



Kollaard Associates

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December 20, 2010

100667

Wicked Garage Inc.
2760 Carousel Crescent - Apt 1104
Ottawa, Ontario K1T 2N4

Attention: Mr. R. Grenon

RE: HYDROGEOLOGICAL INVESTIGATION
EXISTING SUPPLY WELL
PROPOSED COMMERCIAL DEVELOPMENT
1344 BARFIELD ROAD, GREELY
CITY OF OTTAWA, ONTARIO

Dear Sirs:

This letter presents the results of an evaluation of the water quality and quantity for the well that will supply water for the above noted proposed commercial development at 1344 Barfield Road in the City of Ottawa, Ontario (see Figure 1 for location). It is understood that the proposed commercial development is to consist of a custom automotive fabrication shop.

The well in question was constructed by Air Rock Drilling Company of Richmond, Ontario on November 16, 2010. A Ministry of the Environment Well Record for the subject well (TW1) and the Certificate of Well Compliance, provided by the well driller, are provided as Appendix A.

A pumping test was carried out at the well, TW1, by a member of our engineering staff on November 25, 2010. The testing consisted of a 6 hour duration constant discharge rate pumping test. During the pumping test, water level measurements were made on a regular basis to monitor the drawdown of the water level in the well in response to pumping. Groundwater samples were collected from TW1 at about hour 3 and at hour 6 of the pumping test to characterize groundwater quality. After the pumping period, the pump was shut off and the recovery of the water level in the well was monitored for a period of time.

Groundwater Supply Evaluation

The well was pumped for six hours at a pumping rate of about 80 litres per minute. Over the course of the pumping test, the water level in the well dropped some 9.1 metres. At the end of the pumping test, 2.5 minutes were required for 98 percent recovery of the total drawdown in the static water level created during pumping.



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The pumping test drawdown and recovery data and plots for TW1 are shown in Appendix B. The drawdown and recovery data provided were measured with reference to the top of the well casing at the test well location.

The pumping test data for the test well was analyzed using the method of Cooper and Jacob (1946). Although the assumptions on which these equations are based are not strictly met, this method provides a reasonable estimate of the aquifer transmissivity.

Transmissivity was calculated using the following relationship:

$$T = \frac{2.3Q}{4\pi ds}$$

where Q is the pump rate, m³/day
ds is the change in drawdown over one time log cycle, m
T is the transmissivity, m²/day

Based on the pumping test drawdown data the transmissivity of the aquifer is estimated to be about 70 m²/day. Based on the recovery data the aquifer transmissivity is estimated to be about 5 m²/day. The average transmissivity of the bedrock aquifer in the area of the test well is estimated to be about 37 m²/day.

In order to estimate whether or not the water supply is adequate for the proposed use and to estimate the maximum impact of the proposed development on water supply outside of the site, calculations were carried out to predict the thirty year drawdown at the well and at the property boundary. The expected drawdowns were calculated for a thirty year pumping rate of 1210 litres per day. That rate allows for the maximum expected water demand based on the design capacity for the proposed septic system to service the proposed development. The calculation was carried out using the following Cooper-Jacob formula:

$$s = \frac{2.3Q}{4\pi T} \log \left(\frac{2.25Tt}{r^2 S} \right)$$

where Q = 30 year pumping rate, 1210 L/day
T = transmissivity, 37 m²/day
t = duration, 30 years
S = storativity estimate, 5.0 x 10⁻⁵
s = expected drawdown due to the well, m
r = distance to edge of well casing, 0.15 metres and
distance to closest property line, 18 metres

The results of the calculations indicate that the expected 30 year drawdown at the well is about 0.07 metres. The available drawdown at the well is indicated to be about 33.8 metres. Accordingly, drawdown at the well of about 0.07 metres is not expected to impact the water supply for the proposed use of the property. The expected 30 year drawdown at the closest property boundary (18 metres) is about 0.05 metres (see Table II). A drawdown of about 0.05 metres is not expected to impact water supply outside of the site.



