November 30, 2022

PH4674-LET.01

Olu Austin Ayeni
216 Dutchmans Way
Ottawa, Ontario
K2J 5W5

Attention: Olu Austin Ayeni

Subject: **Desktop Hydrogeological Review for a Private Water Well Supply and Preliminary Terrain Analysis**
Due Diligence for Proposed Commercial Development
912 David Manchester Road
Ottawa (Carp), Ontario

PATERSON GROUP
Consulting Engineers
9 Auriga Drive
Ottawa, Ontario
K2E 7T9
Tel: (613) 226-7381

Geotechnical Engineering
Environmental Engineering
Hydrogeology
Materials Testing
Building Science
Rural Development Design
Retaining Wall Design
Noise and Vibration Studies

patersongroup.ca

Introduction

Further to your request, Paterson has conducted a Desktop Hydrogeological Review for a Private Water Well Supply and Preliminary Terrain Analysis as part of a due diligence review for a proposed institutional development, specifically a church, to be located at 912 David Manchester Road in Ottawa (Carp), Ontario.

The subject site is currently occupied by grassland and trees. The ground surface of the retained and proposed severed parcel is generally flat with a slight slope on the southeast end of the property. The general groundwater flow direction is assumed to be to the northeast direction towards the Ottawa River.

The subject site is bordered to the northeast by the Highway 417 followed by undeveloped land, to the northwest by undeveloped land and residential properties, to the southwest by David Manchester Road followed by residential properties and undeveloped land, and to the southeast by residential properties.

The subject site itself and the surrounding areas are zoned RU for Rural Countryside Zone, while the land to the southeast is zoned RR3 (Rural Residential Zone condition 3) (GeoOttawa).

A groundwater sample was collected from a neighboring lot as an attempt to assess the underlying groundwater aquifer likely to be accessed at the subject site. Onsite works need to be completed to confirm the available groundwater quantity and quality. As part of a Site Plan Application, the City of Ottawa requires the supply well for the proposed development to be installed and tested in accordance with the City of Ottawa's Hydrogeological and Terrain Analysis Guidelines (HTAG). An approved Ottawa Septic

System Office (OSSO) septic permit is also required to be submitted as part of a Site Plan application. All work associated with a Desktop Hydrogeological Review and Preliminary Terrain Analysis will need to be confirmed by onsite studies, and as such, may be subject to change.

City of Ottawa Hydrogeological Pre-consultation

A hydrogeological pre-consultation was completed with a City of Ottawa Hydrogeologist on November 17, 2022. During the hydrogeological pre-consultation. The City Hydrogeologist noted that the site is likely to contain thin soils and possible impacts from the adjacent highway. They suggested doubling the standard amount of casing (extending it to 12 m) in an effort to reduce the potential of salt impacts from the highway. Additionally, an 8 hour pumping test with water quality sampling as per the City of Ottawa Hydrogeological and Terrain Analysis Guidelines (HTAG) would be required. The City indicated that the proposed church will likely be a regulated system under O.Reg. 319.

Description of Property

The subject site is a lot with a 2.23-hectare (ha) area. The proposed church will be serviced by an onsite sewage system and a private drilled well. It is our understanding that there are no existing drilled wells on the subject site.

Surrounding Water Supply Well Construction

In an attempt to determine the likely onsite potable water supply well construction, an analysis of the available WWR's directly adjacent to the subject site was completed. The actual construction of the onsite well will depend on the conditions encountered during the installation of the well by certified well drillers. All new wells should be installed in accordance to O.Reg 903. Relevant construction details for the WWR's can be found in Table 1 below:

Table 1a: Construction Summary of surrounding WWR

WWR ID	Depth to Bedrock (m)	Depth to Bottom of Casing (m)	Depth of Aquifer Intercept (m)	Total Depth of Well (m)	Pumping Rate (L/min)	Date Completed
7219455	7.0	8.1	63.1	66.7	45.4	April 28, 2014
7149339	4.0	6.4	69.5	121.9	18.9	June 23, 2010
7309076	4.0	6.1	54.9	59.2	23.0	July 2, 2018

Note: Values in Table 1a are measured in meters below existing ground surface at the drilling location

In general, bedrock is noted to have been encountered at depths varying from 4.0 to 7.0 m below ground surface (bgs). The bedrock is generally recorded as limestone. Recorded casing depths vary from 6.1 to 8.1 m bgs, with an average casing length of 6.9 m bgs. Well depths are recorded from 59.2 to 121.9 m bgs, with an average well depth of

82.6 m bgs. Aquifer intercepts are recorded from 54.9 to 69.5 m bgs, with an average aquifer intercept of 62.5 m bgs. Casing diameters range from 0.15 to 0.16 m in diameter.

The well drillers carried out a minimum of one-hour constant rate pumping test on each of the wells, as required by regulations.

Groundwater Quantity

To assess available aquifer quantity in the vicinity of the subject site, an analysis of the one-hour constant rate pumping tests performed during well construction and recorded on the available nearby WWR's was undertaken.

The relevant information regarding the constant rate pumping tests recorded on the WWRs of the surrounding water wells is presented in Table 1b below:

Table 1b: Summary of Surrounding WWR Pumping Test Data

WWR ID	Static WL (m)	Total Drawdown During Pumping Test (m)	Test Pumping Rate (l/min)	Length of Test (hr)	95 % Recovery Achieved (min)	Water Column Available (m)
7219455	1.7	7.6	45.4	1	60	65.0
7149339	1.7	15.0	18.9	1	30	120.2
7309076	1.4	18.8	1.9	1	unknown	57.8

Note: Values in Table 1b are measured in meters below existing ground surface at the drilling location

Static water levels were recorded to vary between 1.4 and 1.7 m bgs, with an average static water level of 1.6 m bgs. Total drawdown during the 1-hour pumping test varied from 7.6 to 18.8 m, with an average drawdown of 13.8 m. 100% recovery was recorded within one hour for WWR ID 7149339, and 95% recovery was observed within one hour at WWR ID 7219455. The average recommended pumping rate is 29.1 L/min.

According to the pumping tests recorded on the surrounding WWR, the average groundwater volume withdrawn from the wells during the pumping tests was 1,741 L. The drawdown from the pumping tests in the surrounding wells varied from 11.6 to 32.5 % with an average drawdown of approximately 18.9 % of the available water column of the well.

Groundwater Quality

Fieldwork Program

As a means to demonstrate the quality of the groundwater likely to be encountered in the underlying aquifer, an untreated well water sample was collected from a neighboring property. Paterson approached a number of neighbors in an attempt to get a volunteer who would allow their well water to be tested. The resident from 896 David Manchester Road volunteered, and as such, Paterson coordinated the sampling of the groundwater accessed by their well.

A Water Well Record (WWR) for the well, hereafter referred to as TW1, was obtained from the Ministry of the Environment, Conservation and Parks (MECP) online WWR mapping tool. TW1 has a well number of A151643. TW1 has a 152.4 mm diameter steel casing with an 8.1 m casing depth. The well head has a 0.91 m stick up above ground surface. During the site visit, the wellhead was observed to be sealed. According to the WWR, the well had a depth of 66.7 m below ground surface (bgs), with an overburden thickness of 7 m. According to available geological mapping, the drift thickness at TW1 varies from 3 to 5 m bgs. The drift thickness mapped on the subject site varies from 3 to 5 m bgs, extending to 5 to 10 m bgs on the northwestern portion of the property. TW1 is located approximately 110 m southeast from the southeastern border of the subject site.

A groundwater sample was collected from TW1 via an outdoor spigot. All water sampling equipment as well as the spigot was disinfected prior to the collection of the groundwater sample. The water sample was submitted for comprehensive testing of bacteriological, chemical, and physical water quality parameters consistent with the standard “Subdivision Bacti 2 (EC/TC) with Trace Metals” suite of parameters.

All samples were collected unfiltered and unchlorinated and were placed directly into clean bottles supplied by the analytical laboratory. Samples were placed immediately into a cooler with ice and were transported directly to Eurofins laboratory in Ottawa. All samples were received by the laboratory within 24 hours of collection.

Laboratory Data

The Subdivision Package suite of parameters and trace metals laboratory water quality analytical results obtained from the sampling of TW1 is provided in Table 2a and Table 2b below. The laboratory analyses reports can be found attached.

