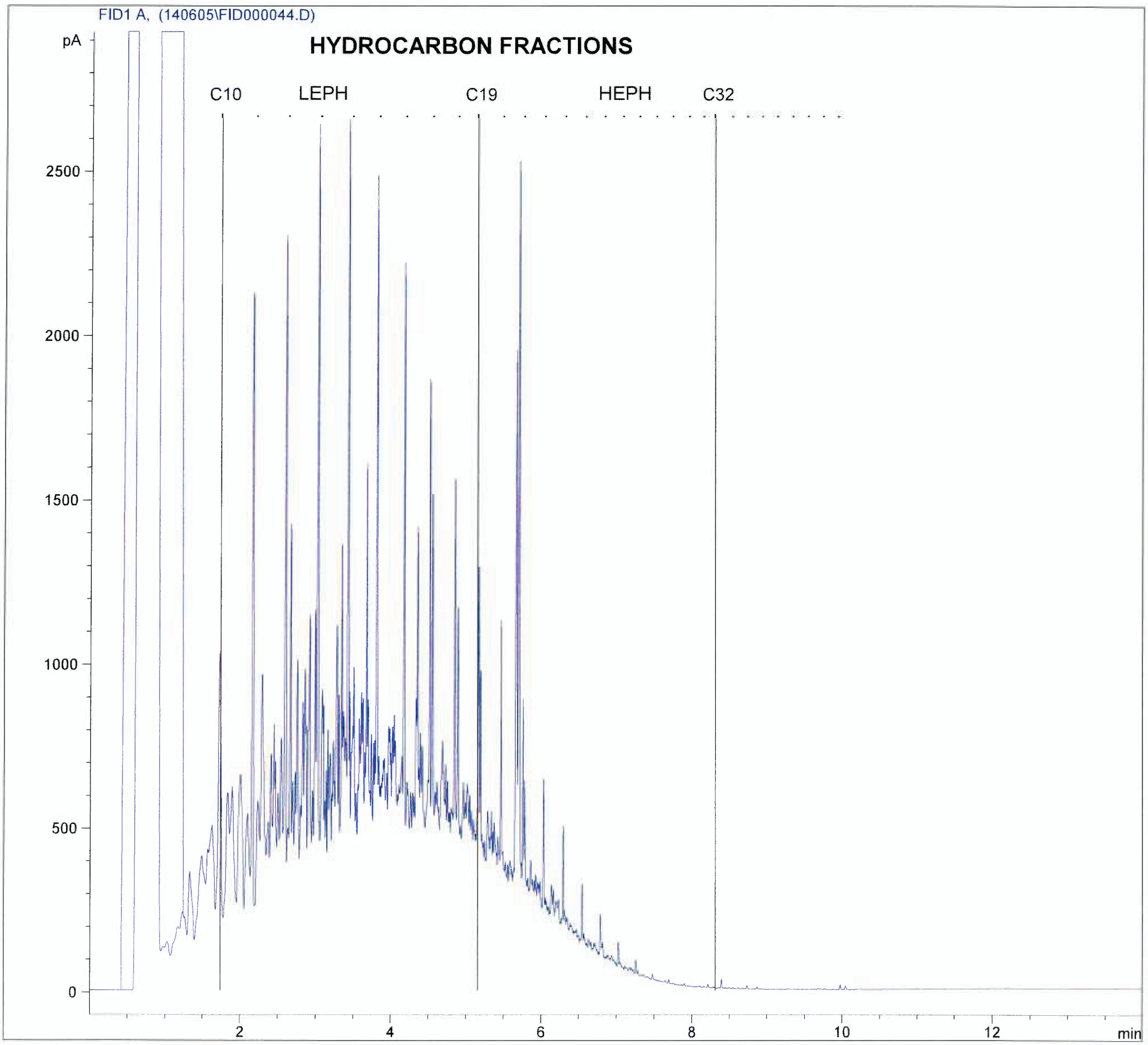

*** End of Report ***

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Sample Name: 1005620-3;8 mL

===

Acq. Operator : Reena Seq. Line : 45
Acq. Instrument : 6890N FID Location : Vial 32
Injection Date : 06-Jun-14, 01:48:24 Inj : 1
Inj Volume : 1 µl
Acq. Method : C:\CHEM32\1\METHODS\BCMESCAN.M
Last changed : 6/3/2014 8:38:47 AM by Huyen
Analysis Method : C:\Chem32\1\Methods\BCMERAW.M
Last changed : 2/12/2010 7:45:41 AM

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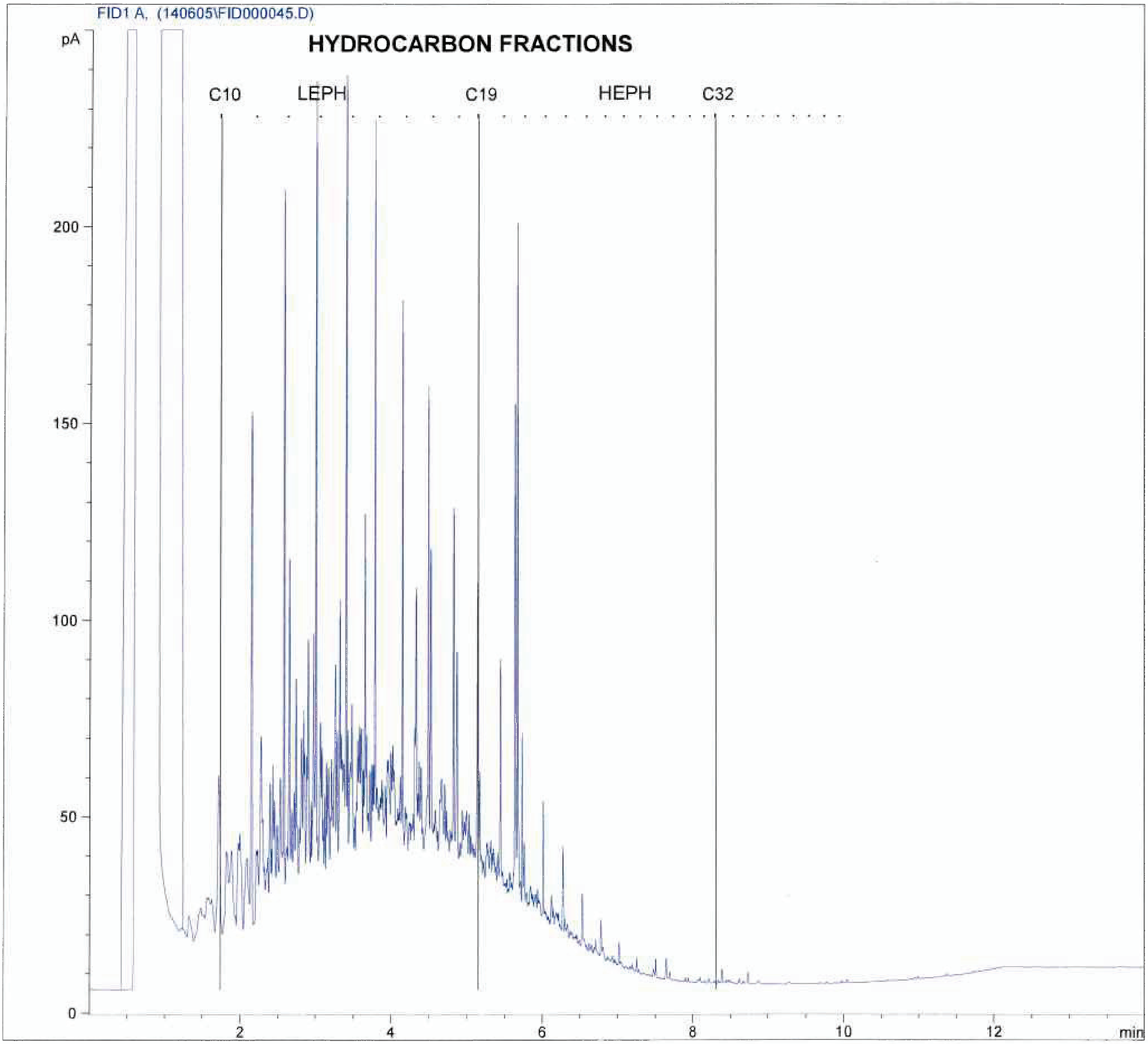

*** End of Report ***

Data File C:\CHEM32\1\DATA\140605\FID000046.D
Sample Name: 1005620-4;8 mL

===

Acq. Operator : Reena Seq. Line : 46
Acq. Instrument : 6890N FID Location : Vial 33
Injection Date : 06-Jun-14, 02:08:32 Inj : 1
Inj Volume : 1 µl
Acq. Method : C:\CHEM32\1\METHODS\BCMESCAN.M
Last changed : 6/3/2014 8:38:47 AM by Huyen
Analysis Method : C:\Chem32\1\Methods\BCMERAW.M
Last changed : 2/12/2010 7:45:41 AM

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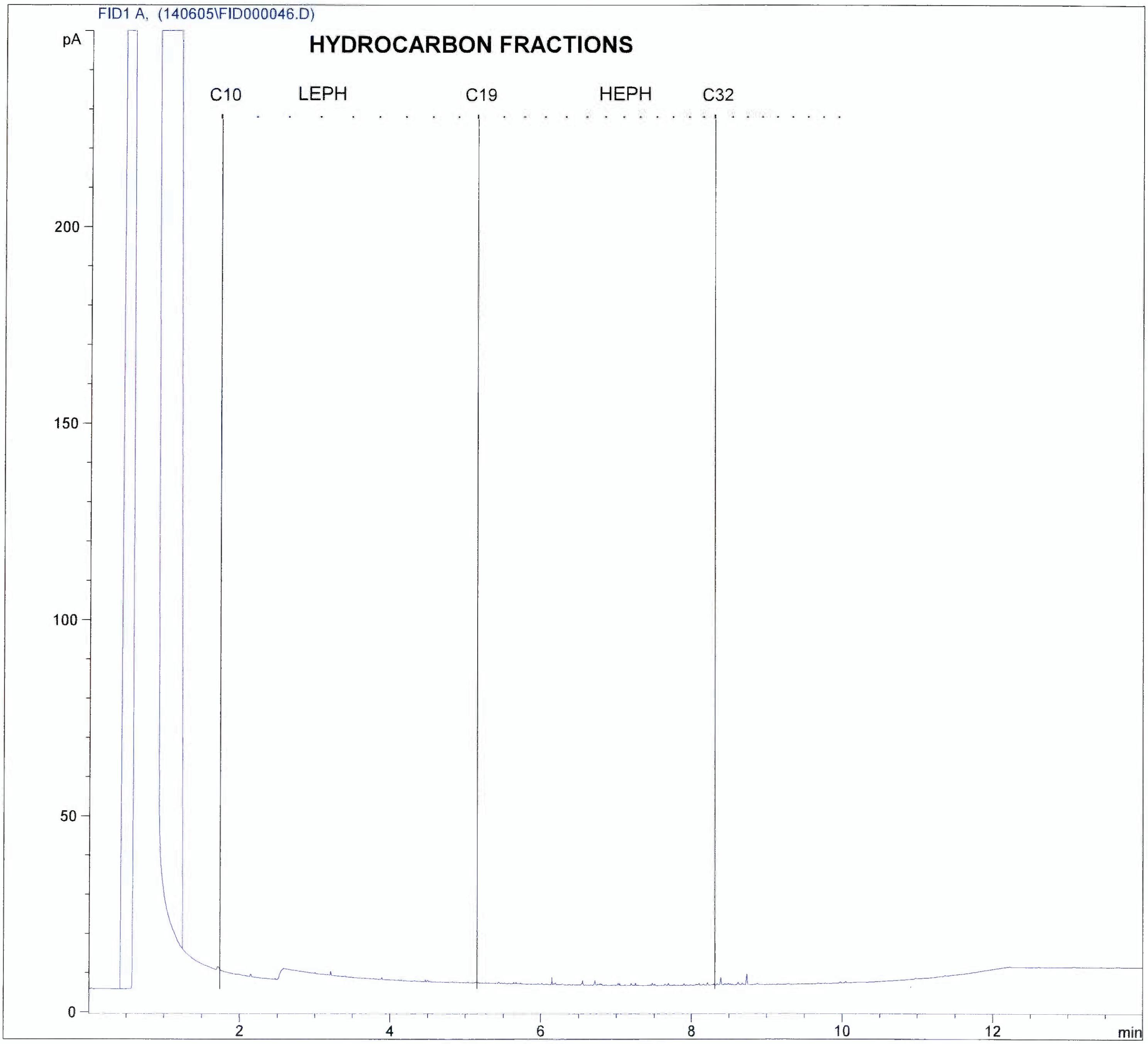
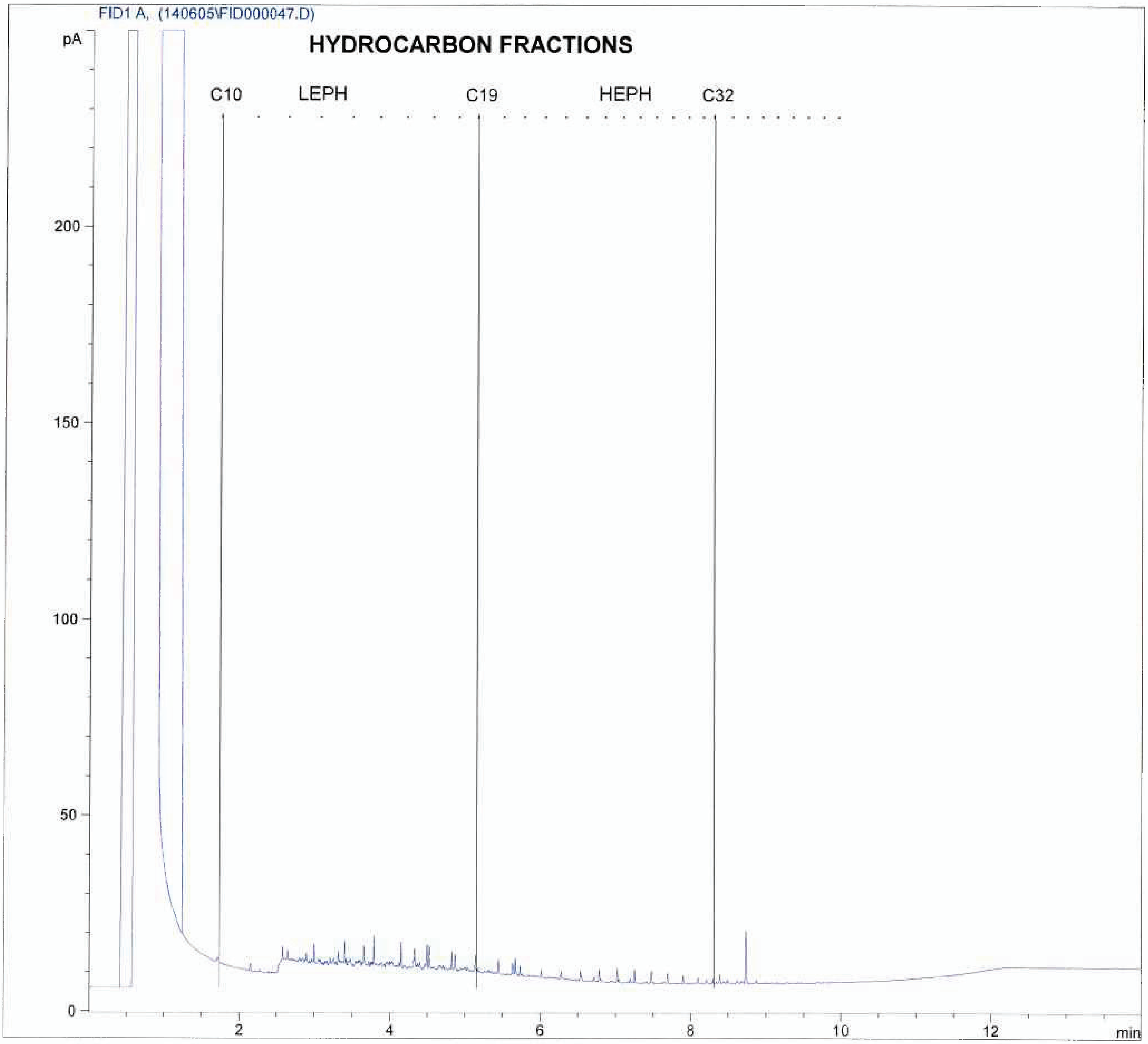


*** End of Report ***

Data File C:\CHEM32\1\DATA\140605\FID000047.D
Sample Name: 1005620-5;8 mL

Acq. Operator	: Reena	Seq. Line :	47
Acq. Instrument	: 6890N FID	Location :	Vial 34
Injection Date	: 06-Jun-14, 02:28:25	Inj :	1
		Inj Volume :	1 µl
Acq. Method	: C:\CHEM32\1\METHODS\BCMESCAN.M		
Last changed	: 6/3/2014 8:38:47 AM by Huyen		
Analysis Method	: C:\Chem32\1\Methods\BCMERAW.M		
Last changed	: 2/12/2010 7:45:41 AM		



*** End of Report ***

Data File C:\CHEM32\1\DATA\140605\FID000048.D
Sample Name: 1005620-6;8 mL

===

Acq. Operator	: Reena	Seq. Line :	48
Acq. Instrument	: 6890N FID	Location :	Vial 35
Injection Date	: 06-Jun-14, 02:48:14	Inj :	1
		Inj Volume :	1 µl
Acq. Method	: C:\CHEM32\1\METHODS\BCMESCAN.M		
Last changed	: 6/3/2014 8:38:47 AM by Huyen		
Analysis Method	: C:\Chem32\1\Methods\BCMERAW.M		
Last changed	: 2/12/2010 7:45:41 AM		

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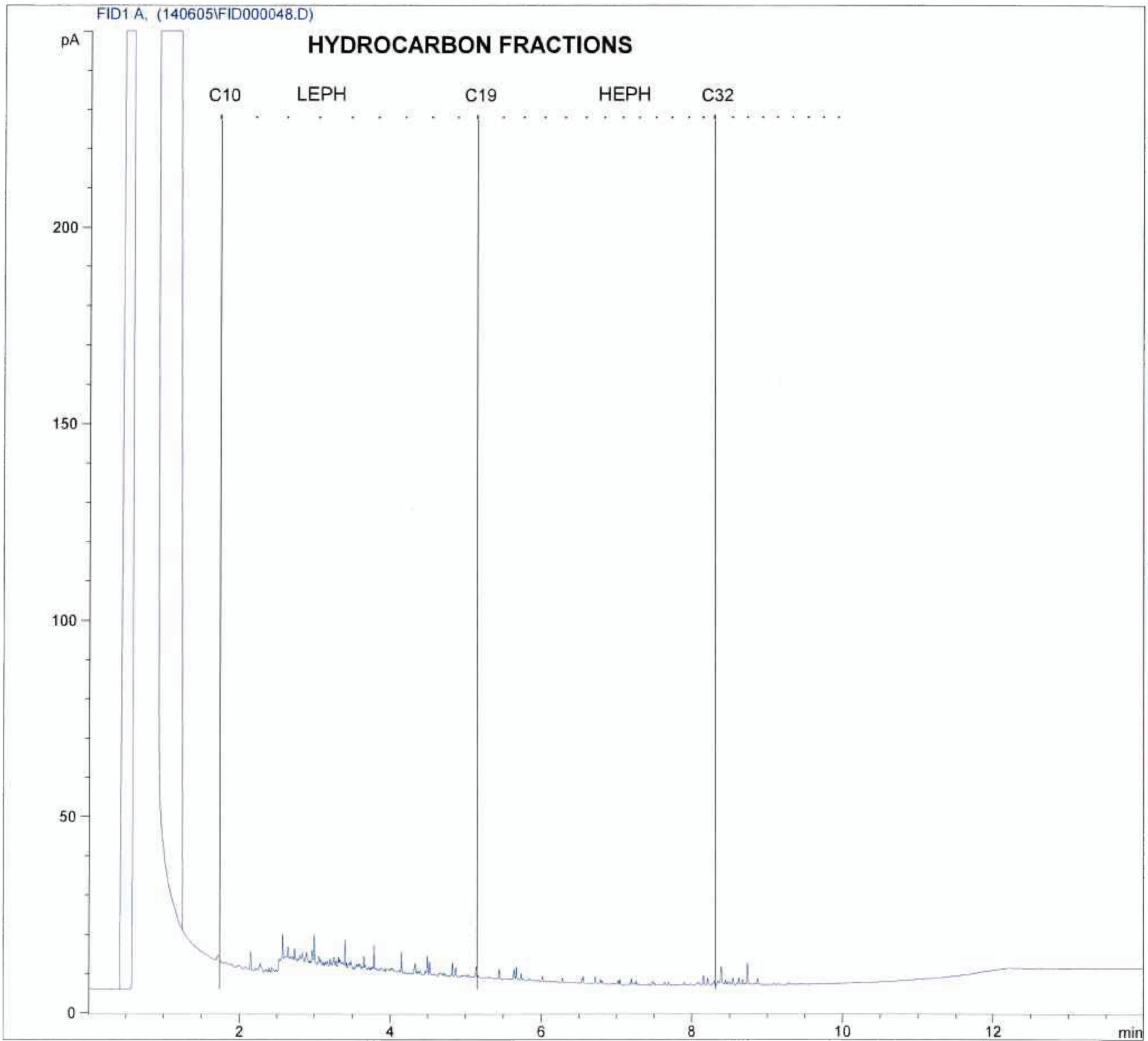

