



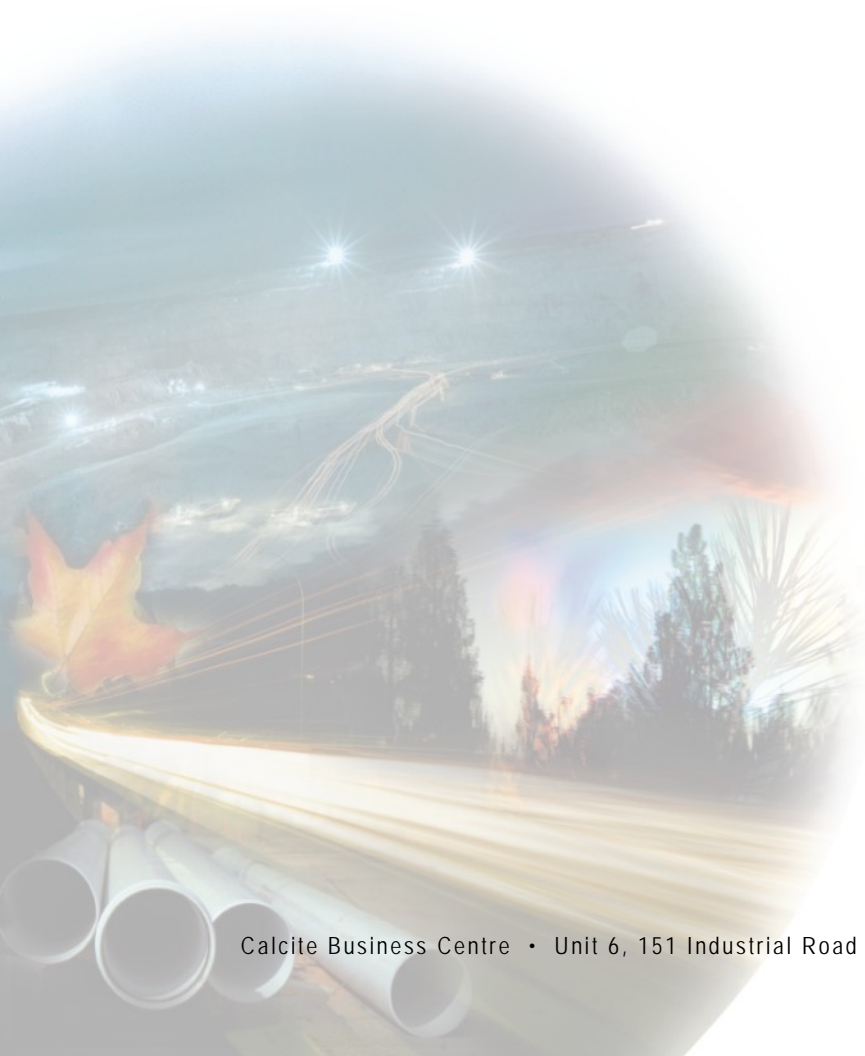
GOVERNMENT OF YUKON
PROPERTY MANAGEMENT DIVISION

ISSUED FOR USE

COMPLETION REPORT FOR WELL 1439
NEW GOLDEN HORN FIRE HALL
WHITEHORSE
YUKON

W23101144

February 2009



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EXECUTIVE SUMMARY

EBA Engineering Consultants Ltd. (EBA) coordinated the drilling, construction and testing of a water well (Well 1439) which will serve as a water supply well for the new Golden Horn Fire Hall. The scope of work for this project included a review of available hydrogeological information of the existing low-capacity Well 1924 supplying the old Golden Horn Fire Hall, preparing specifications for drilling, well construction and testing, supervision of well drilling, construction and testing, data analysis, and preparation of this report.

Hydraulic testing results from a pumping test completed on Well 1439 show that it is completed within a low-productivity aquifer. The yield of the new well will be limited by the low hydraulic conductivity of the aquifer. The rated theoretical long-term sustainable yield of Well 1439 has been determined by EBA to be 0.08 L/s (1.1 Igpm). However, the well storage allows the well to be pumped at 0.3 L/s (4 Igpm) for about 20 min to satisfy peak water demands.

Laboratory results show that the water quality from the new Well 1439 met all Guidelines for Canadian Drinking Water Quality for health based parameters and aesthetic objectives on the date sampled, except for the manganese concentration which slightly exceeded the aesthetic objective value. However, a slight exceedance of the aesthetic objective for manganese is not considered a health concern by Health Canada.



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- Appendix D Pumping Test Analysis
- Appendix E Laboratory Results of Chemical and Bacteriological Analyses

1.0 INTRODUCTION

EBA Engineering Consultants Ltd. (EBA) was retained by the Government of Yukon (YG), Property Management Division (the Owner) to provide hydrogeological consulting and project management services for installation of a water supply well (Well 1439) for the new Golden Horn Fire Hall, Whitehorse, Yukon. A site location map is provided as Figure 1. Figure 2 shows a site plan including the well location. The scope of work for this project involved:

- Background review of available information on the existing water supply well for the old Golden Horn Fire Hall (Well 1924);
- Prepare well drilling, construction, and testing specifications;
- Supervision of well drilling and testing;
- Data compilation and analysis; and,
- Preparation of this report summarizing results and recommendations.

2.0 FIELD PROGRAM

2.1 WELL LOCATION SELECTION

The well location was selected in accordance with the requirements outlined in the guidelines for Small Public Drinking Water Systems (Government of Yukon, Health and Social Services (2007) Guidelines for Part III – Small Public Drinking Water Systems). These guidelines require the well to be located:

- 15 metres from a septic tank, sewage holding tank or contained privy,
- 30 metres from a soil absorption system, pit privy, or other potential sources of pollution that may pose a health and safety risk,
- 120 metres from a solid waste site or dump, and cemetery, and
- 300 metres from a sewage lagoon or pit.

The well location was selected during a site visit by the Owner represented by Mr. Kevin Sumner and the drilling contractor Double D Drilling Ltd. on October 3, 2008. The new Well 1439 is located at distances greater than each of the above recommended set-back distances (see Figure 2).

2.2 WELL DRILLING AND CONSTRUCTION

The well drilling and testing contract was awarded to Double D Drilling Ltd. (Double D) of Terrace, BC. Drilling of Well 1439 commenced on October 3, 2008 and was completed on October 9, 2008.

The well was drilled using the dual air rotary drilling method. Disturbed samples were retained at approximately 1.5 m intervals. A water-bearing zone consisting of silty gravel and sand was encountered at a depth of about 33.5 to 40 m bgs (below ground surface). The bedrock surface was encountered at a depth of about 40.2 m bgs. Preliminary flow tests using air lift suggested a flow rate of about 0.15 L/s (1.7 Igpm). The Owner deemed this anticipated flow rate sufficient for the purpose of Well 1439 and decided to proceed with the installation of the screen and development of the well.

EBA designed the screen based on the grain size of the material from the depth interval to be screened. Sediment sample collection during drilling using the air rotary method is difficult and samples are often not representative of the in situ grain size distribution, especially in fine-grained sediments. Because the aquifer sediments at the site contain a large portion of silt and fine sand, EBA chose a conservative screen design. It should be noted that based on the flow estimate by air-lifting the well, the well yield will be limited by the low hydraulic conductivity of the aquifer rather than the conservative screen design.

A Johnson® v-wire stainless steel screen was installed between 35.1 and 37.7 m bgs. Further details on the screen design are presented in Figure 3. Double D developed the well screen by air lifting and surging for 9 hours. A summary of sediments encountered and well construction details are included on the well log in Figure 3. The driller's well log is included in Appendix B. A summary of relevant well construction details is presented in Table 1.

2.3 WELL AND AQUIFER TESTING

2.3.1 Hydraulic Testing Method

Hydraulic testing was conducted between October 8 and 9, 2008. The pumping test was completed by Double D. A temporary submersible pump was installed in the pumping well (Well 1439) with the intake positioned approximately 1.5 m above the top of the screened interval. Solinst Levelogger automated data loggers were deployed in both the pumping well and the existing well at the old fire hall (Well 1924) to monitor groundwater levels during the pumping tests at time intervals of 30 seconds. In addition, the barometric pressure was recorded during the pumping test to correct the measured water pressures for changes in barometric pressure if necessary.

Double D monitored the flow during the pumping test using a graduated container. The use of a digital flow meter was not possible due to the low flow rate. Water levels were collected on specified intervals using an electric tape. Water from the well during pumping was conveyed to a downgradient location approximately 30 m north of Well 1439 and disposed of via infiltration.

Manual data collected during the pumping test are included as Appendix C.

TABLE 1: SUMMARY OF WELL INFORMATION AND CONSTRUCTION DETAILS OF THE WELL 1439

	Well Construction Details
Name of Well	1439
Date of construction:	October 3-9, 2008
Owner of the well:	Government of Yukon, Property Management Agency
Description of the property:	Golden Horn Fire Hall, Whitehorse, Yukon
UTM Coordinates (Nad 83):	UTM Zone 8 E 506874 N 6718075
Location of well on the property:	See Figure 2
Drilling contractor:	Double D Drilling Ltd., Terrace, B.C.
Method of construction:	Dual air rotary
Description, depth, and thickness of geologic materials encountered during construction:	See well log in Figure 3 and drillers well log in Appendix B.
Depth and diameter of the well:	Total depth of well completion is 37.7 m bgs and diameter of well is 152.4 mm (6"). Construction details are included on Figure 3.
Type of casing materials and thickness:	Steel casing - 0.250 inches (6.35 mm) thick
Static water level:	10.9 m bgs (October 2008)
Type, size, length and location of the screen:	Stainless steel V-wire Johnson screen 15-slot (0.38 mm) from 35.1-36.4 m bgs; Stainless steel V-wire Johnson screen 20-slot (0.51 mm) from 36.4-37.7 m bgs. Total exposed screen length is 2.6 m.
Location of major water-bearing zones:	Water-bearing silty sand and gravel zone from 33.8 - 40.2 m bgs.
Location, type and thickness of grout sealant placed around the well:	Bentonite seal was placed in annulus between casing and native sediments. Seal is completed from grade to 6.0 m bgs.

2.3.2 Step Rate Pumping Test

A step rate test was conducted to determine the optimal rate at which to perform the constant rate pumping test. However, due to the low well yield and pump limitations it was not possible to conduct a proper step test consisting of at least three different flow steps.

The first step was completed at the minimum pump rate of the pump (0.05 L/s) for a duration of 60 min. The second step was conducted at a pump rate of 0.1 L/s, and led into the 24 h constant rate test.

2.3.3 Constant Rate Pumping Test

The observed drawdown during the second step of the step test suggested that the maximum possible pump rate for the constant rate test had already been attained and the step test was therefore led into the constant rate pumping test. The pumping test was conducted for a total of 24 h. The recovery following the constant rate pumping test was recorded until the groundwater level recovered to within 95% of the initial static water level.

2.4 WATER SAMPLE COLLECTION

EBA collected a water sample from the Well 1439 at the end of the constant rate pumping test. The sample was collected in laboratory supplied sample containers in accordance with laboratory sampling procedures. The sample was shipped with a chain of custody log and on ice by air cargo to Bodycote Testing Group in Surrey, BC, for detailed potability analysis. The Bodycote laboratory in Surrey is an accredited ISO/IEC 17025 testing laboratory.

Samples for bacteriological analysis were submitted to Yukon Environmental Health Services.

3.0 HYDRAULIC TESTING RESULTS

3.1 PUMPING TEST RESULTS

The observed drawdown in the pumping well (Well 1439) and the observation well (existing water Well 1924) during the pumping test and the subsequent recovery period is shown in Figure 4. The data logger readings were used for the interpretation as they agree very well with the manual readings (see Figure 4). The change in barometric pressure during the pumping test was < 1%, and therefore no correction of the measured water levels for variation in barometric pressure was necessary.

The maximum drawdown in the pumping well during the constant rate pumping test is about 16 m and remained fairly constant during the second half of the 24 h pumping test. The maximum drawdown observed in the observation well about 50 m west of the pumping well was about 0.16 m. Recovery of the groundwater level in the pumping well to within 95% of the initial static water level occurred in about 3 hours.

The drawdown data during the pumping test were analyzed using the Cooper-Jacob Straight-Line Time-Drawdown Method and the recovery data were interpreted using the Theis Recovery Method (e.g., Fetter, 2001). Both interpretation methods are implemented in the software WHI AquiferTest version 3, which was used to analyze the pumping test data (see Appendix D).

The results of the pumping test are presented in Table 2. The interpretation of the step test data and late-time constant rate test data from the observation well did not yield any reasonable results and therefore is not shown in Table 2. The transmissivities and hydraulic conductivities obtained from the data collected in the observation well are significantly higher compared to those from the pumping well. This difference likely reflects the heterogeneity of the aquifer consisting of fine-grained sediments with intercalated coarser grained silty sand and gravel layers, which predominantly represent the water-bearing zones. Generally, the hydraulic conductivity of about 10^{-7} to 10^{-6} m/s can be described as low and is typical for the sediments encountered.

TABLE 2: PUMPING TEST RESULTS			
Well	Test Interval	T [m ² /s]	K [m/s]
Pumping Well (Well 1439)	Step	4.0E-06	1.6E-07
	Constant Rate - Early	9.4E-07	3.7E-08
	Constant Rate - Late	2.9E-06	1.1E-07
	Recovery	1.1E-06	4.5E-08
	Mean	1.9E-06	7.4E-08
Observation Well (Well 1924)	Step	n/a	n/a
	Constant Rate - Early	8.5E-05	3.3E-06
	Constant Rate - Late	n/a	n/a
	Recovery	6.5E-05	2.5E-06
	Mean	7.4E-05	2.9E-06

3.2 WELL CAPACITY

To calculate the safe yield of a well, the 100-day specific capacity was multiplied by the safe available drawdown. The 100-day specific capacity of the well (at a given pumping rate) is based on the projection of the observed drawdown at the end of the constant rate pumping test extrapolated to 100 days as shown on Figure 5. This conservatively assumes that the well would be continuously pumped at the same rate for 100-days with no recharge to the aquifer. The safe available drawdown of the well is determined by applying a safety factor of 70% to the physical available drawdown after an allowance has been made for seasonal fluctuations in static water level. The safe yield of a well can also be limited by what the well screen is capable of delivering based on the maximum recommended screen entrance velocity. Table 3 details the safe yield calculations for Well 1439.