TABLE 2A: GROUNDWATER GEOCHEMISTRY (TW1)				
PARAMETER	UNITS	ODWS		TW1
		LIMIT	TYPE	896DM 2022-11-18
MICROBIOLOGICAL				
Escherichia Coli (E.Coli)	ct/100mL	0	MAC	0
Total Coliforms	ct/100mL	0	MAC	0
GENERAL CHEMICAL - HEALTH RELATED				
Fluoride	mg/L	1.5(2.4)	MAC	0.33
N-NO2 (Nitrite)	mg/L	1	MAC	<0.10
N-NO3 (Nitrate)	mg/L	10	MAC	<0.10
Turbidity (Laboratory)	NTU	1.0 (5.0)	MAC/AO	4.00
Turbidity (Field)	NTU	1.0 (5.0)	MAC/AO	-
N-NH3 (Ammonia)	mg/L	-	-	0.09
Total Kjeldahl Nitrogen	mg/L	-	-	0.32
GENERAL CHEMICAL - AESTHETIC RELATED				
Hardness (as $CaCO_3$)	mg/L	100	OG	680
Ion Balance	unitless	-	-	0.99
Total Dissolved Solids	mg/L	500	AO	1,100
Alkalinity (as $CaCO_3$)	mg/L	500	OG	531
Chloride	mg/L	250	AO	209
Colour	TCU	5	AO	23
Conductivity	uS/cm	-	-	1690
pH	unitless	6.5-8.5	AO	7.43
Sulphide	mg/L	0.05	AO	<0.01
Sulphate	mg/L	500	AO	134
Phenols	mg/L	-	-	<0.001
Tannin & Lignin	mg/L	-	-	<0.1
Dissolved Organic Carbon	mg/L	5	AO	5.3

1. ODWS identifies the following types of parameters:
   MAC=Maximum Allowable Concentration
   AO = Aesthetic Objective
   OG= Operational Guideline
2. Shaded Concentration Indicates an Exceedance of the ODWS Objective

TABLE 2B: GROUNDWATER GEOCHEMISTRY (TW1)				
PARAMETER	UNITS	ODWS		TW1
		LIMIT	TYPE	896DM 2022-11-18
METALS				
Aluminum (Al)	mg/L	0.1	OG	<0.01
Antimony (Sb)	mg/L	0.006	IMAC	<0.0005
Arsenic (As)	mg/L	0.01	IMAC	<0.001
Barium (Ba)	mg/L	1	MAC	0.14
Beryllium (Be)	mg/L	-	-	<0.0005
Boron (B)	mg/L	5	IMAC	0.21
Cadmium (Cd)	mg/L	0.005	MAC	<0.0001
Calcium (Ca)	mg/L	-	-	185
Chromium (Cr)	mg/L	0.05	MAC	<0.001
Cobalt (Co)	mg/L	-	-	0.0003
Copper (Cu)	mg/L	1	AO	0.023
Iron (Fe)	mg/L	0.3	AO	1.25
Lead (Pb)	mg/L	0.01	MAC	<0.001
Magnesium (Mg)	mg/L	-	-	53
Manganese (Mn)	mg/L	0.05	AO	0.45
Mercury (Hg)	mg/L	0.01	MAC	<0.0001
Molybdenum (Mo)	mg/L	-	-	<0.005
Nickle (Ni)	mg/L	-	-	<0.005
Potassium (K)	mg/L	-	-	6
Selenium (Se)	mg/L	0.05	MAC	<0.001
Silver (Ag)	mg/L	-	-	<0.0001
Sodium (Na)	mg/L	200	AO	123
Strontium (Sr)	mg/L	-	-	4.41
Thallium (Tl)	mg/L	-	-	<0.0001
Uranium (U)	mg/L	0.02	MAC	<0.001
Vanadium (V)	mg/L	-	-	<0.001
Zinc (Z)	mg/L	5	AO	0.04

AO = Aesthetic Objective

OG= Operational Guideline

2. Shaded Concentration Indicates an Exceedance of the ODWS Objective

The bacteriological test results (Certificate of Analysis – Report No. 1990207) indicated that the sample readings for E.Coli and Total Coliforms were non-detect (0 ct/100 mL).

The water quality of the subject water supply well meets all the Ontario Drinking Water Standards maximum acceptable concentrations (MAC). Furthermore, the water meets all of the Aesthetic Objectives (AO) and Operational Guidelines (OG) with the exception of the following:

- Hardness (as $CaCO_3$)
- Colour (Apparent)
- Turbidity
- Alkalinity
- DOC
- TDS
- Iron
- Manganese

Exceedances of the above parameters are not uncommon of the water supply in the subject aquifer. Each of these groundwater parameters are discussed in detail below.

Hardness as $CaCO_3$

Hardness, expressed as calcium carbonate, is an operational guideline and does not appear in the ODWS. Rather, it appears in the Technical Support Documents for Ontario Drinking Water Standards, Objectives and Guidelines as a parameter with an operational guideline at 100 mg/L. At the measured concentrations of 680 mg/L, the water is considered to be very hard, however, the hardness concentration can be treated using conventional softening technologies. The Technical Support Documents for Ontario Drinking Water Standards, Objectives and Guidelines notes that hardness in excess of 500 mg/L in drinking water is unacceptable for most domestic purposes.

Alkalinity

Alkalinity is a measure of the resistance of water to the effects of acids added to water. Alkalinity appears in the Technical Support Document for Ontario Drinking Water Standards and has an Operational Guideline (OG) of 30 to 500 mg $CaCO_3$/L., A low concentration of alkalinity can result in the acceleration of natural corrosion leading to “red water” whereas high alkalinity waters may produce scale on service pipes, water heaters, and other fixtures. Alkalinity can be required for certain water treatment technologies such as coagulation, which are not generally used in private residential systems. The concentration of alkalinity from laboratory testing was 531 mg/L which is close, however exceeding, the OG limit. Alkalinity may be removed using technologies such as acid dosing.

As Alkalinity exceeds the Technical Support Document for Ontario Drinking Water Standards Operational Guideline of 30-500 mg/L, a Site Plan application whose onsite well has levels as high as those recorded in TW1 would not pass Site Plan application.

Total Dissolved Solids (TDS)

TDS refers to the concentration of inorganic substances dissolved in water. The main constituents are typically chloride, sulphates, calcium, magnesium, and bicarbonates. There are various levels of the constituents at a low level and it is not anticipated that they will cause an issue with taste. A point of use reverse osmosis unit may be installed if the owner desires for drinking purposes. As such, no taste problems are anticipated to occur when the system is used.

The Langelier calculation provided an LSI of 0.7. Based on the evaluation of the result, the water is super saturated and tends to precipitate a scale layer of calcium carbonate (scale forming but non-corrosive). See Langelier Saturation Index Calculation attached for calculation details.

Colour

Colour may occur in drinking water for several reasons. It may be due to organic substances from the decay of vegetation; or the presence of metals such as iron, manganese, and copper, which are abundant in nature. The provincial aesthetic objective for colour in drinking water is 5 True Colour Units (TCU). The federal (Health Canada) guideline aesthetic objective limit for colour is 15 TCU (Guidelines for Canadian Drinking Water Quality, Health Canada June 2019). Procedure D-5-5 gives a maximum concentration considered reasonably treatable for colour as 7 TCU. As colour is a strictly aesthetic parameter, it can be reduced from the water supply, if desired, through the use of a manganese greensand treatment.

The apparent colour from the laboratory results was 23 TCU which is above the federal aesthetic guidelines. The elevated colour levels detected in the lab samples are likely attributed to the precipitation of iron and manganese out of the groundwater. Field colour testing during the mandatory onsite pumping test will be able to confirm if the precipitation of iron and manganese are causing the elevated apparent colour levels. It should be noted that if the colour levels are not due to the precipitation of iron and manganese out of the groundwater, and continue to exceed the 7 NTU levels onsite, then the application will not be able to pass Site Plan application.

Dissolved Organic Carbon

Elevated Dissolved Organic Carbon (DOC) concentrations were detected in the groundwater sample at TW1 at a concentration of 5.3 mg/L. High DOC is an indicator of possible water quality deterioration during storage and distribution due to carbon being a growth nutrient for biofilm dwelling bacteria. High DOC is also an indicator of potential chlorination by-product problems. The laboratory sample had a DOC concentration of 5.3 mg/L which exceeded the aesthetic objective of 5.0 mg/L. Coagulant treatment or high-pressure membrane treatment can be used to reduce DOC.

Iron

Concentrations of iron above 0.3 mg/L can contribute to staining of fixtures and a metallic taste at higher concentrations. Precipitation of iron can promote the growth of iron bacteria in pipes. The concentration of iron in the groundwater in TW1 was measured to be 1.25 mg/L, which is considered to be reasonably treatable in accordance with Procedure D-5-5. It is recommended that an iron filter be used to reduce the levels of iron and reduce the potential for excessive precipitate occurring in the water supply system, if desired.

