



Kollaard Associates
Engineers

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

Civil • Geotechnical •
Structural • Environmental •
Hydrogeology •

(613) 860-0923

FAX: (613) 258-0475

REPORT ON

**HYDROGEOLOGICAL
STUDY
PROPOSED COACH HOUSE
5812 RED CASTLE RIDGE
OSGOODE WARD
CITY OF OTTAWA, ONTARIO**

Submitted to:

Hassan Sannoufi
5812 Red Castle Ridge
Manotick, Ontario
K4M 0A4

REVISION DATE September 7, 2022
DATE July 20, 2022

DISTRIBUTION

1 digital copy Hassan Sannoufi
1 copy Kollaard Associates Inc.

220067



Professional Engineers
Ontario

Authorized by the Association of Professional Engineers
of Ontario to offer professional engineering services.



July 20, 2022 (Sept. 7, 2022)

220067

Hassan Sannoufi
5812 Red Castle Ridge
Manotick, Ontario
K4M 0A4

RE: HYDROGEOLOGICAL AND TERRAIN STUDY
PROPOSED COACH HOUSE
5812 RED CASTLE RIDGE
OSGOODE WARD
CITY OF OTTAWA, ONTARIO

Kollaard Associates Inc. was retained by Mr. Hassan Sannoufi to undertake a hydrogeological and terrain study for a proposed coach house on Red Castle Ridge in Manotick, Ontario (Key Plan, Figure 1).

It is understood that it is being proposed to construct a coach house on the existing 0.67 hectare (~1.7 acre) property. It is the intention of the owner that the existing well is to be shared between the coach house and the existing dwelling. A new sewage system is to be constructed to service the coach house. It is understood that the proposed coach house is located east of the existing house with the proposed sewage system for the coach house located southeast of the coach house. The attached drawing (Attachment A) is a Proposed Septic Design Plan, prepared by Kollaard Associates Inc, that shows the location of the proposed coach house, the existing dwelling, septic bed and well and the proposed sewage system location.

Kollaard Associates Inc. carried out a six hour pumping test on the existing well at the site and obtained a water sample that was tested for the subdivision list of parameters to confirm that water quantity and quality are acceptable to service the existing and proposed residential development. Information provided by the client from the sewage system design including test pit and topographic survey were used to establish soil conditions with consideration for sewage system design and the potential for sewage system impacts.

This report consists of an evaluation of the water quality and quantity of the existing well at the subject site, and an assessment of the sewage system impact, to ensure that the water quality and quantity of the existing well is acceptable using the following documents; Ministry of the Environment, Conservation and Parks (MECP) Guideline D-5-5 and the Ontario Drinking Water Standards, Objectives and Guidelines (ODWSOG). Consideration has also been given to the groundwater impact assessment guidelines under MECP D-5-4. The scope of work carried out for this assessment was prepared in consideration of the City of Ottawa document "Terms of Reference Scoped Hydrogeological Study for Coach Houses".



HYDROGEOLOGICAL STUDY

Background

A bedrock geology map for the site area indicates the bedrock at the site consists of dolostone and sandstone of the Beekmantown Group.

The surficial geology map indicates that the soil at the property consists of till on Paleozoic terrain.

One test pit was put down as part of a proposed sewage system design to service the proposed coach house. The test pit was put down by a member of Kollaard Associates Inc. as part of the sewage design for the coach house on February 11, 2022. The test pit encountered about 0.40 metres of topsoil overlying glacial till. The test pit was terminated in the glacial till at about 0.80 metres, where refusal was encountered on a large boulder. The total depth of soil at the site, based on the information from the well record, is some 9.0 metres, consisting of glacial till (described as sand, gravel and boulders in the well record).

The existing well that services the existing dwelling at the site was assessed to determine whether the well is capable of supplying the water demand for the proposed coach house and the existing dwelling. According to the well record, the well is about 54.9 metres deep with 12.2 metres of casing. The pump for the test was installed at about 15 metres below the existing ground surface due to encountering an obstruction. The well record and Certificate of Well Compliance are provided (Attachment B).

Area Well Records

A review of five area well records was carried out. The well records are provided (Attachment B). The depths of the wells are indicated to be between 55 and 83 metres, obtaining water from a limestone aquifer. Test pumping rates for the area wells were 45.4 to 75.7 litres per minute. Recommended pumping rates were between 45.4 and 75.7 litres per minute. Overburden was identified as sand, gravel, clay, and boulders between 4.6 to 9.2 metres in thickness. All area wells had between 12.2 to 13.1 metres of casing below the ground surface.

Water Quantity

A pumping test was carried out on May 19, 2022, at the existing well on the site. The well is a drilled, cased well with about 0.6 metres of casing above the ground surface.

The testing consisted of a 6 hour duration pumping test. During the pumping test, manual water level measurements were made on a regular basis to monitor the drawdown of the water level in the well in response to pumping and water levels were monitored at one minute intervals using a pressure transducer. Groundwater samples were collected from the well after six hours to characterize groundwater quality. Hourly field water quality readings were recorded for the water temperature, pH, total dissolved solids (conductivity) and turbidity. Chlorine residuals were measured prior to obtaining a water sample for lab submission and free chlorine was measured to be zero. After the pump was shut off, the recovery of the water level in the well was measured until 95% recovery of static water level had been achieved or for 24 hours, whichever was less.

The well was pumped for about 360 minutes at a pumping rate of about 41.5 litres per minute. Over the course of the pumping test, the water level in the well dropped some 1.53 metres. At the end of pumping, 95% recovery of the total drawdown in the static water level created during pumping was measured after about 72 minutes.



The pumping test drawdown and recovery data and plots for TW1 are provided as Attachment C. 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 and recovery data, the transmissivity of the aquifer is estimated to be between about 27.4 and 19.9 m²/day, respectively.

Based on the data obtained during the six hour pumping test, it can be concluded that the well is capable of sustaining a short term yield of at least 41.5 litres per minute. During the course of the 6 hour pumping period, 6 percent of the available drawdown in the test well was utilized, based on the recommended pump depth of 30.5 metres and the initial static water level measured at the time of the pumping test (4.85 metres).

The expected water demand for the site was calculated using the total expected residential occupancy. It is understood that the main (existing) house has five bedrooms and that the proposed coach house will contain two bedrooms. Using Guideline D-5-5, total occupancy will consist of six people in the main house and up to three people in the coach house (assuming number of bedrooms plus one for each dwelling). The peak water demand (obtained from MECP D-5-5) is taken as 3.75 litres per person per minute, equivalent to 33.75 litres per minute. This peak demand rate is assumed to occur for a period of two hours each day. The pump test rate was 41.5 litres per minute. Therefore, there is sufficient water quantity available to service the peak water demands at the site.

Water Quality

To determine the water quality of the groundwater supply, groundwater samples were obtained from the well after six hours during the pumping test and prepared/preserved in the field using appropriate techniques and submitted to Eurofins Environmental Testing in Ottawa, Ontario, for the chemical, physical and bacteriological analyses listed in the Ministry of the Environment (MECP) guideline entitled Procedure D-5-5, Technical Guideline for Private Wells: Water Supply Assessment, August 1996. The results of the trace metals, chemical, physical and bacteriological analyses of the water samples obtained from the test well are provided in Attachment D. A summary of the water quality measured in the field are provided as Table I, Water Quality Measurements for Test Well.

The water quality as determined from the results of the analyses is favourable. The water meets all the Ontario Drinking Water Standards, Objectives and Guidelines (ODWSOG) health and aesthetic parameters tested for at the test well except for hardness, total dissolved solids, and total coliforms.



Sodium level is at the 20 mg/l medical advisory limit but well within the aesthetic objective. When sodium levels exceed 20 mg/l, the local Medical Officer of Health should be informed so that the information can be relayed to local physicians.

Hardness

The water is considered to be unacceptable for most domestic purposes, according to the information provided in the ODWSOG. Water with hardness above 80 to 100 milligrams per litre as CaCO_3 is often softened for domestic use. The hardness at the well was 530 milligrams per litre. According to MECP D-5-5, the ODWO is 500 mg/l and there is no maximum concentration considered reasonably treatable (MCCRT) for hardness. 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. Due to the excessive hardness, it is expected that sodium will be elevated in the treated water. Where ion exchange water softeners are used, a separate unsoftened water supply should be used for drinking and culinary purposes.

Total Dissolved Solids

Total dissolved solids (TDS) level was 625 milligrams per litre and is above the ODWS aesthetic objective (AO) of 500 milligrams per litre. Where TDS levels exceed the AO, comments regarding treatment include “written rationale that corrosion, encrustation or taste problems will not occur”, according to the MECP D-5-5 Guideline. The Technical Support Document for Ontario Drinking-Water Quality Standards, Objectives and Guidelines, states the following with regards to TDS.

“The term total dissolved solids refer to inorganic substances dissolved in water. The principal constituents of TDS are chloride, sulphates, calcium, magnesium and bicarbonates. The effects of TDS on drinking water quality depend on the levels of the individual components. Excessive hardness, taste, mineral deposition or corrosion are common properties of highly mineralized water. The palatability of drinking water with a TDS level less than 500 mg/L is generally considered to be good.”

To provide the required rationale regarding the TDS level of 625 mg/L measured at the well, the Ryznar Stability Index (RSI) and Langelier Saturation Index (LSI) were calculated for the water sample to determine the corrosivity or scale formation potential of the water. The RSI value is 6.59, and LSI is 0.39, respectively, indicating that the water has little scale potential and is not expected to be corrosive. In this case, the other constituents that contribute to TDS, including sodium, sulphates and chlorides are all well within their aesthetic objectives. The aesthetic objectives are established for sodium and chlorides based on water palatability. A sodium level of 20 mg/L and a chloride level of 63 mg/L are well within the aesthetic objectives of 200 mg/L and 250 mg/L, respectively. As such, they are not present at sufficient levels to contribute to taste. Sulphates are also present at a level of 131 mg/L. Sulphate at less than 150 mg/L does not result in noticeable taste, as stated in the Technical Support Document. TDS is also contributed to by calcium, magnesium and bicarbonates. These are the components of TDS that also cause high hardness. Consequently, the way to reduce the TDS levels is to improve excessive hardness through the reduction of hardness. The Technical Support document states that hard water has a tendency to form scale deposits and can cause scum with soap. It does not state taste issues in association with high levels of hardness. Therefore, it is considered that treatment to reduce hardness will also reduce the potential for scale formation associated with TDS.

Manganese

Manganese has an aesthetic objective (AO) of 0.05 mg/L and was measured at 0.06 mg/L at the well. The colour related AO for manganese is due to black staining or discolouration of laundry and fixtures and at excessive concentration causes undesirable taste in beverages. At the level that is



present at the well, it is only slightly above the AO and as such is less likely to cause taste issues than if manganese level were excessively high. Manganese can be effectively removed using a water softener or manganese greensand filter at levels of up to 5.0 mg/L.

Total Coliforms

The water sample obtained on May 19, 2022, had total coliforms of 4 counts/100 ml with E. Coli absent.

MECP Procedure D-5-5 states the following with regards to total coliforms:

While the stated ODWS for Total Coliforms is 0 counts per 100 ml of sample, it is recognized that the objective had been set as an indicator of inadequate disinfection within the distribution systems associated with water works. For private water wells not subject to approval under the OWRA, the MOEE and Health Units have historically used the limit of <5 counts per 100 ml in the absence of a chlorine residual as indicating acceptable water quality.

Based on the above noted information, it is considered that the total coliform level is acceptable.

Trace Metals

The results of the trace metals testing indicates that, where present, all trace metals are indicated to be within allowable limits. The strontium level is of particular concern in the Ottawa area, due to its association as naturally occurring in some sedimentary bedrock, such as limestone and sandstone. Strontium currently has a proposed Maximum Acceptable Concentration (MAC) by Health Canada of 7.0 mg/L. The level of strontium measured in the water supply at this site is 0.143 mg/L, which is well within the acceptable limit. There are no concerns with any of the trace metals concentrations in the water supply at the site.

Groundwater Impact Assessment

The Ministry of the Environment, Conservation and Parks (MECP) in the MOE Procedure D-5-4 provides guidelines for evaluating "the ability of the lands identified by and restricted to the development to treat sewage effluent to meet acceptable limits". The guideline requires that the representative background nitrate levels in the receiving groundwater be determined. Where background levels are greater than 10 milligrams per litre the ministry indicates development of the site should not be supported unless it can be demonstrated that existing levels of nitrates are the results of historical agricultural practices on the site. In addition, the guideline requires demonstration that the site is not obviously hydrogeologically sensitive such as karstic areas, areas of fractured bedrock exposed at the surface, areas of thin soil cover or areas of highly permeable soils.

The guideline indicates that the assessment involves a three step process.

Step 1 regards lot size considerations. Where the lot size for each private residence within the development is an average of one hectare or larger and no lot is smaller than 0.8 hectares, and provided the site is not hydrogeologically sensitive, the risk that impact limits may be exceeded by individual systems is considered acceptable.

