210 Prescott Street
P.O. Box 189
Kemptville, Ontario K0G 1J0

Civil • Geotechnical • Structural • Environmental •

Hydrogeology ●

(613) 860-0923

FAX: (613) 258-0475

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.



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,  $m^3/day$  ds is the change in drawdown over one time log cycle, m
T is the transmissivity.  $m^2/day$ 

Based on the pumping test drawdown data the transmissivity of the aquifer is estimated to be about  $70 \text{ m}^2$ /day. Based on the recovery data the aquifer transmissivity is estimated to be about  $5 \text{ m}^2$ /day. The average transmissivity of the bedrock aquifer in the area of the test well is estimated to be about  $37 \text{ m}^2$ /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 m<sup>2</sup>/day

t = duration, 30 years

S = storativity estimate,  $5.0 \times 10^{-5}$ 

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.

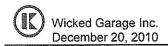
The water is considered to be hard by water treatment standards. Water with hardness above 80 to 100 milligrams per litre as CaC0<sub>3</sub> is often softened for domestic use. The hardness at the well is 258 milligrams per litre. Water softening by conventional sodium ion exchange may introduce relatively 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.)

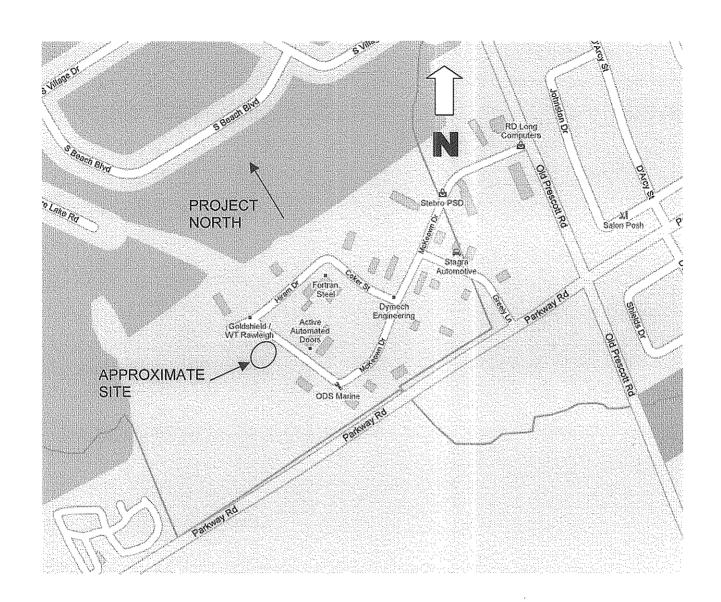


William Kollaard, P. Eng.

Attachments: Figure 1: Key Plan

Tables I to II
Appendices A to C

KEY PLAN



### **NOT TO SCALE**



Project No. 100667

Date December 2010

FIGURE 1

TABLE

FIELD WATER QUALITY MEASUREMENTS FOR TEST WELL

Colour		•	Į.	clear	clear	clear	clear
Pobo		ı	3	none	none	none	none
Taste		1	t	none	none	none	none
Hydrogen	(mg/l)	ı	1	0.0	1	ı	0.0
Free	(mg/l)	ı	1	0.0	1	ı	0.0
Turbidity	(NTU)	1	1	0.0	1	ı	0.0
E S	(mdd)	ı		266	270	270	270
Conductivity	(hS/cm)	t	1	525	539	539	539
Ī.		t	,	8.1	7.9	7.8	7.8
Hours Since Temperature	(°C)	1	ı	6.2	7.7	7.8	7.9
Hours Since	Fumping Test Started	~	2	က	4	Ω	9

## TABLE II WELL INTERFERENCE

Storativity

5.0.E-05 conservative estimate based on range from 0.005-0.00005

(source: Groundwater, Freeze/Cherry)

Transmissivity

37 m<sup>2</sup>/day

calculated by Cooper-Jacob Method

based on expected water demand 1210 L/day

T

4.3.E-04 m<sup>2</sup>/s

Q

0.8 L/min

Q

1.40E-05 m<sup>3</sup>/s

Duration

30 years

Duration

946080000 s

2.3Q/(4piT)

0.006

Lo	ocation	Distance	30 Year Drawdown
		[m]	[m]
	Well	0.15	0.07
	ty Boundary	18	0.05