*** End of Report ***

Data File C:\CHEM32\1\DATA\140605\FID000049.D
Sample Name: 1005620-7;8 mL

===

Acq. Operator : Reena　　　　Seq. Line : 49
Acq. Instrument : 6890N FID　　　　Location : Vial 36
Injection Date : 06-Jun-14, 03:08:07　　　　Inj : 1
Inj Volume : 1 µl
Acq. Method : C:\CHEM32\1\METHODS\BCMESCAN.M
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Analysis Method : C:\Chem32\1\Methods\BCMERAW.M
Last changed : 2/12/2010 7:45:41 AM

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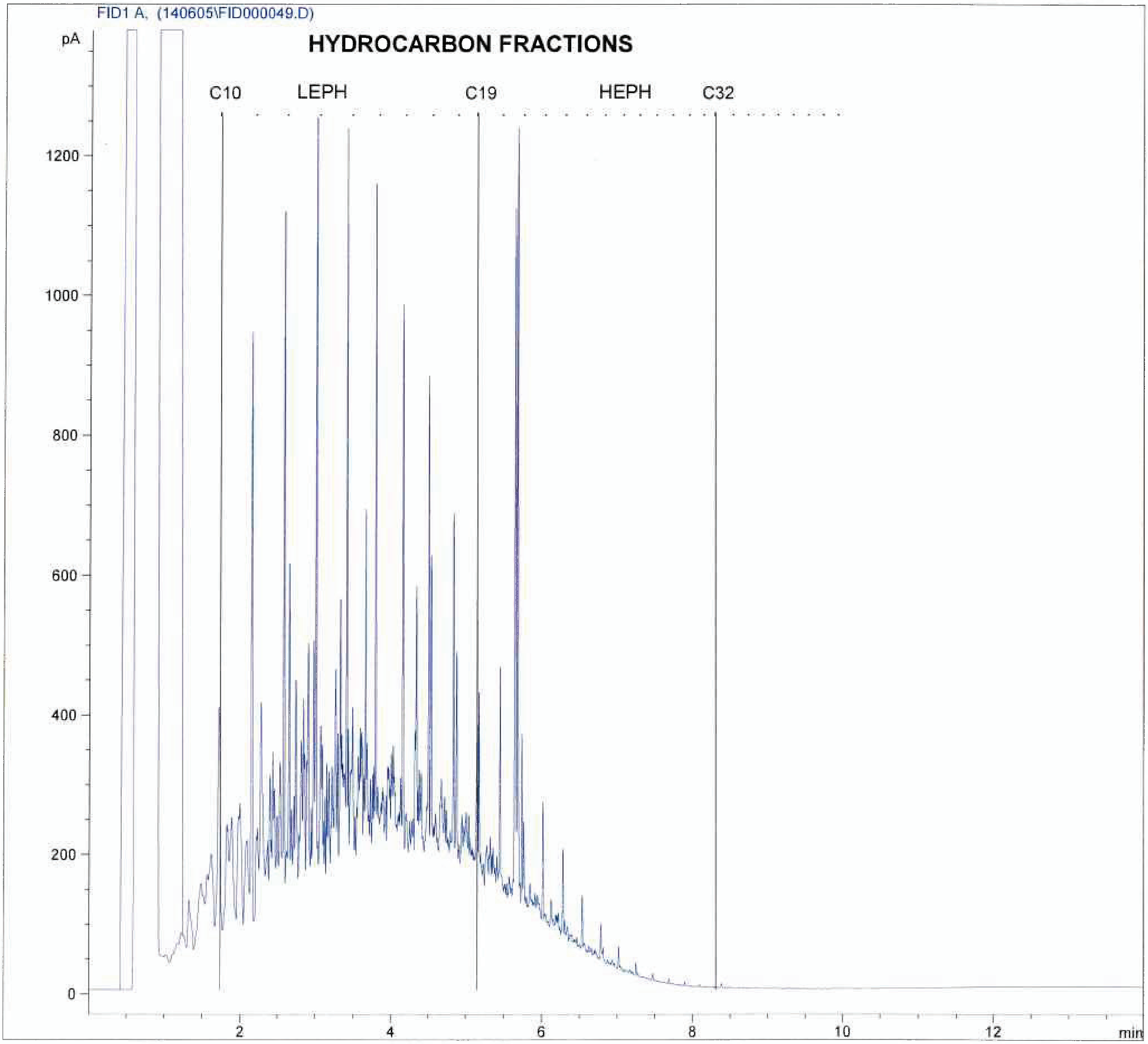

*** End of Report ***

Data File C:\CHEM32\1\DATA\140605\FID000050.D
Sample Name: 1005620-8;8 mL

===

Acq. Operator : Reena
Seq. Line : 50
Acq. Instrument : 6890N FID
Location : Vial 37
Injection Date : 06-Jun-14, 03:28:00
Inj : 1
Inj Volume : 1 µl
Acq. Method : C:\CHEM32\1\METHODS\BCMESCAN.M
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Analysis Method : C:\Chem32\1\Methods\BCMERAW.M
Last changed : 2/12/2010 7:45:41 AM

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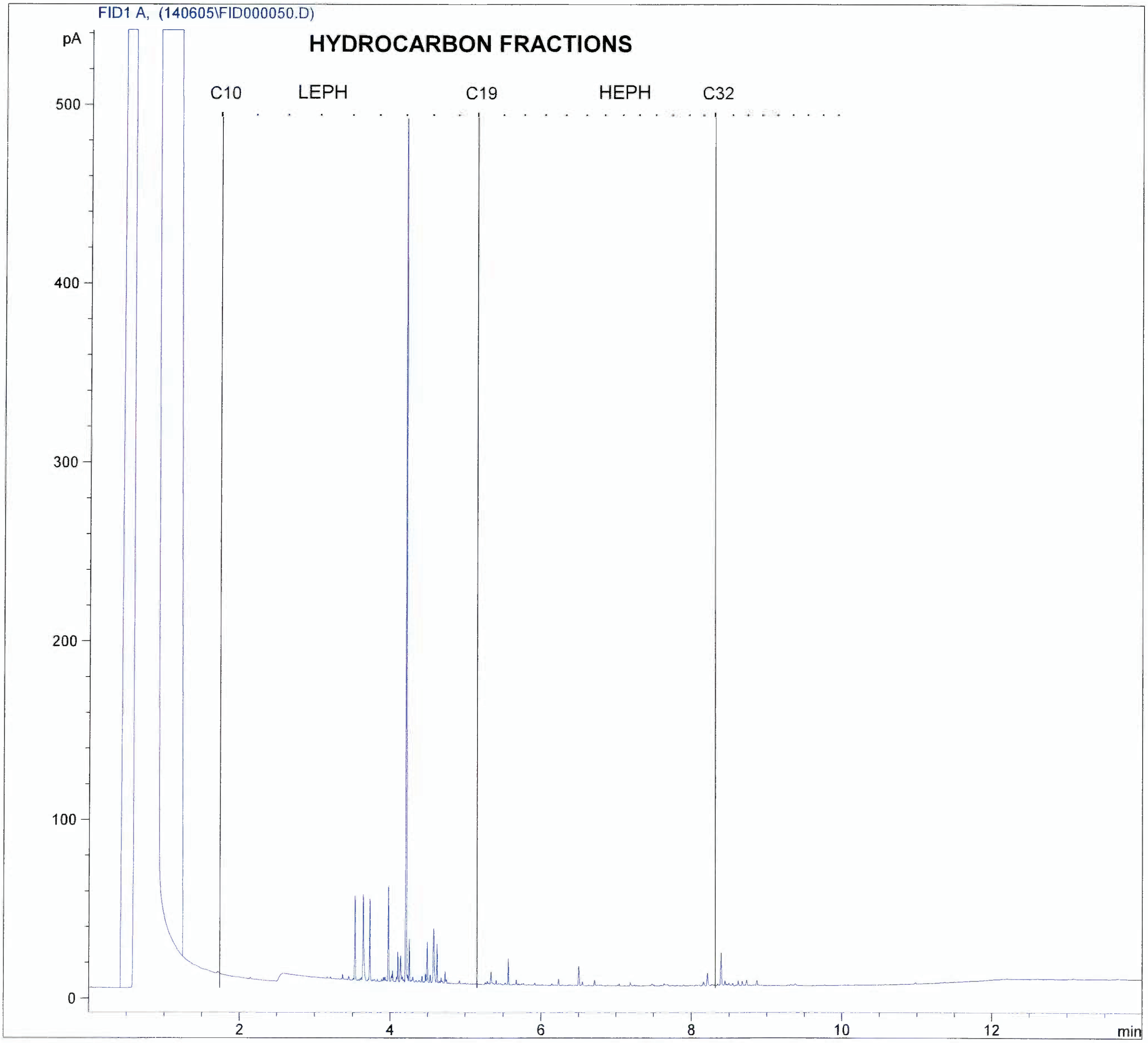

*** End of Report ***

Data File C:\CHEM32\1\DATA\140605\FID000051.D
Sample Name: 1005620-9;8 mL

===

Acq. Operator : Reena Seq. Line : 51
Acq. Instrument : 6890N FID Location : Vial 38
Injection Date : 06-Jun-14, 03:47:49 Inj : 1
Inj Volume : 1 µl
Acq. Method : C:\CHEM32\1\METHODS\BCMESCAN.M
Last changed : 6/3/2014 8:38:47 AM by Huyen
Analysis Method : C:\Chem32\1\Methods\BCMERAW.M
Last changed : 2/12/2010 7:45:41 AM

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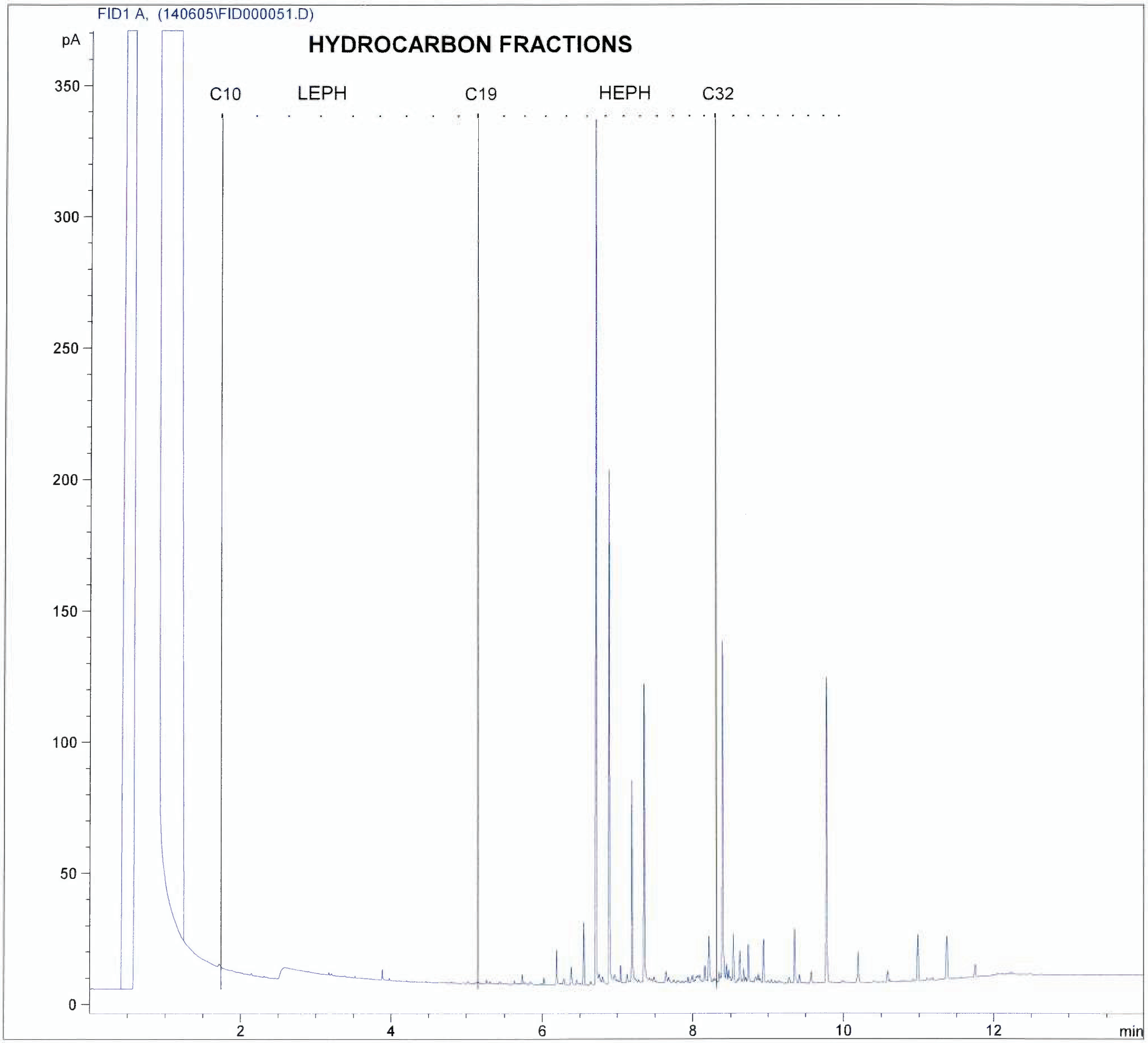

*** End of Report ***

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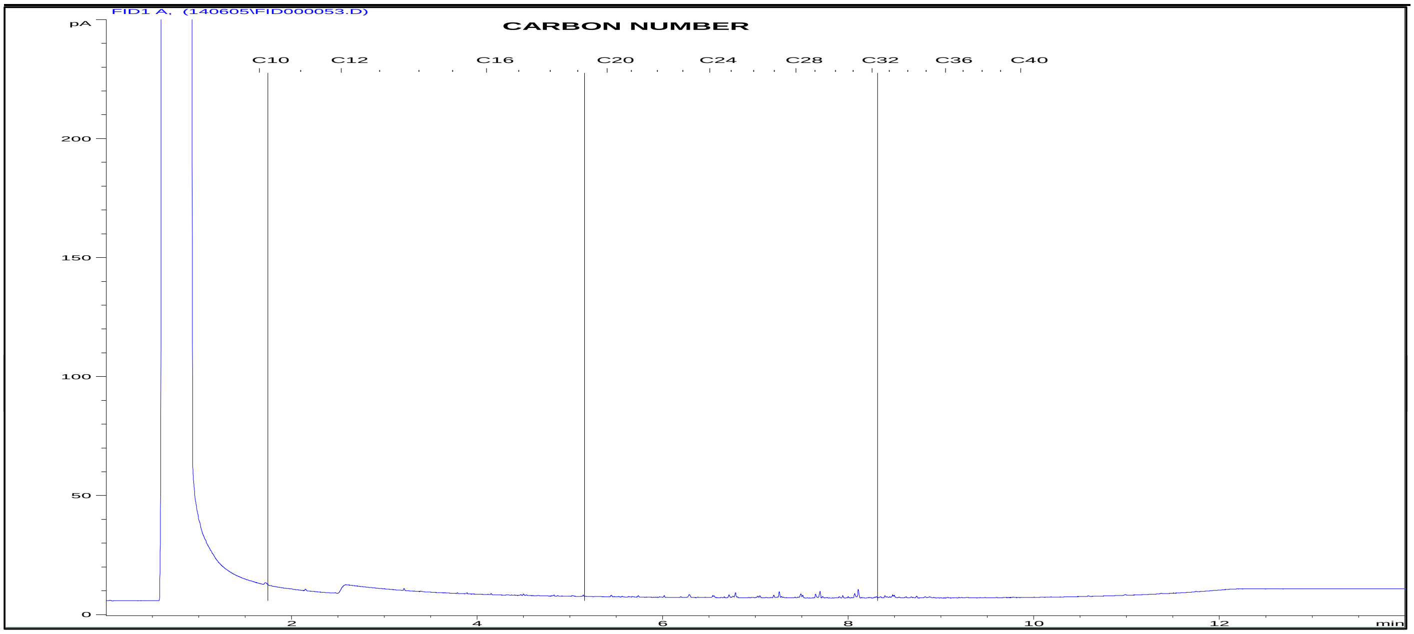
W: www.exova.com

Hydrocarbon Chromatogram

Bill To:	Chilkoot Geological Engineering	Project ID:	Client TTC	Lot ID:	**1005671**
Report To:	Chilkoot Geological Engineering	Name:	Project Sawmill. LTE walls	Control Number:	
	PO 31146	Location:		Date Received:	Jun 2, 2014
		LSD:		Date Reported:	Jun 9, 2014
	Whitehorse, YT, Canada	P.O.:		Report Number:	1921202
	Y1A 5P7				
Attn:	Tares Dhara				
Sampled by:	T.D.				
Company:	Chilkoot				

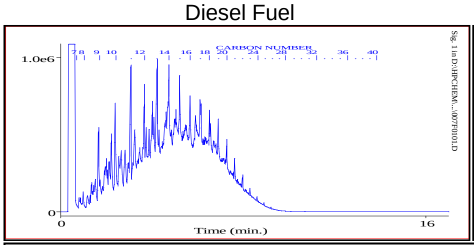
Exova Number: 1005671-1
Sample Date: May 26, 2014

Sample Description: Project Sawmill. LTE walls BH1-14 Sample 9

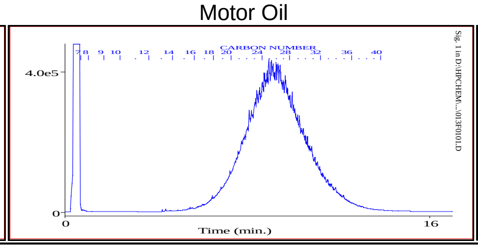


TYPICAL PRODUCT CHROMATOGRAMS

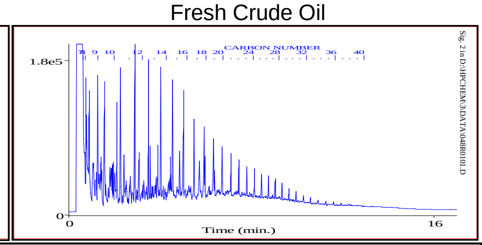
Diesel Fuel



Motor Oil



Fresh Crude Oil



Product Carbon Number Ranges

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

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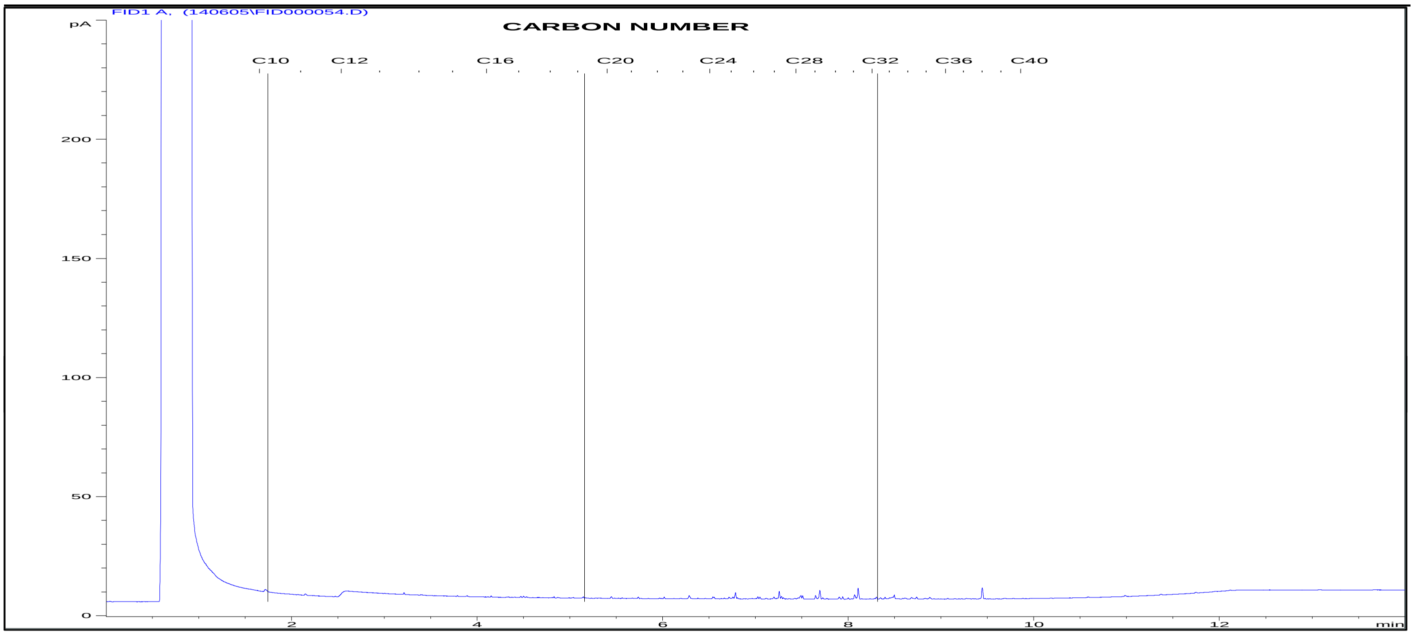
W: www.exova.com

Hydrocarbon Chromatogram

Bill To:	Chilkoot Geological Engineering	Project ID:	Client TTC	Lot ID:	**1005671**
Report To:	Chilkoot Geological Engineering	Name:	Project Sawmill. LTE walls	Control Number:	
	PO 31146	Location:		Date Received:	Jun 2, 2014
		LSD:		Date Reported:	Jun 9, 2014
	Whitehorse, YT, Canada	P.O.:		Report Number:	1921202
	Y1A 5P7				
Attn:	Tares Dhara				
Sampled by:	T.D.				
Company:	Chilkoot				

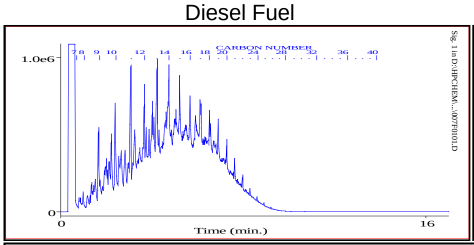
Exova Number: 1005671-2
Sample Date: May 26, 2014

