MOREY ASSOCIATES LTD.
CONSULTING ENGINEERS

2672 Highway 43, PO Box 184
Kemptville, Ontario, K0G 1J0
T:613.215.0605 • F:613.258.0605

REPORT ON

HYDROGEOLOGICAL STUDY
PROPOSED SEMI-DETACHED DWELLING
SOUTH STREET, SPENCERVILLE
TOWNSHIP OF EDWARDSBURGH/CARDINAL
ONTARIO

Submitted to:

Lockwood Brothers Construction
2010 Totem Ranch Road
Oxford Station, Ontario
K0G 1T0

DISTRIBUTION

1 PDF copy – Lockwood Brothers Construction
1 PDF copy – Morey Associates Ltd.

April 2021 File No. 021256

TABLE OF CONTENTS

LIST OF TABLES (within text of report)

LIST OF TABLES (following text of report)

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

Morey Associates Ltd. was retained by Lockwood Brothers Construction to undertake a hydrogeological study for the proposed semi-detached dwelling located on the east side of South Street in Spencerville, within Lot 4, Concession 7, Edwardsburgh/Cardinal Township, Ontario (see Key Plan, Figure 1 and Aerial Photograph, Figure 2).

For the purpose of this report South Street is considered to exist at the west side of the subject site.

It is understood a that a semi-detached dwelling is proposed at the above noted site on two residential lots about 0.05 and 0.03 hectares in plan area with some 25 and 17 metres of frontage on South Street, respectively (see Appendix A). The proposed semi-detached dwelling is to be serviced by existing on-site private wells and municipal sanitary and storm sewers. It is further understood based on a discussion with Lockwood Brothers Construction that each dwelling unit in the proposed semi-detached dwelling will have two bedrooms.

This hydrogeological study was carried out in general accordance with our interpretation of the applicable sections of the Ministry of the Environment, Conservation and Parks (MOE) Procedure D-5-5 Technical Guideline for Private Wells: Water Supply Assessment (August 1996).

2.0 SITE BACKGROUND

The site is bordered on the west by the South Street right-of-way with residential development beyond, on the north by an existing dwelling with residential and commercial development beyond, on the east by an existing commercial building and dwelling with residential and commercial development beyond, and on the south by an existing dwelling with residential development and the South Nation River beyond. The ground cover at the site consists, in general, of grass. No drainage ditches exist at or adjacent to the site. A municipal storm sewer exists within the South Street right-of-way adjacent to the site.

The South Nation River exists some 90 metres south/southeast of the site. A Drummond Gas service station exists southeast of the site. The fuel pumps, an above ground diesel fuel storage tank and below ground fuel storage tank(s) at the service station exist some 60, 65 and 75 metres

from the southeast corner of the site. Based on available topographic mapping the existing service station is some 2 metres downgradient of the site.

Based on a review of surficial geology information for the site area, obtained from the Ontario Geological Survey (2010), the site is indicated to be underlain by a till deposit consisting of stone-poor, sandy silt to silty sand-textured till. Based on a review of the bedrock geology map for the site area and on a previous study carried out in the site area by others (Thompson 1985) the bedrock underlying the site area is indicated to consist of dolostone of the Oxford Formation underlain by limestone and sandstone of the March Formation and sandstone of the Nepean Formation. Based on a previous study carried out in the site area by others (MOE 2020) the Oxford, March and Nepean Formations are indicated to support viable aquifers for domestic use.

Based on the above mentioned previous studies carried out in the site area by others (Thompson 1985 and MOE 2020) the shallow groundwater flow in the site area is expected to be towards the South Nation River and in general follow the local topography.

Two wells exist at the site, one within the north portion (well tag # A298757) and one within the south portion (well tag # A298756) of the site and for the purpose of this report will be referred to as the “north well” and “south well”, respectively. It is understood, based on discussion with Lockwood Brothers Construction, that the north well and south well will each service one of the dwelling units of the proposed semi-detached dwelling at the site. The MOE Water Well Records associated with the north and south wells are attached in Appendix B and a summary of the well construction details are provided in Table 2.1 below.