EBA determined the long-term theoretical sustainable yield of Well 1439 to be 0.08 L/s (1.1 Igpm). However, the available casing storage of the well above the pump intake is about 360 L (80 Ig), and the well could be pumped at a rate of 4 Igpm for about 20 min to satisfy peak water demands. Note that the well yield will be limited by the small hydraulic conductivity of the aquifer rather than the well screen design.

TABLE 3: SUMMARY OF SAFE YIELD CALCULATIONS

Well Parameter		Unit	Key
Constant Rate Pumping Test Discharge Rate	0.1	L/s	a
Projected 100-Day Drawdown	18	m	b
Specific Capacity	0.006	L/s/m	c = a / b
Lowest Expected Seasonal Water Table (1.5 m below static)	12.4	m	d
Depth to top of Aquifer	33.8	m	e
Available Drawdown	21.4	m	f = e-d
Safety Factor	70	%	g
Safe Available Drawdown	15.0	m	h = f × g
Safe Yield Based on Constant Rate Pumping Test			
Theoretical Sustainable Yield	0.08	L/s	i = c × g
Theoretical Sustainable Yield	1.1	Igpm	
Check for Screen Entrance Velocity			
Recommended Maximum Screen Entrance Velocity	0.03	m/s	
Intake Area (m ² / m)	0.074	m ² /m	j
Total Intake Area for 2.6 m Screen	0.19	m ²	k = j × 2.6
Screen Entrance Velocity at Safe Estimated Sustainable Yield	0.0004	m/s	(i / 1000) / k
Check: Less than Recommended Maximum Velocity	YES		

4.0 GROUNDWATER UNDER THE DIRECT INFLUENCE (GUDI) ASSESSMENT

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

The Yukon Department of Health and Social Services has published a document titled "Assessment Guideline for Well Water or Groundwater Under the Direct Influence of

Surface Water” (GUDI) to determine if a well is potentially under the influence of surface water (YG 2006).

EBA conducted a Phase 1 Initial GUDI Screening for Well 1439 and determined that all screening criteria are met by the well. That is, the well:

- produces groundwater from a confined aquifer at depths >15 m;
- is not located within 60 m of any surface water body;
- has been constructed in accordance with the “Guidelines for Water Well Construction”, published by the Canadian Ground Water Association, and the guidelines for Small Public Drinking Water Systems (Government of Yukon Health and Social Services (2007) Guidelines for Part III – Small Public Drinking Water Systems); and,
- raw water does not exhibit any evidence of contamination by or from surface water.

Therefore, EBA identified the Well 1439 to be non-GUDI, and no further assessment is deemed necessary.

5.0 RESULTS OF LABORATORY ANALYSIS

Groundwater analytical results and a comparison with Guidelines for Canadian Drinking Water Quality (GCDWQ) are presented in Table 4. The laboratory reports and certificates are included as Appendix E. To evaluate the quality of the analysis EBA calculated the ion balance, i.e., the balance between sum of anion and cation equivalent charges. Usually, an ion balance of within $\pm 5\%$ is considered satisfactory. The calculated ion balance of 3.7% suggests that analytical errors are within acceptable limits and all major cations and anions were analyzed.

The water sample from Well 1439 is very hard and can be characterized as a magnesium-calcium-bicarbonate-sulphate (Mg-Ca-HCO₃-SO₄) type water.

Based on the analytical results for the water samples collected on October 9, 2008, the water from Well 1439 met all GCDWQ for the parameters tested on the date sampled, with the exception of manganese which slightly exceeded the aesthetic objective (AO). The reported manganese concentration was 0.06 mg/L, and the AO is 0.05 mg/L. Manganese exceedances of the AO are not uncommon in Yukon; and are not considered a health concern by Health Canada (Health Canada, 1987). Note that the arsenic concentration reported by the lab was 0.0036 mg/L which is less than the GCDWQ maximum acceptable concentration of 0.01 mg/L.

Bacteriological results were satisfactory (no coliforms or *E.coli* present).

The most recent water quality analysis for Well 1924 is also shown in Table 4 for comparison with the water quality of the new Well 1439. Both well waters are fairly similar with respect to water chemistry and type of water. An important distinction is that the arsenic concentration in the existing Well 1924 exceeded the health-based drinking water

guideline whereas the arsenic concentration in the new Well 1439 was below the maximum acceptable concentration at the date sampled.

6.0 CONCLUSIONS

The following conclusions are based on the information presented in this well completion report:

- In October 2008, a water supply well (Well 1439), was drilled for the new Golden Horn Fire Hall, Yukon to a depth of approximately 40 m bgs;
- A screen was set from 35.1-37.7 m bgs;
- The well was constructed in accordance with guidelines for Small Public Drinking Water Systems (Government of Yukon Health and Social Services (2007) Guidelines for Part III – Small Public Drinking Water Systems) and the Canadian Groundwater Association's Well Construction Guidelines (CGWA 1995);
- Pumping test results from the wells indicate an aquifer transmissivity on the order of 10^{-6} to 10^{-5} m²/s (0.1 to 1 m²/day);
- The well yield will be limited by the low aquifer hydraulic conductivity. The theoretical long-term sustainable yield has been determined by EBA to be 0.08 L/s (1.1 Igpm). However, the available casing storage of the well above the pump intake is about 360 L (80 Ig), and the well could be pumped at a rate of 0.3 L/s (4 Igpm) for about 20 min to satisfy peak water demands; and,
- Water from the well met all GCDWQ for health based parameters and aesthetic objectives on the date sampled and for the parameters tested, with the exception of the manganese concentration which slightly exceeded the aesthetic objective. However, the slight exceedance of the manganese aesthetic objective is not considered a health concern by Heath Canada.

7.0 WELL COMMISSIONING, OPERATION AND MAINTENANCE RECOMMENDATIONS

Proper well commissioning, operation and maintenance are fundamental to ensuring a reliable drinking water source. Recommendations pertinent to the commissioning, operation and maintenance of the Well 1439 are presented below:

- In accordance with the well construction guidelines published by the Canadian Groundwater Association (CGWA, 1995), the casing of the well should project at least 0.50 m above ground surface upon final completion (it is currently 1 m above grade).
- A submersible pump should be installed at a depth of approximately 32 m bgs (3 m above the top of screen) to maximize drawdown and well performance. The pump to be installed in the well should be capable of pumping at a rate of 0.3 L/s (4 Igpm) overcoming a head of 33 m (depth of pump intake plus 1 m for well head) plus pipe

friction losses and possible additional elevation gains. Given the low yield of the well, it is strongly recommended that the pump to be installed have automatic shut-off capabilities in the event that the water level is drawn down to the pump intake; and a flow restrictor to limit flow to 0.3 L/s (4 Igpm).

- Well 1439 should be connected in accordance with specifications outlined in EBA (2008).
- The water level and specific capacity of a water supply well should be routinely monitored over time to facilitate evaluation of well performance.
- The well should be “shock chlorinated” (disinfected) prior to commissioning.
- The water quality of Well 1439 should be monitored at the time of commissioning, in the subsequent year, and every five years thereafter in accordance with the guidelines for Small Public Drinking Water Systems (Government of Yukon Health and Social Services (2007) Guidelines for Part III – Small Public Drinking Water Systems) to ensure that all health-based parameters meet the drinking water guidelines. This is especially important because the groundwater from the existing Well 1924 is known to exceed the arsenic drinking water guideline and both wells are located close to each other and hydraulically connected.
- Any alterations to the well should be in compliance with the guidelines for Small Public Drinking Water Systems (Government of Yukon Health and Social Services (2007) Guidelines for Part III – Small Public Drinking Water Systems) and the Canadian Groundwater Association’s Well Construction Guidelines (CGWA 1995).
- The proposed location of the parking lot is within 30 m of Well 1439. Although the parking lot is not a significant potential source of contamination, EBA recommends sloping the paving of the parking lot away from the well area. The parking lot should also be monitored and any spills should be cleaned-up thoroughly.
- YG should consider maintaining well 1924 to provide water for fire protection purposes. However, because of its proximity to the new water supply Well 1439 the well should be improved to protect the aquifer. As previously recommended by EBA (2006),
 - a surface seal should be installed to a depth of 3 m bgs; and,
 - the well head enclosure should be improved to prevent access by animals and unauthorized persons.
- If Well 1924 will not be used anymore, YG should decommission the well in accordance with the guidelines for well decommissioning published by the Canadian Groundwater Association (CGWA 1995).

8.0 LIMITATIONS OF REPORT

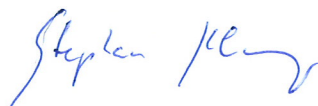
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9.0 CLOSURE

Conclusions and recommendations in this report are based upon the Hydrogeological Investigations as described in the previous sections. This report has been prepared for the use of the Government of Yukon. It has been prepared in accordance with generally accepted hydrogeological practices.

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

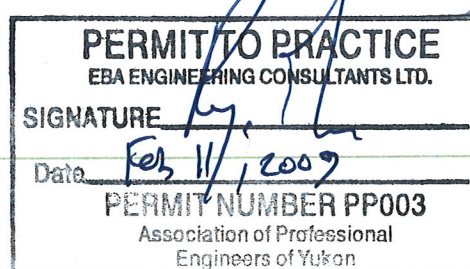
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- Government of Yukon, Health and Social Services (2007) Guidelines for Part III – Small Public Drinking Water Systems.
- Government of Yukon, Health and Social Services. (2006) Assessment Guideline for Well Water or Groundwater Under the Direct Influence of Surface Water (GUDI).
- Health Canada (1987) Guidelines for Canadian Drinking Water Quality – Technical Documents: Manganese.



TABLES



TABLE 4: LABORATORY ANALYTIC RESULTS FOR GOLDEN HORN FIRE HALL WELLS						
Analyte	Well		1439	1924	Canadian Drinking Water Quality Guidelines ¹	
	Description		New Fire Hall	Old Fire Hall		
	Bodycote Report		648492	n/a	Upper Limit	
	Date		9-Oct-08	25-Jun-06		
	Sampled by		EBA	n/a		
		Unit	Results	Results		
Ion Balance		%	3.7	4.6	-	-
Water Type			Mg-Ca-HCO3-SO4	Mg-Ca-HCO3-SO4	-	-
Physical and Field Parameters						
Temperature	T	°C	5.1	-	-	15
Colour		CU	11	<5	-	15
Electrical Conductivity (field)	EC	µS/cm	589	-	-	-
Electrical Conductivity (lab)	EC	µS/cm	584	640	-	-
Total Dissolved Solids (field)	TDS	mg/L	293	-	-	500
Total Dissolved Solids (lab)	TDS	mg/L	350	412	-	500
Hardness (CaCO3)		mg/L	280	337	-	-
pH (field)		pH units	7.40	-	-	6.5-8.5
pH (lab)		pH units	7.93	8.17	-	6.5-8.5
Turbidity (field)		NTU	0.91	-	-	-
Turbidity (lab)		NTU	1.6	1.21	-	-
Dissolved Oxygen (field)	DO	mg/L	0.29	-	-	-
Anions						
Alkalinity-Total (CaCO3)		mg/L	251	294	-	-
Chloride	Cl	mg/L	1.01	1.27	-	250
Fluoride	F	mg/L	0.27	0.406	1.5	-
Sulphate	SO4	mg/L	75.6	101	-	500
Nutrients						
Nitrate Nitrogen	N	NO3	mg/L	<0.01	0.11	10
Nitrite Nitrogen	N	NO2	mg/L	<0.01	<0.10	1
Extractable Metals						
Aluminum	Al	mg/L	<0.02	<0.010	-	-
Antimony	Sb	mg/L	<0.0002	<0.0005	0.006	-
Arsenic	As	mg/L	0.0036	0.0290	0.010	-
Barium	Ba	mg/L	0.029	<0.020	1	-
Boron	B	mg/L	0.017	<0.10	5	-
Cadmium	Cd	mg/L	<0.00007	<0.0002	0.005	-
Calcium	Ca	mg/L	52.0	49.1	-	-
Chromium	Cr	mg/L	0.0023	<0.0020	0.05	-
Copper	Cu	mg/L	<0.001	0.0311	-	1
Iron	Fe	mg/L	0.19	0.142	-	0.3
Lead	Pb	mg/L	<0.0001	0.0014	0.01	-
Magnesium	Mg	mg/L	36.5	52.2	-	-
Manganese	Mn	mg/L	<u>0.06</u>	0.036	-	0.05
Mercury	Hg	mg/L	<0.00001	<0.0002	0.001	-
Phosphorus	P	mg/L	0.01	-	-	-
Potassium	K	mg/L	2.9	2.93	-	-
Selenium	Se	mg/L	<0.0006	<0.0010	0.01	-
Silicon	Si	mg/L	7.28	-	-	-
Sodium	Na	mg/L	11.1	18.6	-	200
Uranium	U	mg/L	0.0082	0.0021	0.02	-
Zinc	Zn	mg/L	0.002	<0.10	-	5
Bacteriological						
Total Coliforms		-	absent	n/a	absent	-
<i>E.coli</i>		-	absent	n/a	absent	-

Notes:

"<" indicates less than detection limit.

"," indicates not analyzed / no guideline established

Bold - indicates parameter above GCDWQ MAC

Underline - indicates parameter above GCDWQ AO.