Sample Description: Project Sawmill. LTE walls BH2-14 Sample 16

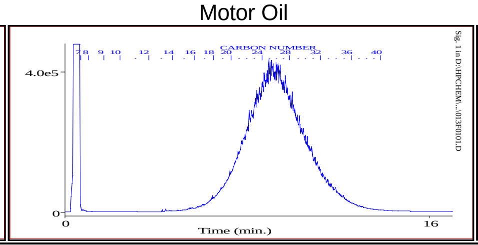


TYPICAL PRODUCT CHROMATOGRAMS

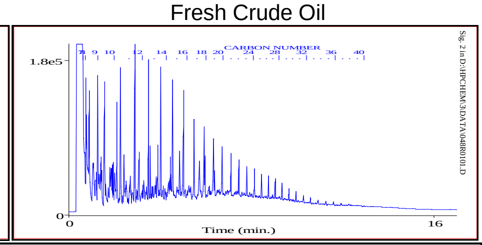
Diesel Fuel



Motor Oil



Fresh Crude Oil



Product Carbon Number Ranges

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

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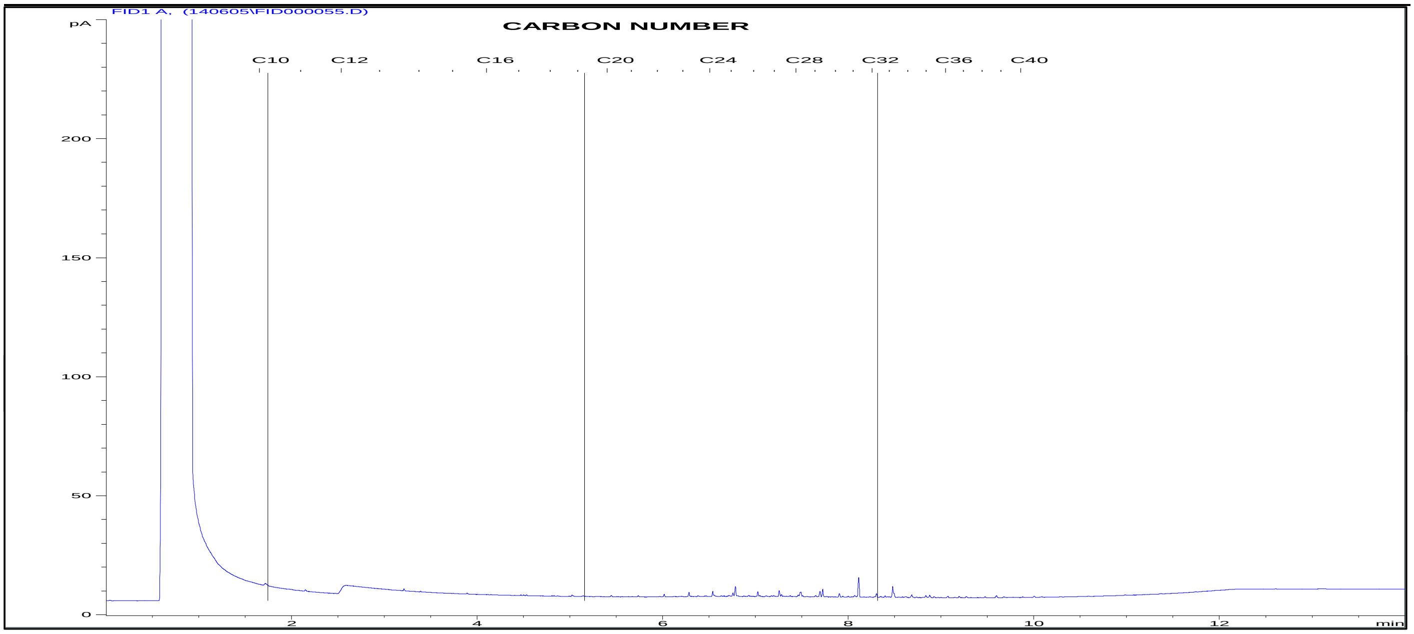
Hydrocarbon Chromatogram

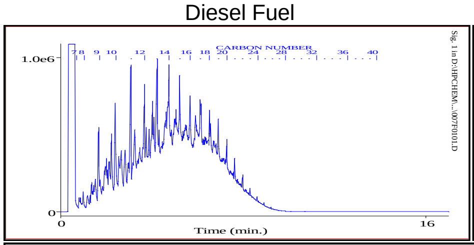
Bill To:	Chilkoot Geological Engineering	Project ID:	Client TTC	Lot ID:	**1005671**
Report To:	Chilkoot Geological Engineering	Name:	Project Sawmill. LTE walls	Control Number:	
	PO 31146	Location:		Date Received:	Jun 2, 2014
		LSD:		Date Reported:	Jun 9, 2014
	Whitehorse, YT, Canada	P.O.:		Report Number:	1921202
	Y1A 5P7				
Attn:	Tares Dhara				
Sampled by:	T.D.				
Company:	Chilkoot				

Exova Number: 1005671-3
Sample Date: May 26, 2014
Sample Description: Project Sawmill. LTE walls BH3-14 Sample 36

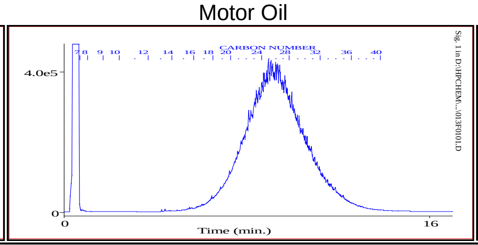


TYPICAL PRODUCT CHROMATOGRAMS

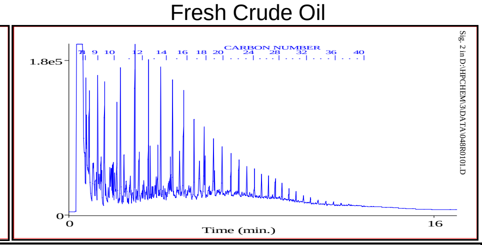
Diesel Fuel



Motor Oil



Fresh Crude Oil



Product Carbon Number Ranges

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

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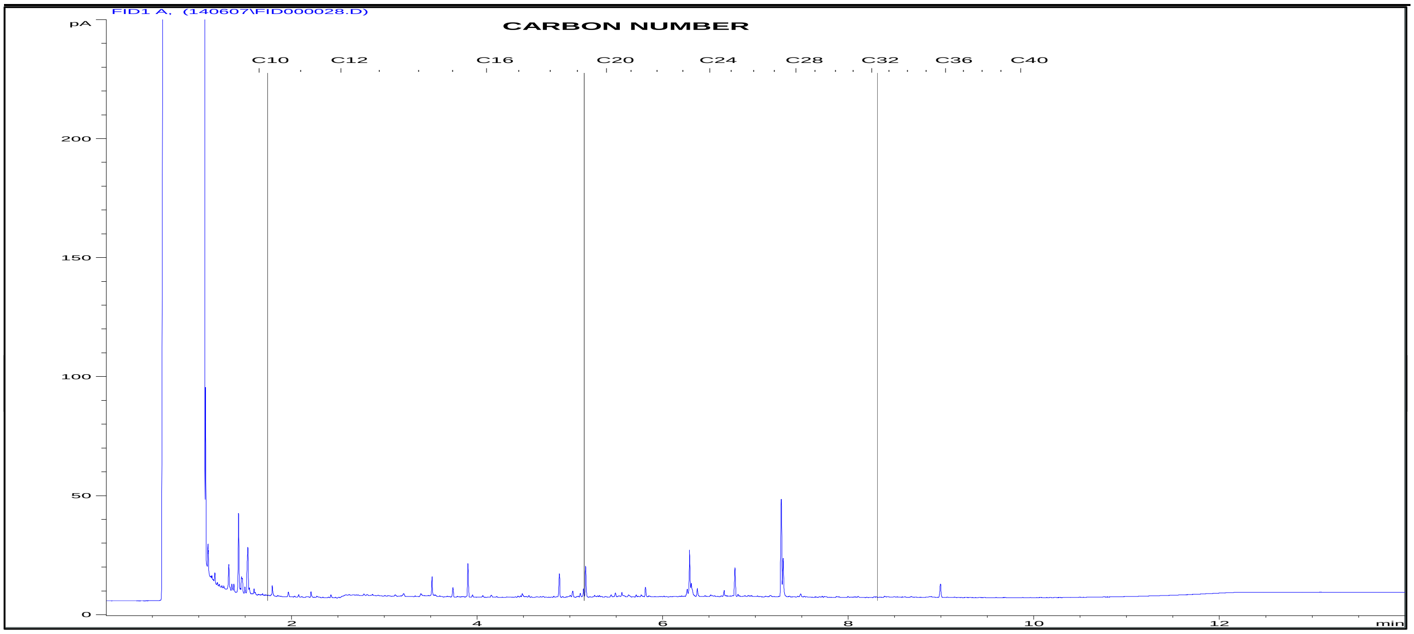
Hydrocarbon Chromatogram

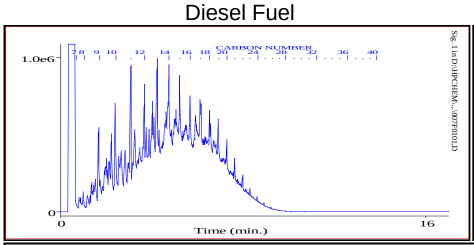
Bill To:	Chilkoot Geological Engineering	Project ID:	Client TTC	Lot ID:	**1005671**
Report To:	Chilkoot Geological Engineering	Name:	Project Sawmill. LTE walls	Control Number:	
	PO 31146	Location:		Date Received:	Jun 2, 2014
		LSD:		Date Reported:	Jun 9, 2014
	Whitehorse, YT, Canada	P.O.:		Report Number:	1921202
	Y1A 5P7				
Attn:	Tares Dhara				
Sampled by:	T.D.				
Company:	Chilkoot				

Exova Number: 1005671-4 Sample Description: Project Sawmill. LTE walls Water Sample
Sample Date: May 26, 2014

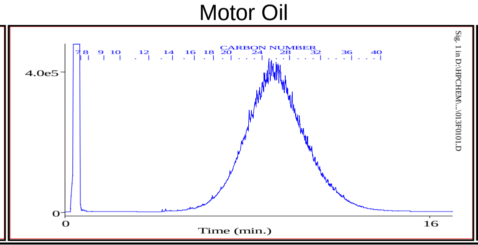


TYPICAL PRODUCT CHROMATOGRAMS

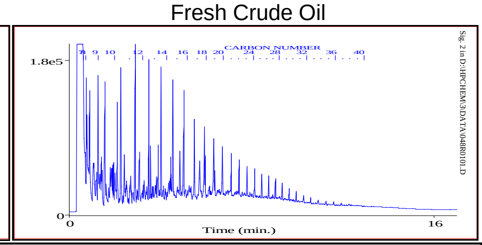
Diesel Fuel



Motor Oil



Fresh Crude Oil



Product Carbon Number Ranges

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

APPENDIX C

Selection of Photos

Photo # 1 – BH 1-14 facing west

May 25, 2014

Photo # 2 – BH 1-14

Sample 7 – Glaciolacustrine

Sample 8 - Glaciolacustrine

May 25, 2014

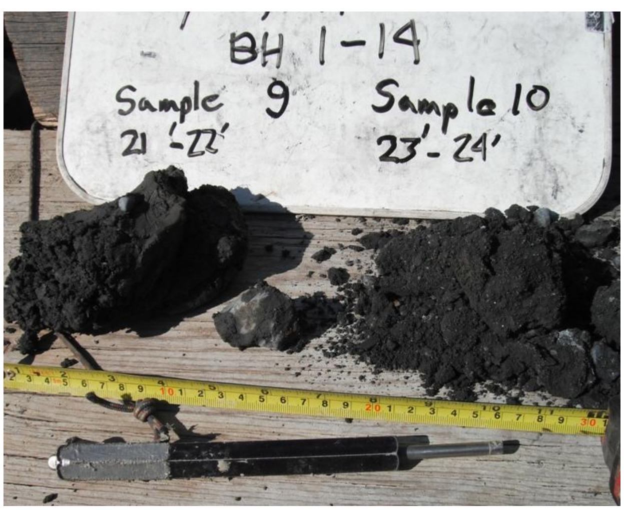


Photo # 3 – BH 1-14

Sample 9 – Glaciolacustrine

Sample 10 – Till

May 25, 2014

Photo # 4 – BH 2-14 facing east

May 25, 2014

Photo # 5 – BH 3-14

Glaciofluvial deposits

10.7 to 12.2 meters

May 26, 2014

Photo # 6 – BH 3-14 – Final Conditions

May 26, 2014

— Appendix B —

Groundwater Monitoring Program, Sawmill LTF – Teslin, Yukon - 2014
Prepared by Chilkoot Geological Engineers Ltd, November 2014

CHILKOOT GEOLOGICAL ENGINEERS LTD.
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chilkoot@northwestel.net (867) 335-2085 c

Environmental Services

Groundwater Monitoring Program

Sawmill LTF - Teslin, Yukon – 2014

Prepared For: **Teslin Tlingit Council**

Date : **November 20, 2014**

Project No: **200-005-14**

TABLE OF CONTENTS

Environmental Services

Groundwater Monitoring Program

Sawmill LTF - Teslin, Yukon – 2014

TABLE OF CONTENTS

Environmental Services

Groundwater Monitoring Program

Sawmill LTF - Teslin, Yukon – 2014

SECTION **PAGE**

APPENDICES

1.0 INTRODUCTION

Chilkoot Geological Engineers Ltd. was retained by *Teslin Tlingit Council (TTC) – Capital & Infrastructure* to monitor the groundwater conditions at the Sawmill Land Treatment Facility (LTF) through observation and sampling of the facilities three (3) groundwater monitoring wells. The intent of the monitoring program was to better characterize the groundwater regime further to the June 25th, 2014 Hydrological Assessment, which was conducted by our firm.

During the work, our firm trained *TTC* environmental staff on monitoring procedures to allow future episodes to be conducted by *TTC* personnel. In addition, as part of our services, our firm formulated Standard Operating Procedures (SOP's) to summarize the observation and sampling procedures for future *TTC* staff reference.

Authorization to proceed with the work was granted on September 12th, 2014 by Mr.Adam Grinde, *TTC* – Director of Capital. The work was conducted in accordance with our Proposal submitted on September 9th, 2014. The field work was conducted by the undersigned and designated *TTC* environmental personnel on September 29th and October 3rd, 2014.

1.1 Site Description

The Sawmill LTF is located at a former industrial sawmill site in Teslin, Yukon, as noted in Figure 1.

During historical development, the central portions of the site were cleared and grubbed. These grubbing piles were pushed to the northern, eastern and southern peripheries of the site. Visual inspection of the grubbing piles noted that they appeared to be well consolidated and were in the order of 2-3 meters in height.

At the time of the monitoring program, the facility was comprised of an existing cell (No.1) and former cell which were situated within the eastern half of the centrally cleared region as noted in Figure 2. A proposed cell (No.2), which is to be completed nearby, has also been illustrated in the figure along with the facilities monitoring wells. The monitoring wells were installed in May 2014 during the Hydrological Assessment.

While the regional drainage is poorly defined, central portions of the site were comprised of low gradient (<1%) undulating terrain that trended down-gradient towards the northwest. The undulations measured up to 0.4 meters in depth with typical diameters in the order of ~ 5 meters. The undulating terrain is likely the result of differential consolidation of varying soil types due to their exposure to precipitation following historical clearing and grubbing operations. The total elevation differences in the central regions of the site were noted to be in the order of 3 meters. Regionally, higher elevations were noted north-east of the site as identified in the *Yukon Water Shed Placer Atlas* website, as noted in Figure 3. In general, the topography suggests regional drainage towards the west and south-west (Teslin Lake) and north-west (Fox Creek/Teslin Lake).

With the exception of an unused administrative office, outdoor storage areas and remnants of sawmill infrastructure located on the south-western periphery, the majority of the site is essentially dormant. A region located approximately 115 meters south-west of the central concrete slab (Figure 2) harbors a number of decommissioned residential fuel storage tanks.

1.2 Background Information

The following letters and reports (which were prepared by our firm) were reviewed to provide information regarding the regional soil deposits that may be present at the facility;

Soil Characterization Letter - July 20, 2013

The letter characterized the near surface soils to verify their low permeability.

Geotechnical Evaluation – Proposed Land Treatment Facility –Aug. 22, 2013

The geotechnical evaluation provided preliminary design criteria to allow for construction of the existing cell.

Hydrological Assessment – Sawmill Land Treatment Facility - June 25, 2014

The hydrological assessment summarized the groundwater conditions which were encountered during installation of three (3) groundwater monitoring wells which were installed at peripheral areas around the facility.

The soil stratigraphy and geomorphology of the soils encountered at the facility have been summarized in Section 1.3, below.

The following well installation data was noted from the hydrological assessment;

Summary of Well Installation Data

Well	***Solid Length (m)***	***Screened Length (m)*** [A]	***Total Length (m)***	***Installed length below ground surface (m)***	***Ground Surface Elevation (m)***	***Top of pipe Elevation (m)***	***Base Elevation of Well (m)***
BH 1-14	5.67	6.10	11.77	10.81	101.87	102.83	91.06
BH 2-14	6.24	4.57	10.81	9.87	99.24	100.17	89.36
BH 3-14	4.50 [B]	6.10	10.60	9.90	100.02	100.72	90.12

Notes; [A] - The screened portions of the monitoring wells were installed in order to target the lower portions of the glaciolacustrine deposits, which were considered the most likely sub-strata to yield groundwater.

[B] - Corrected from 2.42 m

1.3 Soil Stratigraphy and Geomorphology

While the *Surficial Geology of Teslin, Yukon Territory (Map 1891A)* suggests that the soils in the region of the facility are dominated by a morainal blanket (comprised of lodgment and ablation (glacial) till that measure up to 30 meters thick) our previous assessments suggest that the soil conditions and geomorphology is more complex. Specifically, our previous work on the site suggests that the regional stratigraphy is comprised of;

Surficial Deposits, which overlie,
Glaciolacustrine Deposits, which overlie,
Morainal (Till) Deposits, which at (BH 3-14) overlies,
Glaciofluvial Deposits.

There was no indication of permafrost or near surface bedrock.

Surficial Deposits

These deposits were comprised of a 10-15 cm thick veneer of surficial organics which overlay loose sandy silts and silt sands which (in total) measured in the order of 80 cm thick. In addition to these surficial deposits, the site harbors remnant debris such as sawdust piles/fill, wood chips, logs and other similar types of waste materials associated with sawmill facilities. The thickness of the surficial deposits was of course thicker in regions where they had been pushed up during site grubbing operations which were conducted along the sites periphery.

Glaciolacustrine Deposits

Fine grained glaciolacustrine deposits, which on average measured 5.4 meters thick, were encountered below the surficial deposits at an average depth of 0.8 meters.

These soils were comprised of predominately grey inorganic clays which contained varying amounts of silt and were of low to medium (intermediate) plasticity. The soil unit also contained thin seams of fine sand and the odd pebble. There was no indication of cobbles (and/or boulders) within these deposits.

The soils were characterized as 'CL' (clay) soils in accordance with the *Unified Soil Classification System* (USCS). The hydrometer analysis noted that the soils contained up to 95.0 percent clay. The Atterberg Limit analysis indicated that the soils had a plasticity index of up to 22, indicating (in general) soils of medium plasticity.

The permeability of the soils was estimated to be in the order of 10^{-6} cm/s to 10^{-8} cm/s. The permeability of the soils will be lower in regions where higher clay contents and very stiff soils are encountered.

Morainal (Till) Deposits

Grey till deposits were encountered at all borehole locations below the glaciolacustrine soils at depths of 6.7 meters (BH 1-14 and BH 2-14) and 5.2 meters (BH 3-14), below the existing ground surface.

These soils were generally comprised of silty gravelly sand to gravelly silty sand and contained trace amounts of fractured rock particles (possibly chert) in size to 35 mm. The odd rounded cobble in size to 100 mm was also encountered. As is typical with the geomorphology, the tills also may contain boulder sized materials.

The thickness of the till deposits varied. BH 1-14 and BH 2-14 encountered till deposits until the boreholes were terminated (suggesting thicknesses greater than 5.5 and 4.3 meters, respectively). By contrast, the thickness of the till in BH 3-14 was noted to be only 0.3 meters thick, below which, glaciofluvial deposits were encountered.

Glaciofluvial Deposits

Brown glaciofluvial deposits were encountered below the till in BH 3-14. These soils were generally comprised of damp silty gravelly sands to gravelly silty sands. The odd cobble and possible boulder was also noted within the deposit.

Details regarding the elevation, thickness and depths of the above noted soil units have been presented in *Table I – Summary of Soil Stratigraphy* for reference purposes.

2.0 METHODOLOGY

The methodology our firm utilized to conduct the well monitoring and training episodes was comprised of the following;

2.1 Well Monitoring Program

The well monitoring program was comprised of both field and laboratory work programs.

2.1.1 Field Work Program

The field work program consisted of recording our field observations, obtaining groundwater samples from the monitoring wells and training *TTC* personnel.

Field Observations

The groundwater levels were measured in each of the wells both before and after well development on September 29th, 2014 and immediately prior to sampling on October 3rd, 2014.

The well elevations were surveyed on September 29th, 2014 relative to the local benchmark utilizing a *Leica Rugby 100LR* laser level. The local benchmark was the south-west corner of the remnant concrete 'slab' noted in Figure 2, which was given an arbitrary elevation of 100.00 meters.