Table 2.1: Summary of On-Site Well Construction Details

Well	Thickness of Overburden Encountered (m)	Thickness of Rock Encountered [Limestone] (m)	Total Depth of Well (m BGS)	Inside Diameter of Well Casing (m)	Depth of Well Casing (m BGS)	Depth Water Found (m BGS)
North Well	1.4	17.5	18.9	0.16	6.2	12.2, 15.8
South Well	1.4	17.5	18.9	0.16	6.2	12.2, 14.6

Note: m BGS = Metres Below Ground Surface

The water well records for the north and south wells supplied by the well driller indicate that at each well a nominal 16 centimetre inside diameter steel casing was installed through about a 1.4 metre thickness of overburden material consisting of clay and stones and was set some 4.8 metres into

bedrock and grouted in place using cement and bentonite slurry. The wells are indicated to be some 18.9 metres in depth from the ground surface, and advanced into a limestone and dolomite aquifer. Based on the above and on the available general site area bedrock geology it is considered that the north and south wells at the site have been completed in the Oxford Formation.

Eight MOE water well records indicated to be for site area/neighbouring wells (obtained from the MOE online database) indicate that the overburden depth in the area of the site ranges from about 0.6 to 3.1 metres. The well records indicate that the wells are between some 24.7 to 58.5 metres in depth and that the bedrock encountered during drilling consisted of limestone, dolomite and sandstone. The well records indicate that water was found at depths of between some 9 to 55 metres. The well records further indicate recommended pumping rates of between some 5 to 22 gallons per minute (23 to 100 litres per minute). The above mentioned eight MOE water well records are provided in Appendix B.

Table 2.2: Summary of Neighbouring Well Construction Details

Well ID or Well Tag No.	Well Location	Approximate Distance to Site (m)	Year of Well Construction	Total Depth of Well (m BGS)	Depth to Surface of Bedrock (m BGS)	Static Water Level (assumed m BGS)	Available Drawdown (m)
A193373	9 Centre Street	60	2016	30.8	0.6	4	26.8
2406530	[1]12 Centre Street	100	1991	58.5	2.4	6.1	52.4
A006191	[1]13 Centre Street	85	2004	55.2	1.5	3.7	51.5
A275102	15 Centre Street	125	2019	36.9	1.1	5.8	31.1
A059303	16 Centre Street	120	2007	24.7	1.4	5.0	19.7
A074127	9 South Street	30	2008	24.7	1.4	4.0	20.7
A019576	11 Water Street	150	2005	36.6	3.1	0.7	35.9
2400650	[1]16 Spencer Street	70	1962	25.0	1.2	3.7	21.3

Note: m BGS = Metres Below Ground Surface

[1]Likely well location associated with well record based on limited information provided on well record

Based on the above MOE well water records information and on the available general site area bedrock geology it is considered that the above mentioned eight site area/neighbouring wells are completed in the Oxford Formation, except for the wells at 12, 13 and 15 Centre Street which are suspected to have been completed in the March Formation.

3.0 WELL WATER QUANTITY

A pumping test was conducted on the north well at the site on April 20, 2021 by a member of our engineering staff and consisted of a six hour duration constant discharge rate pumping test. During the pumping test, water level measurements were made on a regular basis to monitor the drawdown of the water level in the well in response to pumping. After the pumping period, the pump was shut off and the recovery of the water level in the well was monitored for a period of time. During the pump test, the pump discharge outlet was located an adequate distance and downgradient from the well to ensure the discharge did not interfere with the natural recharge to the well.

The drawdown and recovery data and plots for the well pumping test is shown in Appendix C. The drawdown and recovery data provided were measured with reference to the top of the well casing.

The pumping test data for the 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. The analysis of the data obtained during the pumping tests is summarized in the attached Table II.

The six hour duration pumping test was carried out at a discharge rate of about 25 litres per minute (5.5 Igpm). The static water level prior to testing was about 2.63 metres below the top of the well casing and the water level after six hours of pumping was about 2.83 metres below the top of the well casing for a total drawdown at the end of pumping of 0.20 metres. The available drawdown in the well is about 15.2 metres. The specific capacity of the well at this pumping rate is approximately 180 cubic metres per day per metre of drawdown.