¹ GCDWQ criteria are taken from the "Guidelines for Canadian Drinking Water Quality, May 2008"

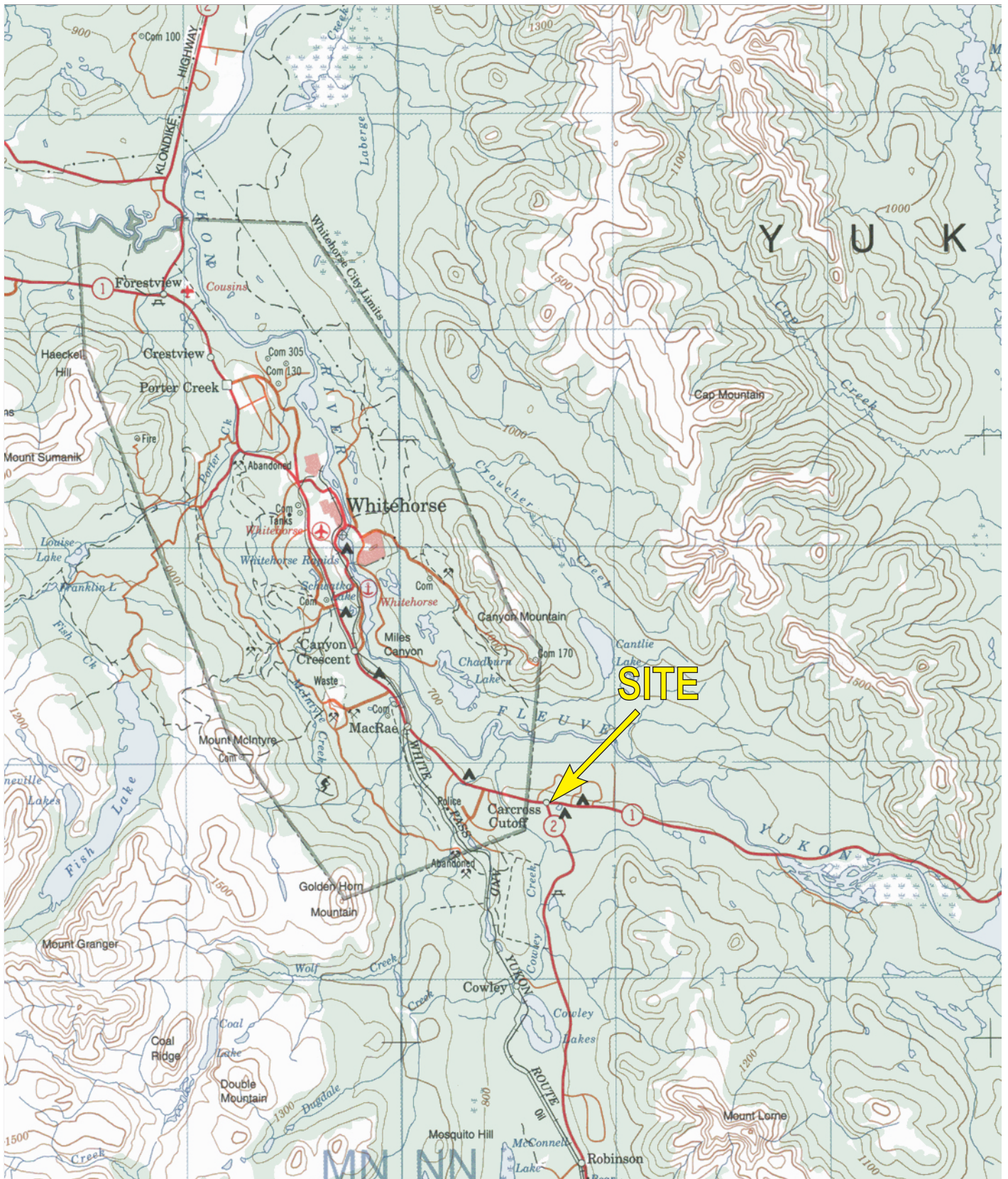
² MAC refers to the Maximum Acceptable Concentration according to the GCDWQ criteria.

³ AO refers to the Aesthetic Objective according to the GCDWQ criteria.



FIGURES





NOTES

Original in colour, black and white reproductions may not be accurate.

Scale: 1 : 250,000



CLIENT



EBA Engineering Consultants Ltd.



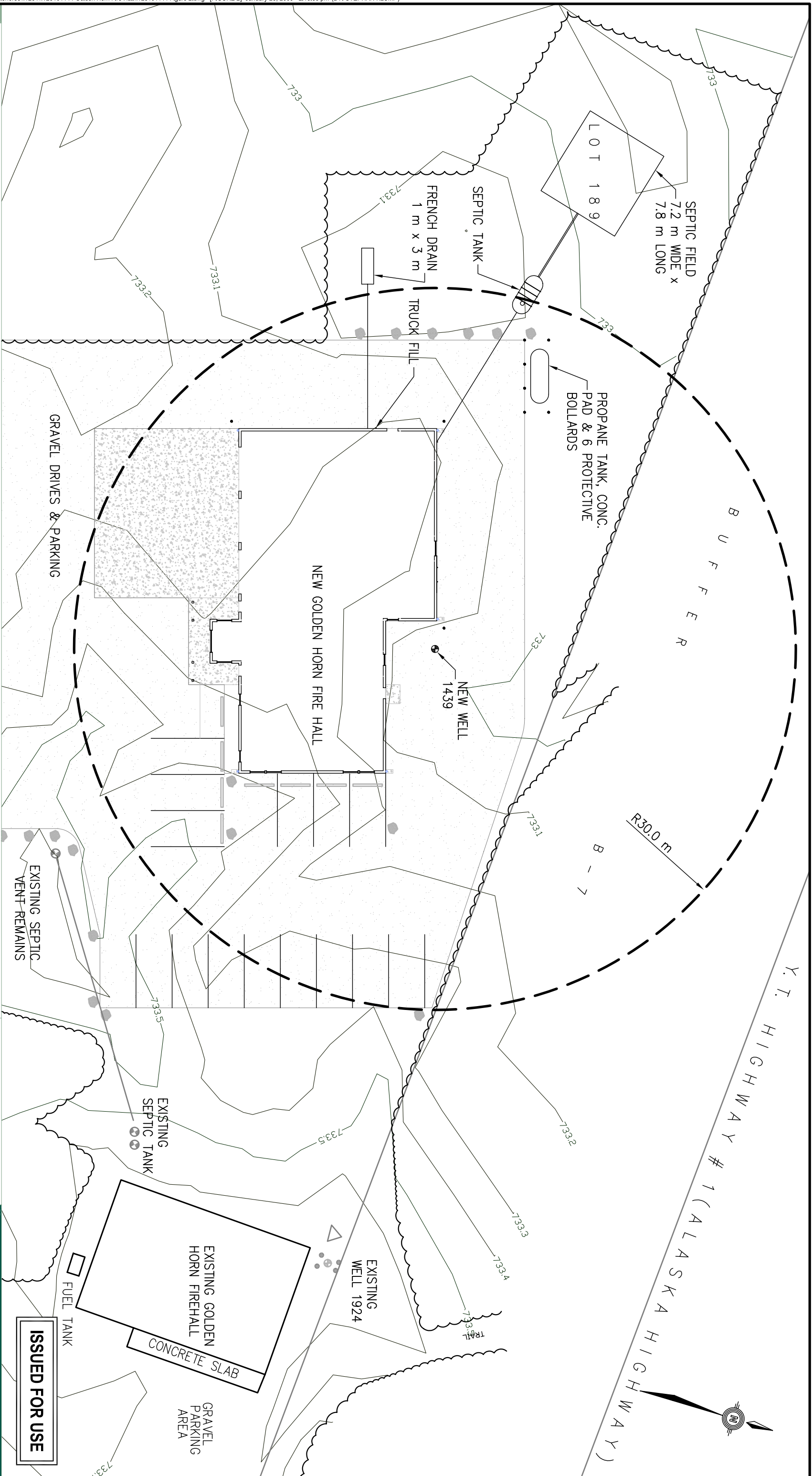
**Golden Horn Fire Hall - Well Completion
Golden Horn, Yukon**

Site Location Map

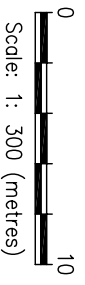
PROJECT NO.
W23101144
OFFICE
EBA-WHSE

DWN SK	CKD RMM	REV 0
DATE January 2009		

Figure 1



LEGEND:
● - WELL LOCATION



Yukon
Property Management Agency

EBA Engineering
Consultants Ltd.



GOLDEN HORN FIRE HALL - WELL COMPLETION
GOLDEN HORN, YUKON

SITE PLAN

ISSUED FOR USE

PROJECT NO.	W23101144	DWN	SK	REV
OFFICE	EBA-WHSE	KJT	SK	0
DATE	January 2009			

Figure 2

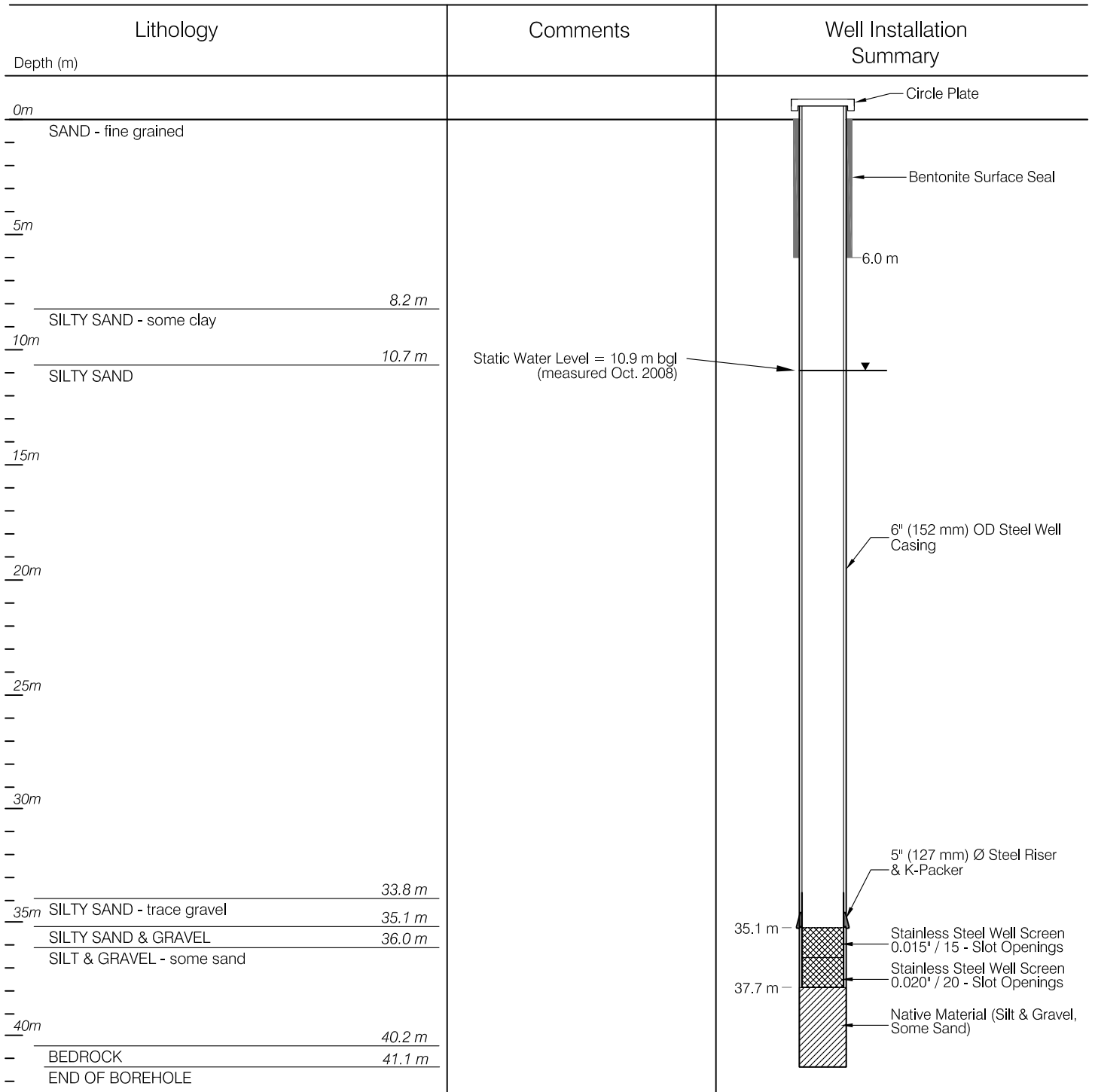
HYDROGEOLOGIC LOG

PURPOSE OF HOLE: Water Supply Well
 DRILLING METHOD: Air Rotary
 DRILLING DATE: 2008/10/09
 SCREEN INSTALLED: 35.1 - 37.7 m
 CONTRACTOR: Double D Drilling Ltd.

BOREHOLE NO.

