Nitrate Impact Assessment

1231 Maple Manor Road
Township of North Dumfries, Ontario

Project 10397

1. INTRODUCTION

Hydrogeology Consulting Services Inc. (HCS) was retained by GRIT Engineering Inc. to conduct a nitrate impact assessment for a proposed two-lot residential severance plus one retained lot at 1231 Maple Manor Road in the Township of North Dunfries, Ontario.

The location of the subject property is shown on Drawing 1 in Appendix A.

This assessment has been prepared based on the Consent Application comments dated July 2024, and the understanding the previously-existing lots being contemplated do not require a Scoped Hydrogeological Study to support them.

2. STUDY AREA PHYSIOGRAPHY AND GEOLOGY

Site Description

2.1 As shown on the appended Drawing 2 the existing 9.5 hectare property is proposed to be severed into two lots (0.339 and 0.357 hectares) with one retained 8.8 hectare lot including the existing single-family dwelling.

As shown on the appended Drawing 1, the property consists of a single-family residential property bordered by rural residential lots to the west, north, and east with an agricultural field to the south. In the southern portion of the property the large agricultural field is bordered by Alder Creek and its associated wetlands to the south, by forested and open areas to the west, and by forested areas to the east. Further afield are a rural estate subdivision to the north, rural residential properties and agricultural fields to the west, forested areas and wetlands associated with Alder Creek to the south at the base of an embankment beyond the southern limits of the proposed lots, and rural residential lots along with forested areas and wetlands associated with Alder Creek to the east.

2.2 The ground surface topography of the subject property is generally level in the area of the proposed lots with an elevation of approximately 295 mASL. In the southern portion of the property an embankment down to Alder Creek and its associated wetlands exhibits a change in elevation from approximately 295 mASL to 270 mASL.

Physiography

The subject property lies within the Spillways physiographic landform (Chapman and Putnam, 2007), typically consisting of glacial meltwater channels formed by massive flows of water, creating deep broad valleys in the glacial deposits associated with the Grand River. The property lies within the Horseshoe Moraines physiographic region.

Geology and Hydrogeology

Quaternary Geology mapping (Ontario Geological Survey, 2003) indicates the subject property is underlain by stone-poor sandy silt to silty sand textured till, with nearby deposits of glaciofluvial gravels and organic deposits associated with the Grand River's historical flowpath.

2.3

The soil grain size analyses from the subject property (GRIT Engineering Inc., May 2025) included in Appendix C illustrates the generally gravelly silty sand (till) nature of the near surface soils.

Based on the nearby well records from the MECP Water Well Records (WWR) online database included in Appendix B overburden deposits are approximately 45 m thick, generally consisting of vertically extensive deposits of clayey till deposits. In some locations a granular water bearing deposit is reported at depths of approximately 30 mBGS. Limestone bedrock was encountered at a depth of approximately 45 mBGS.

Paleozoic geology mapping of Southern Ontario (Armstrong and Dodge, 2007) indicates underlying the overburden deposits is the Guelph Formation dolostone bedrock.

3. PREDICTIVE NITRATE IMPACT ASSESSMENT

The proposed lots will be privately serviced for water supply and privately serviced for sewage disposal. The proposed single-family residential sewage systems will discharge effluent to the subsurface via leaching beds. The leaching beds will load residential waste nutrients to the subsurface, and eventually the overburden groundwater system(s) within the granular deposits beneath the clay deposit that serves as a (partial) aquitard. The principal components of the sewage effluent will be nitrate (as nitrogen), ammonia, and phosphorus (total). As ammonia is normally aerobically converted to nitrate in the unsaturated zone, and phosphorus typically reacts with and attaches to soil particles, nitrate is the primary nutrient parameter that percolates downwards to the water table and can impact groundwater. Nitrate can persist in groundwater; however, under anaerobic conditions it is typically converted to nitrogen gas by bacteria in the process of denitrification.

Assessment of the potential impact of a subsurface sewage disposal system is performed based on nitrate loading of the shallow groundwater aquifer, as excessive amounts of nitrate can impact both drinking water (particularly for infants) and surface water (due to eutrophication and plant growth).

The Ontario Drinking Water Quality Standard (ODWQS) for Nitrate-N is 10 mg/L, and this is the criteria applied to the predictive nitrate impact assessment.