To determine the water quality of the groundwater supply, groundwater samples were obtained from the well during the pumping test and prepared/preserved in the field using appropriate techniques and submitted to Exova Accutest Laboratories Ltd. in Ottawa, Ontario for the chemical, physical and bacteriological analyses listed in the Ministry of the Environment (MOE) guideline entitled Procedure D-5-5, Technical Guideline for Private Wells: Water Supply Assessment, August 1996. The temperature, conductivity, pH, total dissolved solids, turbidity, hydrogen sulphide and residual chlorine levels of the groundwater were measured and qualitative observations of the taste, odour and colour of the groundwater were made at periodic intervals during the pumping test. The results of the chemical, physical and bacteriological analyses of the water samples obtained from the test well and the field water quality are provided in Appendix C and in Table I, respectively.

The water quality as determined from the results of the analyses is favourable. The water meets all the Ontario Drinking Water Standards (ODWS) health and aesthetic parameters tested for at the test wells except for aesthetic objective for hardness.

The water is considered to be hard by water treatment standards. Water with hardness above 80 to 100 milligrams per litre as CaCO_3 is often softened for domestic use. The hardness at the well is 258 milligrams per litre. Water softening by conventional sodium ion exchange may introduce relatively high concentrations of sodium into the drinking water, which may contribute a significant percentage to the daily sodium intake for a consumer on a sodium restricted diet. Where ion exchange water softeners are used, a separate unsoftened water supply could be used for drinking and culinary purposes.

The lab based turbidity measurement for the water sample obtained after six hours of pumping was 2.4 NTU, which exceeds the health related objective for turbidity but is within the aesthetic objective of 5 NTU. The turbidity was measured in the field to be 0 NTU after six hours. It is considered that the lab measured turbidity was slightly elevated due to the presence of iron, which was 0.28 milligrams per litre after six hours of pumping. Iron may precipitate in the water sample between the time of sampling and the time of testing in the laboratory. No bacteria presence was detected in the water sample obtained after six hours of pumping. Consequently, the noted lab measured turbidity is not considered to be of aesthetic or health related concern.

Wellhead Protection

The supply well is located within the southwest portion of the site, while the location of the proposed septic and greywater systems are within the northeast portion of the site, some 30 metres distance from the well location. Groundwater flow direction in the upper overburden aquifer in the site vicinity is indicated to be towards Shields Creek which exists about 270 metres south of the site. The well casing was observed to extend about 600 millimetres above grade. The proposed septic and greywater system locations are not indicated to be up gradient of the well location. The well has been properly grouted and cased to a depth of about 15.2 metres below the existing ground surface. Consequently, it is considered that an adequate amount of wellhead protection is in place to protect the water supply for the proposed commercial automotive fabrication shop.

Recommendations for wellhead protection include ensuring that potential contaminant sources are at least 15 metres and preferably at least 30 metres or more from the well. Possible contaminant sources include; chemical storage, garage and related chemicals, such as antifreeze, gasoline, oils, vehicle/boat/equipment storage, sewer lines, septic systems, animal enclosures, manure or compost piles. Avoid activities which may cause spillage into the soil, such as car repair and machinery maintenance.



Recommendations for well maintenance include; inspect wellhead annually to ensure that the casing is structurally sound, verify well cap is sealed and that surface water is not pooling around wellhead. To protect the well from physical damage, a small structure or fence should be constructed around it, ensuring easy access for well maintenance/repairs. A lock on the well cap is useful to prevent vandalism.

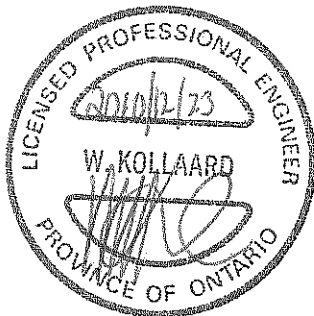
Based on the results of this evaluation it is considered that the well in question should supply water of adequate quantity and quality for the proposed development with suitable treatment and wellhead protection as indicated above. The impact of the use of the well at the proposed development on neighbouring existing wells is expected to be minimal.

We trust this letter provides sufficient information for your purposes. If you have any questions concerning this letter, please do not hesitate to contact our office.

Yours truly,

Kollaard Associates Inc.