Based on the pumping test drawdown data the transmissivity of the aquifer is estimated to be 82.4 m^2/day. Based on the pumping test recovery data the aquifer transmissivity is estimated to be 65.9 m^2/day. The average transmissivity of the aquifer in the area of the well is estimated to be 74.2 m^2/day. At the end of pumping, 40 minutes was required for 100 percent recovery of the total drawdown in the static water level created during pumping.

Based on the data obtained during the pumping test, it can be concluded that the well is capable of sustaining a short term yield of at least 25 litres per minute (5.5 Igpm) and that during the course of the six hour pumping period about 1 percent of the available drawdown in the well was utilized.

3.1 SUMMARY OF ON SITE WELL YIELD

The MOE Guideline D-5-5 Section 4.3.2 for water quantity requirement indicates that the per-person requirement shall be 450 litres per day and relates that quantity to an equivalent peak per person demand rate of 3.75 litres per minute. The MOE guideline indicates that for a dwelling the likely number of persons per well (per dwelling) is considered to be the number of bedrooms in the dwelling plus one. The MOE guidelines further requires that regardless of the demand rate determined using the above mentioned calculation, the demand rate (minimum pumping rate of a well servicing a dwelling) shall not be less than 13.7 litres per minute.

As previously mentioned each dwelling unit in the proposed semi-detached dwelling is to be a two bedroom dwelling. As such, the MOE peak demand rate for each dwelling unit is 13.7 litres per minute.

The results of the well pumping test carried out at the site for this present hydrogeological study indicate that the pumped well at the site is capable of more than meeting the MOE minimum demand rate of 13.7 litres per minute and that the pumped well at the site is capable of more than meeting the MOE peak demand rate for up to a five bedroom dwelling.

3.2 SUMMARY OF TRANSMISSIVITY ANALYSIS

The above mentioned transmissivity values based on the pumping test drawdown and recovery data are summarized in Table 3.1 and classified regarding magnitude, designation and groundwater supply potential based on Krasny (1993).

Table 3.1: Classification of Transmissivity Values

[1]Magnitude (m^2/day)	[1]Class	[1]Designation	[1]Groundwater Supply Potential	Transmissivity Values Based on North Well Pumping Tests		
				Pump.	Rec.	Avg.
>1000	I	Very High	Regional Importance			
100 - 1000	II	High	Lesser Regional Importance			
10 - 100	III	Intermediate	Local Water Supply	82.4	65.9	74.2
1 - 10	IV	Low	Private Consumption			
0.1 - 1	V	Very Low	Limited Consumption			
<0.1	VI	Imperceptible	Very difficult to Utilize for Water Supply			

[1]Kransy (1993) 'Classification of Transmissivity Magnitude and Variation", Vol.31, No.2 - Ground Water

Based on the above, the existing pumped well at the site is indicated to be capable of providing an adequate quantity related to a supply potential of local water supply. It is pointed out that a groundwater supply potential of “Private Consumption” is associated with a water supply well adequate for dwellings.

3.3 WELL INTERFERENCE EFFECTS

During the pumping of the north well periodic water level measurements were made at the south well located some 17 metres south of the north well. The graph of the observation of the south well drawdown versus time during the pumping test at the north well is shown in the attached Appendix C.

In order to estimate the maximum interference of the north and south wells at the site, calculations were carried out to predict the cumulative thirty-year drawdown due to the proposed semi-detached dwelling domestic use of the wells at the site (for the purposes of this calculation the north well is considered to be the centrally located well at the site/site area). The existing site area/neighbouring wells indicated in the above Table 2.2 were also included in the cumulative thirty-year drawdown calculation. Further, wells servicing the properties adjacent to and opposite the subject site (if not already included in Table 2.2) were also included in the cumulative thirty-year drawdown calculation. The cumulative drawdown at the wells was calculated for a thirty-year pumping rate of

3150 litres per day, which allows for six bedroom households in accordance with Section 4.3.2 of MOE Procedure D-5-5.