Step 2 is in regards to septic system isolation considerations. Developments are considered low risk when it can be demonstrated that sewage effluent is hydrogeologically isolated from existing or potential supply aquifers. For this case the most probable groundwater receiver for sewage is to be defined through information obtained through a test pit or test hole program, and the most probable



lower hydraulic or physical boundary of the groundwater receiving sewage effluent is to be defined. The guideline indicates hydrogeological information concerning lands up to 500 metres beyond the actual development boundary may be required. When it can be demonstrated that the sewage will not enter supply aquifers the lot density of the proposed development is determined based on the space required to install a suitable septic system at each lot in accordance with the Ontario Building Code.

Step 3 is in regards to contaminant attenuation considerations. For this case, it is required to assess the risk that the on-site sewage systems within the proposed development will cause a concentration of nitrate in groundwater above 10 milligrams per litre at the down gradient boundary of the site.

The existing residential lot occupies an area of about 1.7 acres (0.67 hectares). A test pit put down in the proposed sewage system area for the coach house encountered about 0.40 metres of topsoil over 0.40 metres of glacial till. Surficial geology maps, combined with the well record for the site indicate that the soil thickness is about 4.6 to 9.0 metres in thickness, and is identified as some combination of sand, gravel, boulders, clay. This is generally consistent with glacial till. The City of Ottawa considers any site with less than 2.0 metres of soil cover to be potentially hydrogeologically sensitive. As such, the site is not considered to be potentially hydrogeologically sensitive. Due to the lot size being less than 1.0 hectares, the consideration of sewage concentrations down gradient of the site is also considered.

To obtain a general indication as to the potential impact of septic effluent on the properties adjoining the proposed development, a nitrate dilution model was used. A daily effluent loading of 1000 litres per day per septic system was assumed and the total expected impact of septic systems at this site was determined by considering the attenuation of nitrate in the effluent from each of the sewage systems at the site. The existing (main) dwelling has a tertiary treatment system that does not rely on denitrification and is not tested for denitrification (Clearstream). The impact from that system is considered to be from an assumed 40 milligrams per litre (mg/l) (NO_3 as N), after the septic system treatment to the property boundary by dilution as a result of the infiltration of meteoric water only. The proposed sewage system to service the coach house is designed for nitrogen reduction using a Waterloo Biofilter Water NO_x -LS. The information and third party testing for this type of system is provided (Attachment F). Based on the information provided, the total nitrogen reduction that can be achieved with this type of system is some 80% to 90% removal. As such, the treated effluent from the proposed coach house sewage system is expected have a Total Nitrogen concentration of some 8 mg/L as N or less. This is due to the treatment level. The following discusses the resulting dilution of the treated effluent due to infiltration and consideration of meteoric water and the site area and other factors.

The following provides the basis whereby the infiltration reduction factors for the site were chosen for the dilution calculations.

Topographic, soil and land cover infiltration factors were selected from *Table 2* of the MOE *Hydrological Technical Information Requirements for Land Development Applications*. The following is a discussion of each of the infiltration reduction factors chosen for the site.

The site and surrounding area is characterized by flat terrain with a slope infiltration factor of 0.30.

The type of land cover observed at the site at the time of site visits using the topographical survey and by use of satellite imagery consists of cultivated lands, with mature trees on the edges and in the rear yard of the property. It is expected that the post-development conditions at the site will



include treed areas over about 30% of the site. The land cover infiltration factor of 0.13 was selected, which corresponds to a mixture of cultivated lands and woodland.

In order to determine water surplus estimates for the site area, a water surplus model was obtained using published information from Environment Canada (EC) for the City of Ottawa. The water balance model output the average yearly moisture surplus value, based on monthly moisture surplus averages for the period from 1993 to 2002. The expected moisture surplus or net potential infiltration for the site area was estimated 328 millimetres, which corresponds to glacial till.

Hard Surfaced Area post-development was calculated as follows. The roofs of the two dwellings cover about 403 square metres. The driveway and other paved areas cover an area of about 709 square metres. The total hard surfaced areas were considered to be 1111 square metres. The resulting Net Infiltration Area is some ~5639 square metres.

In order to determine the impact from the two sewage systems, which have different concentrations in the treated effluent, the impact from each sewage system was considered to occur over half the lot area. Then the combined impact of two sewage systems over the site considering the concentration from each system and the volume of effluent from each system were calculated to determine the final concentration of sewage effluent that can be expected from the combined sewage effluent at the down gradient property boundaries. The existing sewage system, when considering dilution by meteoric water only over half the available lot area is some 15.4 mg/L N-NO₃. The coach house sewage system will contribute an estimated additional input of some 3.1 N-NO₃. Each system is considered to discharge some 1,000 litres of sewage effluent daily for a combined sewage input of 2,000 litres daily. The resulting concentration, based on the combined systems is expected to be 9.2 mg/L N-NO₃.

The results of the sewage dilution calculations indicate that the expected concentration of nitrate at the down gradient property boundaries from the combined sewage effluent is expected to be about 9.2 mg/L N-NO₃. This is within the Ministry of the Environment acceptable nitrate impact limit of 10 milligrams per litre.

Based on the predictive impact assessment and consideration of a tertiary sewage system capable of nitrogen reduction of at least 80% for the proposed coach house, the two private sewage disposal systems are not expected to have an adverse impact on groundwater resources in the site area.

Results and Recommendations

The following is for consideration for water treatment for the proposed coach house:

Hardness

- The water is considered to be excessively hard by water treatment standards. Water with hardness above 80 to 100 milligrams per litre as CaCO₃ is often softened for domestic use. The hardness at the well is 530 milligrams per litre. This level of hardness is “considered to be unacceptable for most domestic purposes”. The treatment to reduce hardness is the use of ion exchange water softeners. Where water hardness is excessive, the water softener can introduce even higher sodium concentrations in the water than for water that is not excessively hard (i.e. hardness of less than 200 mg/L). Of concern, is that the water softener treated water may have sodium levels that exceed the aesthetic objective for sodium in the treated drinking water, which may contribute a significant percentage to the daily sodium intake for a consumer on a sodium restricted diet and increase the corrosive



potential of the treated water. Sodium treated water may be more corrosive to plumbing fixtures and water pipes. Copper concentrations can increase in the treated water due to dissolution of metals in copper water supply pipes. In order to achieve an acceptable balance between reducing incrustation (scale) and corrosive potential, the following options for water treatment should be considered:

- Consider using an ion exchange water softener on the hot water only. This will reduce the scale in the dishwasher and hot water tank (as scale tends to form with heated water) but allow for water that is consumed (cold water faucets) to not have excessive sodium levels. This option would reduce the use and consumption of salt and provide an acceptable balance between incrustation and corrosion in the water supply pipes, fittings and fixtures;
- If the whole water supply is treated using a water softener using sodium chloride salts, consider a bypass for the kitchen for cooking and drinking purposes or a point-of-use reverse osmosis system in the kitchen;
- Consider the use of plastic (PEX) water supply pipes which do not corrode.

Sodium

- The sodium level in the untreated water supply is 20 mg/L, which is at the 20 mg/L medical advisory limit but well within the aesthetic objective of 200 mg/L. When sodium levels exceed 20 mg/L, the local Medical Officer of Health should be informed so that the information can be relayed to local physicians.
- See comments above on elevated sodium in treated water due to hardness.

Total Dissolved Solids

- The total dissolved solids were present at 625 milligrams per litre, exceeding the aesthetic objective of 500 mg/l. The elevated TDS is due to high hardness, which contributes calcium, magnesium and bicarbonates to the TDS levels. The elevated TDS and hardness are reduced through the water softening which will reduce potential for scale formation.

Manganese

- Manganese has an aesthetic objective (AO) of 0.05 mg/L and was measured at 0.06 mg/L at the well. The colour related AO for manganese is due to black staining or discolouration of laundry and fixtures and at excessive concentration causes undesirable taste in beverages. At the level that is present at the well, it is only slightly above the AO and as such is less likely to cause taste issues than if manganese level were excessively high. Manganese can be effectively removed using a water softener or manganese greensand filter at levels of up to 5.0 mg/L.

The following is required for the proposed sewage system to service the coach house:

- Based on the above noted site conditions and consideration of a minimum of 80% nitrogen reduction for the coach house sewage system, Kollaard Associates Inc. considers that the groundwater impact of the proposed development is within the impact limits established by the MECP and the water supply is adequate to provide for the existing dwelling and the proposed coach house.



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.



Colleen Vermeersch, P. Eng.

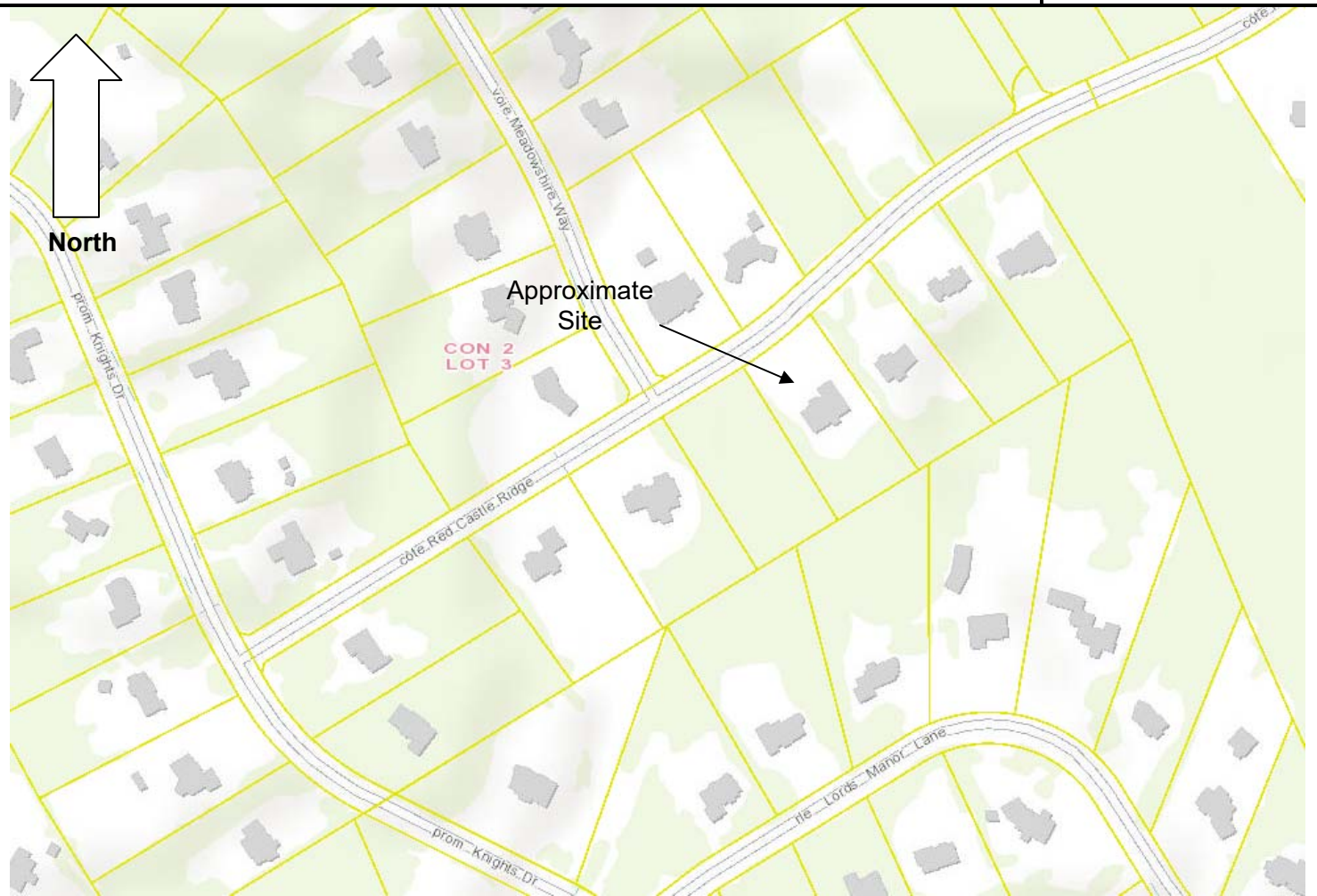
Attachments:	Table I	Summary of Hourly Field Water Quality
	Figure 1	Key Plan
	Attachment A	Proposed Sewage System Design
	Attachment B	TW1-Well Record for Site and Area Wells
	Attachment C	TW1-Pumping Test Data
	Attachment D	TW1-Laboratory Water Testing Results
	Attachment E	Sewage Attenuation Calculations
	Attachment F	Waterloo Biofilter WaterNOx-LS Third Party Testing Summary

TABLE I
FIELD WATER QUALITY MEASUREMENTS
FOR TEST WELL 1

Time Since Pumping Test Started (min)	Temperature (°C)	pH	Turbidity (NTU)	Total Dissolved Solids (ppm)	Conductivity (µS)	Free Chlorine (ppm)
60	11.0	7.54	4.74	529	1061	0.00
120	11.0	7.43	1.76	515	1029	-
180	10.7	7.50	0.68	521	1045	0.00
240	10.9	7.47	0.61	521	1037	-
300	10.7	7.49	0.62	518	1034	-
360	10.7	7.46	0.52	514	1029	0.00

KEY PLAN

FIGURE 1



NOT TO SCALE



Kollaard Associates
Engineers

Project No. 220067

Date June 2022



ATTACHMENT A

SEWAGE SYSTEM DESIGN FOR COACH HOUSE



ATTACHMENT B

MECP WELL RECORD AND CERTIFICATE OF COMPLIANCE
FOR TEST WELL AND
AREA WELL RECORDS



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 BRENNAR CONSTRUCTION

located at #5812 Red Castle Ridge

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

But 243
Lot #4 Conc 2 Plan # 4M-13465/L # 4

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 14TH day of NOVEMBER 2011

Kenny [Signature] 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.