### APPENDIX A

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

PAGE 02/02

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### CERTIFICATE OF WELL COMPLIANCE

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	wells in the Province of Ontario, and that I have supervised the drilling of a well on the
,	properly KOGER GRENON
	looded # 1344 Berfield Street
	Lot/Plan No.) in the City of Ottawa (Geographical Township of Osgooda).
	Plan AM -351 Pt BIK5 RP 4R 05427 Port 62 63 6 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 Lo day of NOVEMBER 2010 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 Osgowle Well compliance Report, Cycly 1998, 52-2
	SIGNED this goth day of Documber, 2010.
	Engineer 1
	(III) Kollaard Associates - 73.73
	Engineers P.O. Box 189

210 Prescott Street, Unit 1

Kemptville, Ontario K0G 1J0

CSURE DE SEURCE

# 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	Depth	h-ho
	(minutes)	(metres)	(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

1000 Q = 115.2 m³/day (17.6 lgpm) T = 2.3Q / 4pi(ds) ds = 0.30 m T = 70 m²/day 100 TIME LAPSED (minutes) 10  $ds = 0.3 \, \text{m}$ 9 0 N က Ŋ ဖ  $\infty$ တ DRAWDOWN DEPTH (metres)

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

### Kollaard File 100667 RECOVERY DATA TW-1

Recovery Time	t/t'	Depth	h-ho
t' (minutes)	(ratio)	(metres)	(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.

TW1- RECOVERY DATA - Kollaard File 100667

### APPENDIX C

## RESULTS OF LABORATORY TESTING OF WELL WATER SAMPLES

Client: Kollaard Associates Inc.						Report Number:	•	1029175	
Z10 Prescott St., Box 189 Kemptville, DN						Date Submitted:		2010-11-27	
Attention: Mr. Bill Kollaard						Project:	·	100667	
						P.O. Number:	•	Mefer	
Chain of Custody Number: 12/126		I AB ID:	849033	849034		Matrix.		GUIDELINE	
	Sam	Sample Date:	2010-11-25	2010-11-25					
	် တိ	Sample ID:	TW1-3 HR	TW1-6 HR		1.4144		opwsog	,
PARAMETER	UNITS	MRL					TYPE	LIMIT	UNITS
Alkalinity as CaCO3	mg/L	5	201	199	Withington		90	500	mg/L
Chloride	mg/L	-	36	35			A A	250	mg/L
Colour	TCU	2	4	7			AO AO	ည	
Conductivity	m2/Sn	က္	557	552			(	L	=
Dissolved Organic Carbon	mg/L	0.5	1.0				9	n ,	mg/L
Fluoride	mg/l.	0.5	0.22	0.22			A C	ر د اور	mg/L
Hydrogen Sulpride N. NH3 (Ammonia)	IIIg/L	0.0	- 60				?	3	j 20
N-NO2 (Nitrite)	mg/L	0.1	<0.10	<0.10			MAC	1.0	mg/L
N-NO3 (Nitrate)	mg/L	0.1	<0.10	<0.10		***	MAC	10.0	mg/L
Fa			8.20	8.21				6.5-8.5	
Phenols	mg/L	0.001	<0.001	<0.001			(	6	
Sulphate	mg/L	- ?	44 4	43			Q	200	mg/L
Tannin & Lignin	mg/L	c. o	<0.1	350			ΟĄ	200	ma/l
Total Cieldahi Mitangan	mg/l	, <u>c</u>	302 <0 10	0, CA			?	3	
Turbidity	NTC	0.1	8.3	2.4			MAC	1.0	NTO
Hardness as CaCO3	mg/L	-	258	258			90	100	mg/L
lon Balance		0.01	96.0	96.0				••	
Calcium	mg/L	-	57	27					
Magnesium	mg/L	_	28						
Potassium	mg/L	-	ന	m					•
Sodium	mg/L	7	12	12			AO	200	mg/L
Iron	mg/L	0.03	0.37	0.28			AO AO	0.3	mg/L
Manganese	mg/L	0.01	<0.01	<0.01			AO AO	0.05	mg/L
		•		11111					•
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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 furbidity.

Inorganic Lab Supervisor APPROVAL:

Ewan McRobbie

Results relate only to the parameters tested on the samples submitted.

APPROVAL:
Jennifer Mitchell
Microbiology Lab Supervisor

Results relate only to the parameters tested on the samples submitted.