Manganese

The manganese concentration results from the laboratory test samples yielded a value of 0.45 mg/L in the onsite well, which is above the aesthetic objectives in the ODWSOG of 0.05 mg/L. Procedure D-5-5 gives a maximum concentration considered reasonably treatable for manganese as 1.0 mg/L. A conventional water softener or manganese greensand filter can be used to reduce the levels of manganese, if desired.

Turbidity

Turbidity, which is generally an aesthetic parameter, was detected in the laboratory test samples at a value of 4.0 NTU in the laboratory test. The ODWS maximum acceptable concentration for turbidity in drinking water entering the distribution system is 1 NTU. The Aesthetic Objective for turbidity in drinking water reaching the consumer is 5 NTU. The laboratory is below the 5 NTU objective.

Sodium

Sodium (Na), an aesthetic parameter, was detected in the laboratory test samples at concentrations of 123 mg/L, which does not exceed the ODWS aesthetic objective of 200 mg/L. Although sodium is not toxic and no maximum acceptable concentration has been set, concentrations above 20 mg/L require that the Medical Officer of Health be notified of the water quality results, so that this information may be passed on to local physicians for use in treatment of those requiring a sodium-restricted diet.

Groundwater Quality Discussion

Alkalinity (as CaCO3) exceeds the Technical Support Document for Ontario Drinking Water Standards Operation Guideline and Colour exceeds the Maximum Concentration Considered Reasonably Treatable in the City of Ottawa's HTAG. Should an onsite well be installed and similar values be encountered for Alkalinity and Colour, then the Site Plan application will not be able to proceed.

It should also be noted that although the concentration of chlorides in the groundwater (209 mg/L) is currently below the Maximum Concentration Considered Reasonably Treatable by the City of Ottawa's HTAG, it is likely to fluctuate based on the seasonal usage of road salt on Highway 417. Should the levels be above 250 mg/L at the time of

testing, a Site Plan application will not be successful. The current timing of the sampling is expected to be nearer a seasonal low for chlorides with increases expected to occur once the winter months require road salting. If the well were to reach a chloride concentration of greater than 500 mg/L, the MECP would require the well to be decommissioned or an additional hydrogeological study/application would be required to maintain the well.

TERRAIN ANLAYSIS

A desktop review was performed to provide a general overview of the surface and subsurface profile of the subject site. Available mapping and surrounding Water Well Records were used to support the assessment.

Surficial Geology

Approximately two-thirds of the subject site is heavily treed in the northwest portion of the site, with the remainder consisting of light brush. The subject site is relatively flat and is mapped to be approximately 1 m below grade of the Trans-Canada Highway 417 and David Manchester Road.

Subsurface Profile

According to available overburden mapping (OGS MRD228), the overburden at the subject site is continuous and is mapped to consist of sand (Glaciomarine Plain). Available WWR's immediately adjacent to the subject site indicate an overburden of clay or clay and sand with gravel and boulders.

Based on available geological mapping (OGS MRD219), the bedrock in the area consists of limestone with minor shales of the Bobcaygeon Formation with an approximate drift thickness of 3 to 5 m, extending to 5 to 10 m in the northwest portion of the site.

Hydrogeological Sensitivity of the Site

The subject site currently consists of grasslands with a heavily treed area and is bordered to the northeast by the Trans-Canada Highway 417, to the southeast by residential properties, and to the north and southwest by residential properties and undeveloped land. The subject site is proposed to be serviced by a private well and septic systems.

The topography of the site is relatively flat with a gradual increase in elevation towards the southeast. The regional ground water flow is generally considered to be north towards the Ottawa River.

Based upon surrounding WWRs, overburden thickness was observed to be generally greater than 2.0 m bgs. The overburden generally consists of sand, gravel, and clay. Based on available geological mapping, the subject site is underlain by limestone of the Bobcaygeon formation in the Simcoe Group with a general mapped overburden thickness of 3 to 5 m.

As the proposed site is not anticipated to have bedrock within 2 m of the ground surface, the site is not considered hydrogeologically sensitive at this time. Site specific works will need to be completed to confirm this assumption. Separation distances are not required to be increased between the septic components and the onsite well. Additionally, the water quality of the bedrock aquifer shows no indication of surface water or surface impacts from sewage system effluent.

Conceptual Lot Development Plan

Building plans and design details were not available at the time of report preparation. As such, three different configurations for the proposed development which would work from a Terrain Analysis standpoint are presented below. It is anticipated that the proposed site will consist of a church, parking lot, sewage system, and reception hall. The Ontario Building Code (OBC) for sewage system design flows uses seating capacity and the availability of food services as the basis for daily sewage production for churches. For the purpose of this study, it is assumed that a single church building with a reception hall is being proposed. The reception hall is intended to be a meeting place after church service, as well as operating as an indoor sporting hall during the winter months. The following scenarios are based on the subject site's ability to meet the City of Ottawa's Terrain Analysis Guideline limit of 10 mg/l nitrate attenuation at the property boundary. It is assumed that the reception hall and church will not be used simultaneously. The maximum number of seats for the church and reception hall are calculated in the section titled Sewage System Total Daily Design Sewage Flow (TDDSF) found below. The three proposed sizing and septic configurations are as follows:

- *Scenario I*
  - Church – 500 m^2 (Max. Capacity- 485 seats)
  - Parking Lot – 3500 m^2
  - Reception Hall – in church basement (Max. Capacity- 485 seats)
  - No Time-dosing in the Sewage System

- Scenario II
  - Church – 500 m^2 (Max. Capacity- 465 seats)
  - Parking Lot – 3500 m^2
  - Reception Hall – beside the church, 500 m^2 (Max. Capacity- 465 seats)
  - No Time-dosing in the Sewage System

- Scenario III
  - Church – 700 m^2 (Max. Capacity -700 seats)
  - Parking Lot – 4000 m^2
  - Reception Hall – in church basement (Max. Capacity 700 seats)
  - Time-dosed Treatment in the Sewage System

Nitrate Impact Assessment

Three proposed configurations are being considered based on assumptions for sizing, location of the reception hall, and septic treatment dosing.

Nitrate is considered to be a critical parameter of concern when assessing impacts to groundwater quality downgradient of an onsite sewage system. The City of Ottawa Hydrogeological and Terrain Analysis Guidelines (HTAG) annotated Procedure D-5-4 applies for the proposed development. For the purpose of this guideline, the City of

Ottawa's Drinking Water Objective of 10 mg/L for nitrate is used as an indicator of groundwater impact potential.

A Nitrate Impact Assessment (NIA) was completed for each of the three proposed scenarios. The values shown in the Predictive Nitrate Impact Assessment attached to this report are summarized below.

Assumptions for all Scenarios:

- ❑ Site area — 2.23 ha
- ❑ Concentration of nitrate in effluent — 40 mg/L
  (Value based on typical effluent concentration)
- ❑ Surplus Water — 341 mm/yr
  (The surplus water value was estimated based on Environment Canada Climate Office values with a soil type comprised of silt loam (Urban Lawns/Shallow Rooted Crops) and anthropogenic sources.)
- ❑ Combined infiltration factor based on: — **0.70**
  - Topography infiltration factor — 0.30
  - Soil texture infiltration factor — 0.25
  - Cover infiltration factor — 0.15

Based on available mapping, the topography infiltration factor of 0.30 is based upon a relatively flat land with an average slope of less than 0.6 m/km, taking into account the different topographies of the area. The soil texture infiltration factor was based upon an "sandy loam" and "clay loam" with a value of 0.3 which is a reasonable generalization based upon neighboring WWR's and available geological mapping. The "cover infiltration factor" was calculated at 0.15 based upon heavily treed and open grassy areas.

The daily sewage flow value for Scenarios I and II are based on the maximum daily sewage flow that would meet the nitrate requirement of <10 mg/L given the infiltration factor, water surplus, permeable area, and impermeable area. The daily sewage flow for Scenario III is based on an expected number of seats during the week (200 seats per day) and weekend (700 seats per day) and evenly discharging over a seven (7) day period (time dosing of the leaching bed).

Scenario I

- ❑ Impervious area (%) — 18 %
- ❑ Daily sewage flow — 3.95 m^3/d
  (See above)

  The calculation for a conventional septic system results in a predicted nitrate concentration of 9.92 mg/L nitrate for the subject site, using a value of 40 mg /L

nitrate concentration within the effluent. This value was based upon a daily sewage flow of 3.95 m^3 per day, as per the City of Ottawa's HTAG.