SIGNED this 28 day of November, 2011

A.C. Houle, P. Eng.
Engineer

Houle Chevrier Engineering Ltd.



Shaping our future together
Ensemble, formons notre avenir

City of Ottawa
Client Service Centre
8742 Victoria Street
Ottawa, ON K0A 1P0

Ville d'Ottawa
Centre de service
8742, rue Victoria
Ottawa, ON K0A 1P0

713060 Fax 838.3271

Measurements recorded in: Metric Imperial

A105334

Page ___ of ___

Well Owner's Information

First Name: _____ Last Name / Organization: **Brenmar Construction** E-mail Address: _____ Well Constructed by Well Owner

Mailing Address (Street Number/Name): **1341 -1 Coker Street** Municipality: **Greely** Province: **On** Postal Code: **K4P 1A1** Telephone No. (inc. area code): _____

Well Location: Address of Well Location (Street Number/Name): **5812 Red Castle Ridge** Township: **Osgoode** Lot: _____ Concession: **PT2-3-4 2**

County/District/Municipality: **Ottawa-Carleton** City/Town/Village: **Greely** Province: **Ontario** Postal Code: _____

USM Coordinates: Zone: _____ Easting: **NAD 83 18 450356** Northing: **5009802** Municipal Plan and Sublot Number: **4M-1346** Other: _____

Overburden and Bedrock Materials: _____ Abandonment/Sealing Record: _____ (See instructions on back of this form) **S/L 4**

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft)
				From To
Grey	Limestone	Sand & Gravel + Boulders		0' 30'
Grey	Limestone			30' 51'
Grey	Limestone	a Sandstone Mix		51' 152'
Grey	Limestone	+ Sandstone Mix		152' 180'

Annular Space			
Depth Set at (m/ft)	From	To	Type of Sealant Used (Material and Type)
40'	30'		Neat cement slurry
30'	0'		Bentonite slurry
			Volume Placed (m³)
			10.9
			18.8

Method of Construction: Cable Tool Rotary (Conventional) Rotary (Reverse) Boring Air percussion Other, specify _____

Well Use: Public Domestic Livestock Irrigation Industrial Other, specify _____

Commercial Not used Dewatering Test Hole Monitoring Cooling & Air Conditioning

Construction Record - Casing				Status of Well	
Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)	From	To
6"	Steel	188"	+2'	40'	
6416	Open Hole		40'		180'

Water Supply Replacement Well Test Hole Recharge Well Dewatering Well Observation and/or Monitoring Hole Alteration (Construction) Abandoned, Insufficient Supply Abandoned, Poor Water Quality Abandoned, other, specify _____ Other, specify _____

Construction Record - Screen			
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)
			From To

Water Details		Hole Diameter	
Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input checked="" type="checkbox"/> Other, specify _____	Depth (m/ft)	Diameter (cm/in)
		From	To
51'			
189'		0'	40'
		40'	180'

Well Contractor and Well Technician Information

Business Name of Well Contractor: **Air Rock Drilling Co. Ltd.** Well Contractor's Licence No.: **1118**

Business Address (Street Number/Name): **6859 Franktown Road, RR#1** Municipality: **Richmond**

Province: **ON** Postal Code: **K0A 2Z0** Business E-mail Address: **air-rock@sympatico.ca**

Bus. Telephone No. (inc. area code): **8138382170** Name of Well Technician (Last Name, First Name): **Hogan, Dan**

Well Technician's Licence No.: **T3058** Signature of Technician and Contractor: _____ Date Submitted: **2011 11 30**

Results of Well Yield Testing				
After test of well yield, water was: <input type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify _____	Draw Down		Recovery	
	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
<input checked="" type="checkbox"/> Not tested If pumping discontinued, give reason: _____	1	21.8	1	22.7
	2	22.8	2	22
	3	23.2	3	21.5
	4	23.4	4	19.9
	5	23.7	5	19.5
	10	24.8	10	18.9
	15	25.4	15	18.9
	20	25.4	20	18.9
	25	26.1	25	18.9
	30	26.3	30	18.9
40	26.3	40	18.9	
50	26.3	50	18.9	
60	26.3	60	18.9	

Static Level: **18.9** m/ft

Recovery Level: **26.3** m/ft

Pump intake set at (m/ft): **180**

Pumping rate (l/min/GPM): **20**

Duration of pumping: **1** hrs **0** min

Final water level end of pumping (m/ft): **26.3**

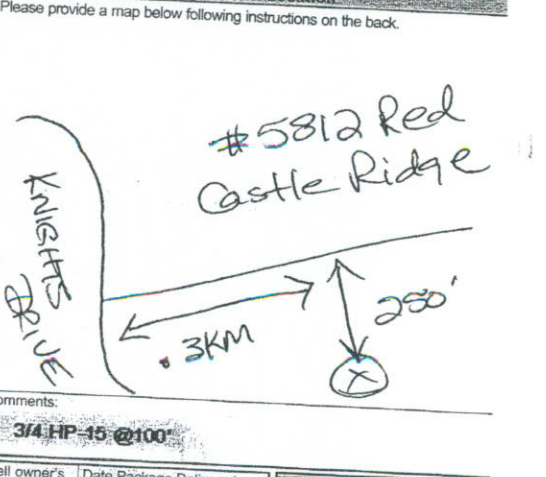
If flowing give rate (l/min/GPM): _____

Recommended pump depth (m/ft): **3 (4HP 15gpm) 100'**

Recommended pump rate (l/min/GPM): **20**

Well production (l/min/GPM): **20**

Disinfected? Yes No



Comments: **3/4 HP-15 @100'**

Well owner's information package delivered: Yes No

Date Package Delivered: **2011 11 14**

Date Work Completed: **2011 11 14**

Ministry Use Only: Audit No.: **z137104**

Received: _____

Well Owner's Information

5820 Red Castle Way (lot 6) Osgoode 4 2
 County/District/Municipality City/Town/Village Province Postal Code
Ottawa Carleton Manotick Ontario
 UTM Coordinates Zone Easting Northing GPS Unit Make Model Mode of Operation: Undifferentiated Averaged
 NAD 83 18 4 5 0 4 6 25 00 9 8 7 8 **Garmin** Differentiated, specify _____

Overburden and Bedrock Materials (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (Metres) From	Depth (Metres) To
Brown	Sandy Clay	Boulders		0	6.09
Gray	Till		Packed	6.09	9.14
Gray	Limestone	Sandstone Layers		9.14	83.20

Annular Space/Abandonment Sealing Record

Depth Set at (Metres) From	Depth Set at (Metres) To	Type of Sealant Used (Material and Type)	Volume Placed (Cubic Metres)
13.10	0	Grouted - Bentonite Slurry	.92m3

Results of Well Yield Testing

Time (Min)	Draw Down		Recovery	
	Water Level (Metres)	Static Level	Water Level (Metres)	Static Level
1	11.14	9.28	16.38	
2	12.37		14.55	
3	13.35		13.03	
4	14.01		11.92	
5	17.54		11.11	
10	16.53		9.74	
15	17.54		9.47	
20	18.01		9.32	
25	18.38		9.28	
30	18.63			
40	18.89			
50	19.06			
60	19.10			

Check box if after test of well yield, water was:
 Clear and sand free
 Cannot develop to sand-free state
 If pumping discontinued, give reason:
 Pumping test method: **submersible**
 Pump intake set at (Metres): **60.95**
 Pumping rate (Litres/min): **54.6**
 Duration of pumping: **1** hrs + **30** min
 Final water level end of pumping (Metres): **19.28**
 Recommended pump type: Shallow Deep
 Recommended pump depth: **24.38** Metres
 Recommended pump rate (Litres/min): **45.5**
 If flowing give rate (Litres/min): _____

Method of Construction

Cable Tool Diamond Public Commercial Not used
 Rotary (Conventional) Jetting Municipal Dewatering
 Rotary (Reverse) Driving Limestone Test Hole Monitoring
 Rotary (Air/Mud) Digging Irrigation Cooling & Air Conditioning
 Air percussion Boring Industrial Other, specify _____
 Other, specify _____

Water Use

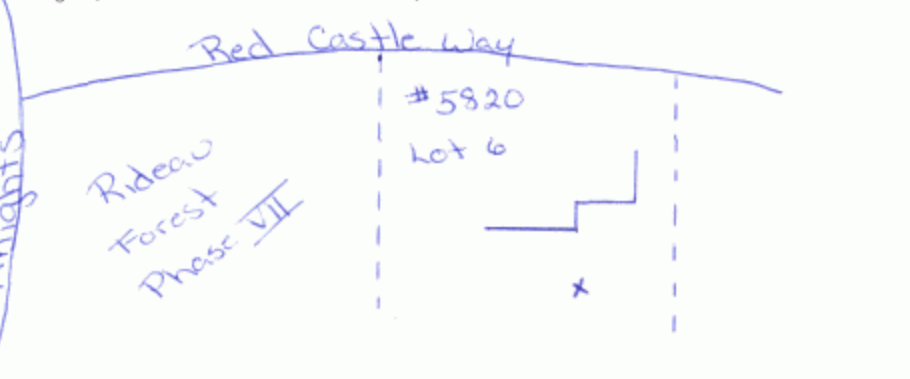
Domestic Commercial Not used
 Livestock Municipal Dewatering
 Irrigation Test Hole Monitoring
 Industrial Cooling & Air Conditioning
 Other, specify _____

Status of Well

Water Supply Dewatering Well Observation and/or Monitoring Hole
 Replacement Well Abandoned, Insufficient Supply Alteration (Construction)
 Test Hole Abandoned, Poor Water Quality Other, specify _____
 Recharge Well Abandoned, other, specify _____

Location of Well

Please provide a map below showing:
 - all property boundaries, and measurements sufficient to locate the well in relation to fixed points,
 - an arrow indicating the North direction
 - detailed drawings can be provided as attachments no larger than legal size (8.5" by 14")
 - digital pictures of inside of well can also be provided



Date Well Completed (yyyy/mm/dd): **2008/5/12**
 Was the well owner's information package delivered? Yes No
 Date the Well Record and Package Delivered to Well Owner (yyyy/mm/dd): **2008/5/13**

Well Contractor and Well Technician Information

Business Name of Well Contractor: **Capital Water Supply Ltd.**
 Well Contractor's Licence No.: **1 5 5 8**
 Business Address (Street No./Name, number, RR): **Box 490**
 Municipality: **Stittsville**
 Province: **Ontario** Postal Code: **K 2S 1 A6** Business E-mail Address: **office@capitalwater.ca**
 Bus. Telephone No. (inc. area code): **6 13 8 3 6 1 7 66** Name of Well Technician (Last Name, First Name): **Miller; Stephen**
 Well Technician's Licence No.: **0 0 9 7** Signature of Technician: *[Signature]* Date Submitted (yyyy/mm/dd): **2008/05/16**

Water Details

Water found at Depth	Kind of Water
64 Metres <input type="checkbox"/> Gas <input type="checkbox"/> Fresh <input type="checkbox"/> Salty <input type="checkbox"/> Sulphur <input type="checkbox"/> Minerals	
81.07 Metres <input type="checkbox"/> Gas <input type="checkbox"/> Fresh <input type="checkbox"/> Salty <input type="checkbox"/> Sulphur <input type="checkbox"/> Minerals	NOT TESTED
_____ Metres <input type="checkbox"/> Gas <input type="checkbox"/> Fresh <input type="checkbox"/> Salty <input type="checkbox"/> Sulphur <input type="checkbox"/> Minerals	

Casing Used	Screen Used	Casing and Well Details
<input type="checkbox"/> Galvanized <input checked="" type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete	<input type="checkbox"/> Galvanized <input type="checkbox"/> Steel <input type="checkbox"/> Fibreglass <input type="checkbox"/> Plastic <input type="checkbox"/> Concrete	Diameter of the Hole (Centimetres): 15.23 Depth of the Hole (Metres): 83.20 Wall Thickness (Metres): .48 Inside Diameter of the Casing (Metres): 15.86 Depth of the Casing (Metres): + .45 to 13.10
No Casing and Screen Used		
<input type="checkbox"/> Open Hole		
Disinfected? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		