The groundwater well readings and elevations have been presented in *Table I – Summary of Soil Stratigraphy* and *Table II – Summary of Well Observations.*

In general, the wells appeared to be in good condition. However, surface water was noted around the monitoring well at BH 3-14 on September 29th. Site improvements were conducted following the observation and positive drainage was subsequently established around the well through placement of clean granular fill prior to the October 3rd sampling episode.

Groundwater Sampling

Our firm developed the wells in accordance with *EPB Protocol # 7* (namely *ASTM D4448-01 Standard Guide for Sampling Ground-Water Monitoring Wells*) on September 29th, 2014. Following purging, the depth to the groundwater within each of the wells was measured at regular intervals to better characterize the recharge rates and groundwater regime. These observations were summarized in *Table II – Summary of Well Observations.*

Following well development, two (2) groundwater samples were obtained from the wells at BH 1-14 and BH 2-14 utilizing hand bailers on October 3rd, 2014. As groundwater was not observed in BH 3-14, a third sample was, of course, unattainable.

The temperature of each sample was recorded immediately following sample retention utilizing a digital thermocouple thermometer. The temperatures of the two samples were noted as follows;

Summary of Sample and Air Temperatures

SAMPLE NUMBER	**AIR TEMP (°C)**	**SAMPLE TEMP (°C)**
1-14	+ 4.7	+ 5.9
2-14	+ 4.7	+ 5.4

Following sample retention, the samples were refrigerated in a cooler and forwarded on October 4th, 2014 to *EXOVA* laboratories in Surrey, B.C., for chemical analysis (as noted in Section 2.1.2, below).

2.1.2 Laboratory Work Program

The chemical laboratory analysis was conducted at *EXOVA* (located in Surrey, B.C.) between October 6th and October 10th, 2014 to assess the degree of potential hydrocarbon contamination and metals content in the two (2) retained groundwater samples.

The groundwater samples were analyzed for the following potential hydrocarbons contaminants;

Mono-aromatic Hydrocarbons

(Benzene, Toluene, Ethylbenzene and Xylene - BTEX)

Volatile Petroleum Hydrocarbons (VPH)

Extractable Petroleum Hydrocarbons – Light & Heavy (LEPH/HEPH)

Polycyclic Aromatic Hydrocarbons (PAH)

The results of the chemical analysis have been enclosed in *Appendix A.* Of note, Page 3 and Page 4 of *Appendix A* presents the results of four (4) interim soil (Cell No.1) samples. The results of the soil samples have been discussed separately in our Interim Sampling Report dated November 20th, 2014.

2.2 Training & Standard Operating Procedures

Two *TTC* environmental personnel (Roxanne Peters and Peter Jules), were present during the field observation component. Roxanne was also present during the groundwater sampling component. As both *TTC* personnel had been involved in similar types of field work, their time onsite served as a review of technical aspects involved with the observation and sampling process.

A standard operating procedure (SOP) was subsequently developed by our firm to summarize *EPB Protocol # 7 (ASTM D4448-01 Standard Guide for Sampling*

Ground-Water Monitoring Wells) to assist *TTC* personnel in conducting future monitoring episodes autonomously.

The SOP has been has been attached for in *Appendix B* for future reference.

3.0 DISCUSSIONS

Our observations of the monitoring wells noted the presence of groundwater in two (BH 1-14 and BH 2-14) of the three (3) wells which were installed during the Hydrological Assessment. This differs from the conditions noted immediately following the well installations (in May 2014) when only one well (BH 1-14) noted the presence of groundwater.

3.1 Groundwater Scenarios

The groundwater regime at the facility is complex and cannot at present be explained through a simple model. The absence of groundwater at the location of the third well (which was installed during the hydrological assessment at BH 3-14) is intriguing and may (as a minimum) suggest the possibility of one of two scenarios.

Scenario 1

As groundwater is present within the other two wells (BH 1-14 and BH 2-14) where the till deposits were noted to be relatively thick (in the order of 5 meters or more), the thin (0.3 meter thick) nature of the till at the location of BH 3-14 may suggest that the groundwater is utilizing the more permeable seepage zones within the upper realms of the till (and lower glaciolacustrine zones) as preferential pathways. Groundwater may not be present at the region of the facility near BH 3-14 given the thin nature of the till deposits at the location.

Scenario 2

The second scenario suggests that a regional groundwater table is located throughout the facility. If this assumption is correct, the groundwater may be flowing within the upper realms of the till deposits (north of BH 3-14) until the more permeable glaciofluvial deposits (surrounding BH 3-14) are encountered. Given the higher permeability of the glaciofluvial deposits, the groundwater in the BH 3-14 area may be present at elevations lower than the base of the monitoring well (potentially flowing at/near the interface between the base of the glaciofluvial deposits and surface of underlying less permeable deposits. If this is true, then the groundwater vector may be towards the south-southwest.

The groundwater vectors of the above noted scenarios have been presented in Figure 3 for illustrative purposes.

3.2 Stratigraphic Elevation

While the groundwater elevations at the site will fluctuate with the seasons, at the time of our observations, the groundwater elevations within each of the two wells coincided with;

the base of the glaciolacustrine deposits (in BH 1-14) and,

the upper realms of the morainal (till) deposits (in BH 2-14)

By contrast, the elevation of the groundwater in BH 1-14 in May 2014 (during the Hydrological Assessment) was noted within the till, approximately two (2) meters below the glaciolacustrine/till interface. However, it should be noted that the observations may not have been representative of static groundwater conditions as the observations were made the day following the well installation and so the groundwater regime would have been disturbed by the recent drilling operations.

Between the two monitoring episodes conducted on September 29th and October 3rd, 2014, an increase in the groundwater elevation of 0.41 meters and 0.19 meters in BH 1-14 and BH 2-14, respectively, was noted. This suggests that groundwater elevations may be found at shallower depths during the upcoming winter months.

3.3 Apparent Groundwater Gradient and Vector

While the groundwater gradient and vector are best characterized through the use of three (3) wells that intercept the groundwater table, our observations suggest that one of two apparent groundwater vectors may be present at the site.

If preferential pathways are being utilized (Scenario 1), the apparent groundwater vector would be towards the west-northwest (from BH 1-14 to BH 2-14) at an apparent gradient in the order of 2.7 percent.

If a regional groundwater table is present (Scenario 2), the apparent groundwater vector would be towards the south-southwest at a steeper gradient.

3.4 Recharge Rate

In general, the overall recharge rates in BH 2-14 appear to be slower than those encountered in BH 1-14. However, within the morainal (till) deposits, the recharge rates were fairly consistent between the two well locations (BH 1-14 and BH 2-14). The well recharge rate noted within the till deposit averaged 2.06 meters per 30 minutes (but varied between 1.91 (BH 2-14) and up to 2.17 (BH 1-14)). By comparison, the recharge rate within the glaciolacustrine deposits (in BH 1-14) was considerably lower, averaging in the order of 0.3 meters per 30 minutes. This variation between the recharge rates may suggest that the groundwater flow is concentrated within the upper realms of the till deposits.

3.5 Chemical Analysis

The results of the chemical analyses noted that the levels of total metals and hydrocarbons were below *Generic Numerical Water Standards* (*CSR Schedule 3*) as found in the *Yukon - Environmental Act*. Specifically, the analysis showed that hydrocarbon concentrations were below the laboratory detection limits.

4.0 RECOMMENDATIONS

4.1 Groundwater Observation Frequency

Groundwater monitoring should be conducted on a (minimum) quarterly basis to observe groundwater elevations as seasonal variations in the groundwater regime will occur. A more frequent (monthly) basis would be beneficial such that optimal times for future sampling episodes can be better assessed. Another episode to monitor the groundwater elevations in the upcoming weeks may reveal the presence of groundwater in BH 3-14 as it appeared the groundwater elevations were increasing at the time of our October 3rd sampling episode.

4.2 Groundwater Sampling Frequency

The sampling episode should be conducted on a yearly basis assuming the overall facility conditions remain the same. Unless groundwater is encountered in BH 3-14 at some other time, we recommend that the sampling episode be conducted near the end of September such that the yearly results are more comparable.

To minimize variations between the individual sampling episodes, the wells should be sampled 4 days following well development.

4.3 Phase I Environmental Site Assessment

In addition to the groundwater monitoring, we recommend a Phase I Environmental Site Assessment be conducted to better characterize the history of the site. The information would allow for better evaluation of future groundwater results in the event that hydrocarbon contamination is detected.

5.0 CONCLUSIONS

The groundwater regime at the facility is complex and may be comprised of zones where preferential pathways are being utilized. If preferential pathways are prevalent, the apparent groundwater vector may be towards Fox Point (west-northwest) at a gradient in the order of 2.7 percent. Otherwise, if a regional groundwater table is present, the groundwater vector may have a south-southwestern vector at a steeper gradient.

An increased monitoring frequency will allow for better characterization of the local groundwater regime and may assist in determining whether or not groundwater may be seasonally encountered in the third well (at BH 3-14).

While the installation of additional monitoring wells would increase characterization of the groundwater regime, there is no guarantee that groundwater will be encountered (regardless of conventional auger installation depths) and so this should be carefully considered. In addition, the introduction of additional wells inevitably increases the potential for downward migration if contaminants are present and so this risk should also be considered.

Given the industrial history of the site, if contamination is detected within the wells, it may not necessarily be associated with the Land Treatment Facility and so this should be considered during future assessments. A Phase I Environmental Site Assessment would allow for a more thorough evaluation in the event that contaminants are detected in future monitoring episodes.

6.0 LIMITATIONS

This report is intended for the sole use of *Teslin Tlingit Council*. No portion may be used as a separate entity; it is intended to be read in its entirety. Any use of this letter by a third party is the responsibility of such third party.

Our recommendations are based upon the subsurface conditions encountered at the time of our observations, current sampling techniques and generally accepted engineering practices.

The comments made are based upon the test results obtained at the sample locations and current *CSR* standards.

Due to the geomorphological nature of the deposits encountered, interpolations of subsurface conditions between the boreholes and chemical test results have not been made or implied. Our interpretation of the data within this report may not be sufficient to assess all factors that may have an effect upon site monitoring and so this should be considered.

Should unexpected subsurface or site conditions be encountered during future monitoring episodes, our firm should be notified immediately in order to confirm the suitability of our recommendations and conclusions. If required, our firm may alter or modify our findings and recommendations at such time.

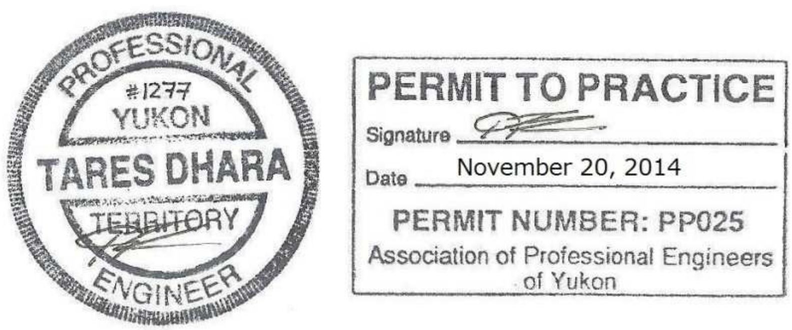
7.0 CLOSURE

Thank you for providing our firm the opportunity to conduct the above noted work.

If you should have any questions or concerns regarding the information contained herein, please feel free to contact the undersigned at your convenience.

Respectfully Submitted,

CHILKOOT GEOLOGICAL ENGINEERS LTD.



Tares Dhara, P.Eng.
Senior Geotechnical Engineer

TD/td

Sawmill Land Treatment Facility, Teslin, Yukon – 2014

FIGURE 1 – Site Location

Based map modified from Google Earth

Compiled September 14, 2013 by T.Dhara

Sawmill Land Treatment Facility - Teslin, Yukon – 2014

FIGURE 2 – Site Features, Well Locations and Surface Drainage

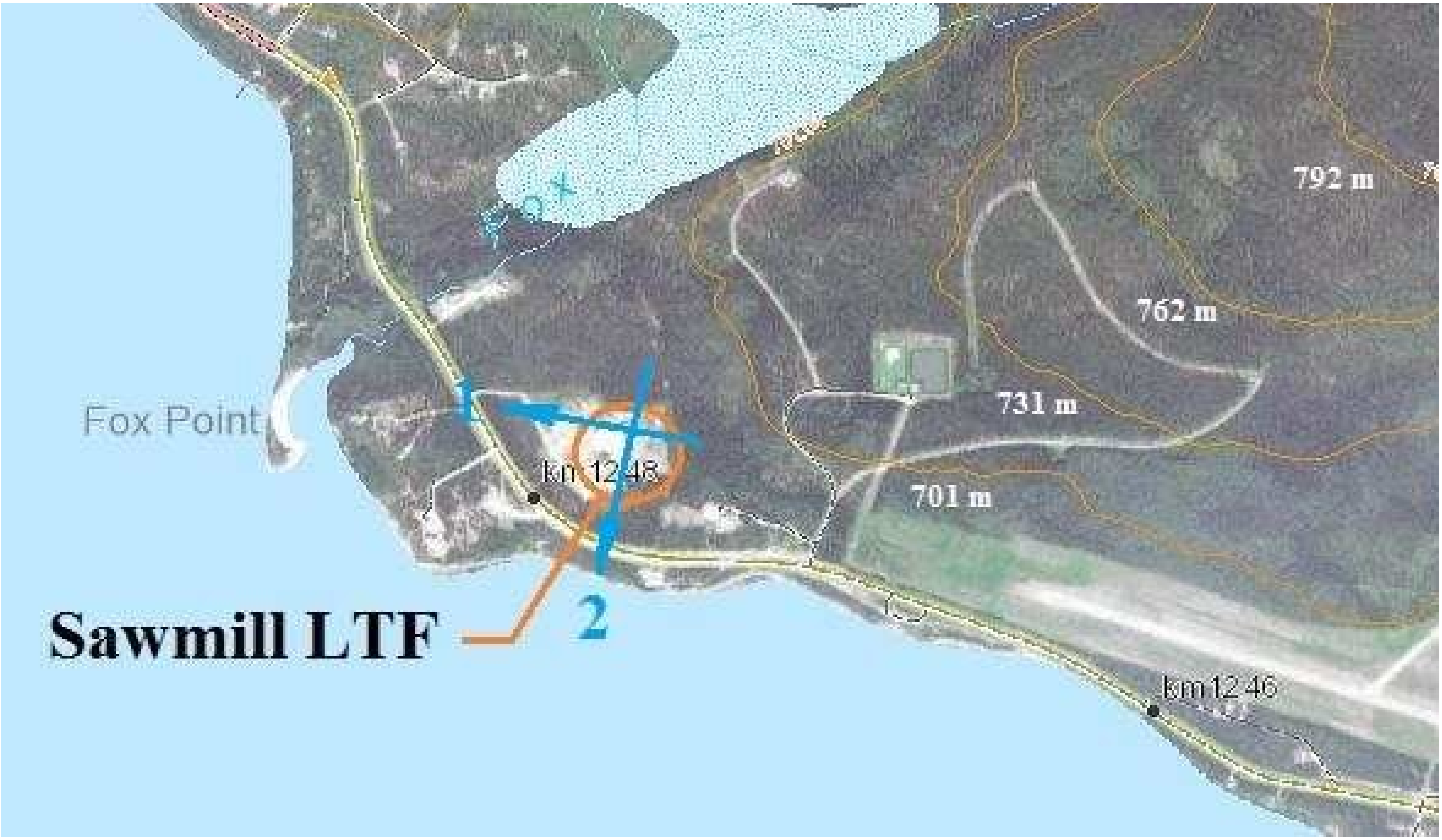
Not to Scale

Compiled Nov.6, 2014 by T.Dhara

CHILKOOT GEOLOGICAL ENGINEERS LTD.

Sawmill Land Treatment Facility - Teslin, Yukon – 2014

FIGURE 3 – Regional Elevations & Potential Groundwater Vectors (Scenarios 1 & 2)



Not to Scale

Compiled Nov.6, 2014 by T.Dhara

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5B Bennett Road, Whitehorse, Yukon

GROUNDWATER MONITORING
SAWMILL LAND TREATMENT FACILITY
TESLIN, YUKON

TABLE I - SUMMARY OF SOIL STRATIGRAPHY

STRATA	Description	BOREHOLE			Average
		BH 1-14	BH 2-14	BH 3-14	
SURFICIAL DEPOSITS	Elevation (m)	101.87	99.23	100.02	100.37
	Thickness (m)	0.70	0.90	0.80	0.80
GLACIOLACUSTRINE DEPOSITS	Elevation (m)	101.17	98.33	99.22	99.57
	Thickness (m)	6.01	5.80	4.38	5.40
SEEPAGE ZONE	Elevation (m)	95.77	93.94	96.22	95.31
	Thickness (m)	0.61	1.41	1.38	1.13
TILL DEPOSITS	Elevation (m)	95.16	92.53	94.84	94.18
	Depth (m)	6.71	6.70	5.18	6.20
	Thickness (m)	5.50	4.26	0.31	3.36
GLACIOFLUVIAL DEPOSITS	Elevation (m)	NA	NA	94.53	94.53
	Thickness (m)	NA	NA	6.70	6.70
GROUNDWATER (Oct 3, 2014)	Elevation (m)	97.78	92.45	NA	95.12
	Depth (m)	4.09	6.78	NA	5.44
GROUNDWATER (Sept 29, 2014)	Elevation (m)	97.37	92.26	NA	94.82
	Depth (m)	4.50	6.97	NA	5.74
GROUNDWATER (May 26, 2014)	Elevation (m)	93.03	NA	NA	93.03
	Depth (m)	8.84	NA	NA	8.84
BOREHOLE TERMINATION	Elevation (m)	89.68	88.27	87.83	88.59
	Depth (m)	12.19	10.97	12.19	11.78

Note - Elevation refers to the top of the deposit or interface.

Prepared by T.Dhara - Nov.3, 2014

CHILKOOT GEOLOGICAL ENGINEERS LTD.

5B Bennett Road, Whitehorse, Yukon

GROUNDWATER MONITORING
SAWMILL LAND TREATMENT FACILITY
TESLIN, YUKON

TABLE II - SUMMARY OF WELL OBSERVATIONS

SUMMARY OF GROUNDWATER OBSERVATIONS - MAY 25, 2014 to OCTOBER 3, 2014

STRATA	Description	BOREHOLE			Average
		BH 1-14	BH 2-14	BH 3-14	
Top of Well Pipe	Elevation (m)	102.83	100.17	100.72	101.24
GROUND SURFACE	Elevation (m)	101.87	99.23	100.02	100.37
Pipe Length Above Ground Surface	Meters (m)	0.96	0.94	0.70	0.87
GROUNDWATER (Oct 3, 2014)	Elevation (m)	97.78	92.45	NA	95.12
	Depth (m)	4.09	6.78	NA	5.44
GROUNDWATER (Sept 29, 2014)	Elevation (m)	97.37	92.26	NA	94.82
	Depth (m)	4.50	6.97	NA	5.74
GROUNDWATER (May 26, 2014)	Elevation (m)	93.03	NA	NA	93.03
	Depth (m)	8.84	NA	NA	8.84
SEEPAGE ZONE (May 25/26, 2014)	Elevation (m)	95.77	93.94	96.22	95.31
	Thickness (m)	0.61	1.41	1.38	1.13
INSTALLED LENGTH OF WELL BELOW OG	Elevation (m)	91.06	89.36	90.12	90.18
	Depth (m)	10.81	9.87	9.90	10.19

SUMMARY OF RECHARGE OBSERVATIONS - SEPTEMBER 29, 2014

DESCRIPTION			BH 1-14	BH 2-14	BH 3-14
MINUTES FOLLOWING PURGING	0	Elevation (m)	91.20	89.60	NA
		Depth (m)	10.67	9.63	NA
		Unflushable (m)	0.14	0.24	NA
		Total Head Increase (m)	0.00	0.00	NA
		meters/last 30 minutes	0.00	0.00	NA
	30	Elevation (m)	93.29	91.51	NA
		Depth (m)	8.58	7.72	NA
		Total Head Increase (m)	2.09	1.91	NA
		meters/last 30 minutes	2.09	1.91	NA
	60	Elevation (m)	95.46	91.77	NA
		Depth (m)	6.41	7.46	NA
		Total Head Increase (m)	4.26	2.17	NA
		meters/last 30 minutes	2.17	0.26	NA
	120	Elevation (m)	96.08	91.93	NA
		Depth (m)	5.79	7.30	NA
		Total Head Increase (m)	4.88	2.33	NA
		meters/last 30 minutes	0.31	0.08	NA

Note - Elevation refers to the top of the deposit or interface.