WELL 1439

CASING STICK UP: 1.0 m above grd.
 DEPTH TO STATIC: 10.9 m bgs
 DEPTH TO SCREEN (m): 35.1 m bgs



C:\Whitehorse\Data\0201\Drawings\Whitehorse\W231\W23101144 Golden Horn Fire Hall\W23101144 Figure 3.dwg [WELL GHFH-2] February 05, 2009 - 4:21 pm kloczyk

CLIENT



Property Management Agency

**GOLDEN HORN FIRE HALL - WELL COMPLETION
 GOLDEN HORN, YUKON**

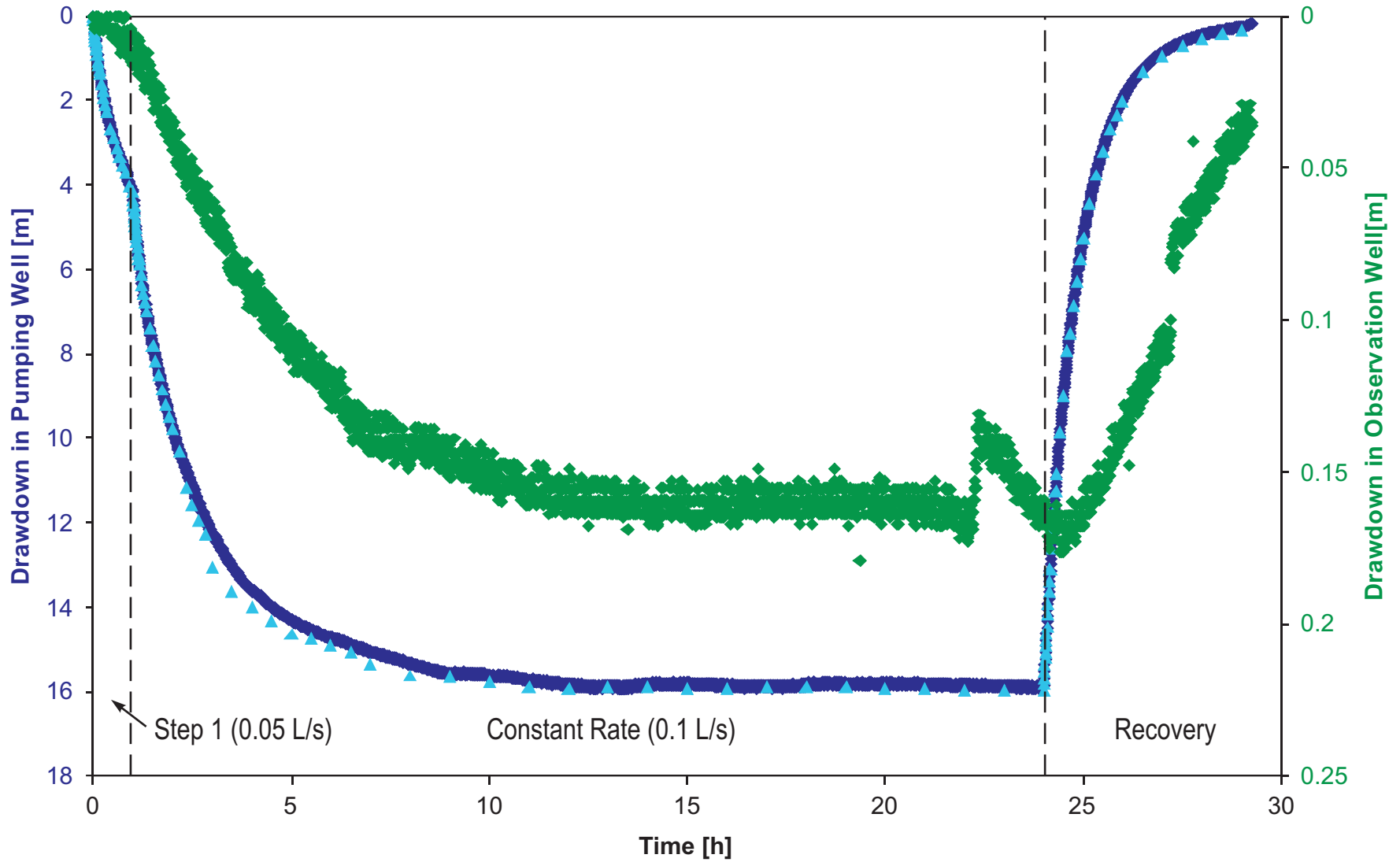
WELL LOG FOR WELL 1439

**EBA Engineering
 Consultants Ltd.**



PROJECT NO. W23101144	DWN KJT	CKD SK	REV 0
OFFICE EBA-WHSE	DATE January 2009		

Figure 3



LEGEND

- ◆ Drawdown in pumping well 1439 during pumping test (data logger)
- ▲ Drawdown in pumping well 1439 during pumping test (manual readings)
- ◆ Drawdown in observation well 1924 during pumping test (data logger)

CLIENT



**Golden Horn Fire Hall - Well Completion
Golden Horn, Yukon**

Observed Drawdown During Pumping Test

EBA Engineering
Consultants Ltd.

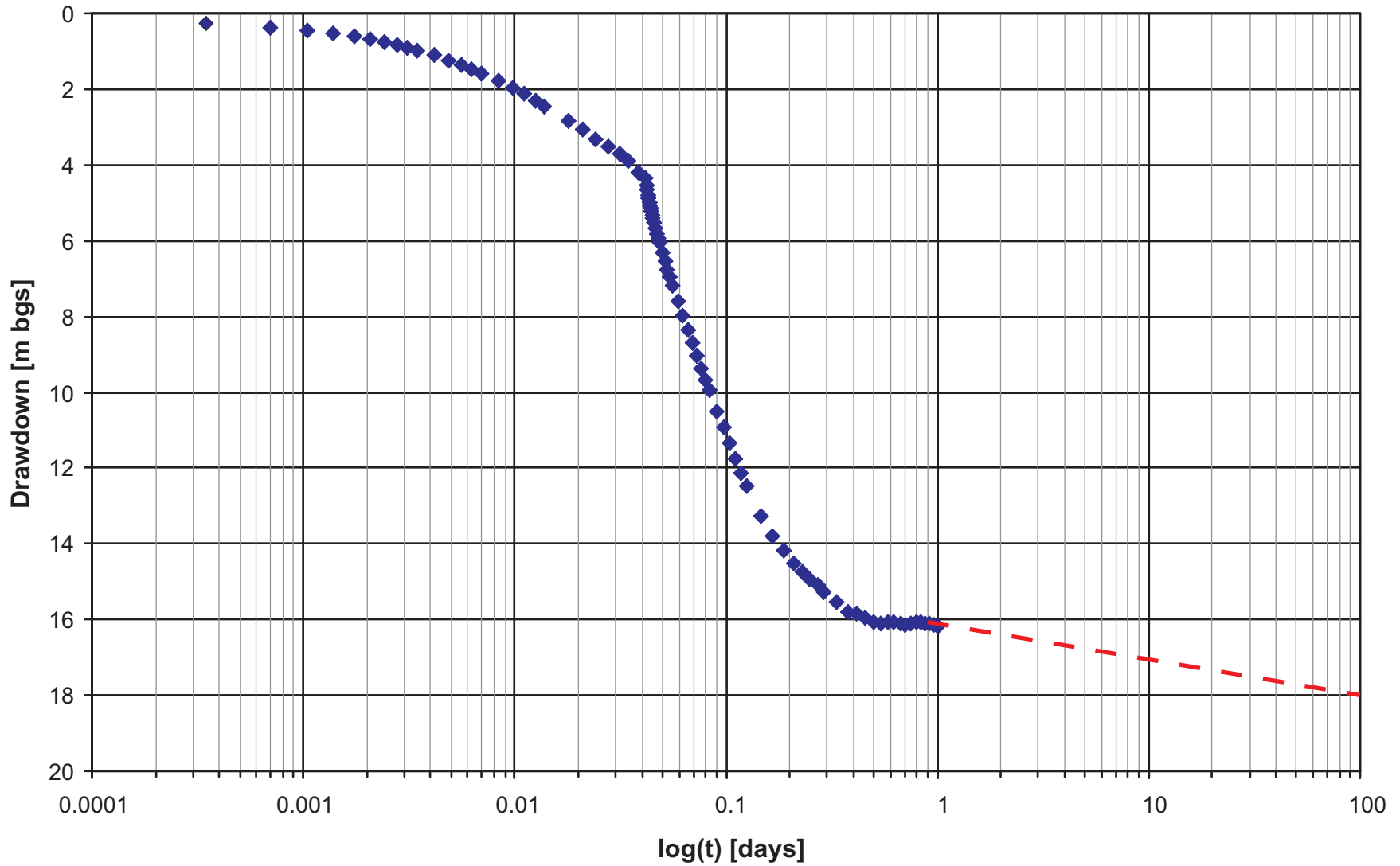


PROJECT NO.
W23101144
OFFICE
EBA-WHSE

DWN
SK
DATE
January 2009

CKD
RMM
REV
0

Figure 4



LEGEND

- ◆ Drawdown in pumping well during constant rate pumping test
- - Extrapolation of drawdown to 100 days

NOTES

CLIENT



**Golden Horn Fire Hall - Well Completion
Golden Horn, Yukon**

**Extrapolation of Drawdown During Constant
Rate Pumping Test to 100 Days**

EBA Engineering
Consultants Ltd.



PROJECT NO.
W23101144
OFFICE
EBA-WHSE

DWN SK	CKD RMM	REV 0
DATE January 2009		

Figure 5



APPENDIX A

APPENDIX A GENERAL CONDITIONS





GEO-ENVIRONMENTAL REPORT – GENERAL CONDITIONS

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

1.0 USE OF REPORT AND OWNERSHIP

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

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

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

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

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

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

3.0 NOTIFICATION OF AUTHORITIES

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



APPENDIX B

APPENDIX B DRILLERS WELL LOG

WATER WELL DRILLERS FORM

Well ID:
 To be assigned by Dept. Of Environment

INSTRUCTIONS FOR COMPLETING THE FORM

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

WELL LOCATION AND OWNER'S INFORMATION

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

A2 Drilled For: First Name: KEVIN Last Name: SUMNER Company / Department / Organization: GOVERNMENT OF YUKON

A3 Street Address of Well Location:

A4 Town / Village / Area / Lot #: GOLDEN HORN FIREHALL

A5 UTM Coordinates (using handheld GPS): NAD 8 3 Zone 1

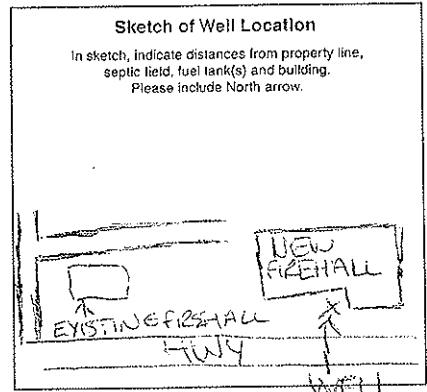
095061814 671181015
 Easting Northing

A6 Elevation of Top of Casing: 730 (m) / ft ASL

A7 Accuracy of GPS: 26 +/- (m) / ft

A8 Purpose of Wells

- | | | | |
|--|---------------------------------------|--|--|
| <input type="checkbox"/> Domestic | <input type="checkbox"/> Test Well | <input type="checkbox"/> Irrigation | <input type="checkbox"/> Environmental (Quality) |
| <input checked="" type="checkbox"/> Commercial | <input type="checkbox"/> Municipal | <input type="checkbox"/> Observation - Water Level | <input checked="" type="checkbox"/> Other (please identify use) |
| <input type="checkbox"/> Industrial | <input type="checkbox"/> Agricultural | <input type="checkbox"/> Public/Recreational | FIREHALL |



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

EXAMPLE ONLY		(brown, grey, green, black, reddish, beige, olive, yellowish)	CLAY, SILT, SAND, GRAVEL, COBBLES, BOULDERS, BEDROCK	"trace" <10% (i.e. SILT trace gravel) "some" 10-20% (i.e. SAND some gravel) "silty / sandy / gravelly" 20-50% (i.e. silty SAND) "and sand" or "and gravel" 35-50%	MOISTURE: dry / moist / saturated (wet) HARDNESS: soft / hard / very hard
		brown	SAND	trace gravel some silt	soft and saturated
Depth (m / ft)	B4 General Colour	B5 Most Common Material	B6 Secondary Materials	B7 General Description	
B2 From	B3 To				
0	27	BRN	FINE SAND		
27	35	BRN/GY	SILTY SAND	SOME CLAY	
35	111	GY	SILTY SAND		W/B @ 35
111	115	GY	SILTY SAND	TRACE GRAVEL	VERY STICKY
115	124	BRN/GY	FINE GRAVEL	TRACE COARSE GRAVEL	
				SOME FINE SAND +	SILT, VERY DENSE MATERIAL
124	132	BRN/GY	FINE-MED GRAVEL	WELL CUT WATER	OFF @ 124 FT
132	135	GRN	BEDROCK	GOOD FRACTURE	@ 134 BUT NO
				WATER INCREASE	

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

WELL CONSTRUCTION (Continues on Page 2)

Date Well Completed: 20081906
 Y Y Y Y M M D D

Example: 2005 01 31

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

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

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

C3 Outside Diameter: 6 (cm / in)
 C4 Casing Material: Steel Plastic Other
 C5 Casing Wall Thickness: 2.50 (cm / in)
 C6 Casing Depth to: 116.4 (m / ft)

C7 Other Comments Regarding Casing:

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

C8 Seal Material Type: 5/8" CEMENT (i.e. Bentonite)
 C9 Diameter of Seal: 4 (cm)
 C10 Seal Depth from: 2.5 (m)
 C11 Seal Depth to: 14.5 (m)
 C12 Volume Placed: 10 (m³)

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

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

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

C14 Outside Diameter: 5 (cm)
 C15 Screen Material: Stainless Steel Steel Plastic N/A Other:
 C16 Screen Type: Continuous Wires Wrap Louver Screen Perforated Slotted Open Hole
 C17 Depth from: 2.5 (m / ft) Screen 1: 11.5 (m / ft) Slot Size / Perforation Dia: .015 Thou. / mm / inches
 Screen 2: 11.5 (m / ft) 11.5 (m / ft) .020 Thou. / mm / inches
 Screen 3: (m / ft) (m / ft) Thou. / mm / inches
 C19 Screen Comments: PACKER RISER = 2 FT 0 IN. OVERALL LENGTH 10 FT 8 IN.