Ministry Use Only

Audit No.: **z 77353**
 Well Contractor No.: _____
 Date Received (yyyy/mm/dd): **JUN 02 2008**
 Date of Inspection (yyyy/mm/dd): _____
 Remarks: _____



Ministry of the Environment

Well

A113281

(see below)

Well Record

Regulation 903 Ontario Water Resources Act

Well Location

Address of Well Location (Street Number/Name): **1151 Meadowshire Way**

Township: **Osgoode** Lot: **P/L 2374 2** Concession: **2**

County/District/Municipality: **Ottawa-Carleton** City/Town/Village: **Greely** Province: **Ontario** Postal Code:

UTM Coordinates Zone Easting Northing: **NAD 83 18 450199 5009813** Municipal Plan and Sublot Number: **4M-1346** Other: **S/L 13**

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Grey	Clay	Gravel		0'	15'
Grey & Brown	Limestone			15'	53'
Grey & Brown	Limestone			53'	158'
Grey & White	Sandstone			158'	233'
Grey & White	Sandstone			233'	240'

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m ³ /ft ³)
40'	0'	Neat cement slurry	21.8

Results of Well Yield Testing

Time (min)	Draw Down		Recovery	
	Water Level (m/ft)	Time (min)	Water Level (m/ft)	Time (min)
Static Level	18.5'		70.8'	
1	28.9	1	55.7	
2	37.4	2	50.5	
3	42.6	3	46	
4	47.5	4	43.1	
5	52	5	40.8	
10	69.6	10	31.3	
15	70.1	15	26.4	
20	70.5	20	23.7	
25	70.8	25	22.1	
30	70.8	30	21.1	
40	70.8	40	20.3	
50	70.8	50	19.6	
60	70.8	60	19.1	

After test of well yield, water was:
 Clear and sand free
 Other, specify **Not tested**

If pumping discontinued, give reason:
X

Pump intake set at (m/ft): **230**

Pumping rate (l/min / GPM): **15**

Duration of pumping: **1** hrs + **0** min

Final water level end of pumping (m/ft): **70.8**

If flowing give rate (l/min / GPM): **X**

Recommended pump depth (m/ft): **200'**

Recommended pump rate (l/min / GPM): **15**

Well production (l/min / GPM): **15**

Disinfected? Yes No

Method of Construction

Cable Tool Diamond Public Commercial Not used

Rotary (Conventional) Jetting Domestic Municipal Dewatering

Rotary (Reverse) Driving Livestock Test Hole Monitoring

Boring Digging Irrigation Cooling & Air Conditioning

Air percussion Industrial Other, specify

Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
6"	Steel	.188"	+2'	40'	<input checked="" type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify <input type="checkbox"/> Other, specify
5 1/8"	Open Hole		40'	240'	

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)		Status of Well
			From	To	
					<input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify <input type="checkbox"/> Other, specify

Water Details

Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify
53 (m/ft)	<input type="checkbox"/> Fresh <input checked="" type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify
233 (m/ft)	<input type="checkbox"/> Fresh <input checked="" type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify
(m/ft)	<input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0'	40'	6"
40'	240'	5 1/8"

Well Contractor and Well Technician Information

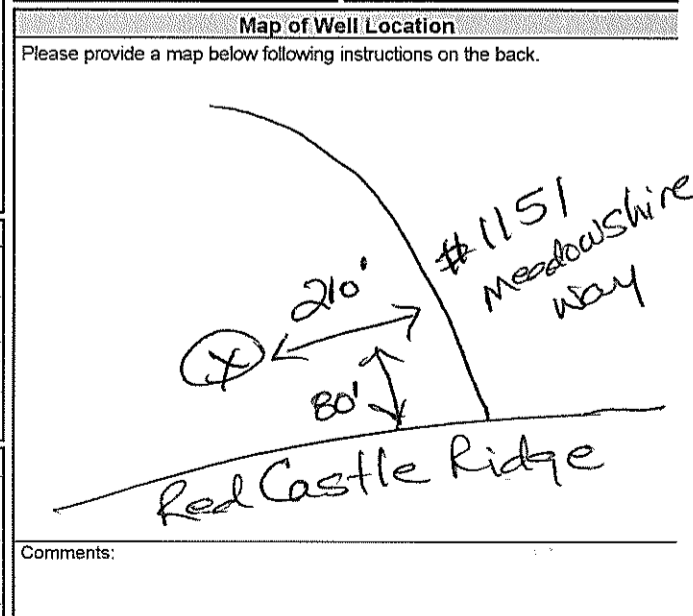
Business Name of Well Contractor: **Air Rock Drilling Co. Ltd.** Well Contractor's Licence No.: **1119**

Business Address (Street Number/Name): **6659 Franktown Road, RR#1** Municipality: **Richmond**

Province: **ON** Postal Code: **K0A 2Z0** Business E-mail Address: **air-rock@sympatico.ca**

Bus. Telephone No. (inc. area code): **6138382170** Name of Well Technician (Last Name, First Name): **Graham, Ryan**

Well Technician's Licence No.: **T3484** Signature of Technician and/or Contractor: *[Signature]* Date Submitted: **2012 02 29**



Well owner's information package delivered Yes No

Date Package Delivered: **2012 02 22**

Date Work Completed: **2012 02 16**

Ministry Use Only

Audit No.: **2128486**

Received: **MAR 29 2012**



Measurements recorded in: Metric Imperial

A135433

Well Owner's Information

First Name, Last Name / Organization (Principia Custom Built Homes), E-mail Address, Mailing Address (1491 Manotick Station Road), Municipality (Greely), Province (ON), Postal Code (K4P 1P6), Telephone No.

Well Location

Address of Well Location (5809 Red Castle Ridge), Township (Osgoode), Lot (P/L 2,3,4), Concession (2), County/District/Municipality (Ottawa-Carleton), City/Town/Village (Greely), Province (Ontario), UTM Coordinates, Municipal Plan and Sublot Number (4M-1346), Other (S/L 12)

Overburden and Bedrock Materials/Abandonment Sealing Record

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To. Rows include Sand & Gravel, Limestone, Sandstone, Boulders.

Annular Space table with columns: Depth Set at (m/ft) From, To, Type of Sealant Used, Volume Placed (m³/ft³). Rows for Neat cement and Bentonite slurry.

Method of Construction and Well Use checkboxes. Includes Cable Tool, Rotary, Boring, Air percussion, and various well uses like Domestic, Commercial, etc.

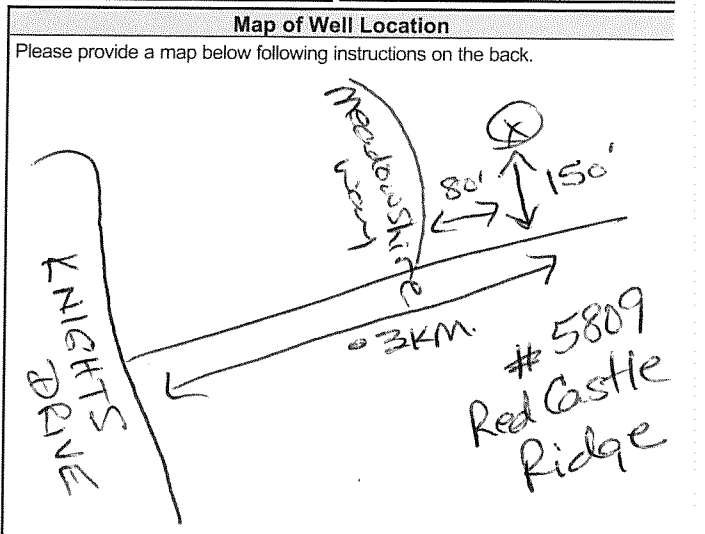
Construction Record - Casing and Status of Well. Includes Inside Diameter, Open Hole OR Material, Wall Thickness, Depth, and checkboxes for Water Supply, Replacement Well, etc.

Construction Record - Screen. Includes Outside Diameter, Material, Slot No., and Depth.

Water Details and Hole Diameter. Includes Water found at Depth, Kind of Water, and Hole Diameter (Depth and Diameter).

Well Contractor and Well Technician Information. Includes Business Name (Air Rock Drilling Co. Ltd.), Licence No., Business Address, Municipality, Province, Postal Code, Business E-mail Address, Name of Well Technician (Purcell, Shannon), and Licences.

Results of Well Yield Testing. Includes After test of well yield, water was; Draw Down and Recovery table; Pumping rate; Duration of pumping; Final water level end of pumping; If flowing give rate; Recommended pump depth and rate; Well production; Disinfected? checkboxes.



Comments: 3/4 HP - 15 GPM SET @ 100 FT. Includes Well owner's information package delivered, Date Package Delivered (2013 04 02), Date Work Completed (2013 03 26), and Ministry Use Only Audit No. (Z 155057).



Measurements recorded in: Metric Imperial

Page of

Well Owner's Information

First Name Last Name / Organization E-mail Address Well Constructed by Well Owner

Mailing Address (Street Number/Name) Municipality Province Postal Code Telephone No. (inc. area code)

Well Location

Address of Well Location (Street Number/Name) Township Lot Concession

County/District/Municipality City/Town/Village Province Postal Code

UTM Coordinates Zone Easting Northing Municipal Plan and Sublot Number Other

Overburden and Bedrock Materials/Abandonment Sealing Record

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth From, Depth To

Annular Space table with columns: Depth Set at (From, To), Type of Sealant Used, Volume Placed

Results of Well Yield Testing table with columns: Draw Down (Time, Water Level), Recovery (Time, Water Level)

Method of Construction and Well Use checkboxes

Construction Record - Casing table with columns: Inside Diameter, Open Hole OR Material, Wall Thickness, Depth, Status of Well

Construction Record - Screen table with columns: Outside Diameter, Material, Slot No., Depth

Water Details and Hole Diameter tables

Well Contractor and Well Technician Information table

Map of Well Location with handwritten annotations: Meadowshire way, 1KM, #5813 RED CASTLE RIDGE

Well Technician's Licence No., Signature, Date Submitted

Ministry Use Only table with Audit No. Z191440, Date Work Completed 2015 05 14



Well Owner's Information

First Name, Last Name / Organization (Brenmar Construction), E-mail Address, Well Constructed by Well Owner

Mailing Address (Street Number/Name), Municipality (Greely), Province (On), Postal Code (K4P 1A1), Telephone No.

Well Location: Address of Well Location (5816 Red Castle Ridge), Township (Osgoode), Lot (P/L 2,3,4 2), Concession, County/District/Municipality (Ottawa-Carleton), City/Town/Village (Greely), Province (Ontario), Postal Code, UTM Coordinates, Zone, Easting, Northing, Municipal Plan and Sublot Number (4M-1345), Other (S/L 5)

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To. Rows include Sand, Gravel, Limestone, Sandstone.

Annular Space table with columns: Depth Set at (m/ft) From, To, Type of Sealant Used (Neat cement, Bentonite slurry), Volume Placed (m³/GPD).

Method of Construction and Well Use checkboxes: Cable Tool, Rotary, Boring, Air percussion, Public, Commercial, Domestic, etc.

Construction Record - Casing table with columns: Inside Diameter (cm/in), Open Hole OR Material, Wall Thickness (cm/in), Depth (m/ft) From, To, Status of Well.

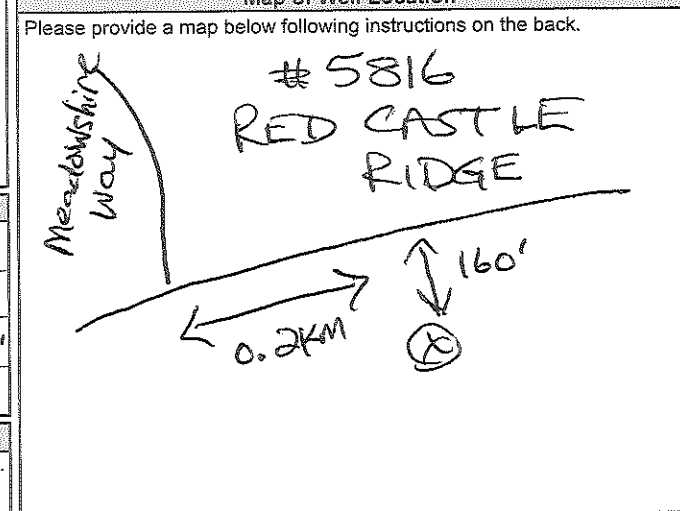
Construction Record - Screen table with columns: Outside Diameter (cm/in), Material, Slot No., Depth (m/ft) From, To.

Water Details and Hole Diameter table with columns: Water found at Depth, Kind of Water, Depth (m/ft) From, To, Diameter (cm/in).

Well Contractor and Well Technician Information: Business Name (Air Rock Drilling Co. Ltd.), Licence No., Business Address, Municipality, Province, Postal Code, Business E-mail Address.