Prepared by T.Dhara - Nov.5, 2014

APPENDIX A

Results of Chemical Analysis

Groundwater Samples

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Report Transmission Cover Page

Bill To:	Chilkoot Geological Engineering	Project:		Lot ID:	**1031096**
Report To:	Chilkoot Geological Engineering	ID:		Control Number:	
	PO 31146	Name:	Sawmill LTF Cell No.1 - Interim &	Date Received:	Oct 6, 2014
	Whitehorse, YT, Canada	Location:		Date Reported:	Oct 10, 2014
	Y1A 5P7	LSD:		Report Number:	1954764
Attn:	Tares Dhara	P.O.:			
Sampled By:		Acct code:			
Company:	T. Dhara				

Contact & Affiliation	Address	Delivery Commitments
Tares Dhara Chilkoot Geological Engineering	, PO 31146 Whitehorse, Yukon Territory Y1A 5P7 Phone: (867) 667-6671 Fax: (867) 667-6673 Email: chilkoot@northwestel.net	On [Lot Verification] send (COA) by Email - Multiple Reports By Agreement On [Report Approval] send (COC, Test Report) by Email - Merge Reports On [Lot Approval and Final Test Report Approval] send (Invoice) by Email - Multiple Reports By Agreement On [Lot Creation] send (COR) by Email - Multiple Reports By Agreement

Notes To Clients:

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Analytical Report

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Report To:	Chilkoot Geological Engineering	ID:		Control Number:	
	PO 31146	Name:	Sawmill LTF Cell No.1 - Interim &	Date Received:	Oct 6, 2014
	Whitehorse, YT, Canada	Location:		Date Reported:	Oct 10, 2014
	Y1A 5P7	LSD:		Report Number:	1954764
Attn:	Tares Dhara	P.O.:			
Sampled By:		Acct code:			
Company:	T. Dhara				

Analyte		Units	Results	Results	Results	Nominal Detection Limit
		Reference Number	1031096-1	1031096-2		
		Sample Date	Oct 03, 2014	Oct 03, 2014		
		Sample Time	14:00	14:00		
		Sample Location	Chilkoot			
		Sample Description	1-14	2-14		
		Matrix	Water	Water		
Metals Total						
Aluminum	Total	mg/L	0.828	0.876		0.005
Antimony	Total	mg/L	0.0007	0.0003		0.0001
Arsenic	Total	mg/L	0.00116	0.00072		0.00005
Barium	Total	mg/L	0.0318	0.0763		0.00005
Beryllium	Total	mg/L	<0.00005	<0.00005		0.00005
Bismuth	Total	mg/L	<0.0001	<0.0001		0.0001
Boron	Total	mg/L	0.031	0.013		0.002
Cadmium	Total	mg/L	0.00007	0.00005		0.00001
Calcium	Total	mg/L	34.0	37.2		0.05
Chromium	Total	mg/L	0.110	0.0334		0.0005
Cobalt	Total	mg/L	0.0010	0.0011		0.0001
Copper	Total	mg/L	0.0052	0.0035		0.0001
Iron	Total	mg/L	1.32	1.49		0.002
Lead	Total	mg/L	0.0004	0.0004		0.0001
Lithium	Total	mg/L	0.0034	0.0034		0.0005
Magnesium	Total	mg/L	119	52.5		0.04
Manganese	Total	mg/L	0.0805	0.0753		0.001
Molybdenum	Total	mg/L	0.0335	0.0102		0.00005
Nickel	Total	mg/L	0.0096	0.0073		0.0002
Potassium	Total	mg/L	3.2	3.2		0.1
Selenium	Total	mg/L	0.101	0.0035		0.0001
Silicon	Total	mg/L	5.11	5.63		0.02
Silver	Total	mg/L	<0.00005	<0.00005		0.00005
Sodium	Total	mg/L	54.5	5.4		0.1
Strontium	Total	mg/L	0.270	0.414		0.0001
Thallium	Total	mg/L	0.00002	0.00002		0.00001
Thorium	Total	mg/L	0.00016	0.00016		0.00001
Tin	Total	mg/L	0.0004	0.0003		0.0001
Titanium	Total	mg/L	0.0652	0.0712		0.0005
Uranium	Total	mg/L	0.0202	0.00498		0.00001
Vanadium	Total	mg/L	0.0039	0.0030		0.0001
Zinc	Total	mg/L	0.0056	0.0051		0.0005
Zirconium	Total	mg/L	0.0009	0.0005		0.0005
Mono-Aromatic Hydrocarbons - Water						
Benzene		ug/L	<1	<1		1
Ethylbenzene		ug/L	<1	<1		1

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	Whitehorse, YT, Canada	Location:		Date Reported:	Oct 10, 2014
	Y1A 5P7	LSD:		Report Number:	1954764
Attn:	Tares Dhara	P.O.:			
Sampled By:		Acct code:			
Company:	T. Dhara				

		Reference Number	1031096-1	1031096-2		
		Sample Date	Oct 03, 2014	Oct 03, 2014		
		Sample Time	14:00	14:00		
		Sample Location	Chilkoot			
		Sample Description	1-14	2-14		
		Matrix	Water	Water		
Analyte		**Units**	**Results**	**Results**	**Results**	Nominal Detection Limit
Mono-Aromatic Hydrocarbons - Water - Continued						
Methyl t-Butyl Ether		ug/L	<1	<1		1
Styrene		ug/L	<1	<1		1
Toluene		ug/L	<1	<1		1
Total Xylenes (m,p,o)		ug/L	<1	<1		1
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	%	86	83		50-130
p-Terphenyl-d14	PAH - Surrogate	%	112	109		60-130
Naphthalene-d8	PAH - Surrogate	%	114	111		50-130
Quinoline-d7	PAH - Surrogate	%	95	89		50-130

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	Y1A 5P7	LSD:		Report Number:	1954764
Attn:	Tares Dhara	P.O.:			
Sampled By:		Acct code:			
Company:	T. Dhara				

		Reference Number	1031096-3	1031096-4	1031096-5	
		Sample Date	Oct 03, 2014	Oct 03, 2014	Oct 03, 2014	
		Sample Time	NA	NA	NA	
		Sample Location				
		Sample Description	Chilkoot 1	Chilkoot 2	Chilkoot 3	
		Matrix	Soil	Soil	Soil	
Analyte		**Units**	**Results**	**Results**	**Results**	Nominal Detection Limit
Extractable Petroleum Hydrocarbons - Soil						
EPHs10-19	Dry Weight	ug/g	4060	2560	1610	20
EPHs19-32	Dry Weight	ug/g	46	26	22	20
Soil % Moisture						
Moisture	Soil % Moisture	%	13.60	12.60	12.00	0.1

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	Whitehorse, YT, Canada	Location:		Date Reported:	Oct 10, 2014
	Y1A 5P7	LSD:		Report Number:	1954764
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Sampled By:		Acct code:			
Company:	T. Dhara				

Reference Number	1031096-6
Sample Date	Oct 03, 2014
Sample Time	NA
Sample Location	
Sample Description	Chilkoot 4
Matrix	Soil

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Extractable Petroleum Hydrocarbons - Soil						
EPHs10-19	Dry Weight	ug/g	1210			20
EPHs19-32	Dry Weight	ug/g	<20			20
Soil % Moisture						
Moisture	Soil % Moisture	%	11.00			0.1

Approved by:

Mathieu Simoneau
Operations Manager

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Methodology and Notes

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	PO 31146	Name:	Sawmill LTF Cell No.1 - Interim &	Date Received:	Oct 6, 2014
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	Y1A 5P7	LSD:		Report Number:	1954764
Attn:	Tares Dhara	P.O.:			
Sampled By:		Acct code:			
Company:	T. Dhara				

Method of Analysis

Method Name	Reference		Method	Date Analysis Started	Location
BC ICP-MS Total Metals in Water	US EPA	*	Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	07-Oct-14	Exova Edmonton
BC Trace Total Metals in Water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	07-Oct-14	Exova Edmonton
BTEX-VPH - Water (MS)	BCELM	*	Volatile Hydrocarbons in Water by GC/FID, VH Water	09-Oct-14	Exova Surrey
EPH - Soil	BCELM	*	Extractable Petroleum Hydrocarbons (EPH) in Solids by GC/FID, EPH Solids	07-Oct-14	Exova Surrey
EPH - Water	BCELM	*	Extractable Petroleum Hydrocarbons (EPH) in Water by GC/FID, EPH Water	07-Oct-14	Exova Surrey
PAH - Water (Surrey)	BCELM	*	Polycyclic Aromatic Hydrocarbons in Water by GC/MS - PBM, PAH Water	09-Oct-14	Exova Surrey

** Reference Method Modified*

References

BCELM	B.C. Environmental Laboratory Manual
B.C.M.O.E	B.C. Ministry of Environment

Comments:

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Hydrocarbon Chromatogram

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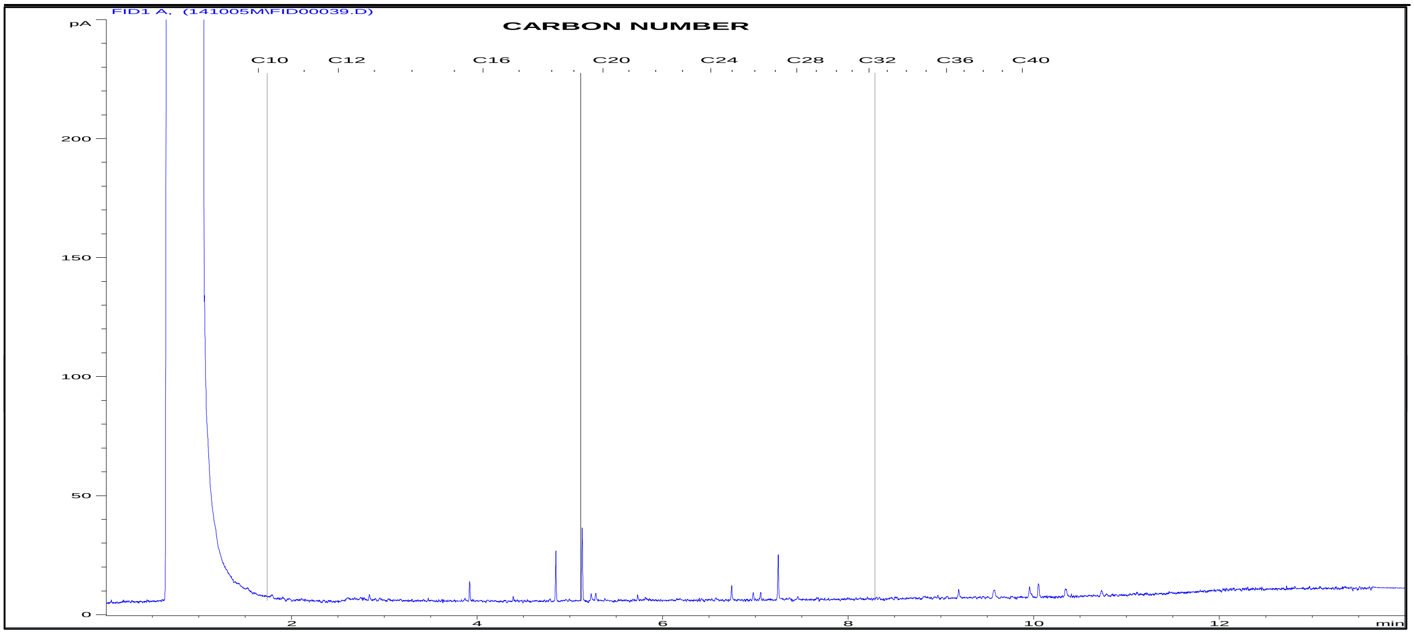
Report To:	Chilkoot Geological Engineering	Name:	Sawmill LTF Cell No.1 - Interim & Well S	Control Number:	
	PO 31146	Location:		Date Received:	Oct 6, 2014
		LSD:		Date Reported:	Oct 9, 2014
	Whitehorse, YT, Canada	P.O.:		Report Number:	1954764
	Y1A 5P7				
Attn:	Tares Dhara				
Sampled by:					
Company:	T. Dhara				

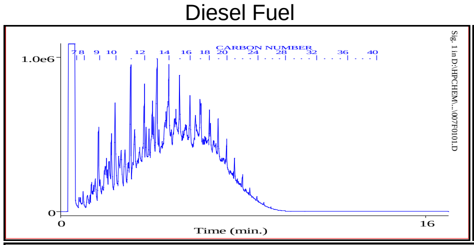
Exova Number: 1031096-1
Sample Date: Oct 3, 2014

Sample Description: 1-14

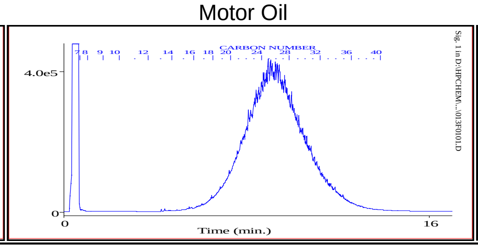


TYPICAL PRODUCT CHROMATOGRAMS

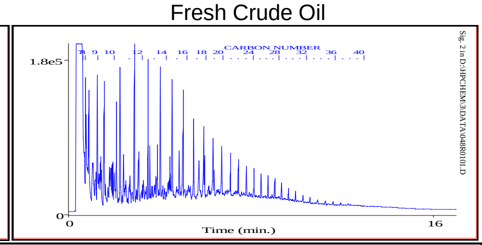
Diesel Fuel



Motor Oil



Fresh Crude Oil



Product Carbon Number Ranges

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

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Hydrocarbon Chromatogram

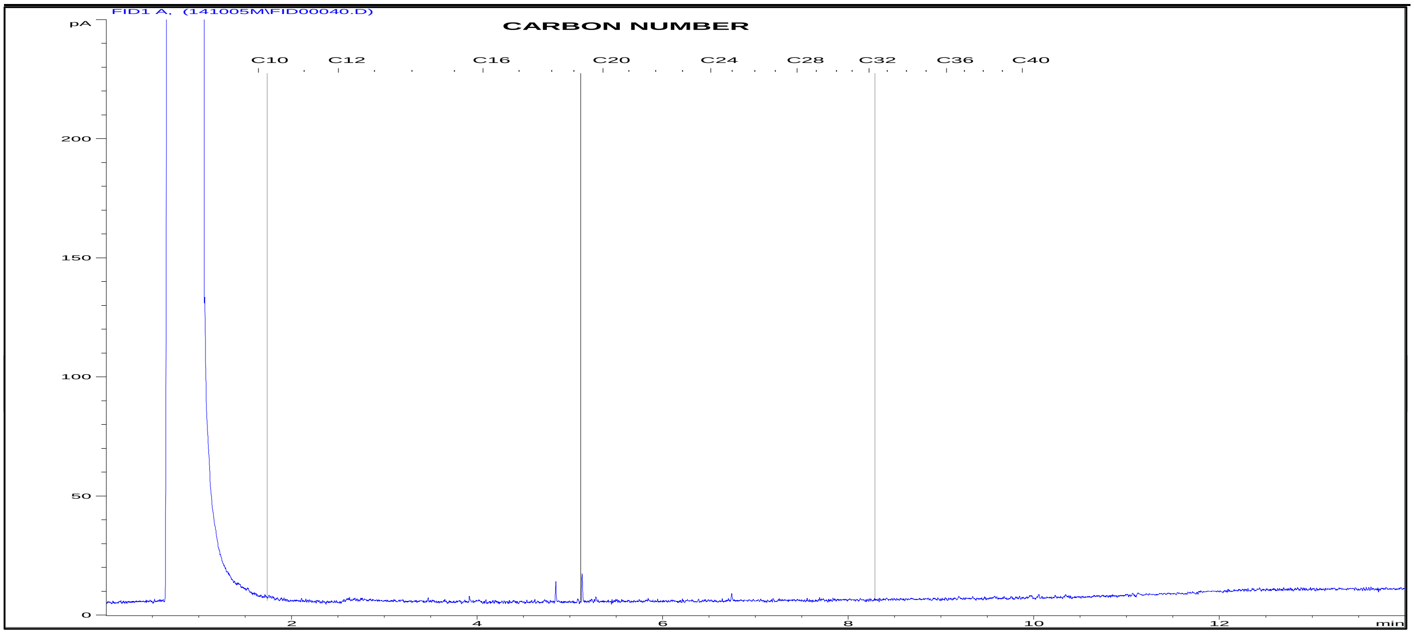
Bill To: Chilkoot Geological Engineering
Report To: Chilkoot Geological Engineering
PO 31146

Whitehorse, YT, Canada
Y1A 5P7
Attn: Tares Dhara
Sampled by:
Company:

Project ID:
Name: Sawmill LTF Cell No.1 - Interim & Well S
Location:
LSD:
P.O.:

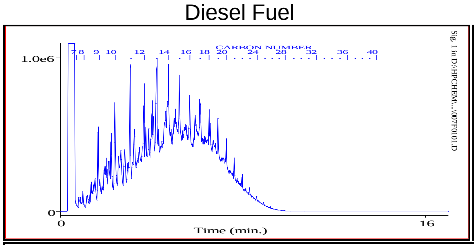
Lot ID: **1031096**
Control Number:
Date Received: Oct 6, 2014
Date Reported: Oct 9, 2014
Report Number: 1954764

Exova Number: 1031096-2
Sample Date: Oct 3, 2014
Sample Description: 2-14

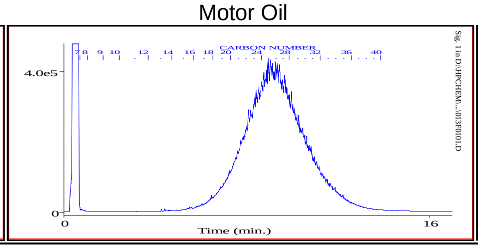


TYPICAL PRODUCT CHROMATOGRAMS

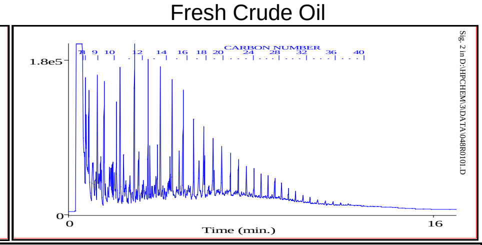
Diesel Fuel



Motor Oil



Fresh Crude Oil



Product Carbon Number Ranges

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

Exova
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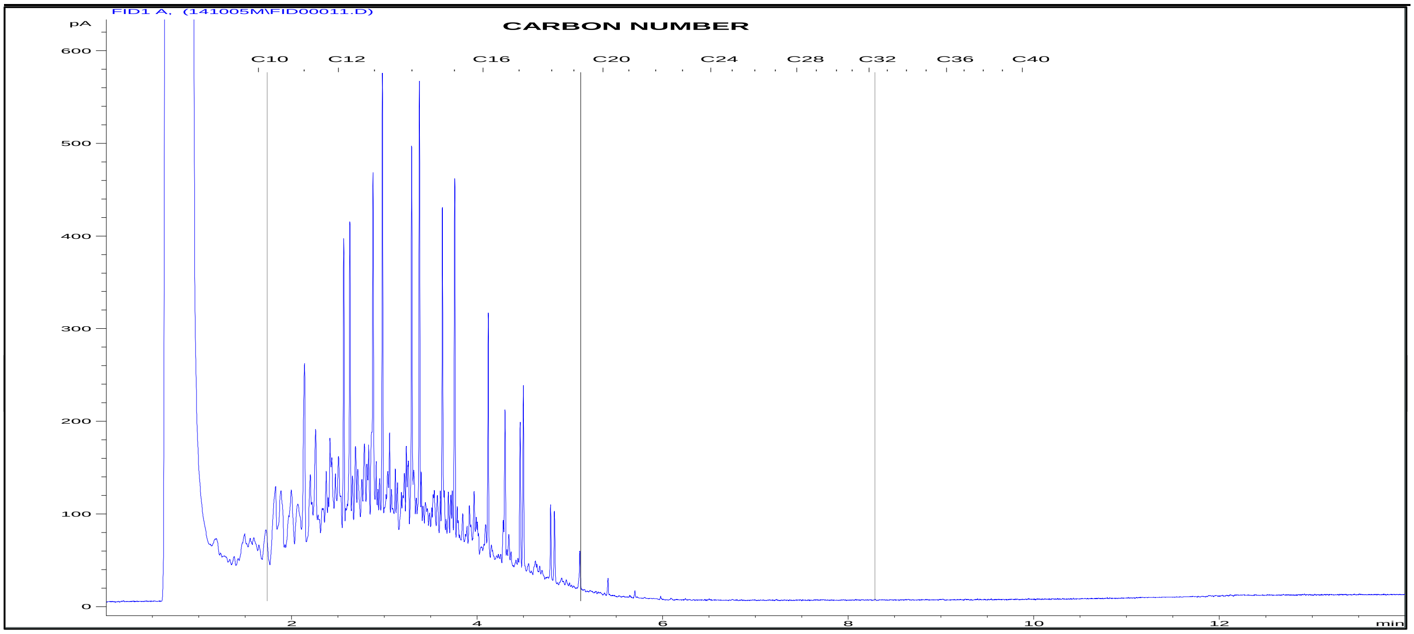
F: +1 (604) 514-3323
E: Surrey@exova.com
W: www.exova.com

Hydrocarbon Chromatogram

Bill To:	Chilkoot Geological Engineering	Project ID:		Lot ID:	**1031096**
Report To:	Chilkoot Geological Engineering	Name:	Sawmill LTF Cell No.1 - Interim & Well S	Control Number:	
	PO 31146	Location:		Date Received:	Oct 6, 2014
		LSD:		Date Reported:	Oct 9, 2014
	Whitehorse, YT, Canada	P.O.:		Report Number:	1954764
	Y1A 5P7				
Attn:	Tares Dhara				
Sampled by:					
Company:					

Exova Number: 1031096-3　　Sample Description: Chilkoot 1
Sample Date: Oct 3, 2014



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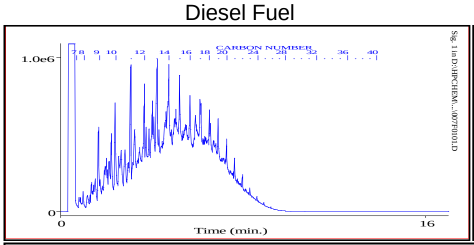

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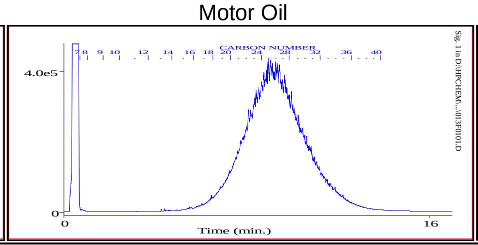