Scenario II

- ❑ Impervious area (%) — 20 %
- ❑ Daily sewage flow (See above) — 3.8 m^3/d

The calculation for a conventional septic system results in a predicted nitrate concentration of 9.84 mg/L nitrate for the subject site, using a value of 40 mg /L nitrate concentration within the effluent. This value was based upon a daily sewage flow of 3.8 m^3 per day, as per the City of Ottawa's HTAG.

Scenario III

For Scenario III it will be assumed that, rather than using a conventional (on demand) release timing, the sewage will be released evenly throughout the 7-day week using timed dosing. Assuming 700 parishioners attend on each Friday, Saturday, and Sunday, the priest is at the church two (2) days per week and 200 parishioners attend each day during the week for sports/ use of the reception hall, the estimated average daily sewage flow will be

- ❑ Impervious area (%) — 21 %
- ❑ Daily sewage flow — 3.4 m^3/d (See above)

The conditions and timed dosing results in a predicted nitrate concentration of 9.11 mg/L nitrate for the subject site, using a value of 40 mg /L nitrate concentration within the effluent. This value of 9.11 mg/L is less than the 10 mg/L limit indicating that time-dosing allows for a much greater number of parishioners to attend. This value was based upon a daily sewage flow of 3.4 m^3 per day, as per the City of Ottawa's HTAG.

Based on the results of the predicted nitrate impact assessment, it is our opinion that the property can adequately support one of the proposed scenarios discussed above without having an adverse impact on the underlying bedrock aquifer, provided that site specific studies confirm the assumptions made in this report.

Sewage System Total Daily Design Sewage Flow (TDDSF)

Based on the various scenarios, a maximum Total Daily Design Sewage Flow (TDDSF)for each set of conditions was determined by the NIA calculation. By taking the TDDSF and back-calculating from the Ontario Building Code (OBC) Table 8.2.1.3A, a maximum

number of seats for the Church and reception hall can be determined. The following assumptions were used for the calculations:

- ❑ That one person will be in the office twice per week.
- ❑ The church service will be attended Friday, Saturday, and Sunday.
- ❑ The church and reception hall will not be used simultaneously.

According to the OBC, each seat at the church provides 8 L per seat (assuming no kitchen facilities), and each office worker provides 75 L per 8-hour shift per employee. The number of available seats based on maximum sewage flow is presented below:

*Scenario 1 (*Maximum TDDSF 3,950 L/d)
- 1 employee – 1 x 75L = 75 L
- No. Seats = (3,950 L – 75 L)/8L = 485 seats

Scenario 2 (Maximum TDDSF – 3,800 L/d)
- 1 employee – 1 x 75L = 75 L
- No. Seats = (3,800 L – 75 L)/8L = 465 seats

Scenario 3 (Maximum TDDSF 3,400 L/d)
- 1 employee – 1 x 75L x 2 days per week = 150 L
- No. Seats for Church/Reception Hall = 700 seats x 8 L = 5600 L per weekend day
- No. Seats for Reception Hall = 200 seats x 8L = 1600 L per weekday
- Total Volume = 150 + 5600 x 3 + 1600 x 4 = 23,350 L/week
- Projected Volume per Day = 23,350 L/7 days = 3,335.7 L/day, rounded to 3,400 L/day

Sewage System Design

In order to minimize the risk of long-term contamination of services, a minimum separation distance of 15 m is required between any drilled well having a minimum casing length of 6 m and the closest distribution pipe or septic tank of a sewage system. This separation distance shall be increased according to the OBC requirements for beds constructed above the original ground surface. In consideration of the lot size of the subject site, all of the minimum distance considerations can be met.

The subject size is sufficient in size to accommodate the sizing of a conventional septic bed with a 3,950 L/day maximum loading rate. Specific sizing and design details will be determined once building design details become available. A sewage system design and approved OSSO septic permit will be required as part of a Site Plan submission.

CONCLUSIONS

Based on the information contained within the body of this report the following conclusions can be drawn:

1. The water supply aquifer intercepted by TW1 is considered to be adequate to support the water quantity demands for the existing dwellings and the proposed lot severance. A pumping test would be required at the Site Plan application stage to confirm the supply well quantity.

2. The preferred water supply intercepted by TW1 contains a water supply that is potable, however, it contains elevated concentrations of TDS, hardness, alkalinity, iron, manganese, apparent colour and DOC. The noted parameters can be treated with current readily available water conditioning equipment.

3. Alkalinity (as CaCO3) exceeds the Technical Support Document for Ontario Drinking Water Standards Operation Guideline and Colour exceeds the Maximum Concentration Considered Reasonably Treatable in the City of Ottawa's HTAG. Should an onsite well be installed and similar values be encountered for Alkalinity and Colour, then the Site Plan application will not be able to proceed.

4. It should also be noted that although the concentration of chlorides in the groundwater (209 mg/L) is currently below the Maximum Concentration Considered Reasonably Treatable by the City of Ottawa's HTAG, it is likely to fluctuate based on the seasonal usage of road salt on Highway 417. Should the levels be above 250 mg/L at the time of testing, a Site Plan application will not be successful.

5. The sodium concentration was measured to be above the 20 mg/L reporting limit and, as such, the Medical Officer of Health for the City of Ottawa should be informed to assist area physicians in the treatment of local residents on sodium reduced diets.

6. A residential grade water softener is recommended to facilitate the removal of the hardness and iron concentration. If a water softener is used for the proposed development, the owner should be made aware that additional sodium will be added to the water to reduce hardness. If desired, a point-of-use reverse osmosis system can be used to provide a drinking tap source.

7. An acid dosage system may be used to reduce alkalinity if desired.

8. An analysis of the surrounding WWR's provided satisfactory evidence of suitable groundwater quantity to service the proposed development.

9. The proposed parcel is sufficient in size to accommodate a new sewage system and meet all the regulatory separation criteria.

10. The construction of an on-site sewage system should not affect the performance or water quality associated with a drilled well, contingent upon the on-site sewage system being designed in accordance with the Ontario Building Code (i.e properly sized sewage system and conforming to all separation distances)

11. A Sewage System Permit and Building Permit needs to be issued for the proposed site construction prior to the commencement of construction on the subject site.

12. The nitrate impact assessments have demonstrated that, given the client design criteria, the site could support a sufficient number of parishioners while attaining sufficient nitrate removal.

13. As part of a Site Plan Application, the City of Ottawa requires the servicing well for the proposed development to be installed and tested in accordance with the City of Ottawa's Hydrogeological and Terrain Analysis Guidelines (HTAG).

14. An approved Ottawa Septic System Office (OSSO) septic permit is also required to be submitted as part of a Site Plan application.

15. All work associated with a Desktop Hydrogeological Review and Preliminary Terrain Analysis will need to be confirmed by onsite studies, and as such, is subject to change.

The results of the Desktop Hydrogeological Review for a Private Water Well Supply and Preliminary Terrain Analysis have provided evidence that the subject site may encounter exceedances of some operational guidelines. If operational guideline exceedances of some of the groundwater parameters are found to be in a future supply well onsite, the Site Plan application would not be able to proceed.

The review of the surrounding wells notes the aquifer is expected to be able to support the proposed commercial development with respect to water quantity, and sewage system placement. **Should the well to be eventually installed onsite encounter alkalinity or color levels similar to those encountered in TW1, the application will not pass Site Plan control.** Further concerns related to the relatively elevated chloride levels in the water samples and their likelihood to fluctuate based on road salt influence should be considered.

We trust that the current submission satisfies your immediate requirements.

Best Regards,

Paterson Group Inc.