The calculation was carried out using the following Cooper-Jacob formula:

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

Where, Q = 30 year pumping rate, 3150L/day

T = lowest transmissivity from north well pumping test, 65.9 m^2/day

t = duration, 30 years

S = storativity estimate from north well pumping test, 2.3 x 10^{-2}

s = expected drawdown from use of site wells and site area/neighbouring wells

The results of the calculations indicate that the cumulative thirty-year drawdown at the north well, including the interference from the south well and the other 18 site area/neighbouring wells included in the calculations is about 0.8 metres (see attached Table V). It is pointed out that it is considered, in Morey Associates Ltd. professional opinion, that the actual cumulative thirty-year drawdown at the centrally located well could be more accurately estimated by the use of the average transmissivity value determined from the pumping test and the use of a more likely daily pumping rate given today's more efficient plumbing. However, for the purpose of this present report and for a conservative approach the cumulative thirty-year drawdown at the north well was estimated using the lowest transmissivity value determined during the pumping test and a daily pumping rate of 3150 litres.

Based on the above mentioned conservative thirty-year drawdown calculation, the expected drawdown was found to be about 0.8 metres at the north well which results in the reduction of available drawdown at the north well of about 5 percent. Applying this drawdown value to the south well and the existing site area/neighbouring wells indicated on Table 2.2 for which available drawdown information is known would result in the reduction of available drawdown at those existing wells of between about 2 percent to 4 percent.

The above estimated drawdown values provide a fair assurance of adequate long term water supply for the proposed semi-detached dwelling based on current site conditions. Further, as

indicated above it is considered that the above estimated drawdown values are conservative and the actual cumulative drawdown values should be less and interference with existing neighbouring wells should not result in significant reduction of available well drawdown for the proposed semi-detached dwelling as well as the above mentioned existing nearby site area/neighbouring wells.

4.0 WELL WATER QUALITY

4.1 ON-SITE WELLS WATER SAMPLES

In order to characterize the groundwater quality of the groundwater supply, a groundwater sample was collected from both the north well and south well by a member of our engineering staff on April 20, 2021. The north well was sampled at about hour 6 of the above mentioned pumping test. The south well was sampled after pumping the south well for about one hour at a rate of some 68 litres per minute (15 Igpm). The groundwater samples were collected and prepared/preserved in the field using appropriate techniques and submitted to Eurofins Environment Testing laboratory in Ottawa, Ontario for the chemical, physical and bacteriological analyses listed in the MOE guideline entitled Procedure D-5-5, Technical Guideline for Private Wells: Water Supply Assessment, August 1996 ("MOE Subdivision Package" list of parameters). The temperature, conductivity, pH, TDS, turbidity and residual chlorine levels of the groundwater were measured just prior to sampling at both wells and at other periodic intervals during the pumping test at the north well.

The results of the above mentioned laboratory testing and field testing are provided in Table 4.1 below and in the attached Table I, respectively.

Table 4.1: On-Site Well Water Samples Laboratory Testing Results

				Test Well	
Parameter	**MRL**	**Units**	**[1]Guideline**	**North Well Sample**	**South Well Sample**
Hardness as CaCO3	1	mg/L	OG-100, [3]500	***373***	***375***
Ion Balance	0.01			1.05	1.03
TDS (COND - CALC)	1	mg/L	AO-500	***580***	***600***
Alkalinity as CaCO3	5	mg/L	OG-30 - 500	259	269
Cl	1	mg/L	AO-250	136	132
Colour	2	TCU	AO-5	<2	2
Conductivity	5	uS/cm		1000	1010
DOC	0.5	mg/L	AO-5	0.7	0.8
F	0.10	mg/L	MAC-1.5	0.40	0.36
N-NO2	0.10	mg/L	MAC-1.0	<0.10	<0.10
N-NO3	0.10	mg/L	MAC-10.0	<0.10	<0.10
pH	1.00		OG-6.5 - 8.5	8.14	8.12
SO4	1	mg/L	AO-500	43	45
Ca	1	mg/L		90	91
Fe	0.03	mg/L	AO-0.3	0.29	0.30
K	1	mg/L		4	4
Mg	1	mg/L		36	36
Mn	0.01	mg/L	AO-0.05	0.03	0.03
Na	2	mg/L	AO-200, [2]A-20	65	64
TKN	0.1	mg/L		0.287	0.490
Phenols	0.001	mg/L		<0.001	<0.001
N-NH3	0.01	mg/L		0.045	0.033
S2-	0.02	mg/L	AO-0.05	<0.01	<0.01
Tannin & Lignin	0.1	mg/L		<0.1	<0.1
Turbidity	0.1	NTU	AO-5.0	1.2	1.5
Heterotrophic Plate Count	0	ct/1mL		5	7
E.Coli	0	ct/100mL	MAC-0	0	0
Faecal Coliforms	0	ct/100mL		0	0
Total Coliforms	0	ct/100mL	MAC-0	0	0
[4]Organic Nitrogen		mg/L	OG-0.15	***0.242***	***0.457***