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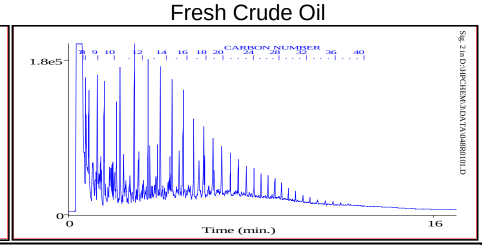

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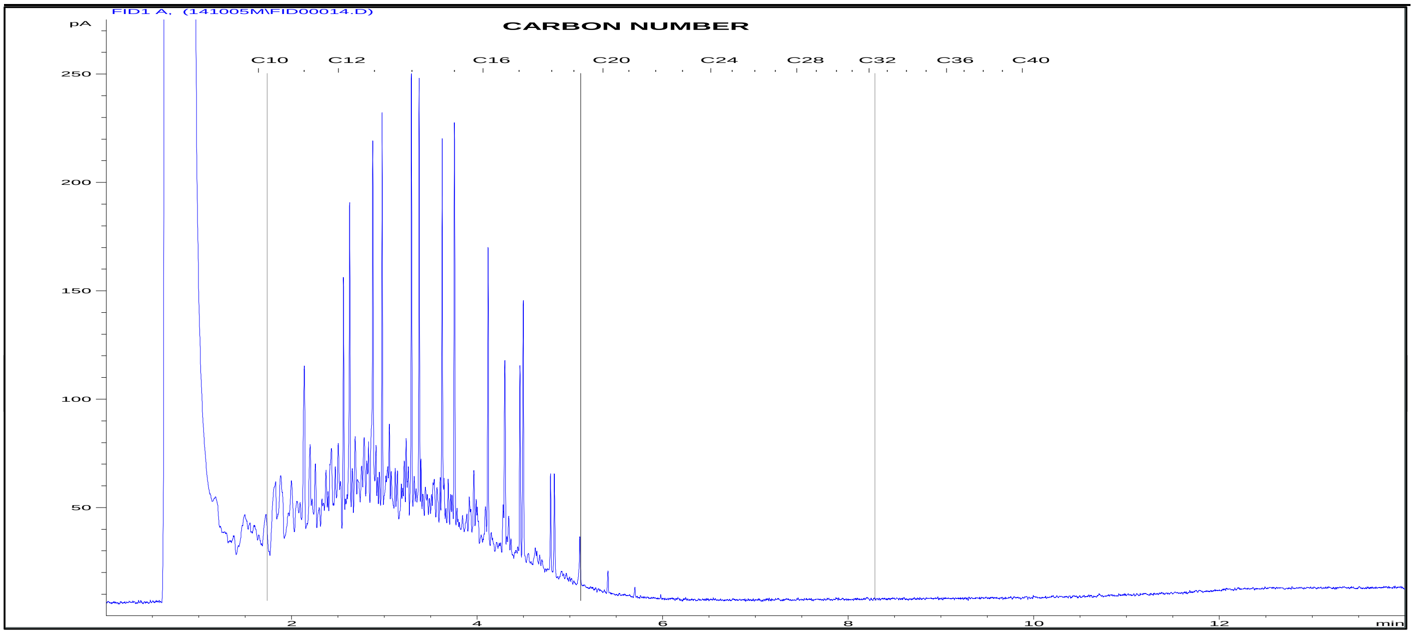
	PO 31146	Location:		Date Received:	Oct 6, 2014
		LSD:		Date Reported:	Oct 9, 2014
	Whitehorse, YT, Canada	P.O.:		Report Number:	1954764
	Y1A 5P7				
Attn:	Tares Dhara				
Sampled by:					
Company:					

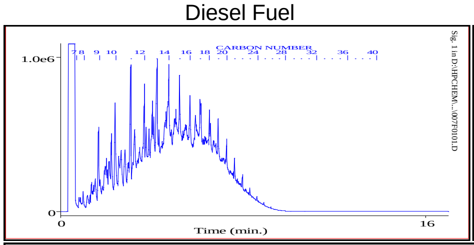
Exova Number: 1031096-6
Sample Date: Oct 3, 2014

Sample Description: Chilkoot 4



TYPICAL PRODUCT CHROMATOGRAMS

Diesel Fuel



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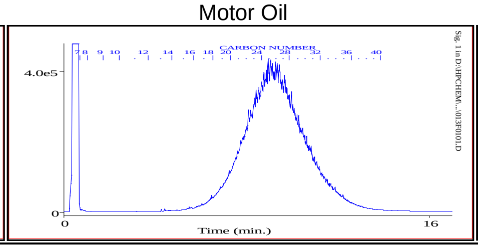

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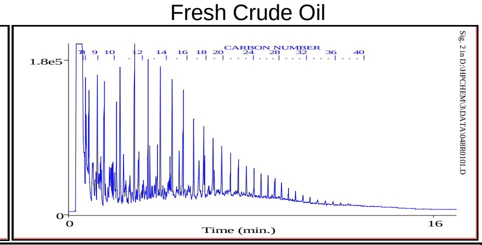

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Hydrocarbon Chromatogram

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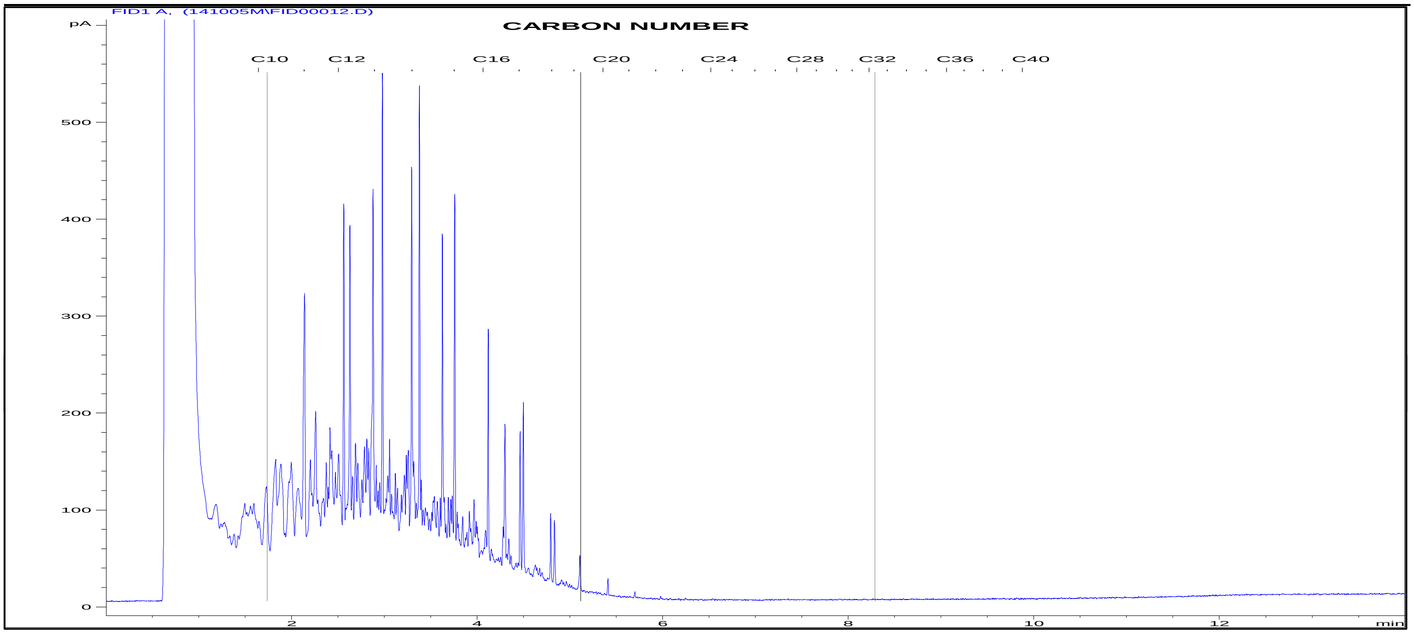
Report To:	Chilkoot Geological Engineering	Name:	Sawmill LTF Cell No.1 - Interim & Well S	Control Number:	
	PO 31146	Location:		Date Received:	Oct 6, 2014
		LSD:		Date Reported:	Oct 9, 2014
	Whitehorse, YT, Canada	P.O.:		Report Number:	1954764
	Y1A 5P7				
Attn:	Tares Dhara				
Sampled by:					
Company:					

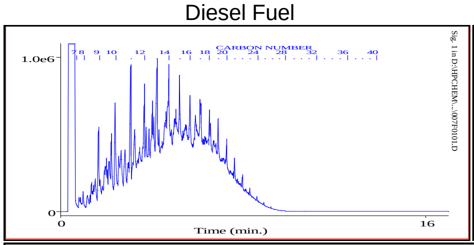
Exova Number: 1031096-4
Sample Date: Oct 3, 2014

Sample Description: Chilkoot 2

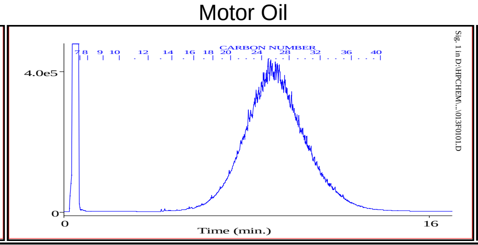


TYPICAL PRODUCT CHROMATOGRAMS

Diesel Fuel



Motor Oil



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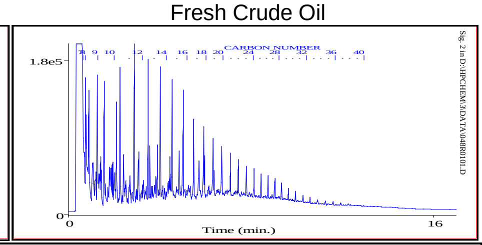

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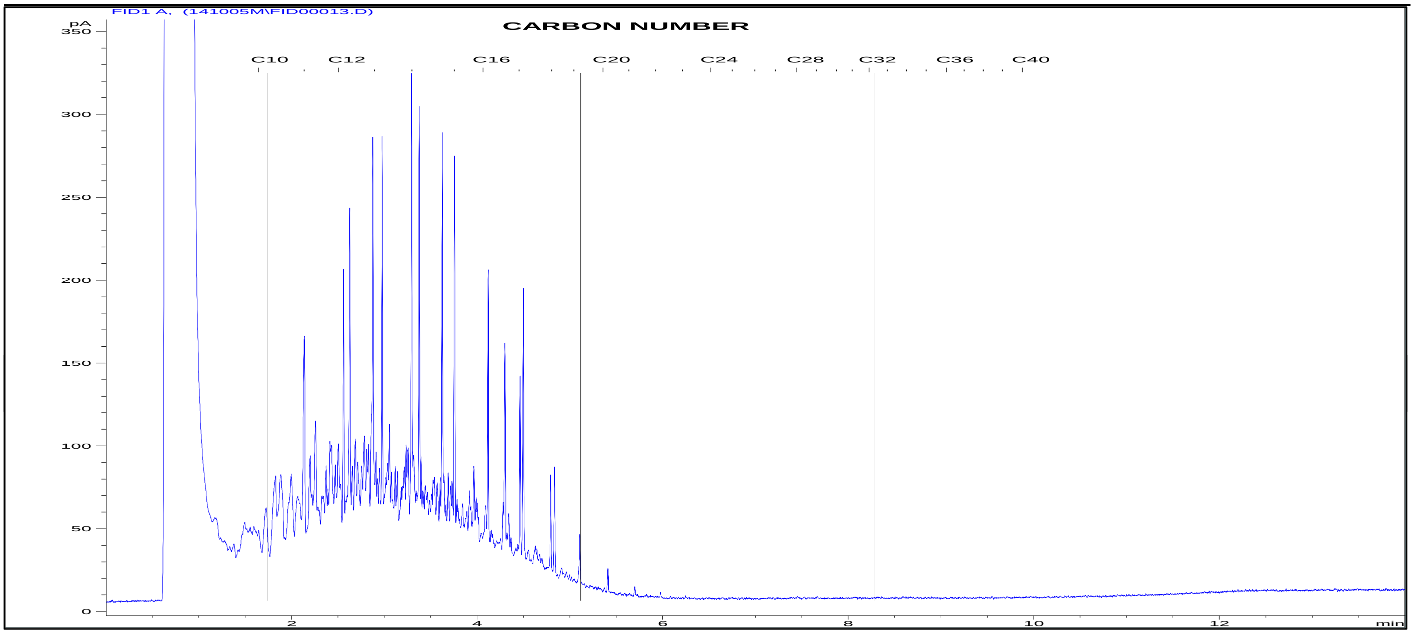
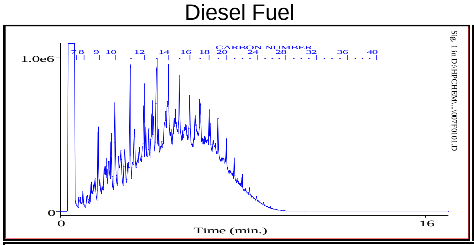
Bill To:	Chilkoot Geological Engineering	Project ID:		Lot ID:	**1031096**
Report To:	Chilkoot Geological Engineering	Name:	Sawmill LTF Cell No.1 - Interim & Well S	Control Number:	
	PO 31146	Location:		Date Received:	Oct 6, 2014
		LSD:		Date Reported:	Oct 9, 2014
	Whitehorse, YT, Canada	P.O.:		Report Number:	1954764
	Y1A 5P7				
Attn:	Tares Dhara				
Sampled by:					
Company:					

Exova Number: 1031096-5 Sample Description: Chilkoot 3
Sample Date: Oct 3, 2014

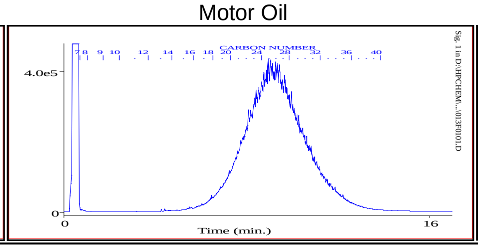


TYPICAL PRODUCT CHROMATOGRAMS

Diesel Fuel



Motor Oil



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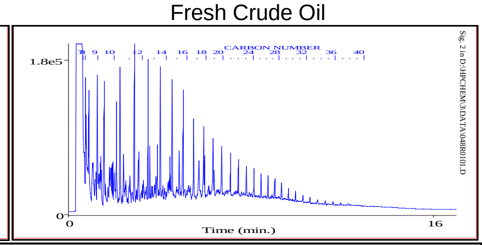

Product Carbon Number Ranges

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Varsol	C8-C12	Diesel	C8-C22	Crude Oils	C3-C60+

LOT: 1031096 COC

Project Name:	Sawmill LTF Cell No.1 – Int[illegible] & Well Sampling
Location:	Teslin, Yukon
Sample Date:	Sept. 30, 2014
Sampled By:	Chilkoot – T.Dhara

Please confirm analysis w/ Donna

Testing Required:	CTEH 4 -	(2 Samples)
	TW24EW	(2 Samples)
	CTEH 5 -	(4 Samples)

RECEIVED
OCT 06 2014
10.7°C

Contact:	Tares Dhara, P.Eng.
	(867) 335-2085 cell

1-14
2-14
Chilkoot 1
Chilkoot ~~1~~ 2
" 3
" 4

APPENDIX B

Standard Operating Procedure

Groundwater Sampling Program

STANDARD OPERATING PROCEDURES

SAWMILL LTF

GROUNDWATER SAMPLING PROGRAM

Step 1 – General Observations (Three Monitoring Wells)

Record the general conditions of the individual wells.
Record the overall site and weather conditions (ie – presence of standing water, snow, etc.)
Record your name, date and time of observations.

Step 2 - Groundwater Measurements

Survey the top of the individual wells (white plastic 2” pipe) relative to south-west corner of the central concrete slab - the elevation of which is 100.00 meters.
Measure the depth from the top of the well to the groundwater in each well. Record the measurement in meters – eg 4.36 meters.

The equipment utilized to measure the depth to the groundwater should be rinsed with distilled water between individual wells to prevent cross-contamination.

Step 3 – Well Development

Withdraw groundwater from each well for a period of 30 minutes utilizing hand bailers – (approximately 40 bails)
Record start and stop time of individual well flushing.

(utilize a new bailer and string line for each well to prevent cross-contamination).
(if contamination is suspected, then place bailed water in a 45 gallon drum to allow for proper disposal following sampling/chemical analysis).

Step 4 – Measure Recharge Rates

Following well development - measure and record the depth to groundwater from the top of the well;
immediately following flushing of each well,
every 30 minutes for a period of 2 hours, and
24 hours following flushing.

(if recharge rate is high, then measure depth and elapsed time at an increased frequency sufficient to determine approximate recharge rate).

Step 5 – Retain Groundwater Samples (4 days following well development)

Lable the vials and bottles (Project Description, Well Number and Date).

Measure and record the depth to the groundwater in each of the wells.

Retain groundwater samples from each well utilizing a separate bailer and string line for each well.

For each well, fill;
3 glass vials for *BTEX Sample,*
1 liter glass bottle – *Hydrocarbon Sample,* and
250 ml plastic bottle – *Metals Sample*

Measure and record the air and (hydrocarbon) sample temperatures.

Step 6 – Package and Ship Samples

Place samples in a cooler with frozen chill packs.
Ship the cooler express to the designated analytical lab OR

To : EXOVA Labs
Attn: Donna Scruggs
\# 104 – 19575-55A Avenue
Surrey, B.C. V3S 8P8

1-800 889-1433 toll cell
(604) 514-3322 ph.

— Appendix C —

Additional Well Installation, Sawmill Land Treatment Facility, Teslin, Yukon - 2015
Prepared by Chilkoot Geological Engineers Ltd, November 2015

CHILKOOT GEOLOGICAL ENGINEERS LTD.
5b Bennett Road, Whitehorse, Yukon Y1A 5Z4
chilkoot@northwestel.net (867) 335-5804 c

Additional Well Installation
Sawmill Land Treatment Facility
Teslin, Yukon – 2015

Prepared For: **Déslin Development Corporation**

Date : **November 29, 2015**

TABLE OF CONTENTS

Additional Well Installation

Sawmill Land Treatment Facility

Teslin, Yukon – 2015

APPENDICES

1.0 INTRODUCTION

Chilkoot Geological Engineers Ltd. was retained by the *Déslin Development Corporation (DDC)* to install an additional well at the Sawmill Land Treatment Facility (LTF) located in Teslin, Yukon.

The purpose of the work was to install a well to a depth of 13 meters in order to allow for additional characterization of the sub-surface regime. Specifically, the intent was to fulfill *Yukon Government (YG) Department of Environment* request that Section 3.14 of the *DDC* Land Treatment Facility Permit (#24-040) be fulfilled. In brief, Section 3.14 of the permit requires the Hydrological Assessment be revised in order to;

- determine the direction and rate of groundwater flow,
- identify potential receiving environments,
- assess travel times for potential contaminant pathways,
- ensure interpretations are based upon a minimum of one well located up-gradient and two wells down-gradient of the facility and are installed in such a manner so as to allow for monitoring of groundwater for contamination.

The facility is currently comprised of two containment cells (No.1 and No.2) which have (hydrocarbon impacted) soil capacities in the order of 3,000 m^3 and 5,000 m^3, respectively. The location of the facility has been denoted in Figure 1.

Authorization to proceed with the work was granted on September 15th, 2015 by Mr.Brad Stoneman, *DDC* – Project Manager. The drilling component of the field work was conducted on October 7th and 8th, 2015. All work was conducted in accordance with our August 17th, 2015 proposal.

A detailed description of our methodology and findings has been provided herein to supplement (and supersede) our June 25th, 2014 Hydrological Assessment and our November 20th, 2014 Groundwater Sampling Report.

2.0 METHODOLOGY

Our methodology was comprised of the following components;

2.1 Literature Review

The June 25th, 2014 Hydrological Assessment and November 20th, 2014 Groundwater Sampling Report were reviewed prior to the field work program to re-familiarize ourselves with the regional soil and groundwater conditions.

2.2 Field Work Program

The field work program was comprised of a site reconnaissance, sub-surface utility locates and drilling program.

Site Reconnaissance

A site reconnaissance was conducted by the undersigned and the *DDC* Project Manager on October 6th, 2015 to assess the potential well location. In brief, the well was situated on the south-west corner of the newly defined *DDC* limits of the Sawmill property to accommodate anticipated facility operations and future LTF expansions.

Sub-surface Utility Locates

Sub-surface utilities were located prior to drilling by contacting *Northwestel* and *Yukon Electric Company Ltd.,* personnel in order to verify that the proposed borehole location was clear of potential underground hazards. In general, there were no subsurface utilities located in the region near where the borehole was advanced. The exception to this was an underground electrical line which was located between a power pole and the some of the sawmill components located west of the LTF region.

Drilling Program

The drilling program was conducted under *Chilkoot* supervision on October 7th and October 8th, 2015 by *Donjek Drilling* utilizing a CME-750 drill mounted on an FN-60 Nodwell. The program was comprised of advancing a single borehole utilizing 150 mm Ø solid-stem continuous flight augers in order to obtain soil samples and characterize the subsurface conditions to a depth of ~ 15 meters. The borehole was advanced at the approximate location noted on Figure 2. Of note, the borehole was initially advanced 1.5 meters west of the location, however, as auger refusal was encountered at a depth of ~ 2.2 meters within fill materials, the borehole was re-situated.

Soil Log

During the borehole drilling, a field soil log was maintained by the undersigned to record the soil stratigraphy. This information was utilized to compile the Soil Log which has been enclosed in Appendix A.

The soil log was compiled utilizing a combination of field notes, visual observations and results of laboratory analysis. These observations were supplemented by utilizing a *Humboldt Manufacturing Ltd*. pocket penetrometer which was utilized on cohesive (fine-grained) soils to provide relative estimates (in kg/cm^2) of the materials unconfined compressive strength. The pocket penetrometer test results have been noted on the borehole soil log. An outline of the *USCS* soil classification system that was utilized has also been included.