Alexander Schopf, PhD, EIT

Erik Ardley, P.Geo

Attachments:

- ❑ Key Plan
- ❑ MECP Water Well Records
- ❑ Nitrate Impact Assessment Calculations
- ❑ Langelier Saturation Calculation
- ❑ Eurofins Certificate of Analysis

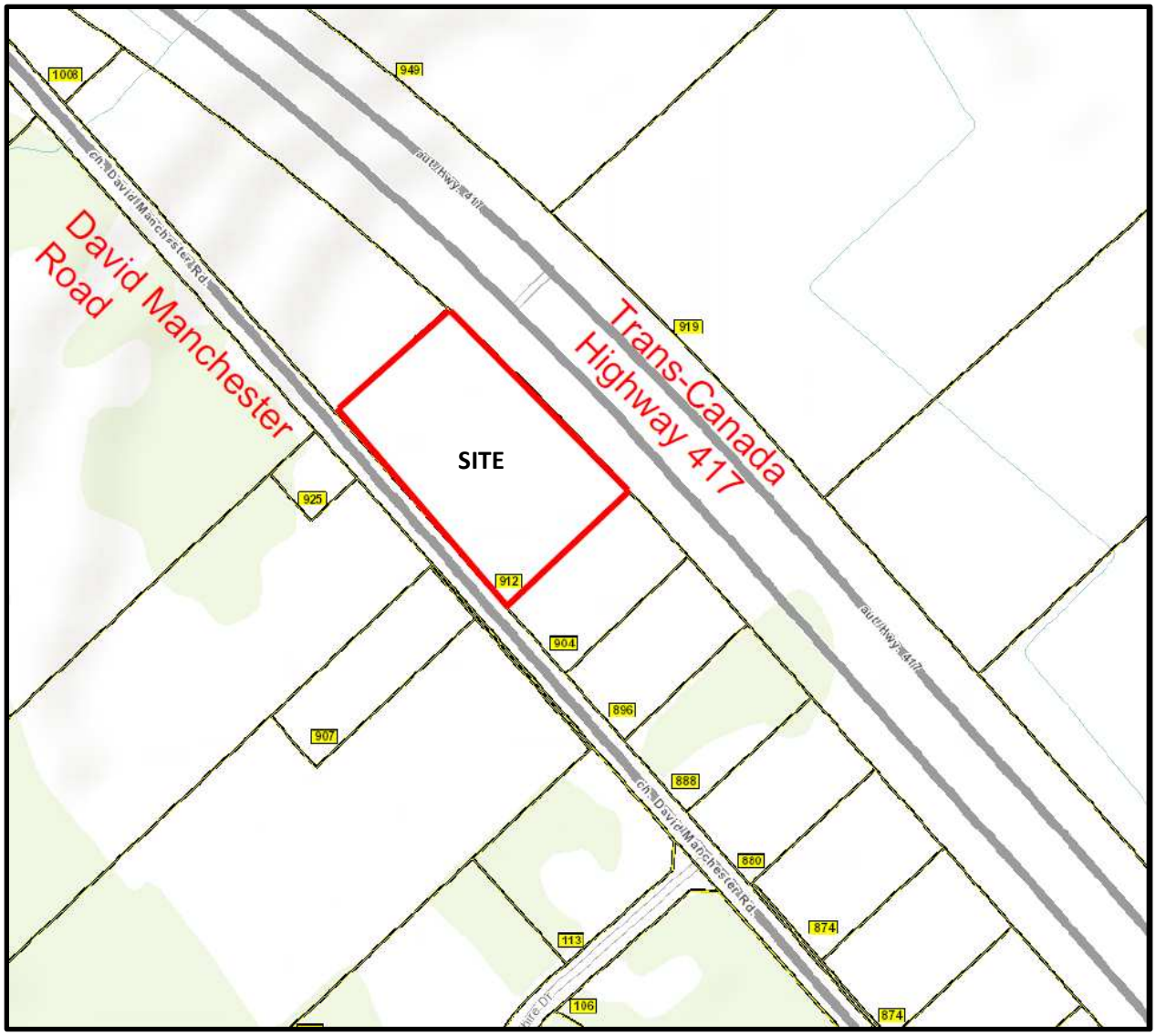


FIGURE 1

KEY PLAN

PATERSON GROUP

Ontario — Ministry of the Environment

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. (Place Sticker and/or Print Below)

Tag#: A151643

Well Record

Regulation 903 Ontario Water Resources Act

Page _____ of _____

[redacted]

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

County/District/Municipality	City/Town/Village	Province	Postal Code
OTTAWA CARELTON	CARP	Ontario	K0A 1L0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	420594	5015613		

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
BROWN	SAND	CLAY	FILL	0	4
BROWN	CLAY	SANDY STONES	TILL	4	23
GREY	LIMESTONE	LAYERS OF BROWN	LIMESTONE	23	219

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³) yd³
0	17	BENTONITE GROUT	ø192
17	26½	CEMENT GROUT	ø150

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☒ Air percussion
☐ Other, *specify* _____

Well Use

☐ Public ☐ Commercial ☐ Not used
☒ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ 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) From	Depth (m/ft) To
6¼	STEEL	ø188	0+3	26½
6	OPEN HOLE		26½	219

Construction Record - Screen

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

Status of Well

☒ 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*

Water Details

Water found at Depth	Kind of Water	
93 (m/ft) ☐ Gas	☐ Fresh ☒ Untested	☐ Other, *specify*
207+ (m/ft) ☐ Gas	☐ Fresh ☒ Untested	☐ Other, *specify*
(m/ft) ☐ Gas	☐ Fresh ☐ Untested	☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
0	219	6"

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☐ Other, *specify* CLEARING

If pumping discontinued, give reason: —

Pump intake set at (m/ft): 200

Pumping rate (l/min / GPM): 12

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 30.49

If flowing give rate (l/min / GPM): —

Recommended pump depth (m/ft): 80

Recommended pump rate (l/min / GPM): 12

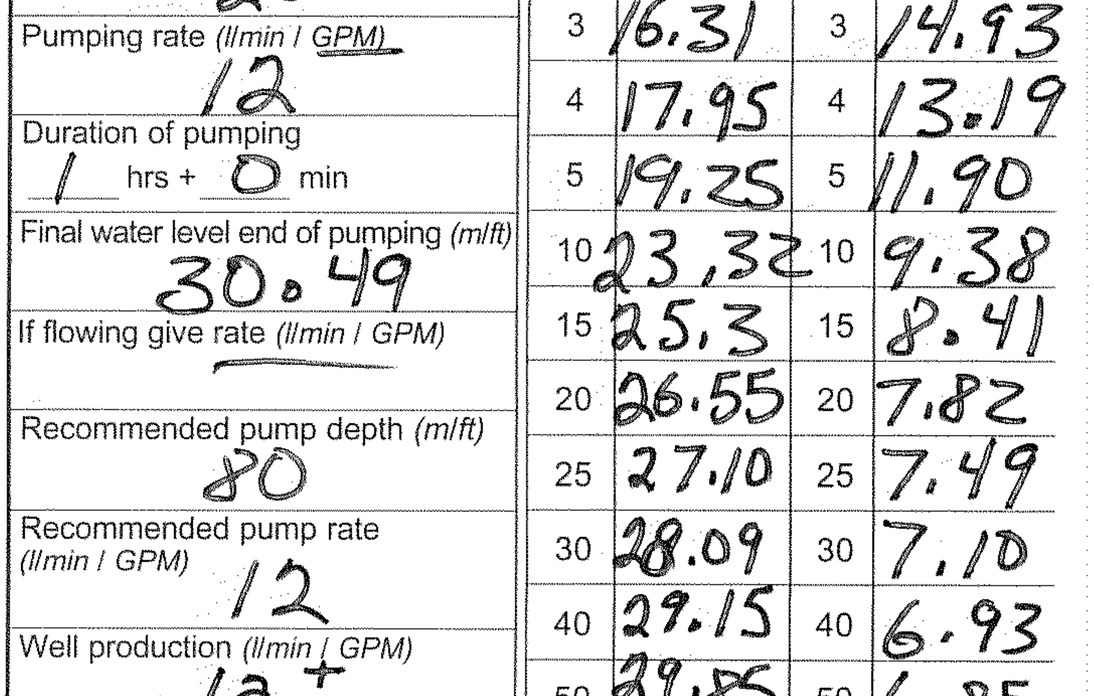
Well production (l/min / GPM): 12+

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	5.6		
1	10.8	1	22.85
2	14.05	2	17.75
3	16.31	3	14.93
4	17.95	4	13.19
5	19.25	5	11.90
10	23.32	10	9.38
15	25.3	15	8.41
20	26.55	20	7.82
25	27.10	25	7.49
30	28.09	30	7.10
40	29.15	40	6.93
50	29.85	50	6.85
60	30.49	60	6.81

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
SAUNDERS WELL DRILLING LTD	4879

Business Address (Street Number/Name)	Municipality
RR#1	BRAESIDE

Province	Postal Code	Business E-mail Address
ONT	K0A 1G0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
6136235648	SAUNDERS TROY

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
T5177	Troy Saunders	20140428

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☒ Yes ☐ No	20140328	20140328

Ministry Use Only

Audit No. Z175281

Received APR 25 2014

Ministry's Copy

Ontario Ministry of the Environment

A 095942

Well Record

Regulation 903 Ontario Water Resources Act

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. *(Place*: A095942

Page _____ of _____

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	Lindon Slewidge /Slewidge Contracting		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. *(inc. area code)*
Box 72	Carp	ON	K0A 1L0	

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
904 David Manchester Road	West Carleton	S½ Lot 9	4

County/District/Municipality	City/Town/Village	Province	Postal Code
Ottawa-Carleton	Carp	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 8 3	18	420515	5015657	5R-13359	Part #2