WELL DEVELOPMENT AND STATUS

D1 Well Developed by: Surge Block Water Jetting Air Jetting / Air Lifting Bailing Pumping Other:
 D2 Well Head Completion: Well House Pileless Adaptor WELD PLATE (mm / ft) Well Pit (NOT PERMITTED) None (well not completed)
 D3 Well Head Stick-up (above ground surface): (ft) (Use negative if below grade)
 D4 Static Water Level (below top of casing): (m / ft) (Use negative if below grade)
 D5 Well Yield Estimate: 2 (Lps) (gpm)
 D6 Final Well Status: Water Supply (in use) Stand by (Back-up) Observation Not in use Deepened Other: Abandoned (If well was abandoned, please give reason:) Dry Poor Quality Insufficient Yield Artesian conditions
 D7 Well Abandonment Status: Was the well properly decommissioned with bentonite grout? YES NO If YES, Indicate Date: Y Y Y Y M M D D
 D8 Method Used to Estimate Well Yield: Air Lifting Bailing Pumping Test (If test conducted, complete Pumping Test Record)

PUMPING TEST RECORD AND GROUNDWATER QUALITY

E1 Pumping Test Information
 Pumping Test Start Date: 20081008 Y Y Y Y M M D D
 Static Water Level (SWL): 10.9 (m / ft)
 Pump Intake Set at: 35.5 (m / ft)
 Duration of pumping: 24 hrs min
 Final Water Level (FWL) at end of Pumping Test: 27.08 (m / ft)
 G1 GROUNDWATER QUALITY
 Field Data: Date Measurements Taken: 20081009 Y Y Y Y M M D D
 Electrical Conductivity: 587 uS
 pH: 7.40
 Temperature: 5.1 °C
 Turbidity/Sand Content: Clear Slightly turbid/cloudy Moderately turbid/cloudy Turbid/cloudy Trace sand present No sand present
 Recommendations: Recomm. Pump Depth: 32 (m / ft) Recomm. Pumping Rate: 0.08 (Lps / gpm) If flowing, provide rate: N/A (Lps / gpm)

F1 Well Water Level Drawdown/Recovery DATA

Drawdown		Recovery	
Time (min)	Water Level (m / ft)	Time (min)	Water Level (m / ft)
0 (SWL)	10.9	0 (FWL)	27.08
1	11.28	1	26.73
2	11.45	2	26.45
3	11.61	3	26.15
4	11.76	4	25.86
5	11.90	5	25.57
10	12.49	10	24.21
15	12.92	15	23.00
20	13.36	20	21.93
25	13.76	25	20.97
30	13.99	30	20.10
40	14.44	40	18.61
50	14.80	50	17.38
60	15.26	60	16.37

Bacteria Testing

Was a sample taken? YES NO If yes, indicate the name of the laboratory:
 Date Sample Taken: 20081009 Y Y Y Y M M D D EHS White

Chemical Analysis of Water

Was a sample taken? YES NO If yes, indicate the name of the laboratory:
 Date Sample Taken: 20081009 Y Y Y Y M M D D Bodycote

WELL CONTRACTOR

H1 Name of Contractor / Drilling Company: DOORS DRILLING LTD
 H2 Name of Driller(s): ROB STANUICE
 H3 Address of Driller: WID # 06 032 802
 Signature of Primary Driller: [Signature]
 Date Submitted to Dept. Of Environment: Y Y Y Y M M D D

CONSULTANT (if applicable)

I1 Company Name: EBA Engineering Consultants
 I2 Company Address: Katikan Business Centre Unit
 I3 Report Reference: W23101144
 I4 Report Date: 210019011219 Y Y Y Y M M D D

ADDITIONAL INSTRUCTIONS

Upon completing this form, please mail or fax it to:
 Water Resources Section (V-310), Department of Environment, Government of Yukon Box 2703, Whitehorse, Yukon, Canada Y1A 2C6
 Please feel free to contact us at:
 Phone: (867) 667-3171, Toll free (in Yukon): (1-800) 661-0408, local 3171)
 Fax: (867) 667-3195 E-mail: Water.Resources@gov.yk.ca

Personal information contained on this form is collected under the authority of the Access to Information and Protection of Privacy (ATIP/PA) Act, Section 29 (c) and will be used to compile a public database of well and ground water information. For further information contact the Manager of Hydrology, Water Resources at (867) 667-3223, toll free within Yukon 1-800-661-0408 Ext 3223.
 I have read the above clause and understand the purpose for collection of personal information.
 Signature of Well Owner:



APPENDIX C

APPENDIX C PUMPING TEST DATA

APPENDIX C: PUMPING TEST DATA								
EBA Project Number: W23101144			Project Location: Golden Horn Fire Hall					
Well Name: 1439			Pump Intake Depth (m): 33.5					
Static Water Level (m): 12.20			Screen Interval: 35.1-37.7 m bgs					
Datum Description: Top of Sounding Tube			Slot Size ("): 0.015 / 0.020					
Datum Stick-Up (m): 1.26			Available Drawdown (m): ~ 19 m					
Well Diameter (mm): 152.4			Screen Diameter (mm): 127					
Total Well Depth: 37.7 m bgs			Observer's Name: Double D Drilling / S. Klump, EBA					
Date	Time	Elapsed Time (min)	Depth to Water (m)	Drawdown (m)	Flow Rate (l/gpm)	Flow Rate (L/s)	Specific Capacity (L/s/m)	Comments
10/8/2008	11:17:00	0	12.35	0.000	0.7	0.05	-	STEP 1
10/8/2008	11:17:30	0.5	12.45	0.100	0.7	0.05	0.50	
10/8/2008	11:18:00	1	12.54	0.190	0.7	0.05	0.26	
10/8/2008	11:18:30	1.5	12.62	0.270	0.7	0.05	0.19	
10/8/2008	11:19:00	2	12.71	0.360	0.7	0.05	0.14	
10/8/2008	11:19:30	2.5	12.79	0.440	0.7	0.05	0.11	
10/8/2008	11:20:00	3	12.87	0.520	0.7	0.05	0.10	
10/8/2008	11:20:30	3.5	12.95	0.600	0.7	0.05	0.08	
10/8/2008	11:21:00	4	13.02	0.670	0.7	0.05	0.07	
10/8/2008	11:21:30	4.5	13.09	0.740	0.7	0.05	0.07	
10/8/2008	11:22:00	5	13.16	0.810	0.7	0.05	0.06	
10/8/2008	11:23:00	6	13.29	0.940	0.7	0.05	0.05	
10/8/2008	11:24:00	7	13.42	1.065	0.7	0.05	0.05	
10/8/2008	11:25:00	8	13.53	1.180	0.7	0.05	0.04	
10/8/2008	11:26:00	9	13.64	1.290	0.7	0.05	0.04	
10/8/2008	11:27:00	10	13.75	1.395	0.7	0.05	0.04	
10/8/2008	11:29:00	12	13.95	1.600	0.7	0.05	0.03	
10/8/2008	11:31:00	14	14.13	1.780	0.7	0.05	0.03	
10/8/2008	11:33:00	16	14.31	1.960	0.7	0.05	0.03	
10/8/2008	11:35:00	18	14.47	2.120	0.7	0.05	0.02	
10/8/2008	11:37:00	20	14.62	2.265	0.7	0.05	0.02	
10/8/2008	11:42:00	25	15.02	2.670	0.7	0.05	0.02	
10/8/2008	11:47:00	30	15.25	2.900	0.7	0.05	0.02	
10/8/2008	11:52:00	35	15.49	3.140	0.7	0.05	0.02	
10/8/2008	11:57:00	40	15.70	3.350	0.7	0.05	0.01	
10/8/2008	12:02:00	45	15.89	3.535	0.7	0.05	0.01	
10/8/2008	12:07:00	50	16.06	3.705	0.7	0.05	0.01	
10/8/2008	12:12:00	55	16.38	4.025	0.7	0.05	0.01	
10/8/2008	12:17:00	60	16.52	4.170	0.7	0.05	0.01	
10/8/2008	12:17:30	60.5	16.70	4.350	1.3	0.10	0.02	CONSTANT RATE
10/8/2008	12:18:00	61	16.83	4.480	1.3	0.10	0.02	
10/8/2008	12:18:30	61.5	16.97	4.620	1.3	0.10	0.02	
10/8/2008	12:19:00	62	17.07	4.720	1.3	0.10	0.02	
10/8/2008	12:19:30	62.5	17.15	4.800	1.3	0.10	0.02	
10/8/2008	12:20:00	63	17.23	4.880	1.3	0.10	0.02	
10/8/2008	12:20:30	63.5	17.32	4.965	1.3	0.10	0.02	
10/8/2008	12:21:00	64	17.39	5.040	1.3	0.10	0.02	
10/8/2008	12:21:30	64.5	17.49	5.140	1.3	0.10	0.02	
10/8/2008	12:22:00	65	17.58	5.230	1.3	0.10	0.02	
10/8/2008	12:23:00	66	17.70	5.345	1.3	0.10	0.02	
10/8/2008	12:24:00	67	17.84	5.490	1.3	0.10	0.02	
10/8/2008	12:25:00	68	17.98	5.630	1.3	0.10	0.02	
10/8/2008	12:26:00	69	18.11	5.760	1.3	0.10	0.02	
10/8/2008	12:27:00	70	18.24	5.890	1.3	0.10	0.02	
10/8/2008	12:29:00	72	18.48	6.130	1.3	0.10	0.02	
10/8/2008	12:31:00	74	18.72	6.365	1.3	0.10	0.02	
10/8/2008	12:33:00	76	18.93	6.580	1.3	0.10	0.02	
10/8/2008	12:35:00	78	19.14	6.785	1.3	0.10	0.01	
10/8/2008	12:37:00	80	19.37	7.015	1.3	0.10	0.01	
10/8/2008	12:42:00	85	19.77	7.417	1.3	0.10	0.01	
10/8/2008	12:47:00	90	20.15	7.803	1.3	0.10	0.01	
10/8/2008	12:52:00	95	20.53	8.180	1.3	0.10	0.01	
10/8/2008	12:57:00	100	20.88	8.525	1.3	0.10	0.01	
10/8/2008	13:02:00	105	21.21	8.860	1.3	0.10	0.01	
10/8/2008	13:07:00	110	21.55	9.195	1.3	0.10	0.01	
10/8/2008	13:12:00	115	21.85	9.495	1.3	0.10	0.01	
10/8/2008	13:17:00	120	22.13	9.782	1.3	0.10	0.01	
10/8/2008	13:27:00	130	22.67	10.320	1.3	0.10	0.01	
10/8/2008	13:37:00	140	23.52	11.167	1.3	0.10	0.01	
10/8/2008	13:47:00	150	23.93	11.575	1.3	0.10	0.01	
10/8/2008	13:57:00	160	24.30	11.948	1.3	0.10	0.01	
10/8/2008	14:07:00	170	24.64	12.290	1.3	0.10	0.01	
10/8/2008	14:17:00	180	25.43	13.080	1.3	0.10	0.01	
10/8/2008	14:47:00	210	25.97	13.622	1.3	0.10	0.01	
10/8/2008	15:17:00	240	26.36	14.014	1.3	0.10	0.01	
10/8/2008	15:47:00	270	26.69	14.337	1.3	0.10	0.01	
10/8/2008	16:17:00	300	26.99	14.640	1.3	0.10	0.01	
10/8/2008	16:47:00	330	27.10	14.747	1.3	0.10	0.01	
10/8/2008	17:17:00	360	27.27	14.917	1.3	0.10	0.01	
10/8/2008	17:47:00	390	27.44	15.088	1.3	0.10	0.01	
10/8/2008	18:17:00	420	27.73	15.380	1.3	0.10	0.01	

APPENDIX C: PUMPING TEST DATA								
EBA Project Number: W23101144			Project Location: Golden Horn Fire Hall					
Well Name: 1439			Pump Intake Depth (m): 33.5					
Static Water Level (m): 12.20			Screen Interval: 35.1-37.7 m bgs					
Datum Description: Top of Sounding Tube			Slot Size ("): 0.015 / 0.020					
Datum Stick-Up (m): 1.26			Available Drawdown (m): ~ 19 m					
Well Diameter (mm): 152.4			Screen Diameter (mm): 127					
Total Well Depth: 37.7 m bgs			Observer's Name: Double D Drilling / S. Klump, EBA					
Date	Time	Elapsed Time (min)	Depth to Water (m)	Drawdown (m)	Flow Rate (l/gpm)	Flow Rate (L/s)	Specific Capacity (L/s/m)	Comments
10/8/2008	19:17:00	480	27.98	15.630	1.3	0.10	0.01	
10/8/2008	20:17:00	540	28.01	15.660	1.3	0.10	0.01	
10/8/2008	21:17:00	600	28.11	15.762	1.3	0.10	0.01	
10/8/2008	22:17:00	660	28.24	15.892	1.3	0.10	0.01	
10/8/2008	23:17:00	720	28.28	15.932	1.3	0.10	0.01	
10/9/2008	0:17:00	780	28.24	15.888	1.3	0.10	0.01	
10/9/2008	1:17:00	840	28.24	15.890	1.3	0.10	0.01	
10/9/2008	2:17:00	900	28.28	15.926	1.3	0.10	0.01	
10/9/2008	3:17:00	960	28.30	15.950	1.3	0.10	0.01	
10/9/2008	4:17:00	1020	28.26	15.914	1.3	0.10	0.01	
10/9/2008	5:17:00	1080	28.25	15.899	1.3	0.10	0.01	
10/9/2008	6:17:00	1140	28.25	15.904	1.3	0.10	0.01	
10/9/2008	7:17:00	1200	28.27	15.924	1.3	0.10	0.01	
10/9/2008	8:17:00	1260	28.30	15.949	1.3	0.10	0.01	
10/9/2008	9:17:00	1320	28.33	15.975	1.3	0.10	0.01	
10/9/2008	10:17:00	1380	28.34	15.992	1.3	0.10	0.01	
10/9/2008	11:17:00	1440	28.34	15.992	1.3	0.10	0.01	
10/9/2008	11:17:30	1440.5	28.18	15.830	0.0	0.00	-	RECOVERY
10/9/2008	11:18:00	1441	28.03	15.680	0.0	0.00	-	
10/9/2008	11:18:30	1441.5	27.88	15.525	0.0	0.00	-	
10/9/2008	11:19:00	1442	27.71	15.360	0.0	0.00	-	
10/9/2008	11:19:30	1442.5	27.56	15.210	0.0	0.00	-	
10/9/2008	11:20:00	1443	27.41	15.060	0.0	0.00	-	
10/9/2008	11:20:30	1443.5	27.26	14.910	0.0	0.00	-	
10/9/2008	11:21:00	1444	27.12	14.770	0.0	0.00	-	
10/9/2008	11:21:30	1444.5	26.98	14.630	0.0	0.00	-	
10/9/2008	11:22:00	1445	26.83	14.480	0.0	0.00	-	
10/9/2008	11:23:00	1446	26.54	14.185	0.0	0.00	-	
10/9/2008	11:24:00	1447	26.27	13.915	0.0	0.00	-	
10/9/2008	11:25:00	1448	26.00	13.645	0.0	0.00	-	
10/9/2008	11:26:00	1449	25.74	13.385	0.0	0.00	-	
10/9/2008	11:27:00	1450	25.47	13.120	0.0	0.00	-	
10/9/2008	11:29:00	1452	24.98	12.625	0.0	0.00	-	
10/9/2008	11:31:00	1454	24.47	12.120	0.0	0.00	-	
10/9/2008	11:33:00	1456	24.04	11.690	0.0	0.00	-	
10/9/2008	11:35:00	1458	23.60	11.250	0.0	0.00	-	
10/9/2008	11:37:00	1460	23.19	10.840	0.0	0.00	-	
10/9/2008	11:42:00	1465	22.23	9.880	0.0	0.00	-	
10/9/2008	11:47:00	1470	21.36	9.010	0.0	0.00	-	
10/9/2008	11:52:00	1475	20.28	7.930	0.0	0.00	-	
10/9/2008	11:57:00	1480	19.87	7.515	0.0	0.00	-	
10/9/2008	12:02:00	1485	19.22	6.870	0.0	0.00	-	
10/9/2008	12:07:00	1490	18.64	6.290	0.0	0.00	-	
10/9/2008	12:12:00	1495	18.11	5.760	0.0	0.00	-	
10/9/2008	12:17:00	1500	17.63	5.280	0.0	0.00	-	
10/9/2008	12:27:00	1510	16.80	4.450	0.0	0.00	-	
10/9/2008	12:37:00	1520	16.12	3.770	0.0	0.00	-	
10/9/2008	12:47:00	1530	15.56	3.210	0.0	0.00	-	
10/9/2008	12:57:00	1540	15.04	2.690	0.0	0.00	-	
10/9/2008	13:07:00	1550	14.71	2.358	0.0	0.00	-	
10/9/2008	13:17:00	1560	14.38	2.032	0.0	0.00	-	
10/9/2008	13:47:00	1590	13.67	1.323	0.0	0.00	-	
10/9/2008	14:17:00	1620	13.30	0.948	0.0	0.00	-	
10/9/2008	14:47:00	1650	13.05	0.698	0.0	0.00	-	
10/9/2008	15:17:00	1680	12.89	0.535	0.0	0.00	-	
10/9/2008	15:47:00	1710	12.78	0.425	0.0	0.00	-	
10/9/2008	16:17:00	1740	12.70	0.345	0.0	0.00	-	