Borehole Survey

Following completion of the drilling, the elevation of the borehole was surveyed relative to the top of a concrete slab located at the center of the facility utilizing a (*Leica LR Rugby*) laser level. The top of the concrete slab was given an arbitrary elevation of 100.00 meters.

The elevation of the borehole has been noted on the soil log attached in Appendix A. The location of the borehole was plotted on Figure 2 relative to prominent site features.

Sampling Program

During the drilling, a total of seventeen (17) soil grab samples were retained at regular (~ 1 meter) intervals, to allow for subsequent laboratory analysis. Once retained, the samples were described on the field soil log by the undersigned. The samples were subsequently sealed in air-tight plastic bags and numbered consecutively in order to allow for laboratory analysis at our Whitehorse laboratory facilities as described in Section 2.3, below.

Monitoring Well Installation

A monitoring well was installed at the borehole location (BH 1-15) as noted in Figure 2, to a depth of 13.28 meters below the existing ground surface (mbgs).

The monitoring well was comprised of solid 2" diameter ABS pipe overlying screened 2" diameter ABS pipe. The screened portions of the pipe were covered with a 'silt sock' to increase the overall longevity of the well. The annular space (between the well pipe and the native soils) was backfilled with silica sand to a level which measured ~ 1.1 meters above the joint between the solid and screened sections of pipe (elevation 92.78 meters). A 300 mm thick layer of bentonite pellets was subsequently placed at this elevation to serve as a seal. Above this, select auger cuttings were placed until within 0.5 meters of the glaciofluvial and fill interface. A second (1.0 meter thick) bentonite plug was established at this elevation. Select auger cuttings were subsequently placed until within 0.6 meters of the ground surface where a final bentonite seal and concrete plug was established to install a lockable steel casing.

The lengths of the solid and screened portions of the individual wells varied as follows;

Well	***Solid Length (m)***	***Screened Length (m)***	***Total Length (m)***	***Installed length below ground surface (m)***	***Ground Surface Elevation (m)***	***Top of pipe Elevation (m)***	***Base Elevation of Well (m)***
BH 1-15	9.54	4.57	14.11	13.28	100.40	101.23	87.12
BH 1-14	5.67	6.10	11.77	10.81	101.87	102.83	91.06
BH 2-14	6.24	4.57	10.81	9.87	99.24	100.17	89.36
BH 3-14	2.42	6.10	10.60	9.90	100.02	100.72	90.12

Borehole Termination

Excluding the initial auger refusal, there were two episodes where the borehole was terminated. The first episode occurred at the end of the day on October 7th. The borehole was initially advanced to 10.67 mbgs and the augers were withdrawn. Upon initiating drilling operations on October 8th, a measurement of the borehole depth revealed that it had collapsed to 9.60 mbgs. Approximately 15 centimeters of groundwater was noted in the base of the borehole at this time.

Drilling operations resumed following the initial October 8th measurements in order to attain the targeted well installation depth of ~ 13 mbgs. Following completion of the drilling, the borehole was terminated at a depth of 14.94 mbgs. During auger withdrawal, the augers removed from between ~ 7.6 mbgs and 10.7 mbgs (elevation 92.8 to 89.7 meters) were coated in saturated grey sandy silts to silty sands (see Appendix B – Photo). Upon completion of auger withdrawal, the borehole was left open for approximately 10 minutes in order to assess the sidewall stability and potential seepage over the course of time. While there was no observable amount of groundwater seepage the borehole collapsed to a depth of 13.38 mbgs.

The borehole locations noted borehole collapse as follows;

Borehole	***Depth of Termination (m)***	***Depth of Collapse (m)***	***Collapsed Material Thickness (m)***
BH 1-15	14.94	13.38	1.56
BH 1-14	12.19	10.97	1.22
BH 2-14	10.97	7.10	3.87
BH 3-14	12.19	9.50	2.69

Photographs

Photographs of the field work, soil samples and site conditions were maintained to document the work. A selection of these photos has been provided in Appendix B.

Groundwater Sampling Program

As the monitoring well was noted to be dry upon completion and subsequent (November 3rd, 2015) monitoring episode, a groundwater sample was not retained.

2.3 Laboratory Work Program

A laboratory work program was conducted at our Whitehorse laboratory in order to characterize the index properties and conditions of the retained soil samples. The analysis was conducted between October 10th and 11th and was comprised of the following analysis;

Description	***ASTM Analysis***	***Quantity***	***Laboratory***
Moisture Content	D 2216-92	17	*Chilkoot Engineers*
Grain Size Distribution	D 422-633	4	*Chilkoot Engineers*

The results of the moisture analysis have been denoted as 'MC' (⦿ - Symbol) on the 'Laboratory Results' column on the Soil Logs enclosed in Appendix A.

The Grain Size Distribution Analysis was conducted in order to assist in soil classification utilizing the *Unified Soils Classification System*. The results of the analysis have been summarized on the Soil Logs with the percent composition of fines (silt & clay), sand and gravel denoted on the Soil Logs with the symbols - ▲, ● & ■, respectively.

3.0 SITE CONDITIONS

3.1 Site Description

With the exception of a newly constructed Land Treatment Unit (Cell No.2), the conditions at the site were unchanged from those described in our June 25th, 2014 Hydrological Assessment. Of note, the well was installed ~ 50 meters north-east of an area which is currently being utilized to store (salvaged and abandoned) above ground storage tanks which were once utilized for home heating purposes.

3.2 Geomorphic Setting

The *Surficial Geology of Teslin, Yukon Territory* (*Map 1891A*) suggests that the soils in the region of the proposed facility are dominated by a morainal blanket which is comprised of lodgment and ablation (glacial) till that measure up to 30 meters thick.

3.3 Subsurface Conditions

A detailed description of the soil stratigraphy which was encountered has been provided on the Soil Log attached in Appendix A. A summary of the stratigraphy relative to the boreholes advanced in 2014 has been attached as Table I.

Soil Stratigraphy

While in general, similar types of soils were encountered in BH 1-15 relative to the three boreholes advanced in 2014, there were some variations with respect to the overall sequence of deposition. Specifically, the boreholes advanced in 2014 each encountered a thin (0.8 meter thick) veneer of surficial (organic and silty sand) deposits which were underlain by glaciolacustrine and morainal (till) deposits. While BH 1-14 and BH 2-14 were terminated within the till, this deposit was underlain by stratified glaciofluvial deposits at BH 3-14. By contrast, BH 1-15 encountered ~ 2.44

meters of fill which overlay a 3.35 meter thick layer of stratified glaciofluvial deposits. The morainal (till) deposits were encountered below the glaciofluvial deposits to the depth of borehole termination (14.94 mbgs).

Fill

The fill was comprised of predominately silty sands to sandy silts which contained varying amounts of gravel, wood chips and sawdust. The fill also contains rubble as refusal was initially encountered during auger advancement at a depth of ~ 2.2 meters (prior to relocation of the borehole).

Glaciofluvial Deposit

The glaciofluvial deposits were comprised of stratified silty sand which contained the odd piece of gravel (in size to 30 mm) and clump of silt (in size to 4 mm). Although the average moisture content of 5.9 % was similar to the 4.6 % average encountered in BH 3-14, an increased moisture content of 8.2 % (indicating moist to wet conditions) was noted in sample No.8 (elevation of 94.91 - 5.49 mbgs).

Morainal (Till) Deposit

The morainal (till) deposit was encountered below the glaciofluvial deposits at an elevation of 94.61 meters (5.79 mbgs). This elevation (and depth) is similar to BH 1-14 and BH 3-14 where the till was encountered at an average elevation of 95.0 meters (5.95 mbgs). By contrast, the till was encountered at and elevation of 92.53 meters (6.70 mbgs) at BH 2-14.

Based upon the results of three (3) grain size distribution analysis conducted on the till, the composition of the material ranged from sandy gravel with some silt to silty sand which contained varying amounts of gravel. The gravel was generally fractured and measured < 30 mm in size.

A trace of oxidation was noted within the upper realms of the till to a depth of ~ 10.3 meters (elevation 90.1 meters). The material was noted to be slightly plastic (indicated the presence of a trace to some clay) at a depth of ~ 10.36 meters (elevation 90.04 meters) where easier drilling was noted. A moist to wet silty sand was encountered at a depth of ~ 12.9 meters (elevation 87.5 meters) to the depth of borehole termination.

The average moisture content of the till was 7.9 % (but ranged between 5.5 % and 15.5 %). This average value is similar to the 7.7 % average noted in the 2014 samples.

As with all tills, the deposit may also contain cobbles and possibly boulder sized materials as was evidenced by grindy drilling near the depth of borehole termination.

Further descriptions of the surficial, glaciolacustrine and till deposits can be found in the June 25th, 2014 Hydrological Assessment.

Groundwater

With the exception of the groundwater which was noted within the borehole on the morning of October 8th, 2015 free groundwater was not encountered. The 15 cm of groundwater encountered in the borehole the morning of October 8th is likely due to seepage which originated near the interface between the glaciofluvial and till deposits (elevation 94.61 meters - 5.79 mbgs).

As the remainder of the wells (BH 1-14 to BH 3-14) were sampled by another consultant (*ERM*) in the days preceding our well installation, it was not possible to retain representative measurements of the groundwater levels in these wells. However, their October 5th, 2015 measurements were forwarded to us through the *DDC* Project Manager. Our firm subsequently measured the groundwater elevations in all four monitoring wells on Nov.3, 2015. In brief, only BH 1-14 was noted to have groundwater within the well. These observations (along with those from previous monitoring episodes) have been summarized in Table II.

Permafrost

There was no evidence of permanently frozen soils in any of the boreholes which were advanced.

Bedrock

Although the till deposits contained trace amounts of fractured rock, there was no indication of bedrock in any of the boreholes that were advanced.

4.0 DISCUSSIONS

Groundwater Regime

The groundwater regime at the facility is complex. The underlying soils are comprised of a series of predominately impermeable soil units where groundwater flows through preferential pathways, of which, some may be perched or else confined. The presence of glaciofluvial deposits [which either overlie (BH 1-15) or underlie (BH 3-14) these impermeable deposits] further compounds the complexity of the regime.

Although free groundwater was not encountered in the newly installed monitoring well during our observations, the sub-surface conditions suggest that it may be present once static conditions have returned. The absence of groundwater within the well (during our time onsite) is likely due to a combination of the disturbance due to the drilling operations, the slow recharge rate and the onsite of winter conditions.

The presence of orange-brown oxidation streaks within the upper realms of the till deposits and the moist to wet zones noted at the base of the glaciofluvial and within the till deposits, suggest that groundwater at BH 1-15 will be encountered in preferential pathways located within these zones.

Based upon the undersigned's experience in the Teslin area, groundwater flow will be concentrated to seepage zones located on the surface of (and within) the till deposits.

Groundwater Observations

In viewing the data noted in Table II, a number of observations can be made with respect to the groundwater elevations at the site. We have for discussion purposes excluded the May 26th, 2014 monitoring episode as the measurements would not have been representative of static conditions as the wells were installed in the days immediately preceding the monitoring event.

Yearly fluctuations between October 5th, 2015 and October 3rd, 2014 noted that the groundwater in BH 1-14 and BH 2-14 had dropped 2.85 meters and 2.83 meters, respectively.

Where groundwater was encountered in BH 1-14 and BH 2-14 during monitoring episodes, the difference in the groundwater elevation was noted to be relatively consistent. The total difference between the two wells was noted as follows;

Date	**Total Difference (m) (@ BH 2-14)**
October 5th, 2015	- 5.31
October 3rd, 2014	- 5.33
September 29th, 2014	- 5.11

The relatively consistent values suggest that the direction of the groundwater vector does not fluctuate to any significant degree.

The recharge of the groundwater in BH 1-14 and BH 2-14 between October 5th, 2015 and November 3rd, 2015 varied. While measurement of BH 1-14 noted that the groundwater had risen 0.12 meters, there was no recharge in BH 2-14 whatsoever since the October 5th groundwater measurement. Based upon the initial differences in groundwater elevations between the two wells, the corresponding groundwater elevation in BH 2-14 should have measured in the order of 89.74 to 89.94 meters (within the measurable portions of the well). Given the consistent drop in the groundwater elevation noted under static conditions between the two wells, the lack of groundwater within BH 2-14 following sampling suggests that the recharge rate is extremely slow.

It's evident from the monitoring episodes that the groundwater elevation will at times coincide with the approximate elevation of the top of the glacial till soil unit, where seepage zones are likely present.

Initially, the September 29th, 2014 and October 3rd, 2014 monitoring episodes noted the groundwater elevation coincided with the top of the till elevation in BH 2-14. During this time, the groundwater elevation in BH 1-14 was noted to be approximately 2.2 meters and 2.6 meters above the top of the till, respectively.

Alternately, the groundwater elevation was noted to coincide with the top of till elevation in BH 1-14 during the October 5th, 2015 monitoring episode. During this time, the groundwater elevation in BH 2-14 was noted to be approximately 2.9 meters below the top of the till.

Based upon the two wells where groundwater was encountered (BH 1-14 and BH 2-14), the approximate direction of groundwater flow would be towards the west.

5.0 RECOMMENDATIONS

The newly installed and previously existing wells should be monitored on a regular basis to better characterize seasonal fluctuations in the groundwater regime.

If groundwater is encountered within the newly installed well (BH 1-15), then a groundwater sample should be retained and chemically analyzed to establish a baseline which will allow for a comparison with future samples.

In accordance with the *Environmental Programs Branch* (*EPB*'s) "Guidelines for Land Treatment Facilities", as groundwater was not encountered at significant depth and as (in our opinion) the transport of contaminants to groundwater would be unlikely, we do not recommend any further well installations at this time.

If an additional well is required, a shallow well which targets the interface between the glaciofluvial and till deposits would have the most likely probability of yielding groundwater if installed within several meters of BH 1-15.

6.0 CONCLUSIONS

General

The well installation program was successful at installing an additional well (BH 1-15) to a depth of 13 meters below the ground surface to allow for additional characterization of the sub-surface regime. It was not possible to assess the static groundwater level in the well as groundwater was not encountered during our observations following its installation. The absence of groundwater within the well during our time onsite is likely due to a combination of the disturbance due to the drilling operations, the slow recharge rate and the onsite of winter conditions. The sub-surface conditions which were encountered suggest that groundwater may be (potential intermittently) present once static conditions have returned.

Based upon the undersigned's experience in the Teslin area, groundwater flow will be concentrated to seepage zones located on the surface of (and within) the till deposits.

Direction and Rate of Groundwater Flow

The direction of groundwater flow would be towards the west.

The groundwater flow rate will vary depending upon the continuity and soil permeability of the preferential pathways. Based upon estimates of the groundwater gradient between BH 1-14 & BH 2-14 (of 0.0265) and soil permeability for the sand/silty sand (which varies between 1.0 E-03 to 5.0 E-05), the rate of groundwater flow will range between 2.65 E-05 and 1.33 E-06.

Receiving Environments

The nearest potential receiving environment would be Teslin Lake.

Travel Times for Potential Pathways

The travel time to Teslin Lake will vary depending upon the continuity and soil permeability of the preferential pathways. Assuming the soil permeability varies between 1.0 E-03 to 5.0 E-05, the travel times will range between 7 months and 12 years.

Future Assessment

Future monitoring of the wells should be conducted on a regular basis to better characterize seasonal fluctuations in the groundwater regime.

In accordance with the *Environmental Programs Branch* (*EPB*'s) "Guidelines for Land Treatment Facilities" as groundwater was not encountered at significant depth and as in our opinion the transport of contaminants to groundwater would be unlikely, we feel that additional well installations would be unwarranted.

7.0 LIMITATIONS

This report is intended for the sole use of the *Déslin Development Corporation*. No portion of this report may be used as a separate entity; it is intended to be read in its entirety. Any use of this report by a third party is the responsibility of such third party.

Our assessment reflects our best judgment of the environmental site conditions at the subject property in light of the information available to our firm at the time of report preparation. Our assessment is based upon the subsurface conditions encountered at the sample locations, current well installation techniques and standards and generally accepted engineering practices.

It is important to emphasize that the samples were obtained through random sampling. Due to the geomorphological nature of the deposits encountered, interpolations of subsurface conditions between the well/sample locations have not been made or been implied.

Our assessment was limited due to the scope-of-work that was undertaken and the time that had elapsed since the time of the well installation. While this limitation precludes us from providing a warranty, our firm provided our best professional assessment of the groundwater regime and potential/actual environmental liabilities that may be associated with the subject property based upon the retained information.

Should any newly found environmental or subsurface conditions become apparent, our firm should be notified immediately such that we can confirm the suitability of our recommendations. If required, our firm may alter or modify our findings at such time.

8.0 CLOSURE

Thank you for providing our firm with the opportunity to conduct the above noted work.

We trust that the information we have provided will be suitable for your purposes, however, if you should have any questions or concerns, please feel free to contact the undersigned at your convenience.

Respectfully Submitted,

CHILKOOT GEOLOGICAL ENGINEERS LTD.

PROFESSIONAL
#1277
YUKON
TARES DHARA
TERRITORY
ENGINEER

PERMIT TO PRACTICE
Signature
Date November 29, 2015
PERMIT NUMBER: PP025
Association of Professional Engineers of Yukon

Tares Dhara, P.Eng.
Senior Geotechnical Engineer

TD/td

CHILKOOT GEOLOGICAL ENGINEERS LTD.

Additional Well Installation
Sawmill Land Treatment Facility, Teslin, Yukon – 2015
FIGURE 1 – Site Location and Groundwater Vector

Based map modified from Water Placer Atlas

Compiled Nov.23, 2015 by T.Dhara

CHILKOOT GEOLOGICAL ENGINEERS LTD.

Additional Well Installation
Sawmill Land Treatment Facility, Teslin, Yukon – 2015
FIGURE 2 – Well Locations

Based map modified from Water Placer Atlas

Compiled Nov.23, 2015 by T.Dhara

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5B Bennett Road, Whitehorse, Yukon

ADDITIONAL WELL INSTALLATION
SAWMILL LAND TREATMENT FACILITY
TESLIN, YUKON - 2015

TABLE I - SUMMARY OF SOIL STRATIGRAPHY

STRATA	Units	BOREHOLE				
		BH 1-15	2014 Average	BH 1-14	BH 2-14	BH 3-14
SURFICIAL DEPOSITS	Elevation (m)	NA	100.37	101.87	99.23	100.02
	Thickness (m)	NA	0.80	0.70	0.90	0.80
FILL	Elevation (m)	100.40	NA	NA	NA	NA
	Thickness (m)	2.44	NA	NA	NA	NA
GLACIOLACUSTRINE DEPOSITS	Elevation (m)	NA	99.57	101.17	98.33	99.22
	Thickness (m)	NA	5.40	6.01	5.80	4.38
POSSIBLE SEEPAGE ZONE	Elevation (m)	94.91	95.31	95.77	93.94	96.22
	Thickness (m)	0.31	1.13	0.61	1.41	1.38
TILL DEPOSITS	Elevation (m)	94.61	94.18	95.16	92.53	94.84
	Depth (m)	5.79	6.20	6.71	6.70	5.18
	Thickness (m)	> 9.45	NA	> 5.5	> 4.26	0.31
GLACIOFLUVIAL DEPOSITS	Elevation (m)	97.96	94.53	NA	NA	94.53
	Thickness (m)	3.35	> 6.70	NA	NA	> 6.70
BOREHOLE TERMINATION	Elevation (m)	85.46	88.59	89.68	88.27	87.83
	Depth (m)	14.94	11.78	12.19	10.97	12.19

Note - Elevation refers to the top of the deposit or interface.

Prepared by T.Dhara - Nov.23, 2015

CHILKOOT GEOLOGICAL ENGINEERS LTD.

5B Bennett Road, Whitehorse, Yukon

ADDITIONAL WELL INSTALLATION

SAWMILL LAND TREATMENT FACILITY

TESLIN, YUKON - 2015

TABLE II - SUMMARY OF WELL OBSERVATIONS

SUMMARY OF GROUNDWATER OBSERVATIONS - MAY 25, 2014 to NOVEMBER 3, 2015)							
DESCRIPTION	**Elevation/Length/Depth**	**BOREHOLE**					
		BH 1-15	**Average 2014**	**BH 1-14**	**BH 2-14**	**BH 3-14**
Top of Well Pipe	Elevation (m)	101.23	101.24	102.83	100.17	100.72
GROUND SURFACE	Elevation (m)	100.40	100.37	101.87	99.23	100.02
Pipe Length Above Ground Surface	Meters (m)	0.83	0.87	0.96	0.94	0.70
GROUNDWATER (Nov.3, 2015)	Elevation (m)	NA	NA	95.05	< 89.36	NA
	Depth (m)	NA	NA	6.82	> 9.87	NA
GROUNDWATER (Oct 5, 2015 - ERM Measurements)	Elevation (m)	NA	92.28	94.93	89.62	NA
	Depth (m)	NA	8.28	6.94	9.61	NA
GROUNDWATER (Oct 3, 2014)	Elevation (m)	NA	95.12	97.78	92.45	NA
	Depth (m)	NA	5.44	4.09	6.78	NA
GROUNDWATER (Sept 29, 2014)	Elevation (m)	NA	94.82	97.37	92.26	NA
	Depth (m)	NA	5.74	4.50	6.97	NA
GROUNDWATER (May 26, 2014)	Elevation (m)	NA	NA	93.03	< 89.36	NA
	Depth (m)	NA	NA	8.84	> 9.87	NA
TOP OF GLACIAL TILL	Elevation (m)	94.61	94.18	95.16	92.53	94.84
POSSIBLE SEEPAGE ZONE	Elevation (m)	94.91	95.31	95.77	93.94	96.22
	Thickness (m)	0.3	1.13	0.61	1.41	1.38
INSTALLED LENGTH OF WELL BELOW OG	Elevation (m)	87.12	90.18	91.06	89.36	90.12
	Depth (m)	13.28	10.19	10.81	9.87	9.90

Note - Elevation refers to the top of the deposit or interface.