Well Technician's Licence No., Signature of Technician and/or Contractor, Date Submitted (07 31).

Results of Well Yield Testing table with columns: Draw Down (Time, Water Level), Recovery (Time, Water Level), Pumping rate, Duration of pumping, Final water level end of pumping, Recommended pump depth, Recommended pump rate, Well production, Disinfected?



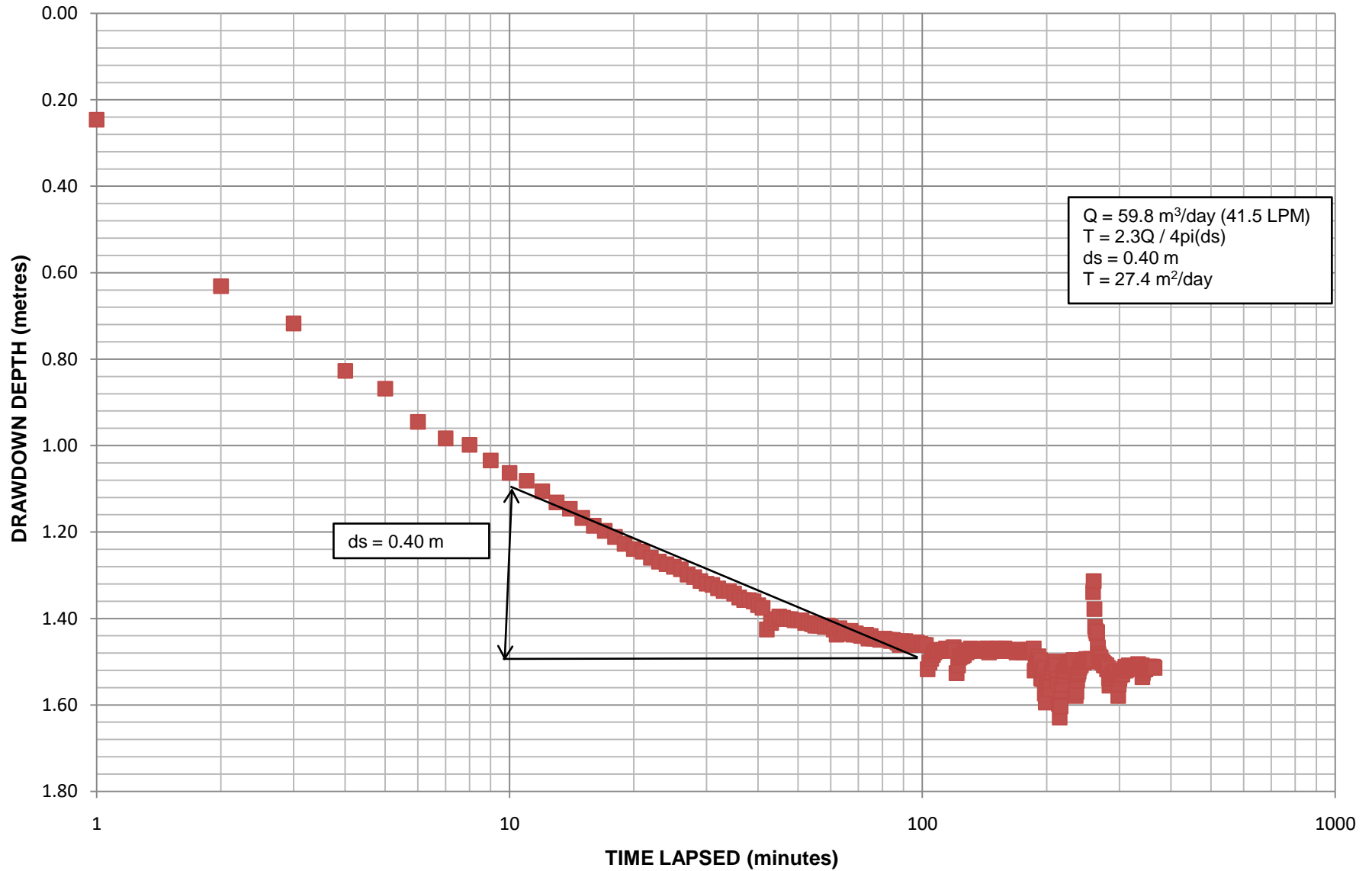
Comments: 1 HP - 20 GPM CPS SET @ 100 FT

Ministry Use Only: Audit No. (2276989), Date Package Delivered (2018 07 16), Date Work Completed (2018 07 06), Received (SEP 10 2018).



ATTACHMENT C
PUMPING TEST DATA

TW1-WELL DRAWDOWN VS. TIME-KOLLAARD FILE 220067



DRAWDOWN DATA TW1

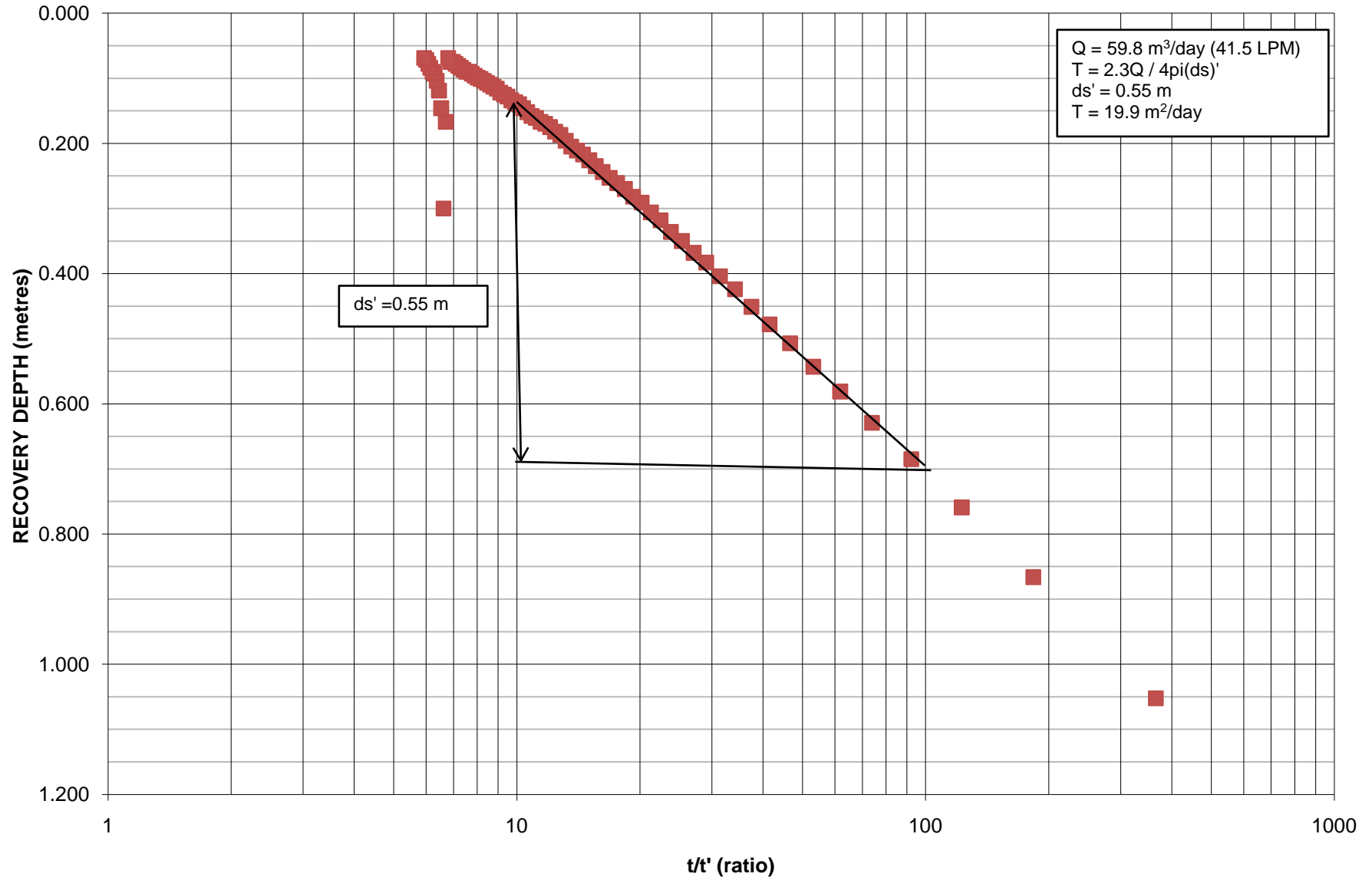
Time Lapsed (minutes)	Abs Pres (kPa)	Temp (°C)	Water Level (m)	Drawdown (m)
0	348.345	9.275	-4.85	0.00
1	345.933	9.275	-5.096	0.25
2	342.156	9.275	-5.481	0.63
3	341.314	9.275	-5.567	0.72
4	340.239	9.275	-5.677	0.83
5	339.833	9.275	-5.718	0.87
6	339.078	9.275	-5.795	0.95
7	338.701	9.275	-5.833	0.98
8	338.556	9.275	-5.848	1.00
9	338.207	9.275	-5.884	1.03
10	337.917	9.275	-5.913	1.06
11	337.743	9.275	-5.931	1.08
12	337.511	9.275	-5.955	1.11
13	337.249	9.275	-5.981	1.13
14	337.104	9.275	-5.996	1.15
15	336.901	9.275	-6.017	1.17
16	336.727	9.275	-6.035	1.19
17	336.611	9.275	-6.047	1.20
18	336.466	9.275	-6.061	1.21
19	336.314	9.176	-6.077	1.23
20	336.198	9.176	-6.089	1.24
21	336.14	9.176	-6.095	1.25
22	335.995	9.176	-6.109	1.26
23	335.908	9.176	-6.118	1.27
24	335.85	9.176	-6.124	1.27
25	335.792	9.176	-6.13	1.28
26	335.734	9.176	-6.136	1.29
27	335.618	9.176	-6.148	1.30
28	335.56	9.176	-6.154	1.30
29	335.473	9.176	-6.163	1.31
30	335.414	9.176	-6.169	1.32
31	335.385	9.176	-6.172	1.32
32	335.298	9.176	-6.18	1.33
33	335.24	9.176	-6.186	1.34
34	335.24	9.176	-6.186	1.34
35	335.182	9.176	-6.192	1.34
36	335.095	9.176	-6.201	1.35
37	335.037	9.176	-6.207	1.36
38	335.037	9.176	-6.207	1.36
39	335.008	9.176	-6.21	1.36
40	334.921	9.176	-6.219	1.37
41	334.863	9.176	-6.225	1.38
42	334.37	9.176	-6.275	1.43
43	334.515	9.176	-6.26	1.41
44	334.602	9.176	-6.251	1.40
45	334.666	9.275	-6.245	1.40
46	334.631	9.176	-6.248	1.40
47	334.602	9.176	-6.251	1.40
48	334.602	9.176	-6.251	1.40
49	334.573	9.176	-6.254	1.40
50	334.573	9.176	-6.254	1.40
51	334.573	9.176	-6.254	1.40
52	334.515	9.176	-6.26	1.41
53	334.515	9.176	-6.26	1.41
54	334.486	9.176	-6.263	1.41
55	334.457	9.176	-6.266	1.42
56	334.457	9.176	-6.266	1.42
57	334.457	9.176	-6.266	1.42
58	334.428	9.176	-6.269	1.42
59	334.457	9.176	-6.266	1.42
60	334.428	9.176	-6.269	1.42
61	334.37	9.176	-6.275	1.43
62	334.254	9.176	-6.287	1.44
63	334.399	9.176	-6.272	1.42
64	334.283	9.176	-6.284	1.43
65	334.341	9.176	-6.278	1.43
66	334.283	9.176	-6.284	1.43
67	334.341	9.176	-6.278	1.43
68	334.254	9.176	-6.287	1.44
69	334.283	9.176	-6.284	1.43
70	334.254	9.176	-6.287	1.44
71	334.225	9.176	-6.29	1.44
72	334.225	9.176	-6.29	1.44
73	334.254	9.176	-6.287	1.44
74	334.167	9.176	-6.296	1.45
75	334.225	9.176	-6.29	1.44
76	334.167	9.176	-6.296	1.45
77	334.167	9.176	-6.296	1.45
78	334.167	9.176	-6.296	1.45
79	334.138	9.176	-6.299	1.45
80	334.167	9.176	-6.296	1.45
81	334.167	9.176	-6.296	1.45
82	334.138	9.176	-6.299	1.45
83	334.138	9.176	-6.299	1.45
84	334.109	9.176	-6.302	1.45
85	334.138	9.176	-6.299	1.45
86	334.109	9.176	-6.302	1.45