APPENDIX D

APPENDIX D PUMPING TEST ANALYSIS



EBA Engineering Consultants Ltd.

Calcite Business Centre
Unit 6, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3

Pumping test analysis

No: W23101144

Project: Golden Horn Fire Hall - Well Completion

Client: Government of Yukon

Location: Golden Horn, Yukon

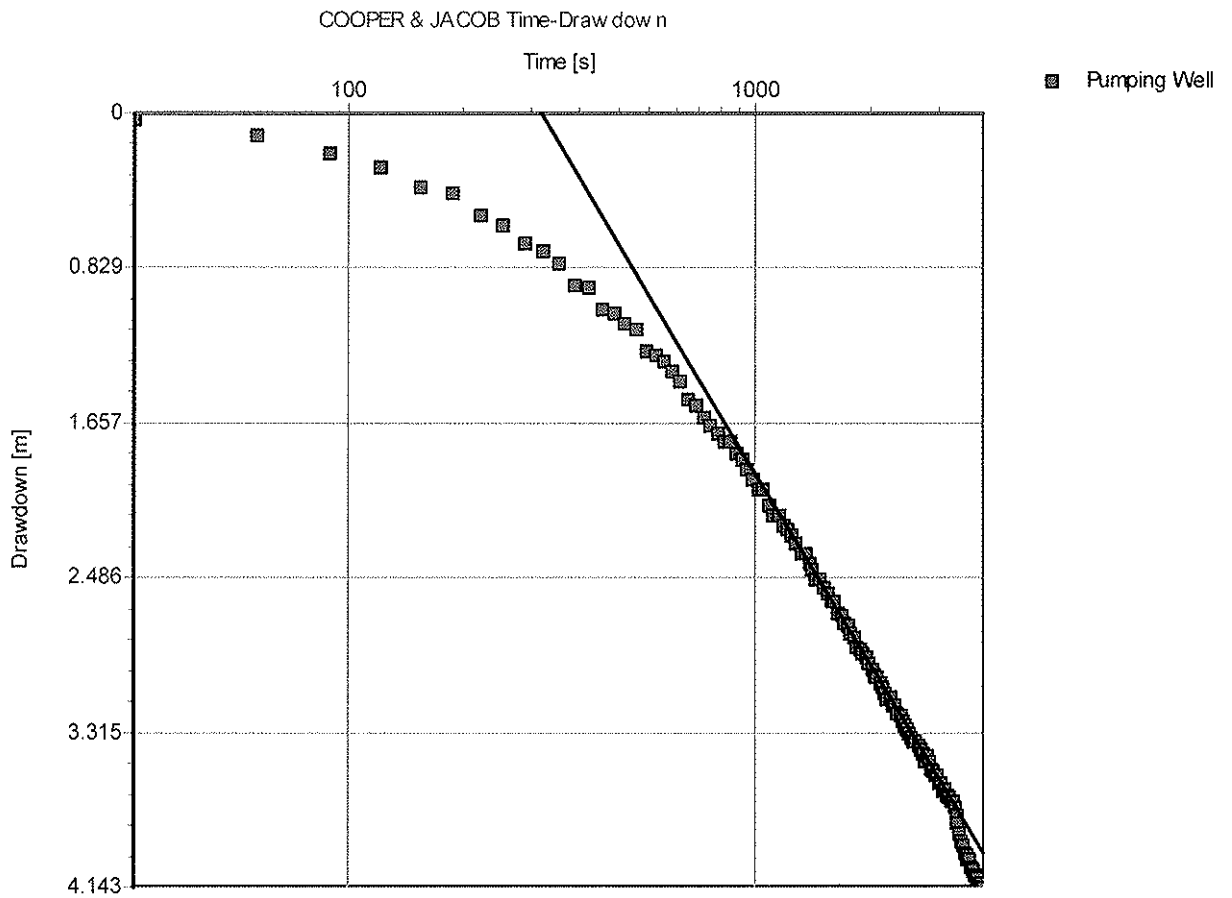
Test performed by: Double D Drilling

Test date: 10/8/2008

Evaluated by: SK

Reviewed by: RMM

Analysis method: COOPER & JACOB Time-Drawdown



Transmissivity: 4.03×10^{-6} [m²/s]

Conductivity: 1.58×10^{-7} [m/s]

Comments:

Pumping Well - Step 1



EBA Engineering Consultants Ltd.

Calcite Business Centre
Unit 6, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3

Pumping test analysis

No: W23101144

Project: Golden Horn Fire Hall - Well Completion

Client: Government of Yukon

Location: Golden Horn, Yukon

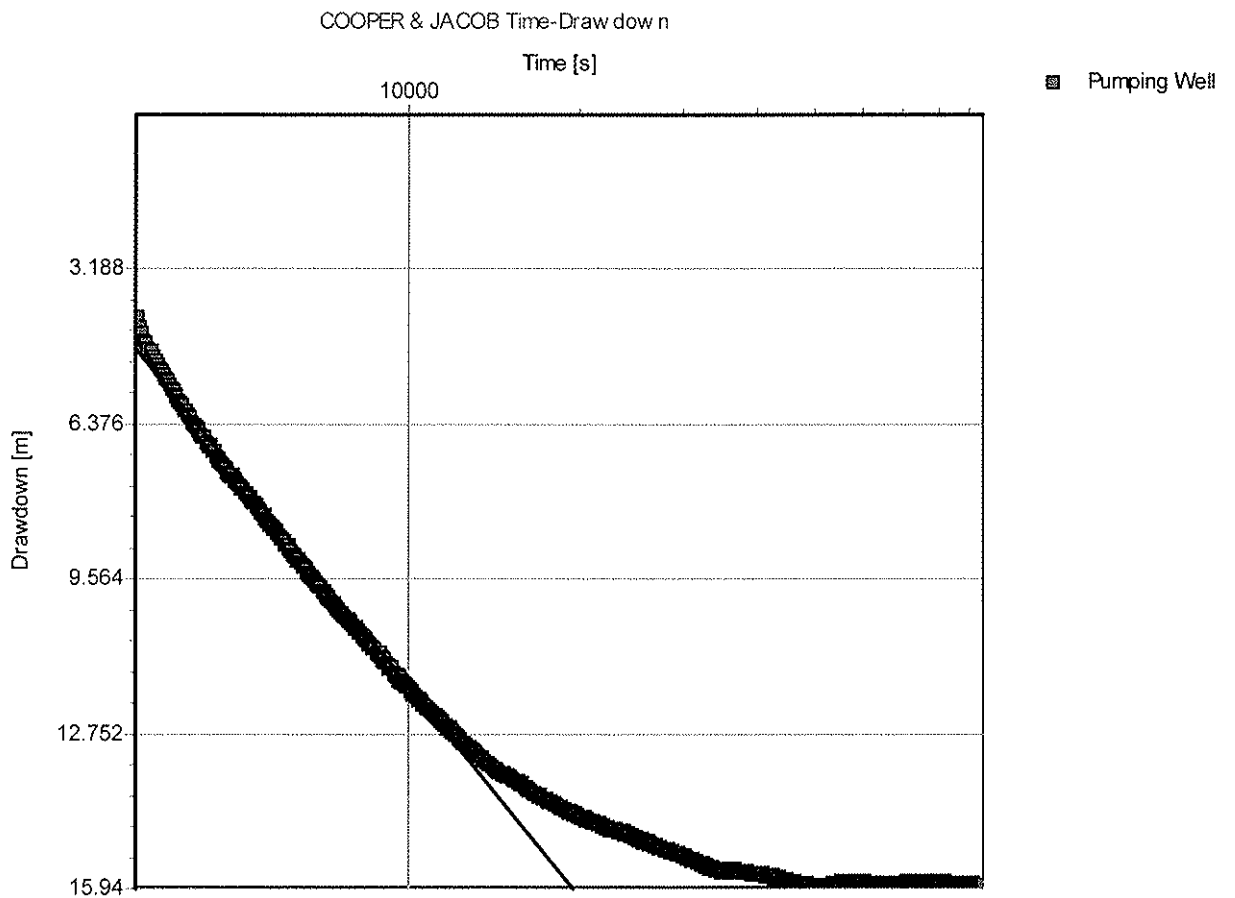
Test performed by: Double D Drilling

Test date: 10/8/2008

Evaluated by: SK

Reviewed by: RMM

Analysis method: COOPER & JACOB Time-Drawdown



Transmissivity: 9.42×10^{-7} [m²/s]

Conductivity: 3.69×10^{-8} [m/s]

Comments:

Pumping Well - Constant Rate, Early Time

**EBA Engineering Consultants Ltd.**

Calcite Business Centre
Unit 6, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3

Pumping test analysis

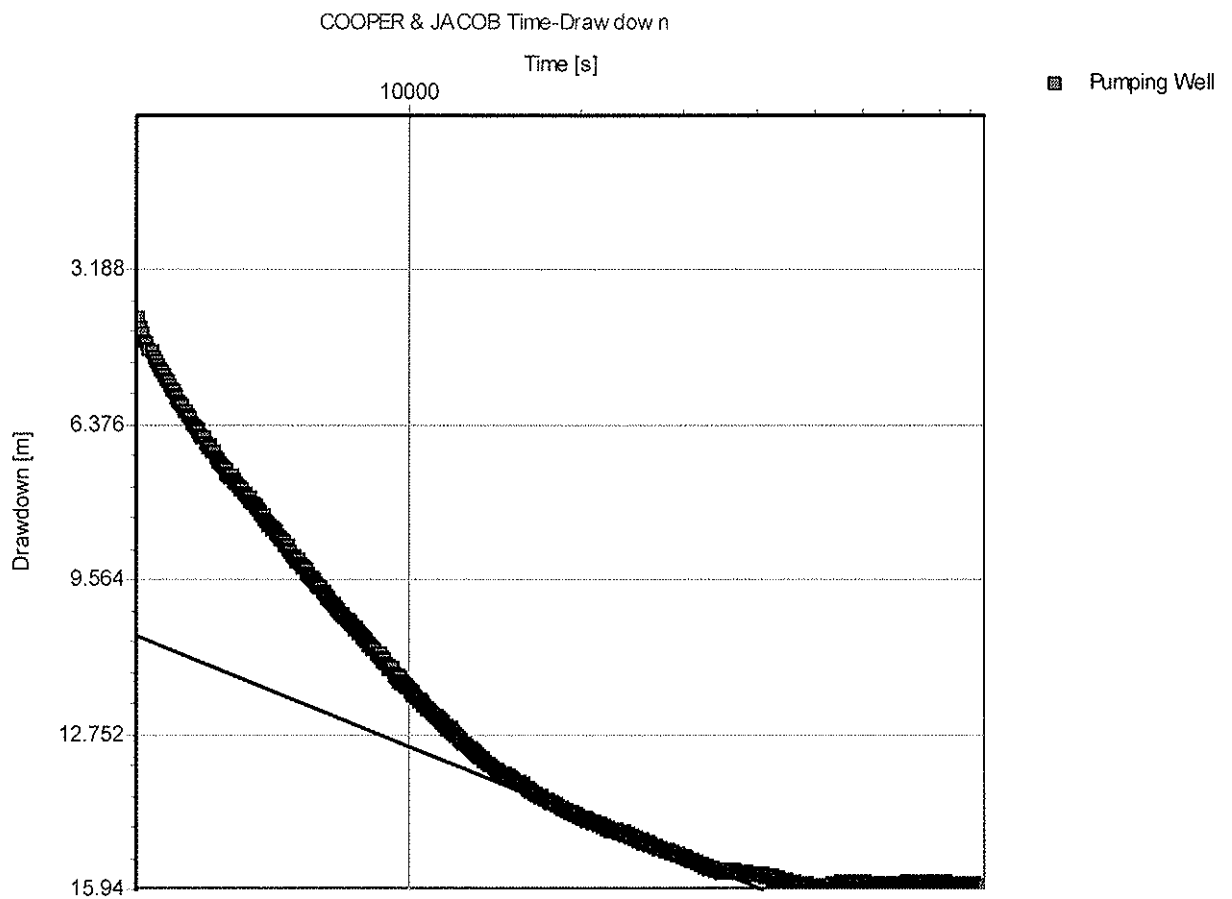
No: W23101144
Project: Golden Horn Fire Hall - Well Completion
Client: Government of Yukon

Location: Golden Horn, Yukon

Test performed by: Double D Drilling
Test date: 10/8/2008

Evaluated by: SK
Reviewed by: RMM

Analysis method: COOPER & JACOB Time-Drawdown



Transmissivity: 2.86×10^{-6} [m²/s]

Conductivity: 1.12×10^{-7} [m/s]

Comments:

Pumping Well - Constant Rate, Late Time



EBA Engineering Consultants Ltd.