The Ontario Ministry of the Environment and Climate Change (MOECC, now MECP) Technical Guideline for Individual On-Site Sewage Systems Procedure D-5-4 (1996) provides a method for assessing the impact of nitrate-nitrogen from residential sewage systems.

The Ontario Ministry of the Environment and Climate Change (MOECC, now MECP) Technical Guideline for Individual On-Site Sewage Systems Procedure D-5-4 (1996) is applied as follows:

$$C_{PB} = \frac{(SEF \times C_{SEF}) + (GR \times C_{GR}) + (GUF \times C_{GUF})}{(SEF + GR + GUF)}$$

Variables:

C_{PB} = Nitrate concentration in groundwater at the down-gradient property boundary (mg/L as nitrate-N)

SEF = Sewage effluent flow (m^3/yr)

An annual sanitary sewage flow of 2,000 L/day[1] has been applied to these calculations.

Lot 1

= 2,000 L/day x 365 days

= 730,000 L/yr

Lot 2

= 2,000 L/day x 365 days

= 730,000 L/yr

C_{SEF} = Nitrate concentration of sewage effluent (mg/L)

Sewage effluent nitrate concentration of 40 mg/L for a conventional treatment system, 20 mg/L for a Level IV (tertiary) treatment system, and 12 mg/L for an enhanced Level IV (enhanced tertiary) treatment system.

[1] Sewage flow volume for a 4-bedroom home per the Ontario Building Code (OBC).

GR = Groundwater recharge from infiltrating precipitation (m^3/yr)

Groundwater Recharge = Infiltration Rate[2] x Site Area[3]

Lot	Infiltration Rate m/yr	Site Area m^2	Groundwater Recharge m^3/yr	Groundwater Recharge L/yr
1	0.150	3,390	508.5	508,500
2	0.150	3,570	535.5	535,500

It is noted the entire site area is normally applied to the groundwater recharge calculation. Conceptually, when site-level water balance calculations using the Thornthwaite-Mather method are prepared for a property with no municipal storm sewer connection, runoff from impervious surfaces such as rooftops and driveways is assumed to flow onto adjacent pervious surfaces where, apart from significant rainfall events where the ground becomes completely saturated, it is reasonable to assume it has the opportunity to infiltrate into the ground at the same rate as precipitation falling directly on the pervious surfaces. Site-level water balance calculations prepared by HCS for properties throughout Southern Ontario with no connection to municipal storm sewers have consistently shown an infiltration surplus under post-development conditions based on this methodology – these calculations have been consistently approved by a wide variety of Conservation Authorities and municipalities. Based on this information it is concluded the application of 100% of site area to the groundwater recharge calculation is typically reasonable and appropriate for a property with no connection to municipal storm sewers. It is noted the nitrate impact assessment calculations do not assume the typical surplus of groundwater recharge under post-development conditions as a conservative factor of safety.

C_{GR} = Nitrate concentration of groundwater recharge (mg/L)

0.1 mg/L Nitrate concentration assumed for infiltrating precipitation.

[2] Infiltration rate from MOEE Hydrogeological Technical Information Requirements for Land Development Application (1995) Section 4.5 Table 3, assuming a general sandy silt soil type across the property.

[3] Site Area is taken as the total lot area, based on methodology outlined in MOEE Procedure D-5-4: Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment

Based on the variables described above, predictive nitrate impact calculation results for the various treatment system types are summarized in Table I below.

Table I: Nitrate Impact Assessment Calculated Results

	Sewage Effluent Concentration (mg/L)	Total Annual Sewage volume (L/yr)	Nitrate-N Concentration at Downgradient Property Boundary (mg/L)
0.339 ha lot	40	730,000	**23.6**
	20	730,000	**11.8**
	12	730,000	**7.1**
0.357 ha lot	40	730,000	**23.1**
	20	730,000	**11.6**
	12	730,000	**7.0**

The nitrate impact assessment calculations, which include a conservative annual precipitation recharge for the subsurface silty sand (till) deposits, show using conventional treatment systems or tertiary (Level IV) treatment systems for the proposed lot severances would result in nitrate-N concentrations at the downgradient lot boundaries exceeding the ODWQS criteria limit of 10 mg/L.