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
		Clay Sand		0	8
	Gravel			8	13
Grey & Brown	Limestone			13	365
Green & Red & Gray	Limestone			37	400

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	21	Neat cement	12.48

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☒ Air percussion
☐ Other, *specify* _____

Well Use

☐ Public ☐ Commercial ☐ Not used
☒ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ 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) From	Depth (m/ft) To
6	Steel	.188	+2	21
5 7/8	Open Hole		21	400

Construction Record - Screen

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

Status of Well

☐ 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*

Water Details

Water found at Depth (m/ft)	☐ Gas	Kind of Water: ☐ Fresh ☒ Untested	☐ Other, *specify*
228			
Water found at Depth (m/ft)	☐ Gas	Kind of Water: ☐ Fresh ☐ Untested	☐ Other, *specify*
Water found at Depth (m/ft)	☐ Gas	Kind of Water: ☐ Fresh ☐ Untested	☐ Other, *specify*

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	21	6"
21	400	5 7/8"

Results of Well Yield Testing

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): 275

Pumping rate (l/min / GPM): 5

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 54.9

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

Recommended pump depth (m/ft): 3/4HP-5gpm 360'

Recommended pump rate (l/min / GPM): 5

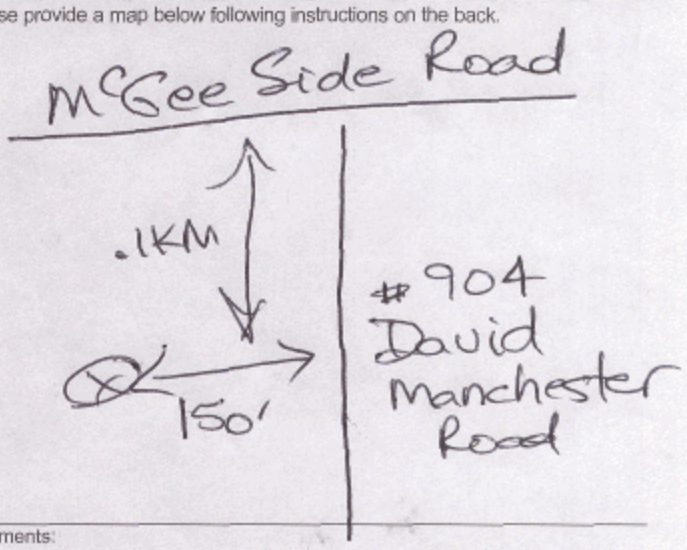
Well production (l/min / GPM): 5

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	5.7		54.9
1	7.9	1	46.6
2	1.9	2	42.7
3	13.3	3	39.4
4	15.35	4	36.2
5	17.3	5	33.2
10	24.3	10	21.5
15	29.7	15	14.6
20	34.2	20	10.2
25	38.1	25	7.5
30	41.2	30	5.7
40	46.85	40	5.7
50	51.4	50	5.7
60	54.9	60	5.7

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

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

Business Address (Street Number/Name)	Municipality	Province	Postal Code	Business E-mail Address
6659 Franktown Road RR#1	Richmond	ON	K0A 2Z0	air-rock@sympatico.ca

Bus. Telephone No. *(inc. area code)*	Name of Well Technician (Last Name, First Name)	Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
6138382170	Graham, Ryan	T3484		2010 07 19

Well owner's information package delivered ☒ Yes ☐ No

Date Package Delivered: 2010 06 23

Date Work Completed: 2010 06 22

Ministry Use Only

Audit No. Z 108401

Received AUG 05 2010

0506E (12/2007)

Ministry's Copy

Ontario — Ministry of the Environment and Climate Change

Measurements recorded in: ☒ Metric ☐ Imperial

Well Tag No. *(Place Sticker and/or Print Below)*

Tag#: A192928

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

[redacted]

Address of Well Location (Street Number/Name)	Township	Lot	Concession
107 DAVID MANCHESTER	HUNTLEY	PT 9	5

County/District/Municipality	City/Town/Village	Province	Postal Code
OTTAWA	CARP	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	18	0420381	5015604		

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
GRY	CLAY			0.00	2.74
GRY	SAND/GRAVEL	BOULDERS		2.74	3.96
GRY	LIMESTONE	SAND		3.96	59.44
					(194')

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)
0.00	6.10	BENTONITE HOLEPLUG GROUT	0.18

Method of Construction

☒ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, *specify* _____

Well Use

☐ Public ☐ Commercial ☐ Not used
☒ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ 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) From	Depth (m/ft) To
15.88	STEEL 156.	0.48	+0.60	6.10

Construction Record - Screen N/A.

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

Status of Well

☒ 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* _____

Water Details

Water found at Depth (m/ft)	Gas	Kind of Water	Hole Diameter Depth From (m/ft)	Depth To	Diameter (cm/in)
2.50	☐	☐ Fresh ☒ Untested ☐ Other, *specify* _____	0.00	6.10	21.6
54.90	☐	☐ Fresh ☒ Untested ☐ Other, *specify* _____	6.10	59.74	14.92
	☐	☐ Fresh ☐ Untested ☐ Other, *specify* _____			

Results of Well Yield Testing

After test of well yield, water was:
☐ Clear and sand free
☒ Other, *specify* Cloudy

If pumping discontinued, give reason: N/A

Pump intake set at (m/ft): 27.5m (90').

Pumping rate (l/min / GPM): 23 LPM (5 GPM).

Duration of pumping: 1 hrs + 20 min

Final water level end of pumping (m/ft): 20.10m

If flowing give rate (l/min / GPM): N/A.

Recommended pump depth (m/ft): 47.5m (90').

Recommended pump rate (l/min / GPM): 23 LPM (5 GPM)

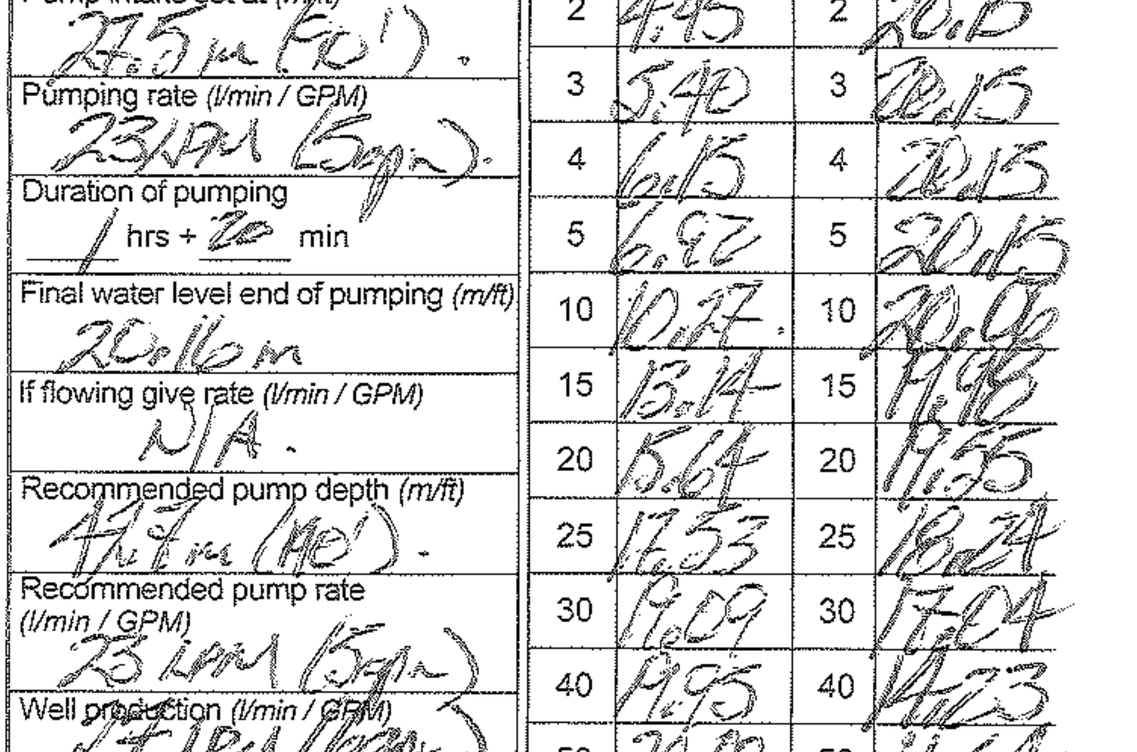
Well production (l/min / GPM): 4.5 LPM (1 GPM).