Calcite Business Centre
Unit 6, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3

Pumping test analysis

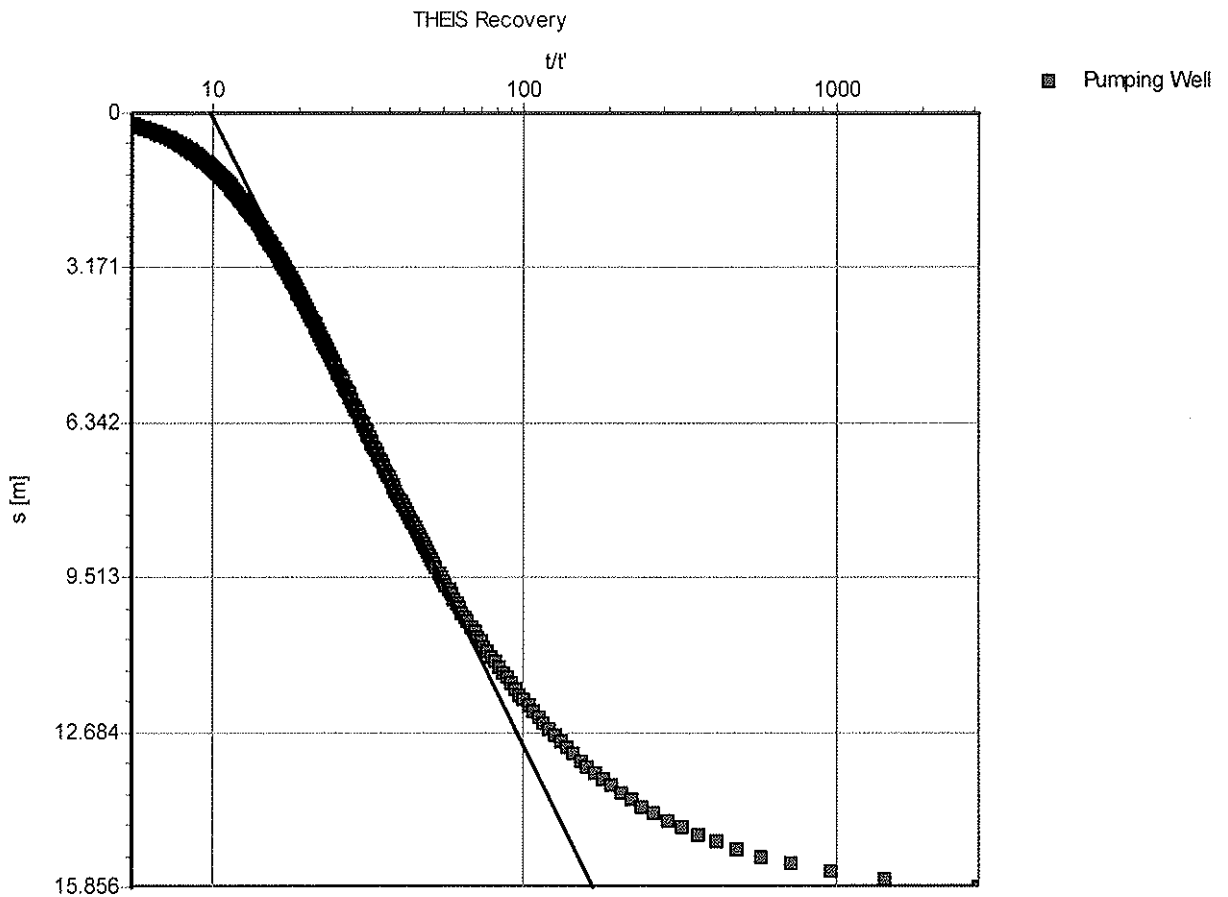
No: W23101144
Project: Golden Horn Fire Hall - Well Completion
Client: Government of Yukon

Location: Golden Horn, Yukon

Test performed by: Double D Drilling
Test date: 10/8/2008

Evaluated by: SK
Reviewed by: RMM

Analysis method: THEIS Recovery



Transmissivity: 1.14×10^{-6} [m²/s]

Conductivity: 4.47×10^{-8} [m/s]

Comments:

Pumping Well - Recovery

**EBA Engineering Consultants Ltd.**

Calcite Business Centre
Unit 6, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3

Pumping test analysis

No: W23101144

Project: Golden Horn Fire Hall - Well Completion

Client: Government of Yukon

Location: Golden Horn, Yukon

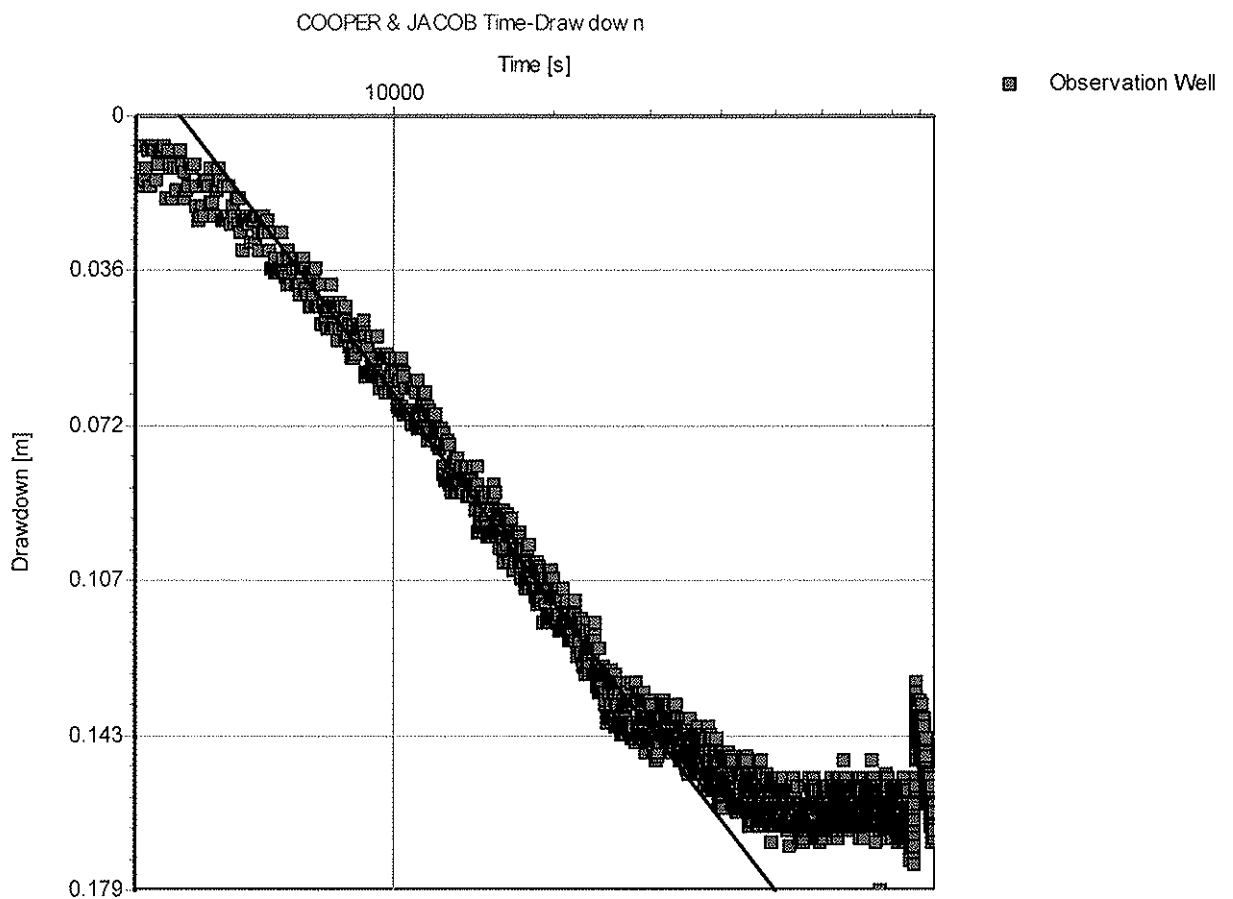
Test performed by: Double D Drilling

Test date: 10/8/2008

Evaluated by: SK

Reviewed by: RMM

Analysis method: COOPER & JACOB Time-Drawdown

Transmissivity: 8.48×10^{-5} [m²/s]Conductivity: 3.33×10^{-6} [m/s]

Comments:

Observation Well - Constant Rate, Early Time



EBA Engineering Consultants Ltd.

Calcite Business Centre
Unit 6, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3

Pumping test analysis

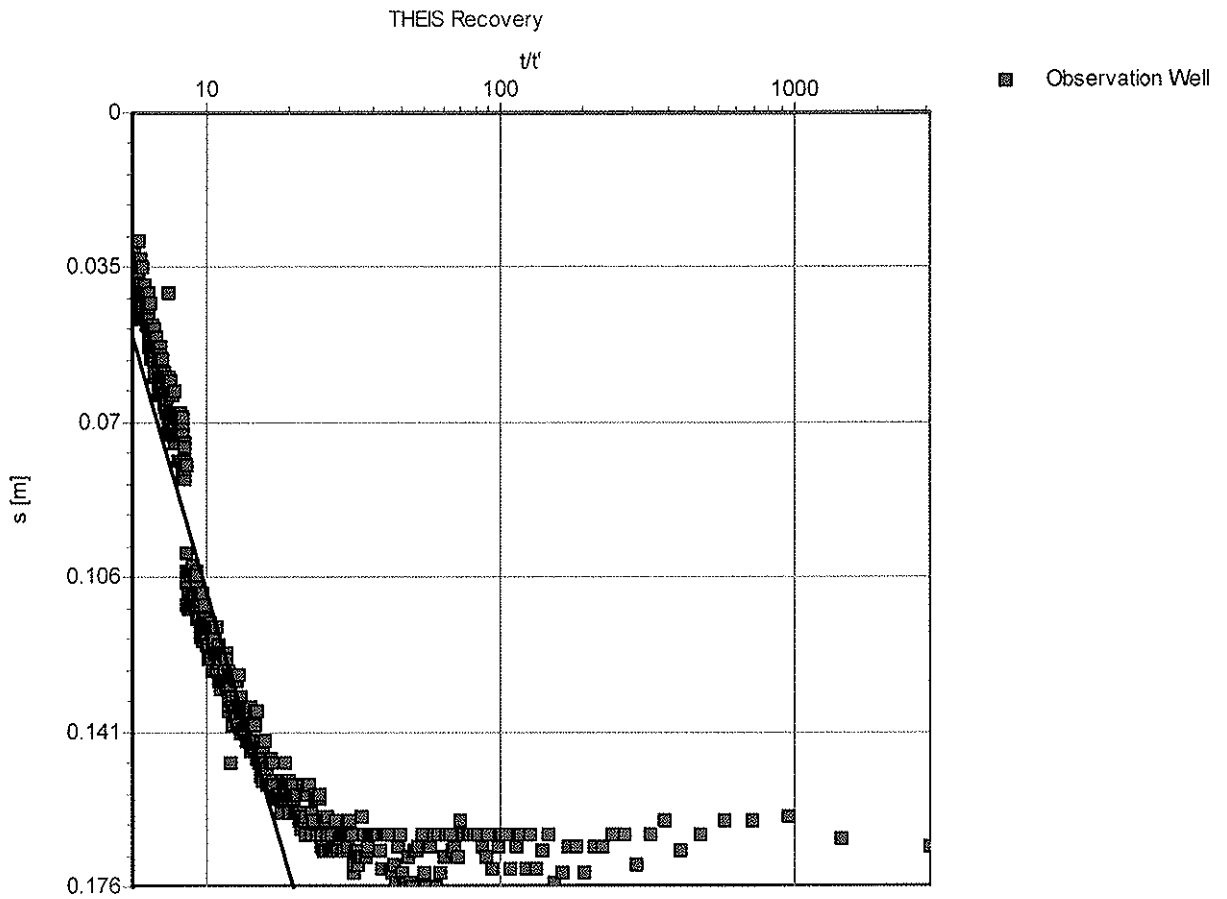
No: W23101144
Project: Golden Horn Fire Hall - Well Completion
Client: Government of Yukon

Location: Golden Horn, Yukon

Test performed by: Double D Drilling
Test date: 10/8/2008

Evaluated by: SK
Reviewed by: RMM

Analysis method: THEIS Recovery



Transmissivity: 6.45×10^{-5} [m²/s]

Conductivity: 2.53×10^{-6} [m/s]

Comments:

Observation Well - Recovery



APPENDIX E

APPENDIX E LABORATORY RESULTS OF CHEMICAL AND BACTERIOLOGICAL ANALYSES

NOTE: Proper completion of this form is required in order to proceed with analysis
See reverse for your nearest Bodycote location and proper sampling protocol

Billing Address: Company: EBA Engineering Consulting Ltd. Address: Calcite Business Center Unit 6, 151 Industrial Road Whitehorse, YT Y1A 2V3 Attention: Stephan Klump Phone: _____ Fax: Ph (867) 668-2071 x 250 Cell Fax (867) 668-4349 e-mail: sklump@eba.ca	Copy of Report To: Company: _____ Address: _____ Attention: _____ Phone: _____ Fax: _____ Cell: _____ e-mail: _____	Copy of Invoice: <input type="checkbox"/> Mail Invoice to this address for approval <input type="checkbox"/> Report Results: Fax <input type="checkbox"/> Mail <input checked="" type="checkbox"/> Courier <input type="checkbox"/> e-mail <input checked="" type="checkbox"/> e-Service <input type="checkbox"/>	Report Results: Fax <input type="checkbox"/> Mail <input type="checkbox"/> Courier <input type="checkbox"/> e-mail <input type="checkbox"/> e-Service <input type="checkbox"/>
---	---	--	--

Information to be included on Report and Invoice
 Project ID: **W23101144**
 Project Name: **Golden Horn**
 Project Location: **Golden Horn Firehall**
 Legal Location: **Whitehorse, YT**
 PO#: _____
 Proj. Acct. Code: _____
 Agreement ID: _____

Rush Please contact the laboratory to confirm rush dates and times before submitting samples.