As an example, empirical test results provided by Waterloo Biofilter for CAN-BNQ 3680-600 testing of their Water NOx system demonstrated a six month average total nitrogen effluent concentration of 11.9 mg/L, an average nitrate + nitrite concentration of 3.4 mg/L, and an average total nitrogen reduction rate of 80.3%. It is reasonable to conclude enhanced tertiary treatment systems can achieve the required nitrate reduction.

Using enhanced tertiary treatment systems for the proposed lots would result in nitrate-N concentrations at the downgradient lot boundary below the ODWQS criteria limit of 10 mg/L.

Assessment of Nitrate Impact Calculations

To minimize the potential for impacts to the shallow overburden soils and overburden aquifers, enhanced tertiary treatment of sewage effluent with a maximum design effluent concentration of 12 mg/L for nitrate-N should be used for the sewage effluent disposal system for the proposed lot severance.

3.1

It is important to note that these calculations have conservatively assumed no dilution effects from groundwater underflow. Conceptually, when sewage effluent percolating vertically downwards through the unsaturated zone reaches the groundwater table, mixing of the sewage effluent with groundwater having a Nitrate-N concentration lower than the sewage effluent would result in dilution of the sewage effluent by the groundwater, and therefore result in a lower Nitrate-N concentration than if the sewage were only diluted by infiltrating precipitation.

3.1.1 Nitrate Impact Assessment and On-Site/Downgradient Water Supply Wells

As described previously in Section 2.3 the subsurface stratigraphy beneath the subject property generally consists of approximately 30 m of generally clay-rich overburden deposits overlying a granular aquifer deposit (where present), and approximately 45 m in total of generally clay-rich overburden deposits overlying limestone bedrock. The low permeability overburden would be expected to act as an aquitard to hydraulically isolate the deeper water-bearing overburden aquifer and the bedrock aquifer from the ground surface.

It is reasonable to conclude the proposed two-lot development of the subject property and the future new sewage effluent disposal systems would not be expected to impact future on-site water supply wells or existing downgradient water supply wells. The use of enhanced tertiary treatment systems with significantly lower effluent concentrations (i.e. 12 mg/L Nitrate-N) compared to existing conventional treatment systems operating on existing properties will provide a net benefit to the natural environment.

3.1.2 Nitrate Impact Assessment and Surface Water Features

The closest surface water features are a small pond and wetlands associated with Alder Creek at the southern limits of the property, more than 260 m from the proposed lot severances.

With the nitrate impact assessment calculations above showing Nitrate-N concentrations less than 10 mg/L at the downgradient property boundary with the use of enhanced tertiary sewage effluent treatment systems, it is reasonable to conclude further dilution and attenuation of any sewage effluent that may flow beyond the downgradient property boundary will occur between the property boundary and any downgradient surface water features. As a result, it is concluded no material impacts to the pond and wetlands associated with Alder Creek or other surface water features would be expected by the proposed development of the property.

4. ASSESSMENT OF POTENTIAL IMPACTS

Policy Areas

4.1 Grand River Conservation Authority (GRCA) mapping shows the nearest surface water features are a pond and wetlands associated with Alder Creek, more than 260 m south of the proposed lot severances, with GRCA regulated areas and MNRF regulated areas associated with Alder Creek and its wetlands. The property is not located within a Greenbelt and is not located within an Area of Natural and Scientific Interest (ANSI).

Municipal Wellhead Protection Areas

4.2 Ontario Source Protection Information Atlas (OSPIA) mapping included on the appended Drawing 3 shows that the property is not located within a municipal Wellhead Protection Area (WHPA) and is not located within an Intake Protection Zone.

The closest WHPA is located approximately 1.5 km north of the subject property.

Private Water Supply Wells

4.3 Well Records from the Ontario Ministry of the Environment, Conservation, and Parks (MECP) Water Well Record (WWR) Database were reviewed to determine the number of private water supply wells present. As shown on the well records in Appendix B, forty-eight wells are located within an approximate radius of 500 m from the subject property according to the MECP WWR Database. Of these wells three are abandonment records and three have no completion details. These wells have been excluded from further discussion.

Of the remaining forty-two wells, all are identified as domestic wells. Twenty-one are completed in overburden deposits at depths ranging from 26.5 to 40.5 m, and twenty-one are completed in bedrock at depths ranging from 30.5 to 79.6 mBGS.