[1] Guideline = Ontario Drinking Water Standards Objectives and Guidelines

[2] Table 2, Appendix, MOECC Guideline `D-5-5 Private Wells: Water Supply Assessment` document

[3] "Hardness in excess of 500mg/L in drinking water is unacceptable for most domestic purposes" - Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines, Revised June 2006, Province of Ontario.

[4] Organic Nitrogen = Total Kjeldahl Nitrogen - N-NH3

MRL = Method Reporting Limit
AO = MOE Aesthetic Objective
OG = MOE Operational Guideline
MAC = MOE Max. Acceptable Concentration
A = MOE Advisory Limit (See Note 2)

The well water samples meet all the Ontario Drinking Water Standards, Objectives and Guidelines (ODWSOG) health and aesthetic parameters tested for except for hardness, total dissolved solids (TDS) and for organic nitrogen.

The water samples obtained from the existing on-site wells are considered to be hard by water treatment standards with a hardness level above the ODWSOG operational guideline of 80 to 100 mg/L. The hardness at the north well and south well was measured at 373 and 375 mg/L, respectively. However, based on the Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines, Revised June 2006, the hardness levels of the water samples are less than what is considered unacceptable (greater than 500 mg/L) for most domestic purposes and is considered treatable. Water with hardness above 80 to 100 mg/L as $CaC0_3$ is often softened for domestic use. Water softening by conventional sodium ion exchange may introduce relatively high concentrations of sodium into the drinking water, which may contribute a significant percentage to the daily sodium intake for a consumer on a sodium restricted diet. Where ion exchange water softeners are used, a separate unsoftened water supply could be used for drinking and culinary purposes.

The levels of TDS measured for the samples obtained from the north well and south well were 580 and 600 mg/L respectively, which are above the ODWS aesthetic objective of 500 mg/L. The results of Langelier Saturation Index (LSI) calculations (see attached Table III) for the water samples gave LSI values of about 0.94 and can be interpreted (based on Carrier 1965) to indicate potential for the groundwater to be scale-forming but non-corrosive (LSI 0.5 to 2.0). The results of Ryznar Stability Index (RSI) calculations for the water samples gave RSI values of about 5.8 and indicate potential for the groundwater to form light scale.

Organic nitrogen concentration is calculated as the difference between Total Kjeldahl Nitrogen (TKN) and ammonia. The concentration of organic nitrogen for the north well and south well water samples is calculated as about 0.24 and 0.46 mg/L, respectively. The ODWSOG operational guideline for organic nitrogen is 0.15 mg/L and relates to the potential severe reduction for chlorine as a disinfectant. Organic nitrogen may also result in taste and odour problems with levels greater than 0.15 mg/L. Based on the results of bacteriological testing of the above mentioned well water samples it is considered that continuous/permanent disinfectant treatment systems using chlorine for the well water at the proposed semi-detached dwelling is not likely. As such, it is considered that the presence of organic nitrogen slightly above the ODWSOG operational guideline in the well water sample is not a concern from an operational point of view.