Prepared by T.Dhara - Nov.23, 2015

APPENDIX A

Borehole Soil Log

NOTES ON SOIL LOGS

Soil Description

The soil is named after its principal component and modified by other components as follows;

Percent of Component	Modifier
> 15 %	XXX - ey
11% to 15%	some XXX
5% to 10%	trace XXX

Examples;

SILT	SAND	GRAVEL	Description
6	32	62	Sandy Gravel trace Silt
55	6	39	Gravelly Silt trace Sand
43	36	21	Silty Gravelly Sand

Note: In the cases where the coarse fraction (sand & gravel) comprise > 50% of the sample, then the larger component of the coarse fraction becomes the principal component.

Undrained Shear Strength of Cohesive Soils

Consistency	Undrained Shear Strength	
	p.s.f	kN/m^2
Very Soft	< 375	<20
Soft	375-750	20-40
Firm	750-1500	40-75
Stiff	1500-3000	75-150
Very Stiff	3000-6000	150-300
Hard	>6000	<300

Relative Density (Qualitative Classification)

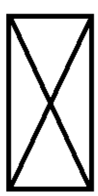
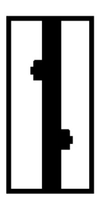
Cohesive Soils

Very Soft	- Exudes between fingers when squeezed by hand
Soft	- Moulded by light finger pressure
Firm	- Moulded by strong finger pressure
Stiff	- Cannot be moulded by fingers – Can be indented by thumb
Very Stiff	- Can only be indented by thumbnail
Hard	- Cannot be indented by thumbnail

Granular Soils

Very Loose	- Considerable sidewall sloughage noted
Loose	- Some sidewall sloughage noted – Easy digging
Compact/ Medium-Dense	- Unimpeded excavation – little to no sidewall sloughage
Dense	- Considerable effort required during excavation – Stable vertical sidewalls
Very Dense	- Extreme difficulty in excavation

Soil Log - Sample Type

Symbol	Test Pitting	Drilling
	**Grab Sample** Retained from excavation sidewall or base	**Auger Sample** Retained from Auger flighting
	**Bucket Sample** Retained from leading edge of excavator bucket	**Split-Spoon Sample** Retained from Split-Spoon Sampler tube

Relative Moisture

Described as - *dry*, *damp*, *moist*, *wet* or *saturated* - relative to the principal soil matrix.

For example, a moisture content of 10 percent may be classified as '*moist*' for a coarse grained soil (sand or gravel) but '*damp*' for a fine grained (silt) soil.

The moisture content is recorded as a percentage (%) of the weight of water within the soil sample relative to the dry weight of the sample.

Recovery

Refers to the (linear) amount of sample retained after driving the Split Spoon (SPT) sampler tube 18 inches.

Recorded as a percentage (i.e. 12 inch sample/18 drive = 66 %)

N-Value

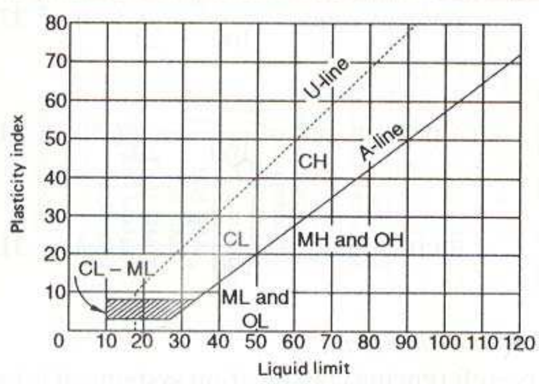
Refers to the total number of blows required to drive the Split Spoon sampler tube the final 12 inches of the 18 inch drive.

Relative Density based upon SPT 'N' Value

Non-cohesive (Granular) Soil		**Cohesive (Clayey) Soils**	
Relative Density	**Blows per Foot (N-value)**	**Consistency**	**Blows per Foot (N-value)**
Very Loose	< 5	*Very Soft*	0 to 2
Loose	5 to 9	*Soft*	3 to 4
Compact	10 to 29	*Firm*	5 to 8
Dense	30 to 50	*Stiff*	9 to 15
Very Dense	> 50	*Very Stiff*	16 to 30
		Hard	> 30

Unified Soil Classification System
(ASTM Designation D-2487)

Major division			Group Symbols	Typical Names		Classification Criteria
Coarse-grained soils More than 50% retained on No. 200 sieve	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines: Less than 5% Pass No. 200 sieve — GW, GP, SW, SP; More than 12% Pass No. 200 sieve — GM, GC, SM, SC; 5% to 12% Pass No. 200 sieve — Borderline classification requiring use of dual symbols	$C_u = D_{60}/D_{10}$ Greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits plot above "A" line and plasticity index greater than 7
	Sands More than 50% of coarse fraction passes No. 4 sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines		$C_u = D_{60}/D_{10}$ Greater than 6; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW
		Sands with fines	SM	Silty sands, sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4
			SC	Clayey sands, sand-clay mixtures		Atterberg limits plot above "A" line and plasticity index greater than 7
Fine-grained soils 50% or more passes No. 200 sieve	Silts and Clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands		Check plasticity chart
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	Silts and Clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity		
Highly organic soils			Pt	Peat, muck and other highly organic soils		Fibrous organic matter; will char, burn, or glow



Note: U-line represents approximate upper limit of LL and PI combinations for natural soils

Plasticity chart for the classification of fine-grained soils. Tests made on fraction finer than No. 40 sieve.

Unified Soil Classification System

Figure 18. UNIFIED SOIL CLASSIFICATION SYSTEM

CHILKOOT GEOLOGICAL ENGINEERS LTD.

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BOREHOLE LOG

Client : Deslin Development Corporation
Location : Sawmill Land Treatment Facility
Project : Hydrological Assessment - Additional Well Installation
Chilkoot Project No. : 200-002-15

Date Drilled: Oct.7-8, 2015
Elevation : 100.40 meters
Depth of BH: 14.94 meters
Instrumentation: Well to 87.12 m

BOREHOLE **1-15**

Depth (m)	Relative Density	Stratigraphic Description	Relative Moisture	Sample Number	Temperature (degrees C)	Recovery %	Penetrometer (kg/cm2)	SPT 'N'	Laboratory Results (%)	USCS/NRC	Elev. (m)
0.00–0.20	loose	Sawdust and Rotting Timber	damp							FILL	100.4–100.2
0.20–2.44	firm	FILL SILTY SAND to SANDY SILT - non-plastic, grey	damp	1	NA	NA	NA	NA	MC 17.6	FILL	100.2
		- as above		2	NA	NA	NA	1.75-2.25	MC 14.4		99.4
	firm	hard grindy drilling	moist	3	NA	NA	NA	0.75	MC 11.9		98.57–98.2
		Refusal in initial borehole advanced @ 2.2 m. Borehole relocated 1.5 meters east.									
2.44–3.80	loose	GLACIOFLUVIAL DEPOSITS SAND with odd SILT clump in size to 4 mm - medium grained, poorly graded - brown	damp	4	NA	NA	NA	NA	MC 6.4		97.96
				5	NA	NA	NA	NA	MC 4.2		
3.80–4.70	compact	GRAVELLY SAND - gravel in size to 30 mm, medium grained, poorly graded - brown	damp	6	NA	NA	NA	NA	MC 4.1	SM	96.6
4.70–5.30	compact	SILTY SAND trace GRAVEL with odd SILT clump in size to 4 mm, gravel in size to 5 mm, fine to medium grained, poorly graded - brown	moist	7	NA	NA	NA	NA	Gravel 6.6, Fines 17.4, Sand 75.9		95.7
5.30–5.79	loose	- as above	moist to wet	8	NA	NA	NA	NA	MC 8.2		95.1
5.79–7.00	stiff	TILL - GRAVELLY SILTY SAND - fine to medium grained, poorly graded, grey - traces of orange-brown oxidation streaks to 10.3 m	damp	9	NA	NA	>4.5	NA	MC 7.1	SM	94.61–93.39

Drilled By : Donjek Drilling
Drill Type : CME 750 (FN60)
Auger Type : 150 mm Solid Stem
Bit Type : Fish Tail

Water Level(s): During Drilling; After Drilling; At End of Drilling

Logged By : T.Dhara, P.Eng. Date : Oct.7-8, 2015
Data Entry By : T.Dhara, P.Eng. Date : Nov.24-25, 2015
Reviewed By: Date : Nov.26, 2015

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5B Bennett Road, Whitehorse, Yukon
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BOREHOLE LOG

Client : Deslin Development Corporation
Location : Sawmill Land Treatment Facility
Project : Hydrological Assessment - Additional Well Installation
Chilkoot Project No. : 200-002-15

Date Drilled: Oct.7-8, 2015
Elevation : 100.40 meters
Depth of BH: 14.94 meters
Instrumentation: Well to 87.12 m

BOREHOLE **1-15**

Stratigraphic Description

Depth (m)	Relative Density	Stratigraphic Description	Relative Moisture	USCS/NRC
to 7.80	hard	SANDY SILTY GRAVEL - fine to medium grained, poorly graded - grey - possible cobble to boulder sized materials	damp	GM
7.80 – 12.90	hard	GRAVELLY SILTY SAND - fine to medium grained, poorly graded, grey	damp	SM
		- as above		
9.5		- 15 cm of groundwater noted in borehole morning of Oct.8		
		- as above		
		- Borehole collapsed to 9.6 m upon auger withdrawl from 10.67 m		
	firm	- as above	damp	
		- as above but possible trace of CLAY		
11.3	soft	- easier drilling	moist	
		- as above		
12.90 – 14.00	loose	SILTY SAND - fine to medium grained, poorly graded - grey	moist to wet	SM
		- 2" diameter well installed to 13.28 m		
		- Borehole collapsed to 13.38 m		

Field Sample and Laboratory Results (%)

Type	Number	Temperature (degrees C)	Recovery %	Penetrometer (kg/cm2)	SPT "N"	MC	Fines	Sand	Gravel
X	10	NA	NA	>4.5	NA	5.6	14.2	37.1	48.6
X	11	NA	NA	NA	NA	6.6			
X	12	NA	NA	NA	NA	7.1			
X	13	NA	NA	NA	NA	5.9			
X	14	NA	NA	NA	NA	5.5	18.8	58.8	22.5
X	15	NA	NA	NA	NA	8.2			
X	16	NA	NA	NA	NA	9.9			
X	17	NA	NA	NA	NA	15.5	19.0	77.8	3.4

▲ - FINES ● - SAND ■ - GRAVEL; PL — MC — LL; scale 20 40 60 80

Caved To 13.38

Elevations noted (m): 92.6, 91.8, 90.95, 90.9, 90.8, 90.25, 90.04, 89.12, 88.7, 87.5, 87.12, 87.02, 86.38

Drilled By : Donjek Drilling
Drill Type : CME 750 (FN60)
Auger Type : 150 mm Solid Stem
Bit Type : Fish Tail

Water Level(s): ▽ During Drilling ▼ After Drilling ▼ At End of Drilling

Logged By : T.Dhara, P.Eng. Date : Oct.7-8, 2015
Data Entry By : T.Dhara, P.Eng. Date : Nov.24-25, 2015
Reviewed By: TD Date : Nov.26, 2015

CHILKOOT GEOLOGICAL ENGINEERS LTD.

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BOREHOLE LOG

Client : Deslin Development Corporation
Location : Sawmill Land Treatment Facility
Project : Hydrological Assessment - Additional Well Installation
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Date Drilled: Oct.7-8, 2015
Elevation : 100.40 meters
Depth of BH: 14.94 meters
Instrumentation: Well to 87.12 m

BOREHOLE **1-15**

Elev. (m)	Depth ft	Depth m	Stratigraphic Description (Relative Density / Relative Moisture)	Type	Number	Temperature (degrees C)	Recovery %	Penetrometer (kg/cm2)	SPT 'N'	Laboratory Results (%) ▲ - FINES ● - SAND ■ - GRAVEL; PL MC LL; 20 40 60 80	USCS/NRC Depth (m)	Symbol	Elev. (m)
			loose; moist to wet										86.1
86.0	47.0	14.5	- grindy drilling - possible cobbles and/or boulders								SM		86.0
	48.0												
85.5	49.0	14.94	End of Borehole. Borehole terminated at 14.94 m. below the existing ground surface.										85.46
85.0													85.0
84.5													84.5
84.0													84.0
83.5													83.5
83.0													83.0
82.5													82.5
82.0													82.0
81.5													81.5
81.0													81.0
80.5													80.5
80.0													80.0
79.5													79.5

Drilled By : Donjek Drilling
Drill Type : CME 750 (FN60)

Auger Type : 150 mm Solid Stem
Bit Type : Fish Tail

Water Level(s): During Drilling; After Drilling; At End of Drilling

Logged By : T.Dhara, P.Eng. Date : Oct.7-8, 2015

Data Entry By : T.Dhara, P.Eng. Date : Nov.24-25, 2015

Reviewed By: [signature] Date : Nov.26, 2015

APPENDIX B – SELECTION OF PHOTOS

Above – Site conditions Oct.7, 2015

Left -
Till - Sample No.9
@ 6.5 m

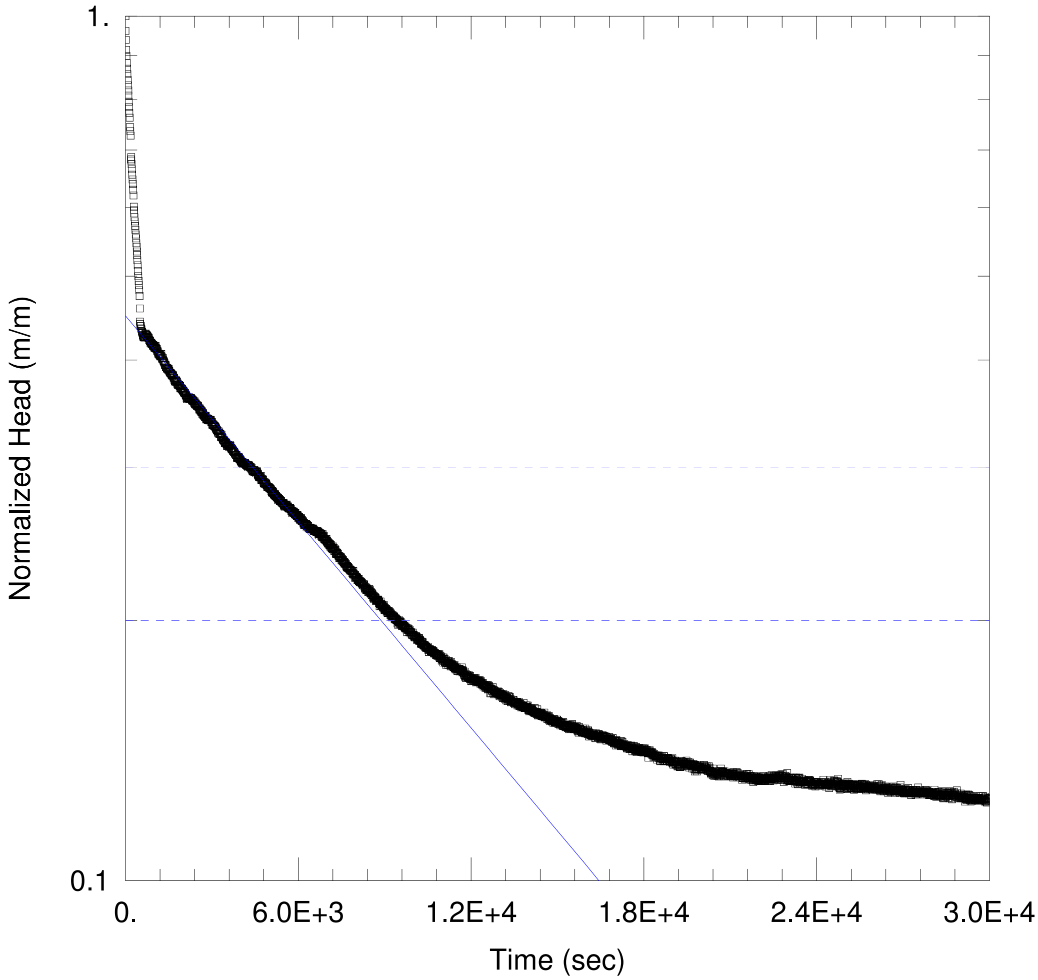
Above – Auger sample conditions. Till from 7.6 to 9.1 m

Above – Saturated conditions during withdrawal. (~ 7.6 to 10.7 m)

Left -
Oxidation in till
@ 7.6 m

— Appendix D —

Single Well Response Test Analysis Reports



WELL TEST ANALYSIS

Data Set: C:\Projects\Teslin LTF\BH1-14.aqt
Date: 05/11/16 Time: 12:06:41

PROJECT INFORMATION

Company: ERM Canada Ltd.
Client: Deslin Development Corp.
Project: 0319569
Location: Teslin LTF
Test Well: BH1-14
Test Date: October 5 2015

AQUIFER DATA

Saturated Thickness: 5.3 m
Anisotropy Ratio (Kz/Kr): 1.

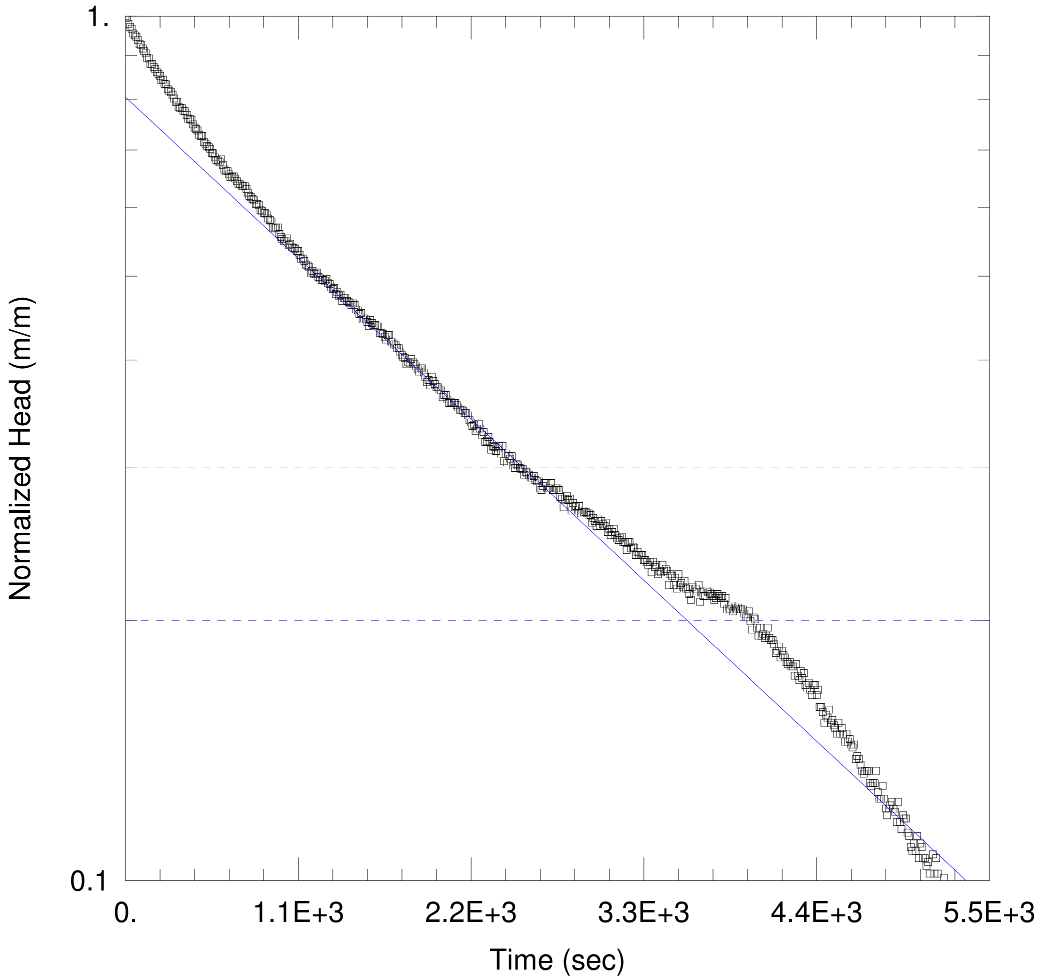
WELL DATA (BH1-14)

Initial Displacement: 0.3777 m
Total Well Penetration Depth: 6.1 m
Casing Radius: 0.025 m
Static Water Column Height: 3.92 m
Screen Length: 6.1 m
Well Radius: 0.075 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 6.162E-8 m/sec
y0 = 0.17 m



WELL TEST ANALYSIS

Data Set: C:\Projects\Teslin LTF\BH2-14.aqt
Date: 05/11/16 Time: 11:59:41

PROJECT INFORMATION

Company: ERM Canada Ltd.
Client: Deslin Development Corp.
Project: 0319569
Location: Teslin Sawmill LTF
Test Well: BH2-14
Test Date: October 5 2015

AQUIFER DATA

Saturated Thickness: 1.4 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH1-14)

Initial Displacement: 0.0933 m
Total Well Penetration Depth: 4.57 m
Casing Radius: 0.025 m
Static Water Column Height: 0.285 m
Screen Length: 4.57 m
Well Radius: 0.075 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 8.351E-7 m/sec y0 = 0.07518 m