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	4.36		
1	7.95	1	20.15
2	4.45	2	20.15
3	5.40	3	20.15
4	6.15	4	20.15
5	6.92	5	20.15
10	10.27	10	20.05
15	13.14	15	19.98
20	15.64	20	19.95
25	17.53	25	19.84
30	19.09	30	19.84
40	19.95	40	19.83
50	20.10	50	19.84
60	20.15	60	19.84

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☒ Yes ☐ No	2016/10/26	2016/10/26

Ministry Use Only

Audit No. 2252108

APR 10 2017

Received 2018

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
STANTON DRILLING INC	4865

Business Address (Street Number/Name)	Municipality
BOX 29, 157 FIVE ARCHES DRIVE	PAKENHAM

Province	Postal Code	Business E-mail Address
ON	K0A 2W0	Stanton.drilling@bell.net

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
(613) 624-5800	STANTON, PETER

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
0086		2016/10/26

0506E (2014/11)

Ministry's Copy

patersongroup

912 David Manchester

PREDICTIVE NITRATE IMPACT ASSESSEMENT

Infiltration Factors		
Topography	0.30	
Soil	0.25	
Cover	0.15	
Total	**0.70**	
Site Characteristics		
Area of Site :	22319.81	m^2
Total of roof areas:	500	m^2
Total area of paved driveway areas:	3500	m^2
Roof + paved driveway areas	4000	m^2
Impervious Area	4000	m^2
Percent Impervious Area =	18	%
Infiltration Area =	18320	m^2
Septic Effluent		
Concentration of Effluent (Cs) =	40	mg/L
Daily Sewage Flow (Qs)=	3.95	m^3
See Notes below.		
Infiltration Calculation		
Nitrate concentration in precipitation (C_i) =	0	mg/L
Surplus Water (Environment Canada)	341	mm/yr
Factored Water Surplus =	239	mm/yr
Infiltration % due to stormwater management measures	-	%
Infiltration rate from stormwater management measures =	0	mm/yr
Infiltration Flow Entering the System (Q_i) =	12	m^3/day
Mass Balance Model (MOEE, 1995)		
$C_T = (Q_bC_b+Q_eC_e+Q_iC_i)/(Q_b+Q_e+Q_i)$ = Cumulative Nitrate Concentration		
Q_b = flow entering the system across the upgradient area	0	m^3/day
C_b = background nitrate concentration	0	mg/L
Q_e = flow entering the system from the septic drainfield	3.95	m^3/day
C_e = concentration of nitrates in the septic effluent	40	mg/L
Q_i = flow entering the system from infiltration	12	m^3/day
C_i = Concentration of nitrates in the infiltrate	0	mg/L
C_T =	**9.92**	**mg/L**
Estimate Number of Lots	**1**	**lots**

Notes: Site characteristic values were measured as approximate values from the available site plan. Daily Sewage Flow volume was calculted by Paterson Group as a preliminary design flow.

patersongroup

912 David Manchester

PREDICTIVE NITRATE IMPACT ASSESSEMENT

Infiltration Factors		
Topography	0.30	
Soil	0.25	
Cover	0.15	
Total	**0.70**	
Site Characteristics		
Area of Site :	22319.81	m^2
Total of roof areas:	1000	m^2
Total area of paved driveway areas:	3500	m^2
Roof + paved driveway areas	4500	m^2
Impervious Area	4500	m^2
Percent Impervious Area =	20	%
Infiltration Area =	17820	m^2
Septic Effluent		
Concentration of Effluent (Cs) =	40	mg/L
Daily Sewage Flow (Qs)=	3.8	m^3
See Notes below.		
Infiltration Calculation		
Nitrate concentration in precipitation (C_i) =	0	mg/L
Surplus Water (Environment Canada)	341	mm/yr
Factored Water Surplus =	239	mm/yr
Infiltration % due to stormwater management measures	-	%
Infiltration rate from stormwater management measures =	0	mm/yr
Infiltration Flow Entering the System (Q_i) =	12	m^3/day
Mass Balance Model (MOEE, 1995)		
$C_T = (Q_bC_b+Q_eC_e+Q_iC_i)/(Q_b+Q_e+Q_i)$ = Cumulative Nitrate Concentration		
Q_b = flow entering the system across the upgradient area	0	m^3/day
C_b = background nitrate concentration	0	mg/L
Q_e = flow entering the system from the septic drainfield	3.8	m^3/day
C_e = concentration of nitrates in the septic effluent	40	mg/L
Q_i = flow entering the system from infiltration	12	m^3/day
C_i = Concentration of nitrates in the infiltrate	0	mg/L
C_T =	**9.84**	**mg/L**
Estimate Number of Lots	**1**	**lots**

Notes: Site characteristic values were measured as approximate values from the available site plan. Daily Sewage Flow volume was calculted by Paterson Group as a preliminary design flow.

patersongroup

912 David Manchester

PREDICTIVE NITRATE IMPACT ASSESSEMENT

Infiltration Factors		
Topography	0.30	
Soil	0.25	
Cover	0.15	
Total	**0.70**	
Site Characteristics		
Area of Site :	22319.81	m^2
Total of roof areas:	700	m^2
Total area of paved driveway areas:	4000	m^2
Roof + paved driveway areas	4700	m^2
Impervious Area	4700	m^2
Percent Impervious Area =	21	%
Infiltration Area =	17620	m^2
Septic Effluent		
Concentration of Effluent (Cs) =	40	mg/L
Daily Sewage Flow (Qs)=	3.4	m^3
See Notes below.		
Infiltration Calculation		
Nitrate concentration in precipitation (C_i) =	0	mg/L
Surplus Water (Environment Canada)	341	mm/yr
Factored Water Surplus =	239	mm/yr
Infiltration % due to stormwater management measures	-	%
Infiltration rate from stormwater management measures =	0	mm/yr
Infiltration Flow Entering the System (Q_i) =	12	m^3/day
Mass Balance Model (MOEE, 1995)		
$C_T = (Q_bC_b+Q_eC_e+Q_iC_i)/(Q_b+Q_e+Q_i)$ = Cumulative Nitrate Concentration		
Q_b = flow entering the system across the upgradient area	0	m^3/day
C_b = background nitrate concentration	0	mg/L
Q_e = flow entering the system from the septic drainfield	3.4	m^3/day
C_e = concentration of nitrates in the septic effluent	40	mg/L
Q_i = flow entering the system from infiltration	12	m^3/day
C_i = Concentration of nitrates in the infiltrate	0	mg/L
C_T =	**9.11**	**mg/L**
Estimate Number of Lots	**1**	**lots**

Notes: Site characteristic values were measured as approximate values from the available site plan. Daily Sewage Flow volume was calculted by Paterson Group as a preliminary design flow.

patersongroup

912 david manchester

PH4674

TW1	inputs		
pH	7.43	A	0.20
TDS	1100	B	2.36
Hardness	680	C	2.43
Alkalinity	531	D	2.73
Temp.	11		
		pHs =	6.708999213

Langelier Saturation Index (LSI) Calculation

(Langelier, 1936)

LSI = pH - pHs

pHs = (9.3 + A + B) - (C + D)

Where:

A = (Log10 [TDS] - 1) / 10

B = -13.12 x Log10 (oC + 273) + 34.55

C = Log10 [Ca2+ as CaCO3] - 0.4

D = Log10 [alkalinity as CaCO3]

LSI =	0.7

LSI	Effect
0.5 to 2	**Water is super saturated and tends to precipitate a scale layer of calcium carbonate (scale forming but non-corrosive)**
0 to 0.5	**Water is super saturated and tends to precipitate a scale layer of calcium carbonate (slightly scale forming and corrosive).**
0	Water is saturated (in equilibrium) with calcium carbonate. A scale layer of calcium carbonate is neither precipitated nor dissolved.
0 to -0.5	Water is under saturated and tends to dissolve solid calcium carbonate (slightly corrosivebut non-scale forming).
-0.5 to -2	Water is under saturated and tends to dissolve solid calcium carbonate (seriously corrosive).

Certificate of Analysis

Client: Paterson Group
9 Auriga Dr
Nepean, ON
K2E 7T9
Attention: Mr. Alex Schopf
PO#:
Invoice to: Paterson Group

Report Number: 1990207
Date Submitted: 2022-11-18
Date Reported:
Project: PH4674
COC #: 903020

Dear Alex Schopf:

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:

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: https://directory.cala.ca/.