C. E. Vermeersch, B. Eng. (Env.)

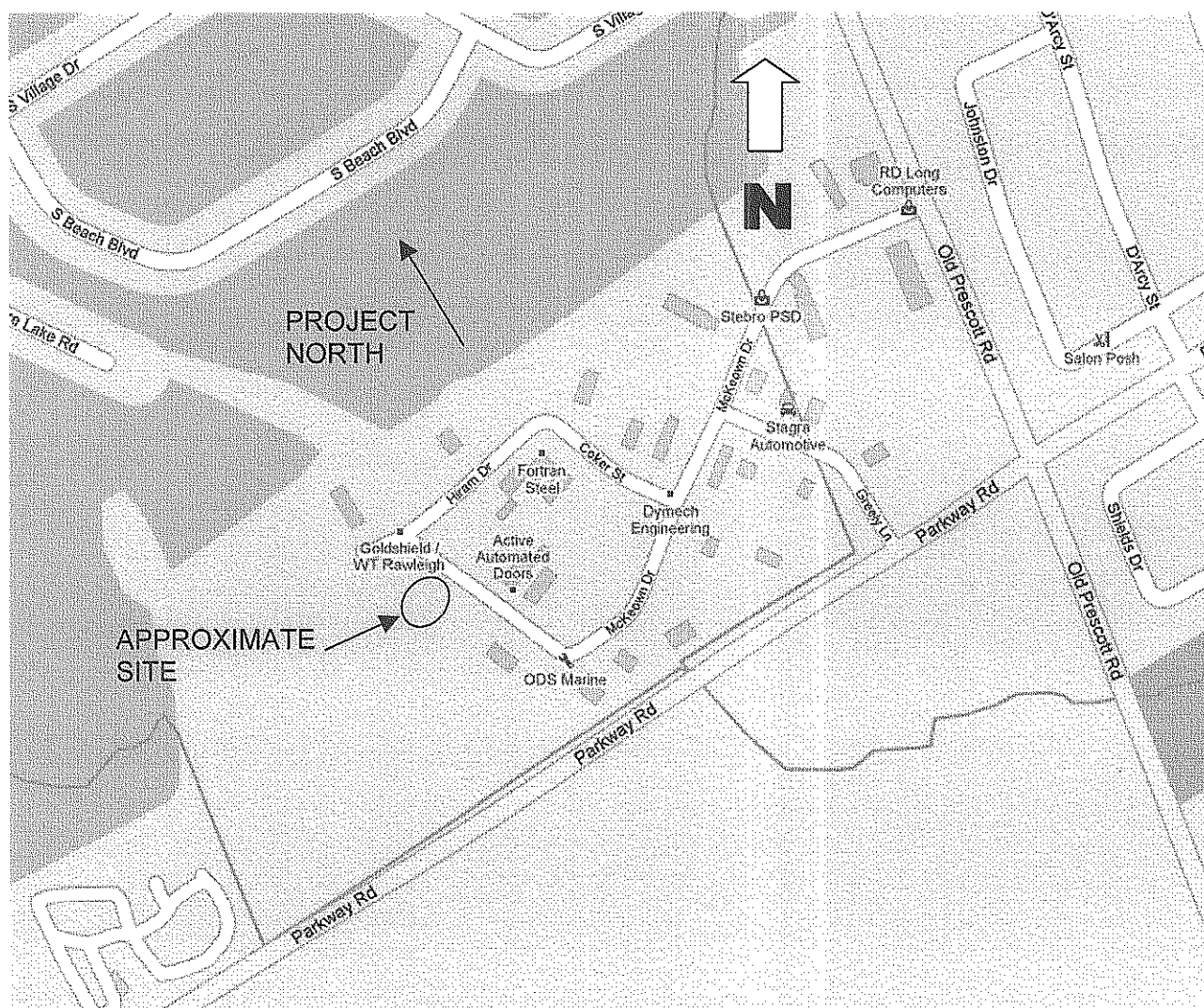


William Kollaard, P. Eng.