87	334.08	9.176	-6.305	1.46
88	334.022	9.176	-6.311	1.46
89	334.109	9.176	-6.302	1.45
90	334.08	9.176	-6.305	1.46
91	334.109	9.176	-6.302	1.45
92	334.051	9.176	-6.308	1.46
93	334.022	9.176	-6.311	1.46
94	334.022	9.176	-6.311	1.46
95	334.08	9.176	-6.305	1.46
96	334.051	9.176	-6.308	1.46
97	334.08	9.176	-6.305	1.46
98	334.022	9.176	-6.311	1.46
99	334.051	9.176	-6.308	1.46
100	334.022	9.176	-6.311	1.46
101	334.022	9.176	-6.311	1.46
102	334.022	9.176	-6.311	1.46
103	333.471	9.176	-6.367	1.52
104	333.616	9.176	-6.352	1.50
105	333.703	9.176	-6.343	1.49
106	333.79	9.176	-6.334	1.48
107	333.848	9.176	-6.328	1.48
108	333.877	9.176	-6.325	1.48
109	333.906	9.176	-6.322	1.47
110	333.877	9.176	-6.325	1.48
111	333.906	9.176	-6.322	1.47
112	333.906	9.176	-6.322	1.47
113	333.877	9.176	-6.325	1.48
114	333.935	9.176	-6.319	1.47
115	333.906	9.176	-6.322	1.47
116	333.906	9.176	-6.322	1.47
117	333.906	9.176	-6.322	1.47
118	333.935	9.176	-6.319	1.47
119	333.964	9.176	-6.316	1.47
120	333.906	9.176	-6.322	1.47
121	333.384	9.176	-6.376	1.53
122	333.558	9.176	-6.358	1.51
123	333.732	9.176	-6.34	1.49
124	333.761	9.176	-6.337	1.49
125	333.761	9.176	-6.337	1.49
126	333.79	9.176	-6.334	1.48
127	333.877	9.176	-6.325	1.48
128	333.848	9.176	-6.328	1.48
129	333.877	9.176	-6.325	1.48
130	333.877	9.176	-6.325	1.48
131	333.935	9.176	-6.319	1.47
132	333.906	9.176	-6.322	1.47
133	333.906	9.176	-6.322	1.47
134	333.906	9.176	-6.322	1.47
135	333.906	9.176	-6.322	1.47
136	333.906	9.176	-6.322	1.47
137	333.906	9.176	-6.322	1.47
138	333.877	9.176	-6.325	1.48
139	333.906	9.176	-6.322	1.47
140	333.906	9.176	-6.322	1.47
141	333.906	9.176	-6.322	1.47
142	333.906	9.176	-6.322	1.47
143	333.935	9.176	-6.319	1.47
144	333.935	9.176	-6.319	1.47
145	333.848	9.176	-6.328	1.48
146	333.906	9.176	-6.322	1.47
147	333.906	9.176	-6.322	1.47
148	333.906	9.176	-6.322	1.47
149	333.906	9.176	-6.322	1.47
150	333.906	9.176	-6.322	1.47
151	333.906	9.176	-6.322	1.47
152	333.935	9.176	-6.319	1.47
153	333.906	9.176	-6.322	1.47
154	333.877	9.176	-6.325	1.48
155	333.877	9.176	-6.325	1.48
156	333.935	9.176	-6.319	1.47
157	333.906	9.176	-6.322	1.47
158	333.935	9.176	-6.319	1.47
159	333.877	9.176	-6.325	1.48
160	333.906	9.176	-6.322	1.47
161	333.877	9.176	-6.325	1.48
162	333.906	9.176	-6.322	1.47
163	333.877	9.176	-6.325	1.48
164	333.877	9.176	-6.325	1.48
165	333.906	9.176	-6.322	1.47
166	333.877	9.176	-6.325	1.48
167	333.877	9.176	-6.325	1.48
168	333.877	9.176	-6.325	1.48
169	333.848	9.176	-6.328	1.48
170	333.906	9.176	-6.322	1.47
171	333.906	9.176	-6.322	1.47
172	333.877	9.176	-6.325	1.48
173	333.877	9.176	-6.325	1.48
174	333.906	9.176	-6.322	1.47
175	333.848	9.176	-6.328	1.48
176	333.877	9.176	-6.325	1.48
177	333.848	9.176	-6.328	1.48
178	333.906	9.176	-6.322	1.47
179	333.906	9.176	-6.322	1.47

180	333.848	9.176	-6.328	1.48
181	333.877	9.176	-6.325	1.48
182	333.906	9.176	-6.322	1.47
183	333.877	9.176	-6.325	1.48
184	333.877	9.176	-6.325	1.48
185	333.848	9.176	-6.328	1.48
186	333.935	9.176	-6.319	1.47
187	333.442	9.176	-6.37	1.52
188	333.5	9.176	-6.364	1.51
189	333.587	9.176	-6.355	1.51
190	333.703	9.176	-6.343	1.49
191	333.761	9.176	-6.337	1.49
192	333.645	9.176	-6.349	1.50
193	333.674	9.176	-6.346	1.50
194	333.267	9.176	-6.388	1.54
195	333.238	9.176	-6.39	1.54
196	333.442	9.176	-6.37	1.52
197	333.5	9.176	-6.364	1.51
198	332.919	9.176	-6.423	1.57
199	332.716	9.176	-6.444	1.59
200	333.093	9.176	-6.405	1.56
201	333.296	9.176	-6.385	1.54
202	333.151	9.176	-6.399	1.55
203	333.006	9.176	-6.414	1.56
204	333.209	9.176	-6.393	1.54
205	333.384	9.176	-6.376	1.53
206	333.413	9.176	-6.373	1.52
207	333.5	9.176	-6.364	1.51
208	333.587	9.176	-6.355	1.51
209	333.587	9.176	-6.355	1.51
210	333.645	9.176	-6.349	1.50
211	333.558	9.176	-6.358	1.51
212	333.238	9.176	-6.39	1.54
213	333.122	9.176	-6.402	1.55
214	332.687	9.176	-6.447	1.60
215	332.368	9.176	-6.479	1.63
216	332.629	9.176	-6.453	1.60
217	332.977	9.176	-6.417	1.57
218	333.122	9.176	-6.402	1.55
219	333.325	9.176	-6.382	1.53
220	333.325	9.176	-6.382	1.53
221	333.413	9.176	-6.373	1.52
222	333.442	9.176	-6.37	1.52
223	333.529	9.176	-6.361	1.51
224	333.558	9.176	-6.358	1.51
225	333.587	9.176	-6.355	1.51
226	333.616	9.176	-6.352	1.50
227	333.616	9.176	-6.352	1.50
228	333.645	9.176	-6.349	1.50
229	333.616	9.176	-6.352	1.50
230	333.645	9.176	-6.349	1.50
231	333.645	9.176	-6.349	1.50
232	333.674	9.176	-6.346	1.50
233	333.674	9.176	-6.346	1.50
234	333.296	9.176	-6.385	1.54
235	332.861	9.176	-6.429	1.58
236	332.948	9.176	-6.42	1.57
237	333.209	9.176	-6.393	1.54
238	333.355	9.176	-6.379	1.53
239	333.413	9.176	-6.373	1.52
240	333.5	9.176	-6.364	1.51
241	333.558	9.176	-6.358	1.51
242	333.558	9.176	-6.358	1.51
243	333.616	9.176	-6.352	1.50
244	333.645	9.176	-6.349	1.50
245	333.674	9.176	-6.346	1.50
246	333.616	9.176	-6.352	1.50
247	333.645	9.176	-6.349	1.50
248	333.645	9.176	-6.349	1.50
249	333.703	9.176	-6.343	1.49
250	333.645	9.176	-6.349	1.50
251	333.674	9.176	-6.346	1.50
252	333.674	9.176	-6.346	1.50
253	333.674	9.176	-6.346	1.50
254	333.674	9.176	-6.346	1.50
255	333.703	9.176	-6.343	1.49
256	333.703	9.176	-6.343	1.49
257	333.674	9.176	-6.346	1.50
258	333.674	9.176	-6.346	1.50
259	335.211	9.176	-6.189	1.34
260	335.473	9.176	-6.163	1.31
261	334.834	9.176	-6.228	1.38
262	334.428	9.176	-6.269	1.42
263	334.341	9.176	-6.278	1.43
264	334.283	9.176	-6.284	1.43
265	334.312	9.176	-6.281	1.43
266	333.964	9.176	-6.316	1.47
267	333.819	9.176	-6.331	1.48
268	333.761	9.176	-6.337	1.49
269	333.703	9.176	-6.343	1.49
270	333.732	9.176	-6.34	1.49
271	333.645	9.176	-6.349	1.50
272	333.645	9.176	-6.349	1.50

273	333.616	9.176	-6.352	1.50
274	333.616	9.176	-6.352	1.50
275	333.558	9.176	-6.358	1.51
276	333.587	9.176	-6.355	1.51
277	333.558	9.176	-6.358	1.51
278	333.558	9.176	-6.358	1.51
279	333.558	9.176	-6.358	1.51
280	333.471	9.176	-6.367	1.52
281	333.471	9.176	-6.367	1.52
282	333.5	9.176	-6.364	1.51
283	333.267	9.176	-6.388	1.54
284	333.093	9.176	-6.405	1.56
285	333.151	9.176	-6.399	1.55
286	333.238	9.176	-6.39	1.54
287	333.267	9.176	-6.388	1.54
288	333.355	9.176	-6.379	1.53
289	333.355	9.176	-6.379	1.53
290	333.384	9.176	-6.376	1.53
291	333.355	9.176	-6.379	1.53
292	333.384	9.176	-6.376	1.53
293	333.413	9.176	-6.373	1.52
294	333.413	9.176	-6.373	1.52
295	333.267	9.176	-6.388	1.54
296	333.325	9.176	-6.382	1.53
297	333.355	9.176	-6.379	1.53
298	332.861	9.176	-6.429	1.58
299	333.122	9.176	-6.402	1.55
300	333.238	9.176	-6.39	1.54
301	333.325	9.176	-6.382	1.53
302	333.355	9.176	-6.379	1.53
303	333.355	9.176	-6.379	1.53
304	333.413	9.176	-6.373	1.52
305	333.355	9.176	-6.379	1.53
306	333.442	9.176	-6.37	1.52
307	333.442	9.176	-6.37	1.52
308	333.471	9.176	-6.367	1.52
309	333.471	9.176	-6.367	1.52
310	333.529	9.176	-6.361	1.51
311	333.442	9.176	-6.37	1.52
312	333.471	9.176	-6.367	1.52
313	333.471	9.176	-6.367	1.52
314	333.5	9.176	-6.364	1.51
315	333.5	9.176	-6.364	1.51
316	333.558	9.176	-6.358	1.51
317	333.5	9.176	-6.364	1.51
318	333.5	9.176	-6.364	1.51
319	333.529	9.176	-6.361	1.51
320	333.5	9.176	-6.364	1.51
321	333.5	9.176	-6.364	1.51
322	333.5	9.176	-6.364	1.51
323	333.5	9.176	-6.364	1.51
324	333.5	9.176	-6.364	1.51
325	333.529	9.176	-6.361	1.51
326	333.529	9.176	-6.361	1.51
327	333.529	9.176	-6.361	1.51
328	333.558	9.176	-6.358	1.51
329	333.558	9.176	-6.358	1.51
330	333.529	9.176	-6.361	1.51
331	333.529	9.176	-6.361	1.51
332	333.558	9.176	-6.358	1.51
333	333.587	9.176	-6.355	1.51
334	333.558	9.176	-6.358	1.51
335	333.529	9.176	-6.361	1.51
336	333.529	9.176	-6.361	1.51
337	333.5	9.176	-6.364	1.51
338	333.558	9.176	-6.358	1.51
339	333.558	9.176	-6.358	1.51
340	333.558	9.176	-6.358	1.51
341	333.296	9.176	-6.385	1.54
342	333.384	9.176	-6.376	1.53
343	333.442	9.176	-6.37	1.52
344	333.471	9.176	-6.367	1.52
345	333.471	9.176	-6.367	1.52
346	333.471	9.176	-6.367	1.52
347	333.471	9.176	-6.367	1.52
348	333.5	9.176	-6.364	1.51
349	333.5	9.176	-6.364	1.51
350	333.5	9.176	-6.364	1.51
351	333.5	9.176	-6.364	1.51
352	333.529	9.176	-6.361	1.51
353	333.529	9.176	-6.361	1.51
354	333.529	9.176	-6.361	1.51
355	333.529	9.176	-6.361	1.51
356	333.5	9.176	-6.364	1.51
357	333.529	9.176	-6.361	1.51
358	333.529	9.176	-6.361	1.51
359	333.5	9.176	-6.364	1.51
360	333.529	9.176	-6.361	1.51
361	333.529	9.176	-6.361	1.51
362	333.529	9.176	-6.361	1.51
363	333.5	9.176	-6.364	1.51
364	333.5	9.176	-6.364	1.51
365	333.5	9.176	-6.364	1.51