Upon filling out this section, client accepts that surcharges will be attached to this analysis

RUSH All analysis As indicated
 required on: **or**

Date Required: _____
 Signature: _____
 Bodycote Authorization: _____

 Sample Custody (Please Print)
 Sampled by: **Stephan Klump**
 Company **EBA** Signature *[Signature]*
 I authorize Bodycote to proceed with the work indicated on this form:
 Date: **Oct 9, 2008** Initial: **SK**
 Received by: _____ Sample Temp. _____ °C
 Waybill # _____ Date: **OCT 10 2008**
 Company _____ Time _____

Special Instructions / Comments
Drinking Water Package
 + Mercury
 + EC

FOR LAB USE ONLY
 Condition of containers / coolers upon arrival at lab

 Check here if Bodycote is required to report results directly to a regulatory body (Please include contact information)
 Check here if you're testing POTABLE WATER for **HUMAN CONSUMPTION**.

Please indicate which regulations you are required to meet: _____

Number of Containers	W99	Mercury	EC	Enter tests above (✓ relevant samples below)															
				Pb	Cu	Zn	Mn	Cd	Ni	Cr	Fe	As	Hg						
↓	X	X	X																
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			

Bill To: EBA Engineering Consulting Lt	Project:	Lot ID: 648492
Report To: EBA Engineering Consulting Lt	ID: W23101144	Approval Status: Approved
Calcite Business Centre	Name: Golden Horn	Invoice Frequency: by Lot
Unit 6, 151 Industrial Road	Location: Golden Horn Firehall	COD Status:
Whitehorse, YT, Canada	LSD: Whitehorse, YT	Control Number: A015606
Y1A 2V3	P.O.:	Date Received: Oct 10, 2008
Attn: Stephan Klump	Acct code:	Date Reported: Oct 22, 2008
Sampled By: Stephan Klump		Report Number: 1160479
Company: EBA		

Contact	Company	Address
Stephan Klump	EBA Engineering Consulting Lt	Calcite Business Centre, Unit 6, 151 Industrial Road Whitehorse, YT Y1A 2V3 Phone: (867) 668-2071 Fax: (867) 668-4349 Email: sklump@eba.ca

	Copies	Delivery	Format
M	1	Post	
	1	Email - Single Report	PDF

_____ PAGES IN THIS TRANSMISSION

Notes To Clients:**Reports associated with this Lot**Id/Format/Report DateId/Format/Report DateId/Format/Report Date

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Analytical Report

Bill To: EBA Engineering Consulting Lt	Project:	Lot ID: 648492
Report To: EBA Engineering Consulting Lt	ID: W23101144	Control Number: A015606
Calcite Business Centre	Name: Golden Horn	Date Received: Oct 10, 2008
Unit 6, 151 Industrial Road	Location: Golden Horn Firehall	Date Reported: Oct 22, 2008
Whitehorse, YT, Canada	LSD: Whitehorse, YT	Report Number: 1160479
Y1A 2V3	P.O.:	
Attn: Stephan Klump	Acct code:	
Sampled By: Stephan Klump		
Company: EBA		

Reference Number	648492-1
Sample Date	October 09, 2008
Sample Location	
Sample Description	Golden Horn / W23101144
Sample Matrix	Drinking Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Metals Extractable						
Hardness	as CaCO3	mg/L	280	1		Very Hard
Calcium	Extractable	mg/L	52.0	0.03		n/a
Iron	Extractable	mg/L	0.19	0.02	0.3	Acceptable
Magnesium	Extractable	mg/L	36.5	0.02		n/a
Manganese	Extractable	mg/L	0.060	0.005	0.05	Above Aesthetic
Phosphorus	Extractable	mg/L	0.01	0.01		n/a
Potassium	Extractable	mg/L	2.9	0.1		n/a
Silicon	Extractable	mg/L	7.28	0.05		n/a
Sodium	Extractable	mg/L	11.1	0.2	200	Acceptable
Aluminum	Extractable	mg/L	<0.02	0.02	0.1	Acceptable
Antimony	Extractable	mg/L	<0.0002	0.0002	0.006	Pass
Arsenic	Extractable	mg/L	0.0036	0.0002	0.01	Pass
Barium	Extractable	mg/L	0.029	0.001	1	Pass
Boron	Extractable	mg/L	0.017	0.005	5	Pass
Cadmium	Extractable	mg/L	<0.00007	0.00007	0.005	Pass
Chromium	Extractable	mg/L	0.0023	0.0005	0.05	Pass
Copper	Extractable	mg/L	<0.001	0.001	1	Acceptable
Lead	Extractable	mg/L	<0.0001	0.0001	0.01	Pass
Selenium	Extractable	mg/L	<0.0006	0.0006	0.01	Pass
Uranium	Extractable	mg/L	0.0082	0.0005	0.02	Pass
Zinc	Extractable	mg/L	0.002	0.001	5	Acceptable
Metals Total						
Mercury	Total	ug/L	<0.01	0.01	1.0	Pass
Physical and Aggregate Properties						
Colour	Apparent, Potable	Colour units	11	5	15	Acceptable
Turbidity		NTU	1.6	0.1	5	Acceptable
Routine Water						
pH	@ 25 °C		7.93		6.5 - 8.5	Acceptable
Electrical Conductivity		µS/cm at 25 C	584	1		n/a
Chloride	Dissolved	mg/L	1.01	0.02	250	Acceptable
Fluoride	Dissolved	mg/L	0.27	0.01	1.5	Pass
Nitrate - N	Dissolved	mg/L	<0.01	0.01	10	Pass
Nitrite - N	Dissolved	mg/L	<0.01	0.01	1	Pass
Sulfate (SO4)	Dissolved	mg/L	75.6	0.05	500	Acceptable
T-Alkalinity	as CaCO3	mg/L	251	5		n/a
Total Dissolved Solids	Extractable	mg/L	350	1	500	Acceptable

Analytical Report

Bill To: EBA Engineering Consulting Lt	Project:	Lot ID: 648492
Report To: EBA Engineering Consulting Lt	ID: W23101144	Control Number: A015606
Calcite Business Centre	Name: Golden Horn	Date Received: Oct 10, 2008
Unit 6, 151 Industrial Road	Location: Golden Horn Firehall	Date Reported: Oct 22, 2008
Whitehorse, YT, Canada	LSD: Whitehorse, YT	Report Number: 1160479
Y1A 2V3	P.O.:	
Attn: Stephan Klump	Acct code:	
Sampled By: Stephan Klump		
Company: EBA		

Approved by: 
Andrew Garrard, BSc
Operations Manager

Methodology and Notes

Bill To: EBA Engineering Consulting Lt	Project:	Lot ID: 648492
Report To: EBA Engineering Consulting Lt	ID: W23101144	Control Number: A015606
Calcite Business Centre	Name: Golden Horn	Date Received: Oct 10, 2008
Unit 6, 151 Industrial Road	Location: Golden Horn Firehall	Date Reported: Oct 22, 2008
Whitehorse, YT, Canada	LSD: Whitehorse, YT	Report Number: 1160479
Y1A 2V3	P.O.:	
Attn: Stephan Klump	Acct code:	
Sampled By: Stephan Klump		
Company: EBA		

Method of Analysis

Method Name	Reference	Method	Date Analysis Started	Location
Alk, pH, EC, Turb in water	APHA	* Conductivity, 2510	14-Oct-08	BTG Surrey
Alk, pH, EC, Turb in water	APHA	* Electrometric Method, 4500-H+ B	14-Oct-08	BTG Surrey
Alk, pH, EC, Turb in water	APHA	* Nephelometric Method, 2130 B	14-Oct-08	BTG Surrey
Alk, pH, EC, Turb in water	APHA	* Titration Method, 2320 B	14-Oct-08	BTG Surrey
Anions by IEC in water (Surrey)	APHA	* Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	14-Oct-08	BTG Surrey
Colour (Apparent) in water	APHA	* Visual Comparison Method, 2120 B	15-Oct-08	BTG Surrey
Mercury Low Level (Total) in water	EPA	* Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry, 245.7	15-Oct-08	BTG Surrey
Metals SemiTrace (Extractable) in water	US EPA	* Metals & Trace Elements by ICP-AES, 6010B	14-Oct-08	BTG Surrey
Trace Metals (extractable) in Water	US EPA	* Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	14-Oct-08	BTG Surrey

* Bodycote method(s) based on reference method

References

APHA	Standard Methods for the Examination of Water and Wastewater
EPA	Environmental Protection Agency Test Methods - US
Guideline	Guidelines for Canadian Drinking Water Quality, 6th Edition, May 16, 2006
US EPA	US Environmental Protection Agency Test Methods

Comments:

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

Results relate only to samples as submitted.

The test report shall not be reproduced except in full, without the written approval of the laboratory.



Yukon Engineering Consultants Ltd.
BACTERIOLOGICAL ANALYSIS OF DRINKING WATER
ANALYSE BACTÉRIOLOGIQUE DE L'EAU POTABLE

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

OCT 16 2008

Fax

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

RECEIVED

Contact Information • Coordonnées de la personne-ressource

Contact Person EBA / Stephan Klump Phone 867 668 3068
 Personne-ressource EBA Téléphone 867 668 3068
 Mailing address Unit 6, 151 Industrial Road Fax 867 668 4349
 Adresse postale Unit 6, 151 Industrial Road Télécopieur 867 668 4349
Calcutta Business Centre / Whitehorse Postal code Y1A 2V3
 Code postal Y1A 2V3

First Nation, Municipal or Business Name
 Nom de la première nation, de la municipalité ou de l'entreprise
 Agent _____ Fax _____
 Agent _____ Télécopieur _____

Sampling Location • Lieu de la prise d'échantillon

Municipal Address Golden Horn Firehall Subdivision _____
 Adresse municipale Golden Horn Firehall Lotissement _____
 Legal Description Lot _____ Ouid _____ Plan no. _____
 Désignation officielle Terrain _____ Quadrilatère _____ Plan n° _____
 Other information (e.g., Location, Business / Building Name)
 Autres renseignements (par ex. : emplacement, nom de l'entreprise, nom de l'édifice) New Firehall

Sample Collection / Échantillonnage

Sample Collected By Stephan Klump / EBA Date 08/10/09 Time 11:00 am
 Échantillon prélevé par EBA Date 08/10/09 Heure 11:00 am
 Sampling Site (e.g., kitchen tap) New groundwater well, pump hose
 Point d'échantillonnage (par ex. : robinet de cuisine) New groundwater well, pump hose
 Is this a Resample from a Previous Test? Yes No Previous Sample Number _____
 Est-ce un deuxième échantillon d'un test antérieur? Oui Non Numéro de l'échantillon précédent _____

Sample Supply / Source d'approvisionnement

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

Sample Source / Provenance de l'échantillon

Dug Well Driven Well Drilled Well Depth of Well 124 ft
 Puits creusé Puits tubulaire Puits foré à la sondeuse Profondeur du puits 124 ft
 Water Holding Tank Other (explain) _____
 Eau livrée Autre (précisez) _____

Water Treatment / Traitement de l'eau

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

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

Receipt of Sample 08/10/09 Time 12:00 am By JK
 Réception de l'échantillon Date 08/10/09 Heure 12:00 am Par JK

Condition of Sample Satisfactory Unsatisfactory (explain)
 État de l'échantillon Satisfaisant Non satisfaisant (précisez)

Incubation 08/10/09 Time 3:55 am By JK Incubator 2
 Incubation Date 08/10/09 Heure 3:55 am Par JK Incubation 2

Analysis Completed 08/10/10 Time 3:55 am By FB
 Analyse terminée Date 08/10/10 Heure 3:55 am Par FB

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

Total Coliforms/Coliformes totaux	E. coli/E. coli
<input type="checkbox"/> Present / Présence <input checked="" type="checkbox"/> Absent / Absence	<input type="checkbox"/> Present / Présence <input checked="" type="checkbox"/> Absent / Absence

Comments / Commentaires

Results Satisfactory for Bacteriological Quality
 Résultats satisfaisants à l'égard de la qualité bactériologique
 Immediately Resample
 Rééchantillonnage immédiat
 Investigate and Take Appropriate Corrective Actions
 Faire enquête et appliquer les mesures correctives nécessaires
 Boil Water Before Consumption
 Traiter l'eau avant de la consommer

Report Authorized By FB Bergsveic Position EHO Date 08/10/10
 Report Autorisé Par FB Bergsveic Position EHO Date 08/10/10

YG14649/NC3 Rev.03/2005

Sample Number 28206
 Numéro de l'échantillon 28206