Attachments: Figure 1: Key Plan
Tables I to II
Appendices A to C

KEY PLAN

FIGURE 1



NOT TO SCALE



Kollaard Associates
Engineers

Project No. 100667

Date December 2010

TABLE I

FIELD WATER QUALITY MEASUREMENTS
FOR TEST WELL

Hours Since Pumping Test Started	Temperature (°C)	pH	Conductivity (µS/cm)	TDS (ppm)	Turbidity (NTU)	Free Chlorine (mg/l)	Hydrogen Sulphide (mg/l)	Taste	Odour	Colour
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	6.2	8.1	525	266	0.9	0.0	0.0	none	none	clear
4	7.7	7.9	539	270	-	-	-	none	none	clear
5	7.8	7.8	539	270	-	-	-	none	none	clear
6	7.9	7.8	539	270	0.0	0.0	0.0	none	none	clear

TABLE II
WELL INTERFERENCE

Storativity	5.0.E-05 conservative estimate based on range from 0.005-0.00005 (source: <i>Groundwater</i> , Freeze/Cherry)	
Transmissivity	37 m ² /day	calculated by Cooper-Jacob Method
T	4.3.E-04 m ² /s	
Q	0.8 L/min	based on expected water demand 1210 L/day
Q	1.40E-05 m ³ /s	
Duration	30 years	
Duration	946080000 s	
2.3Q/(4piT)	0.006	

Location	Distance [m]	30 Year Drawdown [m]
Well	0.15	0.07
Property Boundary	18	0.05



APPENDIX A

MOE WELL RECORD FOR TW1
CERTIFICATE OF WELL COMPLIANCE
PROVIDED BY WELL DRILLER



CERTIFICATE OF WELL COMPLIANCE

I, Ken Desaulniers DO HEREBY CERTIFY that I am licensed to drill

wells in the Province of Ontario, and that I have supervised the drilling of a well on the

property of ROGER GRENON

located at #1344 Barfield Street

(Lot/Plan No.) in the City of Ottawa (Geographical Township of Osgoode).

Plan 4M-351 Pt BIK5 RP 4805427, Part 62, 63, 64

CERTIFY FURTHER that, I am aware of the well drilling requirements, the guidelines, recommendations and regulations of the Ministry of the Environment governing well installations in the Province of Ontario, and the standards specified in any subdivision agreement and ~~hydrogeological report applicable to this site and~~ City Standards.

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) as applicable and constructed in strict conformity with the standards required.

Signed this 16TH day of NOVEMBER 2010

Kenny Desaulniers Air Rock Drilling Co. Ltd.
Well Driller/Company

The Engineer on behalf of the landowner set out above Certifies that he/she has inspected the well and it was constructed in accordance with the specifications in O.Reg. 903, this report and the ~~Hydrogeological Report~~ with regards to casing length and grouting requirements. *→ Township of Osgoode Well Compliance Report, July 1998, 52-2*

SIGNED this 9th day of December, 2010

Engineer [Signature]



Kollaard Associates

Engineers

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Shaping our future together

Ensemble, formons notre avenir.

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APPENDIX B
PUMPING TEST DATA FOR TW1