TW1- WELL RECOVERY VS. TIME - KOLLAARD FILE 220067



RECOVERY DATA TW-1

t'	t / t'	Abs Pres (kPa)	Temp (°C)	Water Level (m)	Drawdown (m)	Recovery (%)
1	366	338.027	9.176	-5.902	1.05	31%
2	183.5	339.856	9.176	-5.716	0.87	43%
3	122.7	340.901	9.176	-5.609	0.76	50%
4	92.3	341.627	9.176	-5.535	0.69	55%
5	74.0	342.179	9.176	-5.479	0.63	58%
6	61.8	342.643	9.176	-5.431	0.58	62%
7	53.1	343.021	9.176	-5.393	0.54	64%
8	46.6	343.369	9.176	-5.357	0.51	67%
9	41.6	343.66	9.176	-5.328	0.48	68%
10	37.5	343.921	9.176	-5.301	0.45	70%
11	34.2	344.183	9.176	-5.274	0.42	72%
12	31.4	344.386	9.176	-5.254	0.40	73%
13	29.1	344.59	9.176	-5.233	0.38	75%
14	27.1	344.735	9.176	-5.218	0.37	76%
15	25.3	344.909	9.176	-5.2	0.35	77%
16	23.8	345.054	9.176	-5.186	0.34	78%
17	22.5	345.229	9.176	-5.168	0.32	79%
18	21.3	345.345	9.176	-5.156	0.31	80%
19	20.2	345.49	9.176	-5.141	0.29	81%
20	19.3	345.577	9.176	-5.132	0.28	81%
21	18.4	345.694	9.176	-5.12	0.27	82%
22	17.6	345.781	9.176	-5.111	0.26	83%
23	16.9	345.868	9.176	-5.103	0.25	83%
24	16.2	345.955	9.176	-5.094	0.24	84%
25	15.6	346.042	9.176	-5.085	0.24	84%
26	15.0	346.13	9.176	-5.076	0.23	85%
27	14.5	346.217	9.176	-5.067	0.22	86%
28	14.0	346.275	9.176	-5.061	0.21	86%
29	13.6	346.333	9.176	-5.055	0.21	86%
30	13.2	346.42	9.176	-5.046	0.20	87%
31	12.8	346.507	9.176	-5.037	0.19	88%
32	12.4	346.565	9.176	-5.032	0.18	88%
33	12.1	346.624	9.176	-5.025	0.18	88%
34	11.7	346.682	9.176	-5.02	0.17	89%
35	11.4	346.711	9.176	-5.017	0.17	89%
36	11.1	346.769	9.176	-5.011	0.16	89%
37	10.9	346.798	9.176	-5.008	0.16	90%
38	10.6	346.856	9.176	-5.002	0.15	90%
39	10.4	346.914	9.176	-4.996	0.15	90%
40	10.1	346.972	9.176	-4.99	0.14	91%
41	9.9	347.001	9.176	-4.987	0.14	91%
42	9.7	347.03	9.176	-4.984	0.13	91%
43	9.5	347.089	9.176	-4.978	0.13	92%
44	9.3	347.118	9.176	-4.975	0.13	92%
45	9.1	347.147	9.176	-4.972	0.12	92%
46	8.9	347.205	9.176	-4.966	0.12	92%

47	8.8	347.234	9.176	-4.963	0.11	93%
48	8.6	347.263	9.176	-4.96	0.11	93%
49	8.4	347.292	9.176	-4.957	0.11	93%
50	8.3	347.321	9.176	-4.954	0.10	93%
51	8.2	347.35	9.176	-4.951	0.10	93%
52	8.0	347.379	9.176	-4.949	0.10	93%
53	7.9	347.408	9.176	-4.946	0.10	94%
54	7.8	347.437	9.176	-4.943	0.09	94%
55	7.6	347.466	9.176	-4.94	0.09	94%
56	7.5	347.466	9.176	-4.94	0.09	94%
57	7.4	347.495	9.176	-4.937	0.09	94%
58	7.3	347.524	9.176	-4.934	0.08	94%
59	7.2	347.554	9.176	-4.931	0.08	95%
60	7.1	347.583	9.176	-4.928	0.08	95%
61	7.0	347.612	9.176	-4.925	0.08	95%
62	6.9	347.612	9.176	-4.925	0.08	95%
63	6.8	347.67	9.176	-4.919	0.07	95%
64	6.7	346.711	9.176	-5.017	0.17	89%
65	6.6	345.403	9.176	-5.15	0.30	80%
66	6.5	346.914	9.176	-4.996	0.15	90%
67	6.4	347.176	9.176	-4.969	0.12	92%
68	6.4	347.321	9.176	-4.954	0.10	93%
69	6.3	347.437	9.176	-4.943	0.09	94%
70	6.2	347.466	9.176	-4.94	0.09	94%
71	6.1	347.524	9.176	-4.934	0.08	94%
72	6.1	347.583	9.176	-4.928	0.08	95%
73	6.0	347.641	9.176	-4.922	0.07	95%
74	5.9	347.67	9.176	-4.919	0.07	95%



ATTACHMENT D
WATER QUALITY TEST RESULTS



Environment Testing

Certificate of Analysis

Client: Kollaard Associates Inc.
210 Prescott St., Box 189
Kemptville, ON
K0G 1J0
Attention: Ms. Colleen Vermeersch
PO#: _____
Invoice to: Kollaard Associates Inc.

Report Number: 1977709
Date Submitted: 2022-05-20
Date Reported: 2022-06-03
Project: 220067
COC #: 891018

Page 1 of 8

Dear Colleen Vermeersch:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

Emma-
Dawn
Ferguson
2022.06.0
3 15:32:30
-04'00'

APPROVAL: _____
Emma-Dawn Ferguson, Chemist

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: <http://www.cala.ca/scopes/2602.pdf>.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.



Environment Testing

Certificate of Analysis

Client: Kollaard Associates Inc.
 210 Prescott St., Box 189
 Kemptville, ON
 K0G 1J0
 Attention: Ms. Colleen Vermeersch
 PO#:
 Invoice to: Kollaard Associates Inc.

Report Number: 1977709
 Date Submitted: 2022-05-20
 Date Reported: 2022-06-03
 Project: 220067
 COC #: 891018

Group	Analyte	MRL	Units	Guideline	1627129 Water 2022-05-19 TW1-6hrs
Anions	Cl	1	mg/L	AO 250	63
	F	0.10	mg/L	MAC 1.5	<0.10
	N-NO2	0.10	mg/L	MAC 1.0	<0.10
	N-NO3	0.10	mg/L	MAC 10.0	0.15
	SO4	1	mg/L	AO 500	131
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG 30-500	346
	Colour (True)	2	TCU		<2
	Conductivity	5	uS/cm		962
	pH	1.00		6.5-8.5	7.37
	Phenols	0.001	mg/L		<0.001
	S2-	0.01	mg/L	AO 0.05	<0.01
	TDS (COND - CALC)	1	mg/L	AO 500	625*
Hardness	Turbidity	0.1	NTU	AO 5	2.7
	Hardness as CaCO3	1	mg/L	OG 80-100	530*
	Ion Balance	0.01			1.00
Indices/Calc Metals	Ag	0.0001	mg/L		<0.0001
	Al	0.01	mg/L	OG 0.1	<0.01
	As	0.001	mg/L	IMAC 0.01	<0.001
	B	0.01	mg/L	IMAC 5.0	<0.01
	Ba	0.01	mg/L	MAC 1.0	0.10
	Be	0.0005	mg/L		<0.0005
	Ca	1	mg/L		125
	Cd	0.0001	mg/L	MAC 0.005	<0.0001
	Co	0.0002	mg/L		0.0004
	Cr	0.001	mg/L	MAC 0.05	<0.001

Guideline = ODWSOG

*** = Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
 Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range



Environment Testing

Certificate of Analysis

Client: Kollaard Associates Inc.
 210 Prescott St., Box 189
 Kemptville, ON
 K0G 1J0
 Attention: Ms. Colleen Vermeersch
 PO#:
 Invoice to: Kollaard Associates Inc.

Report Number: 1977709
 Date Submitted: 2022-05-20
 Date Reported: 2022-06-03
 Project: 220067
 COC #: 891018

Group	Analyte	MRL	Units	Guideline	1627129 Water 2022-05-19 TW1-6hrs
Metals	Cu	0.001	mg/L	AO 1	<0.001
	Fe	0.03	mg/L	AO 0.3	0.15
	Hg	0.0001	mg/L	MAC 0.001	<0.0001
	K	1	mg/L		1
	Mg	1	mg/L		53
	Mn	0.01	mg/L	AO 0.05	0.06*
	Mo	0.005	mg/L		<0.005
	Na	1	mg/L	AO 200	20
	Ni	0.005	mg/L		<0.005
	Pb	0.001	mg/L	MAC 0.010	<0.001
	Sb	0.0005	mg/L	IMAC 0.006	<0.0005
	Se	0.001	mg/L	MAC 0.05	<0.001
	Sr	0.001	mg/L		0.143
	Tl	0.0001	mg/L		<0.0001
Nutrients	U	0.001	mg/L	MAC 0.02	0.004
	V	0.001	mg/L		<0.001
	Zn	0.01	mg/L	AO 5	<0.01
	N-NH3	0.010	mg/L		<0.010
Subcontract	Total Kjeldahl Nitrogen	0.100	mg/L		0.312
	Tannin & Lignin	1	mg/L		1
Subcontract-Inorg	DOC	0.2	mg/L	AO 5	1.7

Guideline = ODWSOG

* = Guideline Exceedence

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Results relate only to the parameters tested on the samples submitted.
 Methods references and/or additional QA/QC information available on request.



Environment Testing

Certificate of Analysis

Client: Kollaard Associates Inc.
 210 Prescott St., Box 189
 Kemptville, ON
 K0G 1J0
 Attention: Ms. Colleen Vermeersch
 PO#:
 Invoice to: Kollaard Associates Inc.

Report Number: 1977709
 Date Submitted: 2022-05-20
 Date Reported: 2022-06-03
 Project: 220067
 COC #: 891018

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 422498 Method C SM2130B	Analysis/Extraction Date 2022-05-21	Analyst CK	
Turbidity	<0.1 NTU	99	70-130
Run No 422509 Method C SM2120C	Analysis/Extraction Date 2022-05-27	Analyst AsA	
Colour (True)	<2 TCU	104	80-120
Run No 422512 Method SUBCONTRACT-A	Analysis/Extraction Date 2022-05-24	Analyst AET	
Tannin & Lignin	<1.0 mg/L	99	
Run No 422533 Method C SM4500-S2-D	Analysis/Extraction Date 2022-05-27	Analyst AsA	
S2-	<0.01 mg/L		80-120
Run No 422569 Method SM 4110	Analysis/Extraction Date 2022-05-28	Analyst AaN	
Chloride	<1 mg/L	100	90-110
N-NO2	<0.10 mg/L	100	90-110
N-NO3	<0.10 mg/L	101	90-110
Run No 422635 Method SM2320,2510,4500H/F	Analysis/Extraction Date 2022-05-27	Analyst AsA	

Guideline = ODWSOG

* = Guideline Exceedence

Results relate only to the parameters tested on the samples submitted.
 Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range



Environment Testing

Certificate of Analysis

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

Attention: Ms. Colleen Vermeersch
 PO#:

Invoice to: Kollaard Associates Inc.

Report Number: 1977709
 Date Submitted: 2022-05-20
 Date Reported: 2022-06-03
 Project: 220067
 COC #: 891018

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Alkalinity (CaCO3)	<5 mg/L	97	90-110
Conductivity	<5 uS/cm	99	90-110
F	<0.10 mg/L	102	90-110
pH		100	90-110
Run No 422640	Analysis/Extraction Date 2022-05-30	Analyst AaN	
Method SM 4110			
SO4	<5 mg/L	110	90-110
Run No 422650	Analysis/Extraction Date 2022-05-28	Analyst SKH	
Method EPA 350.1			
N-NH3	<0.010 mg/L	90	80-120
Run No 422655	Analysis/Extraction Date 2022-05-28	Analyst SKH	
Method EPA 351.2			
Total Kjeldahl Nitrogen	<0.100 mg/L	105	70-130
Run No 422713	Analysis/Extraction Date 2022-05-29	Analyst IP	
Method SM5530D/EPA420.2			
Phenols	<0.001 mg/L	96	50-120
Run No 422754	Analysis/Extraction Date 2022-05-30	Analyst Z S	
Method M SM3120B-3500C			
Calcium	<1 mg/L	102	90-110

* = Guideline Exceedence

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Guideline = ODWSOG

Results relate only to the parameters tested on the samples submitted.
 Methods references and/or additional QA/QC information available on request.



Environment Testing

Certificate of Analysis

Client: Kollaard Associates Inc.
 210 Prescott St., Box 189
 Kemptonville, ON
 K0G 1J0
 Attention: Ms. Colleen Vermeersch
 PO#:
 Invoice to: Kollaard Associates Inc.