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.

eurofins | Environment Testing

Certificate of Analysis

Client: Paterson Group
9 Auriga Dr
Nepean, ON
K2E 7T9
Attention: Mr. Alex Schopf
PO#:
Invoice to: Paterson Group

Report Number: 1990207
Date Submitted: 2022-11-18
Date Reported:
Project: PH4674
COC #: 903020

				Lab I.D.	1663621
				Sample Matrix	GW
				Sample Type	
				Sampling Date	2022-11-18
				Sample I.D.	896DM
Group	**Analyte**	**MRL**	**Units**	**Guideline**	
Anions	Cl	1	mg/L	AO 250	209
	F	0.10	mg/L	MAC 1.5	0.33
	N-NO2	0.10	mg/L	MAC 1.0	<0.10
	N-NO3	0.10	mg/L	MAC 10.0	<0.10
	SO4	1	mg/L	AO 500	134
General Chemistry	Alkalinity as CaCO3	5	mg/L	OG 30-500	531*
	Colour (Apparent)	2	TCU	AO 5	23*
	Conductivity	5	uS/cm		1690
	DOC	0.5	mg/L	AO 5	5.3*
	pH	1.00		6.5-8.5	7.43
	Phenols	0.001	mg/L		<0.001
	S2-	0.01	mg/L	AO 0.05	<0.01
	Tannin & Lignin				in-progress
	TDS (COND - CALC)	1	mg/L	AO 500	1100*
	Turbidity	0.1	NTU	AO 5	4.0
Hardness	Hardness as CaCO3	1	mg/L	OG 80-100	680*
Indices/Calc	Ion Balance	0.01			0.99
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	0.21
	Ba	0.01	mg/L	MAC 1.0	0.14
	Be	0.0005	mg/L		<0.0005
	Ca	1	mg/L		185
	Cd	0.0001	mg/L	MAC 0.005	<0.0001

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

Certificate of Analysis

eurofins | Environment Testing

Client: Paterson Group
9 Auriga Dr
Nepean, ON
K2E 7T9
Attention: Mr. Alex Schopf
PO#:
Invoice to: Paterson Group

Report Number: 1990207
Date Submitted: 2022-11-18
Date Reported:
Project: PH4674
COC #: 903020

Group	Analyte	MRL	Units	Guideline	Lab I.D. Sample Matrix Sample Type Sampling Date Sample I.D. 1663621 GW 2022-11-18 896DM
Metals	Co	0.0002	mg/L		0.0003
	Cr	0.001	mg/L	MAC 0.05	<0.001
	Cu	0.001	mg/L	AO 1	0.023
	Fe	0.03	mg/L	AO 0.3	1.25*
	Hg	0.0001	mg/L	MAC 0.001	<0.0001
	K	1	mg/L		6
	Mg	1	mg/L		53
	Mn	0.01	mg/L	AO 0.05	0.45*
	Mo	0.005	mg/L		<0.005
	Na	1	mg/L	AO 200	123
	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		4.41
	Tl	0.0001	mg/L		<0.0001
	U	0.001	mg/L	MAC 0.02	<0.001
	V	0.001	mg/L		<0.001
	Zn	0.01	mg/L	AO 5	0.04
Microbiology	Escherichia Coli	0	ct/100mL	MAC 0	0
	Total Coliforms	0	ct/100mL	MAC 0	0
Nutrients	N-NH3	0.020	mg/L		0.090
	Total Kjeldahl Nitrogen	0.100	mg/L		0.315

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

Certificate of Analysis

Client: Paterson Group
9 Auriga Dr
Nepean, ON
K2E 7T9
Attention: Mr. Alex Schopf
PO#:
Invoice to: Paterson Group

Report Number: 1990207
Date Submitted: 2022-11-18
Date Reported:
Project: PH4674
COC #: 903020

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 433507 **Analysis/Extraction Date** 2022-11-19 **Analyst** CK **Method** C SM2130B			
Turbidity	<0.1 NTU	101	70-130
Run No 433508 **Analysis/Extraction Date** 2022-11-20 **Analyst** L V **Method** AMBCOLM1			
Escherichia Coli			
Total Coliforms			
Run No 433531 **Analysis/Extraction Date** 2022-11-21 **Analyst** ACG **Method** C SM2120C			
Colour (Apparent)	<2 TCU	100	90-110
Run No 433584 **Analysis/Extraction Date** 2022-11-21 **Analyst** SD **Method** EPA 200.8			
Silver	<0.0001 mg/L	91	80-120
Aluminum	<0.01 mg/L	106	80-120
Arsenic	<0.001 mg/L	87	80-120
Boron (total)	<0.01 mg/L	105	80-120
Barium	<0.01 mg/L	91	80-120
Beryllium	<0.0005 mg/L	98	80-120
Cadmium	<0.0001 mg/L	94	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

Certificate of Analysis

Client: Paterson Group
9 Auriga Dr
Nepean, ON
K2E 7T9
Attention: Mr. Alex Schopf
PO#:
Invoice to: Paterson Group

Report Number: 1990207
Date Submitted: 2022-11-18
Date Reported:
Project: PH4674
COC #: 903020

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Cobalt	<0.0002 mg/L	96	80-120
Chromium Total	<0.001 mg/L	96	80-120
Copper	<0.001 mg/L	97	80-120
Iron	<0.03 mg/L	100	80-120
Mercury	<0.0001 mg/L	118	80-120
Manganese	<0.01 mg/L	99	80-120
Molybdenum	<0.005 mg/L	91	80-120
Nickel	<0.005 mg/L	95	80-120
Lead	<0.001 mg/L	97	80-120
Antimony	<0.0005 mg/L	83	80-120
Selenium	<0.001 mg/L	92	80-120
Strontium	<0.001 mg/L	94	80-120
Thallium	<0.0001 mg/L	96	80-120
Uranium	<0.001 mg/L	92	80-120
Vanadium	<0.001 mg/L	94	80-120
Zinc	<0.01 mg/L	95	80-120

Run No 433652 **Analysis/Extraction Date** 2022-11-22 **Analyst** ML
Method EPA 350.1

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

Certificate of Analysis

Client: Paterson Group
9 Auriga Dr
Nepean, ON
K2E 7T9
Attention: Mr. Alex Schopf
PO#:
Invoice to: Paterson Group

Report Number: 1990207
Date Submitted: 2022-11-18
Date Reported:
Project: PH4674
COC #: 903020

QC Summary

Analyte	Blank	QC % Rec	QC Limits
N-NH3	<0.020 mg/L	109	80-120
Run No 433691 **Analysis/Extraction Date** 2022-11-22 **Analyst** SKH **Method** EPA 351.2			
Total Kjeldahl Nitrogen	<0.100 mg/L	117	70-130
Run No 433697 **Analysis/Extraction Date** 2022-11-22 **Analyst** ACG **Method** SM2320,2510,4500H/F			
Alkalinity (CaCO3)	<5 mg/L	100	90-110
Conductivity	<5 uS/cm	101	90-110
F	<0.10 mg/L	100	90-110
pH		99	90-110
Run No 433735 **Analysis/Extraction Date** 2022-11-23 **Analyst** Z S **Method** M SM3120B-3500C			
Calcium	<1 mg/L	99	90-110
Potassium	<1 mg/L	102	87-113
Magnesium	<1 mg/L	96	76-124
Sodium	<1 mg/L	100	82-118
Run No 433781 **Analysis/Extraction Date** 2022-11-24 **Analyst** AaN **Method** SM 4110			
N-NO2	<0.10 mg/L	109	90-110

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

Certificate of Analysis

Client: Paterson Group
9 Auriga Dr
Nepean, ON
K2E 7T9
Attention: Mr. Alex Schopf
PO#:
Invoice to: Paterson Group

Report Number: 1990207
Date Submitted: 2022-11-18
Date Reported:
Project: PH4674
COC #: 903020

QC Summary

Analyte	Blank	QC % Rec	QC Limits
N-NO3	<0.10 mg/L	103	90-110
Run No 433803 **Analysis/Extraction Date** 2022-11-24 **Analyst** ACG **Method** C SM4500-S2-D			
S2-	<0.01 mg/L	92	80-120
Run No 433804 **Analysis/Extraction Date** 2022-11-24 **Analyst** ACG **Method** C SM5310C			
DOC	<0.5 mg/L	116	84-116
Run No 433820 **Analysis/Extraction Date** 2022-11-24 **Analyst** AaN **Method** SM 4110			
Chloride	<5 mg/L		90-110
SO4	<5 mg/L	100	90-110
Run No 433829 **Analysis/Extraction Date** 2022-11-24 **Analyst** IP **Method** SM5530D/EPA420.2			
Phenols	<0.001 mg/L	110	50-120
Run No 433836 **Analysis/Extraction Date** 2022-11-24 **Analyst** AET **Method** C SM2340B			
Hardness as CaCO3			
Ion Balance			
TDS (COND - CALC)			

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