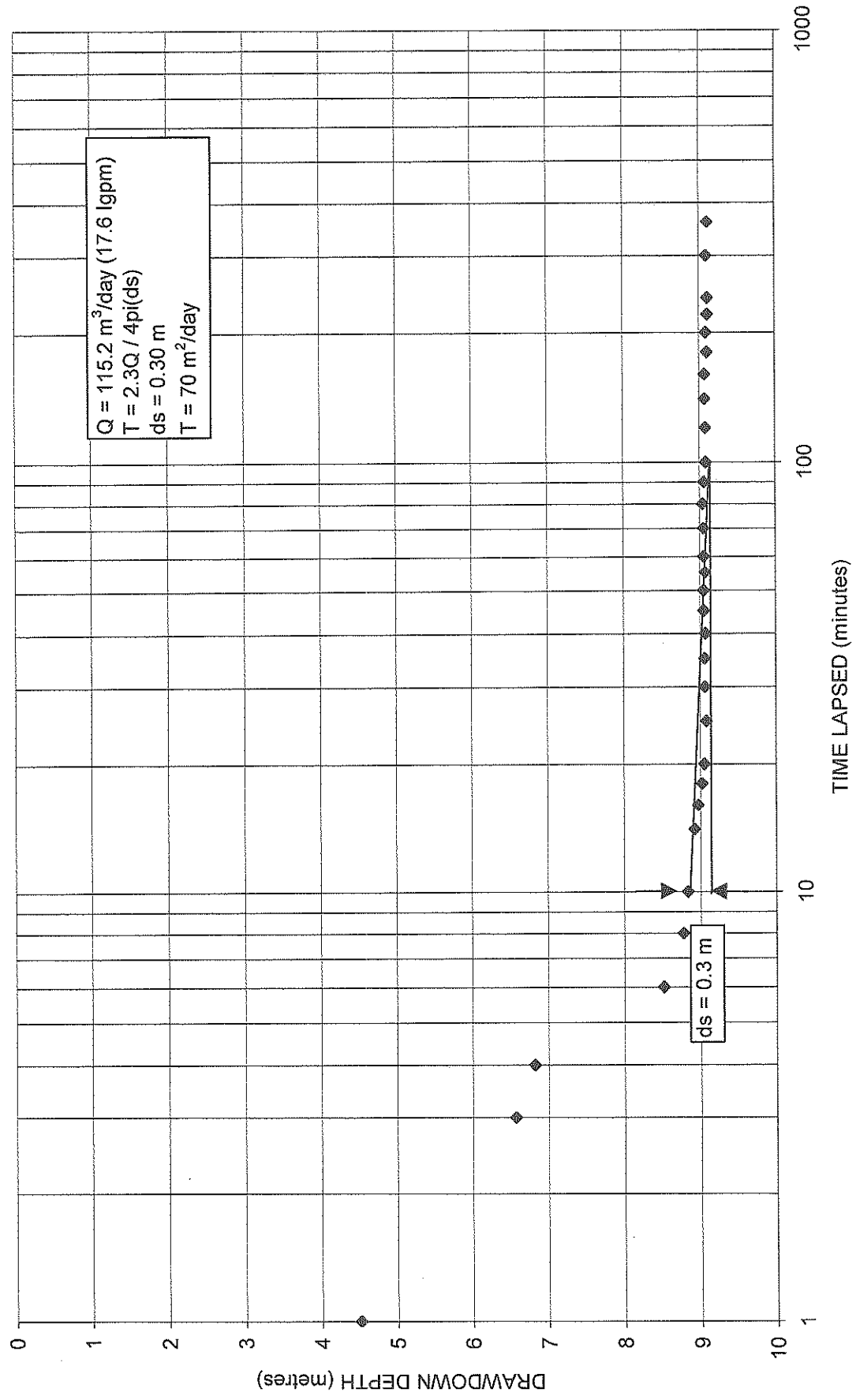
Kollaard File 100667
DRAWDOWN DATA TW-1

Pump Rate

17.6 gal/min

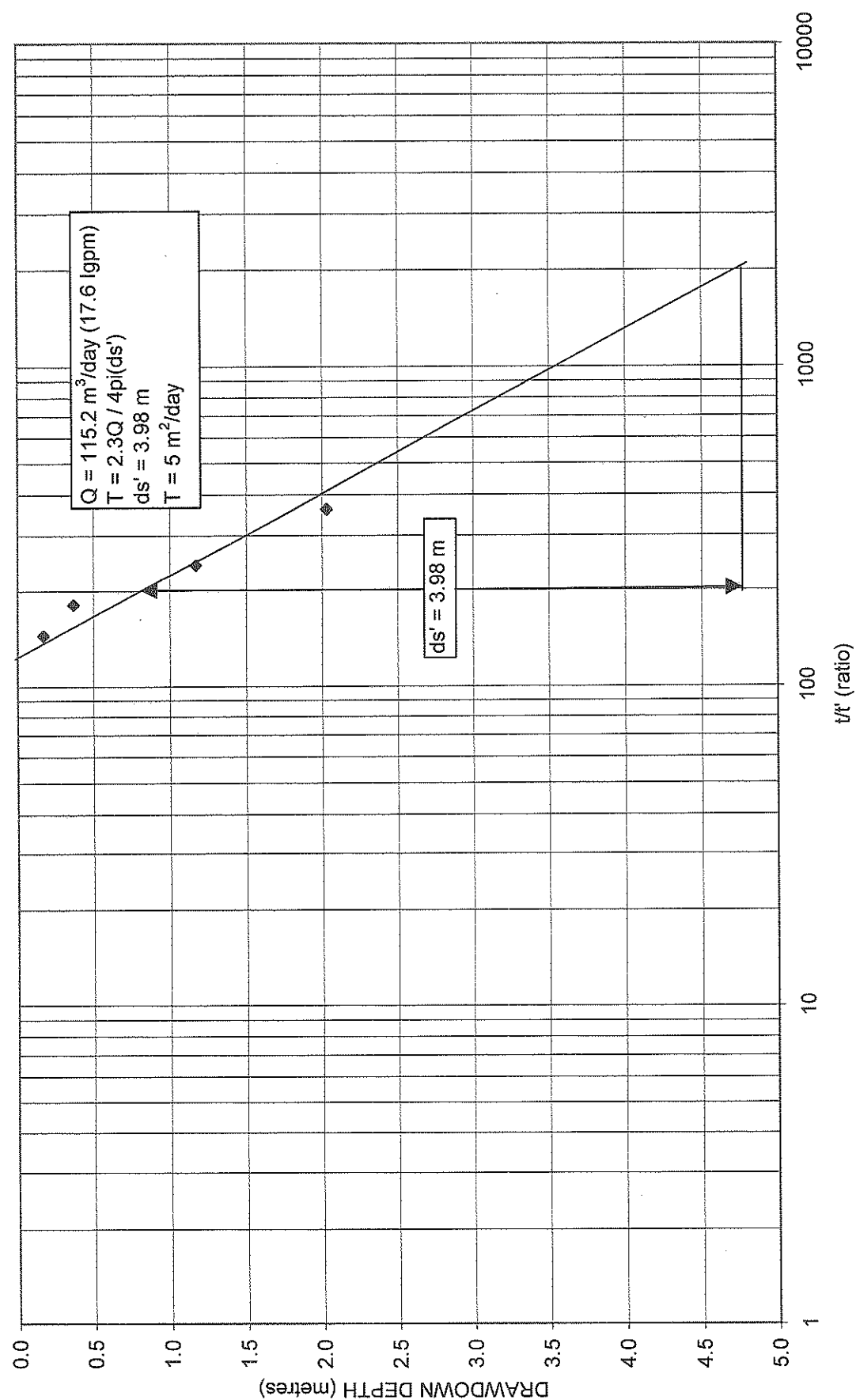
Time of Day	Time Lapsed (minutes)	Depth (metres)	h-ho (metres)
11:15	0	1.43	0.00
11:16	1	5.94	4.51
11:18	3	8.00	6.57
11:19	4	8.25	6.82
11:21	6	9.94	8.51
11:23	8	10.20	8.77
11:25	10	10.26	8.83
11:29	14	10.35	8.92
11:31	16	10.40	8.97
11:33	18	10.45	9.02
11:35	20	10.48	9.05
11:40	25	10.51	9.08
11:45	30	10.49	9.06
11:50	35	10.49	9.06
11:55	40	10.50	9.07
12:00	45	10.48	9.05
12:05	50	10.48	9.05
12:10	55	10.50	9.07
12:15	60	10.48	9.05
12:25	70	10.48	9.05
12:35	80	10.47	9.04
12:45	90	10.49	9.06
12:55	100	10.52	9.09
13:15	120	10.51	9.08
13:35	140	10.50	9.07
13:55	160	10.50	9.07
14:15	180	10.54	9.11
14:35	200	10.52	9.09
14:55	220	10.54	9.11
15:15	240	10.54	9.11
16:15	300	10.53	9.10
17:15	360	10.54	9.11

TW-1 WELL DRAWDOWN VS. TIME-Kollaard File 100667



Kollaard File 100667
RECOVERY DATA TW-1

Recovery Time t' (minutes)	t / t' (ratio)	Depth (metres)	h-ho (metres)
0	0	10.50	9.07
0.5	721	5.45	4.02
1	361	3.46	2.03
1.5	241	2.60	1.17
2	181	1.80	0.37
2.5	145	1.60	0.17
98%	RECOVERY AFTER	3	MINUTES.