Report Number: 1977709
 Date Submitted: 2022-05-20
 Date Reported: 2022-06-03
 Project: 220067
 COC #: 891018

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Potassium	<1 mg/L	109	87-113
Magnesium	<1 mg/L	97	76-124
Sodium	<1 mg/L	113	82-118
Run No 422756 Analysis/Extraction Date 2022-05-30 Analyst AET			
Method C SM2340B			
Hardness as CaCO3			
Ion Balance			
TDS (COND - CALC)			
Run No 422838 Analysis/Extraction Date 2022-05-30 Analyst SD			
Method EPA 200.8			
Silver	<0.0001 mg/L	89	80-120
Aluminum	<0.01 mg/L	117	80-120
Arsenic	<0.001 mg/L	103	80-120
Boron (total)	<0.01 mg/L	108	80-120
Barium	<0.01 mg/L	102	80-120
Beryllium	<0.0005 mg/L	111	80-120
Cadmium	<0.0001 mg/L	106	80-120
Cobalt	<0.0002 mg/L	106	80-120

Guideline = ODWSOG

* = Guideline Exceedence

Results relate only to the parameters tested on the samples submitted.
 Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range



Environment Testing

Certificate of Analysis

Client: Kollaard Associates Inc.
 210 Prescott St., Box 189
 Kemptville, ON
 K0G 1J0
 Attention: Ms. Colleen Vermeersch
 PO#:
 Invoice to: Kollaard Associates Inc.

Report Number: 1977709
 Date Submitted: 2022-05-20
 Date Reported: 2022-06-03
 Project: 220067
 COC #: 891018

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Chromium Total	<0.001 mg/L	108	80-120
Copper	<0.001 mg/L	111	80-120
Iron	<0.03 mg/L	97	80-120
Mercury	<0.0001 mg/L	99	80-120
Manganese	<0.01 mg/L	108	80-120
Molybdenum	<0.005 mg/L	102	80-120
Nickel	<0.005 mg/L	109	80-120
Lead	<0.001 mg/L	101	80-120
Antimony	<0.0005 mg/L	101	80-120
Selenium	<0.001 mg/L	109	80-120
Strontium	<0.001 mg/L	107	80-120
Thallium	<0.0001 mg/L	101	80-120
Uranium	<0.001 mg/L	91	80-120
Vanadium	<0.001 mg/L	108	80-120
Zinc	<0.01 mg/L	110	80-120
Run No 423131 Analysis/Extraction Date 2022-06-02 Analyst R S			
Method SUBCONTRACT-CA-INORG			
DOC			

Guideline = ODWSOG

* = Guideline Exceedence

Results relate only to the parameters tested on the samples submitted.
 Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range



Environment Testing

Certificate of Analysis

Client: Kollaard Associates Inc.
210 Prescott St., Box 189
Kemptville, ON
K0G 1J0
Attention: Ms. Colleen Vermeersch
PO#:
Invoice to: Kollaard Associates Inc.

Report Number: 1977709
Date Submitted: 2022-05-20
Date Reported: 2022-06-03
Project: 220067
COC #: 891018

Sample Comment Summary

Sample ID: 1627129 TW1-6hrs Due to a power outage true color, pH, conductivity, alkalinity, F, anions, N-NO2, N-NO3, N-NH3, TKN, and S2- were analyzed after being held outside of recommended temperature for a prolonged period of time. pH, alkalinity, conductivity, N-NO2 and N-NO3 were analyzed past the holding time. SO4 MRL elevated due to matrix interference (dilution was done). DOC analysis subcontracted.

Guideline = ODWSOG

* = Guideline Exceedence

Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range



Environment Testing

Certificate of Analysis

Client: Kollaard Associates Inc.
210 Prescott St., Box 189
Kemptville, ON
K0G 1J0
Attention: Ms. Colleen Vermeersch
PO#:
Invoice to: Kollaard Associates Inc.

Report Number: 1977696
Date Submitted: 2022-05-20
Date Reported: 2022-05-27
Project: 220067
COC #: 891018

Page 1 of 3

Dear Colleen Vermeersch:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

Emma-
Dawn
Ferguson
2022.05.27
12:54:39
-04'00'

APPROVAL: _____
Emma-Dawn Ferguson, Chemist

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: <http://www.cala.ca/scopes/2602.pdf>.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.



Environment Testing

Certificate of Analysis

Client: Kollaard Associates Inc.
 210 Prescott St., Box 189
 Kemptville, ON
 K0G 1J0
 Attention: Ms. Colleen Vermeersch
 PO#:
 Invoice to: Kollaard Associates Inc.

Report Number: 1977696
 Date Submitted: 2022-05-20
 Date Reported: 2022-05-27
 Project: 220067
 COC #: 891018

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D.
Microbiology	Escherichia Coli	0	ct/100mL	MAC 0	1627103 Water 2022-05-19 TW1-6hrs
	Heterotrophic Plate Count	0	ct/1mL	NDLA	
	Total Coliforms	0	ct/100mL	MAC 0 4*	

Guideline = ODWSOG

*** = Guideline Exceedence**

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

Analytical Method: **AMBCOLM1**

additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range



Environment Testing

Certificate of Analysis

Client: Kollaard Associates Inc.
210 Prescott St., Box 189
Kemptville, ON
K0G 1J0
Attention: Ms. Colleen Vermeersch
PO#:
Invoice to: Kollaard Associates Inc.

Report Number: 1977696
Date Submitted: 2022-05-20
Date Reported: 2022-05-27
Project: 220067
COC #: 891018

Sample Comment Summary

Sample ID: 1627103 TW1-6hrs NDLA: No data, lab accident (power outage).

Guideline = ODWSOG * = Guideline Exceedence

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

Analytical Method: AMBCOLM1

additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Ryznar Stability Index

$$RSI = 2(pH_s) - pH$$

RSI << 6 → the scale tendency increases as the index decreases

RSI >> 7 → the calcium carbonate formation probably does not lead to a protective corrosion inhibitor film

RSI >> 8 → mild steel corrosion becomes an increasing problem

Langelier Saturation Index

$$LSI = pH - pH_s$$

If LSI is negative → no potential to scale, the water will dissolve CaCO₃

If LSI is positive → scale can form and CaCO₃ precipitation may occur

If LSI is close to zero → borderline scale potential, water quality or temperature change or evaporation could change the index

where pH measured from sample

pH_s = pH at saturation in calcite or calcium carbonate

$$pH_s = (9.3 + A + B) - (C + D)$$

$$A = \frac{\log_{10}[TDS] - 1}{10}$$

$$B = -13.12 \times \log_{10}(\text{°C} + 273) + 34.55$$

$$C = \log_{10}[Ca^{2+} \text{ as } CaCO_3] - 0.4$$

$$D = \log_{10}[\text{alkalinity as } CaCO_3]$$

	TW1-final
pH	7.37
hardness [mg/l as CaCO ₃]	530
Alkalinity [mg/l as CaCO ₃]	346
total dissolved solids [mg/l]	625
temperature (°C)	11
A	0.179588002
B	2.362463379
C	2.32427587
D	2.539076099
pH _s	6.978699412
→→ RSI	6.59
→→ LSI	0.39



ATTACHMENT E
SEWAGE ATTENUATION CALCULATIONS

SEPTIC EFFLUENT DILUTION CALCULATIONS

Number of Lots	1
Gross Site Area	6750 m ²
Env. Can. Water Surplus (NPI-glacial till)	328 mm

Hard Surface Area (Post-Development)

Roofs	403
Driveway	<u>709</u>
Total	1111 m ²

Net Infiltration Area = Gross Site Area - Hard Surface Area (Post-Development)

5638.84 m²

Each system is expected to use half the infiltration area 2819.42 m²

Infiltration Reduction Factor:

Topography (flat)	0.30
Soil (medium combinations clay and loam)	0.20
<u>Cover (cultivated/wood)</u>	<u>0.13</u>
Total IRF	0.63

Nitrate Concentration for main house

$$C_H = \frac{365 \text{ m}^3 \text{ Effluent Per Year} \times 40 \text{ mg/L NO}_3}{365 \text{ m}^3 \text{ Effluent Per Year} + (1/2 \times \text{Net Infiltration Area} \times \text{NPI} \times \text{IRF})} = 15.4 \text{ mg/L NO}_3\text{-N}$$

Nitrate Dilution for coach house (with denitrification-effluent Nitrate concentration-8 mg/L)

$$C_c = \frac{365 \text{ m}^3 \text{ Effluent Per Year} \times 8 \text{ mg/L NO}_3}{365 \text{ m}^3 \text{ Effluent Per Year} + (1/2 \times \text{Net Infiltration Area} \times \text{NPI} \times \text{IRF})} = 3.1 \text{ mg/L NO}_3\text{-N}$$

Total Concentration $C_T = C_H V_H + C_c V_c / V_t$ V_H and V_c each = 365 m³/year

$$C_T = 9.2 \text{ mg/L N-NO}_3$$



ATTACHMENT F

WATERLOO BIOFILTER WATER NO_x-LS THIRD PARTY TESTING SUMMARY

WaterNOx-LS Third Party Testing Summary

In the fall of 2016, Waterloo Biofilter Systems Inc. installed their WaterNOx-LS™ denitrification unit at the Bureau de Normalisation du Quebec (BNQ) test site located in Quebec City. The system underwent BNQ 3680-600 test protocol which includes two parts - Period A and Period B. Period A is based on the methodology of NSF/ANSI Standards 40 and 245, containing the same flow patterns and stress tests. Period B provides for a further 6 months of seasonal reliability testing to ensure that the test includes cold weather results.

The WaterNOx-LS is a passive autotrophic denitrification process using sulphur-limestone minerals in a submerged, up-flow configuration. The WaterNOx-LS, which was sized for 1,600 L/day (350 gpd) followed a Waterloo Biofilter nitrifying treatment unit.

Period A Test Results

During Period A wastewater is dosed according to the hydraulic loading specified in NSF-40. Period A includes the wash-day, working-parent, power failure, and vacation period stress tests. All sample results taken during stress tests are included in the analysis. Influent wastewater temperature values ranged from 10.0 °C (50 °F) to 16.5 °C (62 °F) with an average value of 13.3 °C (56 °F). Influent pH averaged 7.9 and effluent pH averaged 7.2.

Table 1 – Period A Results for the WaterNOx-LS

Parameters	Influent	Effluent	Removal
(c)BOD ₅	260	6	97.6%
TSS	312	3	99.2%
Fecal Coliforms	2,403,000	4,900	99.8%
NO _{2,3}	0.08	0.20	
TKN	57.1	4.6	92.0%
TN	57.1	4.8	91.6%

n = 123; n = 357 for fecals

All parameters in mg/L except Fecal Coliforms in cfu/100mL

All values arithmetic averages except Fecal Coliforms in geometric average

Weekly influent total nitrogen concentrations ranged from 43.0 mg/L to 68.8 mg/L with a six-month average concentration of 57.1 mg/L.

Weekly effluent NO_{2,3} concentrations ranged from < 0.02 mg/L to 3.33 mg/L with a six-month average of 0.20 mg/L. Weekly effluent TKN concentrations ranged from 1.5 mg/L to 16.9 mg/L with a six-month average of 4.6 mg/L. Weekly effluent total nitrogen concentrations ranged from 1.7 mg/L to 17.1 mg/L with a six-month average of 4.8 mg/L. The total nitrogen reduction over the six-month period was 91.6%.

Period B Test Results

Weekday hydraulic loading is modified during Period B to a strenuous 'working parent' schedule where 40% of the flow is delivered over three hours in the morning, and 60% is delivered over three hours in the evening. All samples taken during Period B are included in the analysis. Influent wastewater temperature values ranged from 10.1 °C (50 °F) to 15.8 °C (60 °F) with an average value of 12.3 °C (54 °F). Influent pH averaged 8.0 and effluent pH averaged 7.1.

Table 2 – Period B Results for the WaterNOx-LS

Parameters	Influent	Effluent	Removal
(c)BOD ₅	248	4	98.2%
TSS	304	3	99.1%
Fecal Coliforms	2,142,000	2,800	99.9%
NO _{2,3}	0.17	3.38	
TKN	60.3	8.5	85.9%
TN	60.4	11.9	80.3%

n = 59 except Fecal Coliforms n = 118

All parameters in mg/L except Fecal Coliforms in cfu/100mL

All values arithmetic averages except Fecal Coliforms in geometric average

Weekly influent total nitrogen concentrations ranged from 21.2 mg/L to 85.6 mg/L with a six-month average concentration of 60.4 mg/L.

Weekly effluent NO_{2,3} concentrations ranged from < 0.04 mg/L to 15.2 mg/L with a six-month average of 3.38 mg/L. Weekly effluent TKN concentrations ranged from 1.2 mg/L to 21.2 mg/L with a weekly average of 8.5 mg/L. Weekly effluent total nitrogen concentrations ranged from 3.7 mg/L to 22.2 mg/L with a six-month average of 11.9 mg/L. The total nitrogen reduction over the six-month period was 80.3%.

Conclusion

In summary, the WaterNOx-LS system can successfully remove very high levels of total nitrogen passively, while buffering pH to neutral and keeping cBOD₅ and TSS levels below 10 mg/L.