It is pointed out that the levels of sodium for the north well and south well water samples were measured at 65 and 64 mg/L, respectively, which is below the ODWSOG aesthetic objective of 200 mg/L. However, according to the MOE the local Medical Office of Health should be notified where sodium levels are above 20 milligrams per litre in order that this information may be relayed to local physicians. Accordingly, the levels of sodium for the well water samples obtained from the existing on-site wells may be of interest to persons on a sodium restricted diet.

4.2 IMPACTS TO WELL WATER QUALITY

The above mentioned previous studies carried out by Thompson (1985) and the MOE (2020) indicate that the water quality of a relatively large number of drinking water wells in the general site area (Spencerville) have been impacted by existing private sewage systems in Spencerville. The MOE 2020 study report indicates elevated levels of total coliform, E.Coli and nitrate measured for samples obtained from drinking water wells.

A combination of elevated levels of E.Coli, total coliform, faecal coliform, nitrate, nitrite and organic nitrogen are commonly associated with septic system effluent impacting drinking water wells. The results of the above mentioned laboratory testing indicate 0 ct/100mL for E.Coli, total coliform and faecal coliform and less than the method reporting limit for nitrate and nitrate for both the north and south wells. As mentioned above the organic nitrogen levels for the north and south wells are calculated as about 0.24 and 0.46 mg/L, respectively.

Based on the above and considering that organic nitrogen is the only above mentioned parameter somewhat elevated, the laboratory testing results of the well water samples obtained from the north and south wells at the site indicate that the north and south wells at the site have not been impacted by existing septic system effluent.

The above mentioned previous studies carried out by Thompson (1985) and the MOE (2020) also indicate that due to the geological setting (shallow discontinuous overburden and weathered/fractured upper bedrock unit) in the general site area, wells are vulnerable to surface impacts.

The overburden encountered by the well driller at the subject site wells is indicated to be 1.4 metres thick and consists of clay and stones, as per the MOE well records. No exposed bedrock was observed at the site and the cement and bentonite slurry grout indicated on the MOE well records for the north and south wells was observed at the ground surface around the well casings by members of our engineering staff at the time of the field work. Notwithstanding the above, and due to the above mentioned well vulnerability and groundwater impacts indicated by Thompson (1985) and the MOE (2020), recommendations to encourage safe domestic well usage for the future residents of the proposed semi-detached dwelling is provided in Section 5 of this report.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY AND CONCLUSIONS

Based on the groundwater supply investigation carried out for the subject site, the following summary and conclusions are provided by Morey Associates Ltd. and are based on our professional opinion and our interpretation of the relevant sections of the MOE Procedure D-5-5 guideline document:

1) There is a sufficient groundwater supply of acceptable drinking water quality in the bedrock aquifer system to satisfy the water requirements of the proposed semi-detached dwelling at the site.

2) The groundwater quality in the aquifer system at the existing wells at the site meets all the ODWSOG concentrations for all health related chemical, physical and bacteriological parameters tested, except for hardness, TDS and organic nitrogen. The level of hardness measured at the wells is well within the acceptable range that is considered reasonably treatable. Water softeners and manganese greensand filters are indicated to be adequate to lower hardness to acceptable levels, respectively. In relation to the measured TDS levels, the results of LSI and RSI calculations for the water samples from the existing wells at the site indicate there is a potential for scale to form on plumbing fixtures. The levels of organic nitrogen measured at the existing wells at the site were above the ODWSOG operational guideline concentration. However, based on the results of bacteriological testing of the well water samples it is considered that need for continuous/permanent disinfectant treatment

systems using chlorine for the well water at the proposed semi-detached dwelling is not likely. As such, it is considered that the presence of organic nitrogen above the ODWSOG operational guideline in the well water samples is not a concern from an operational point of view.

3) The levels of sodium for the water samples obtained from the existing on site wells may be of interest to persons on a sodium restricted diet (see report Section 4.1).

5.2 RECOMMENDATIONS

Morey Associates Ltd. provides the following recommendations regarding the existing groundwater supply well at the site:

1) The final landscaping at the site should be graded such that surface water (including any eavestrough downspout discharge and sumpline discharge) is not directed to or ponds around the existing well heads and such that the well casing heights extend not less than 0.4 metres above the ground surface.