APPENDIX C
RESULTS OF LABORATORY TESTING
OF WELL WATER SAMPLES

Client: Kollaard Associates Inc.
210 Prescott St., Box 189
Kemptville, ON
K0G 1J0

Attention: Mr. Bill Kollaard

Report Number: 1029175
Date: 2010-12-07
Date Submitted: 2010-11-27
Project: 100667

Chain of Custody Number: 127128

P.O. Number:
Matrix:

Water

PARAMETER	UNITS	MRL	LAB ID:		GUIDELINE
			Sample Date:	Sample ID:	
			2010-11-25	849033	849034
			TW1-3 HR	TW1-6 HR	
Alkalinity as CaCO ₃	mg/L	5	201	199	OG 500 mg/L
Chloride	mg/L	1	36	35	AO 250 mg/L
Colour	TCU	2	4	<2	AO 5 TCU
Conductivity	uS/cm	5	557	552	
Dissolved Organic Carbon	mg/L	0.5	1.0	1.1	AO 5 mg/L
Fluoride	mg/L	0.1	0.22	0.22	MAC 1.5 mg/L
Hydrogen Sulphide	mg/L	0.01	<0.1	<0.01	AO 0.05 mg/L
N-NH ₃ (Ammonia)	mg/L	0.02	0.03	0.03	
N-NO ₂ (Nitrite)	mg/L	0.1	<0.10	<0.10	MAC 1.0 mg/L
N-NO ₃ (Nitrate)	mg/L	0.1	<0.10	<0.10	MAC 10.0 mg/L
pH			8.20	8.21	6.5-8.5
Phenols	mg/L	0.001	<0.001	<0.001	
Sulphate	mg/L	1	44	43	AO 500 mg/L
Tannin & Lignin	mg/L	0.1	<0.1	<0.1	
Total Dissolved Solids (COND - CALC)	mg/L	5	362	359	AO 500 mg/L
Total Kjeldahl Nitrogen	mg/L	0.1	<0.10	<0.10	
Turbidity	NTU	0.1	8.3	2.4	MAC 1.0 NTU
Hardness as CaCO ₃	mg/L	1	258	258	OG 100 mg/L
Ion Balance		0.01	0.96	0.98	
Calcium	mg/L	1	57	57	
Magnesium	mg/L	1	28	28	
Potassium	mg/L	1	3	3	
Sodium	mg/L	2	12	12	AO 200 mg/L
Iron	mg/L	0.03	0.37	0.28	AO 0.3 mg/L
Manganese	mg/L	0.01	<0.01	<0.01	AO 0.05 mg/L

MRL = Method Reporting Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

849033: H₂S MRL elevated due to sample turbidity.

APPROVAL:

Ewan McRobbie

Inorganic Lab Supervisor

Methods references and/or additional QA/QC information available on request.

Client: Kollaard Associates Inc.
210 Prescott St., Box 189
Kemptville, ON
K0G 1J0

Attention: Mr. Bill Kollaard

Report Number:
Date:
Date Submitted:

1029176
2010-11-29
2010-11-27

Project:

100667

P.O. Number:
Matrix:

Chain of Custody Number: 127128

Water

GUIDELINE									
ODWSOG									
PARAMETER		UNITS	MRL	849035		849036			
Total Coliforms		CFU/100mL		0		0		MAC	0
Escherichia Coli		CFU/100mL		0		0		MAC	0
Heterotrophic Plate Count		CFU/1mL		8		0			
Faecal Coliforms		CFU/100mL		0		0			

MRL = Method Reporting Limit INC = Incomplete AO = Aesthetic Objective OG = Operational Guideline MAC = Maximum Allowable Concentration IMAC = Interim Maximum Allowable Concentration

Comment:

APPROVAL:

Jennifer Mitchell
Microbiology Lab Supervisor