2) In order to encourage domestic supply well education and best management practices future residents at the site should be made aware of and refer to the province of Ontario web-doc publication: ontario.ca/document/water-supply-wells-requirements-and-best-practices

3) Future residents at the site should be made aware that it is considered prudent to adhere to the regulatory well maintenance requirements, general maintenance for well owners (Table 11-1: Well Maintenance Checklist Items), and well water quality laboratory testing outlined in the above mentioned province of Ontario web-doc publication.

4) Future residents at the site should be made aware that the use of a water softener for treatment of hardness may be desired based on the results of the water quality testing carried out for this present hydrogeological study.

5) Future residents at the site should be made aware that the use of conventional sodium ion exchange water softeners may introduce relatively high concentrations of sodium into the

drinking water, which may contribute a significant percentage to the daily sodium intake for a consumer on a sodium restricted diet. Where ion exchange water softeners are used, a separate unsoftened water supply could be used for drinking and culinary purposes.

6) Future residents at the site should be made aware that water wells should be adequately disinfected by chlorination prior to use for the proposed semi-detached dwelling at the site.

7) Future residents at the site should be made aware that Langelier Saturation Index (LSI) and Ryznar Stability Index (RSI) calculations for water samples obtained from the existing wells at the site can be interpreted to indicate potential for the groundwater to cause scale to form on plumbing fixtures.

6.0 LIMITATIONS AND USE OF REPORT

This report was prepared for the exclusive use of Lockwood Brothers Construction. This report may not be relied upon by any other person or entity without the express written consent of Lockwood Brothers Construction and Morey Associates Ltd.

This report documents work that was carried out with generally accepted professional standards at the time and location in which the services were provided and in a manner consistent with a level of care and skill normally exercised by other professional engineering and geoscientist firms practicing under similar conditions and subject to the time limits and financial and physical constraints applicable to the services.

Any third party use of this report, including reliance of this report and/or decisions made based on this report, is the sole responsibility of the third party. Morey Associates Ltd. accepts no responsibility for damages, whether direct or indirect, suffered by any third party as a result of any third party use of this report.

The conclusions provided herein represent an opinion of Morey Associates Ltd. as of the time of preparation of this report. It is recognized that the passage of time affects the information provided in this report. This report should not be construed as legal advice, nothing in this report is intended to provide a legal opinion. If new information is discovered during future work, including

excavations, borings or other studies, Morey Associates Ltd. should be requested to re-evaluate the conclusions presented in this report and provide amendments as required.

7.0 SIGNATURES

We trust that this report is sufficient for your present requirements. If you have any questions concerning this report, please do not hesitate to contact our office.

Yours truly,
Morey Associates Ltd.

D. G. Morey, P.Eng.
Director/Civil Engineer

C. R. Morey, M.Sc. (Eng.), P. Eng.
Senior Consulting Engineer

8.0 REFERENCES

Province of Ontario: The Surficial Geology of Southern Ontario data set: Ontario Geological Survey, Miscellaneous Release 2010

Ontario Ministry of the Environment, Conservation and Parks: Procedure D-5-5: Technical Guideline for Private Wells: Water Supply Assessment, August 1996

Ontario Ministry of the Environment, Conservation and Parks: On line map-based water well records search website

Ontario Ministry of the Environment, Conservation and Parks: Technical Report, Potable Well Water Quality Survey, Village of Spencerville, November 2020

Thompson, M.S. and Associates Ltd. In association with Water and Earth Science Associates Ltd.: Private Services Grant Program, Police Village of Spencerville, Township of Edwardsburgh, Ministry of the Environment Project Number 8-0082, 4-0094, March 1985.

Kransy: Classification of Transmissivity Magnitude and Variation, Vol.31, No.2 - Ground Water, dated 1993

Province of Ontario: Web-doc publication – Water Supply Wells: Requirements and Best Practices, revised April 2015

Province of Ontario: Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines, revised June 2006