With all private water supply wells completed at depths of 26.5 mBGS or more, and with vertically extensive low-permeability till deposits hydraulically isolating both the deep overburden and bedrock aquifers from the near-surface where sewage effluent will be discharged, it is reasonable to conclude private water supply wells in the area would not be expected to be impacted by the proposed development.

Sensitive Features

OSPIA mapping indicates the property lies within a significant groundwater recharge area (SGRA), but does not lie within a Highly Vulnerable Aquifer (HVA).

4.4 The significant groundwater recharge area designation refers to the ability for precipitation to infiltrate into the ground and recharge underlying aquifers. Based on the on-site soil grainsize analyses indicating relatively low permeability till near-surface deposits it is possible the regional-scale mapping does not consider the site-level subsurface conditions.

The proposed single-family residential developments will discharge precipitation from rooftops onto the ground surface where it will have the opportunity to infiltration; therefore, it is reasonable to anticipate the residential use of the proposed lots will not significantly impact the ability of precipitation to infiltrate into the ground.

5. CLOSURE

The nitrate impact assessment compiled data for the subject property from existing sources and site-level soil samples to gain an understanding of the subsurface statigraphy.

Nitrate impact assessment calculations using conservatively assessed values for daily sewage effluent flow and annual recharge demonstrate that the two proposed lots will require the use of enhanced tertiary treatment with an effluent nitrate-N concentration of 12 mg/L or less to support the sewage effluent disposal systems in order to achieve nitrate-N concentrations at the downgradient property boundary below the ODWQS criteria limit of 10 mg/L.

Please consider that changes to sewage system design parameters would require updated nitrate impact assessment calculations.

We trust that this report satisfies your present requirements, and we thank you for this opportunity to be of service. If you have any questions, or require further hydrogeological consulting services, please feel free to contact me directly.

Respectfully submitted,

PROFESSIONAL GEOSCIENTIST
27-May-2025
CHRIS HELMER
PRACTICING MEMBER
2285
ONTARIO

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Senior Hydrogeologist
MECP Licensed Well Contractor
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6. LIMITATIONS AND USE

This report has been prepared for the exclusive use of the Client indicated in Section 1. Chris F Helmer and Hydrogeology Consulting Services Inc. (HCS) hereby disclaim any liability or responsibility to any person or party, other than the Client, for any loss, damage, expense, fines, or penalties which may arise from the use of any information or recommendations contained in this report by anyone other than the Client.

The conclusions and recommendations provided in this report are not intended as specifications or instructions to contractors. Any use contractors may make of this report, or decisions made based on it, are the responsibility of the contractors. Contractors must accept responsibility for means and methods of construction they select, seek additional information if required, and draw their own conclusions as to how the subsurface conditions may affect them.

In preparing this report Chris F Helmer ad HCS have relied in good faith on information provided by individuals and companies noted in this report, and assumes that the information provided is factual and accurate. No responsibility is accepted for any deficiencies, misstatements, or inaccuracies contained in this report as a result of errors, omissions, misinterpretations, or fraudulent acts in the resources referenced, or of persons interviewed or consulted during the preparation of this report.

The report and its complete contents are based on data and information collected during investigations conducted by Chris F Helmer and HCS, and pertains solely to the conditions of the site at the time of the investigation, supplemented by historical information and data as described in this report. It is important to note that the investigation involves sampling of the site at specific locations, and the conclusions in this report are based on the information gathered. Limitations of the data and information include the fact that conditions between and beyond the sampling locations may vary; that the assessment is dependent upon the accuracy of the analytical data generated through sample analysis; and that conditions or contaminants may exist for which no analyses have been conducted. Furthermore, no assurance is made regarding potential changes in site conditions and/or the regulatory regime (standards, guidelines, etc.), subsequent to the time of investigation.

The professional services provided for this project include only the hydrogeological aspects of the subsurface conditions at the site, unless otherwise stated specifically in the report. No other warranty or representation is either expressed or implied, as to the accuracy of the information or recommendations included or intended in this report.

7. REFERENCES

Armstrong, D.K. and Dodge, J.E.P. *Paleozoic Geology Map of Southern Ontario*. Ontario Geological Survey.

Chapman, L.J. and Putnam, D.F. 2007. *Physiography of Southern Ontario*. Ontario Geological Survey.

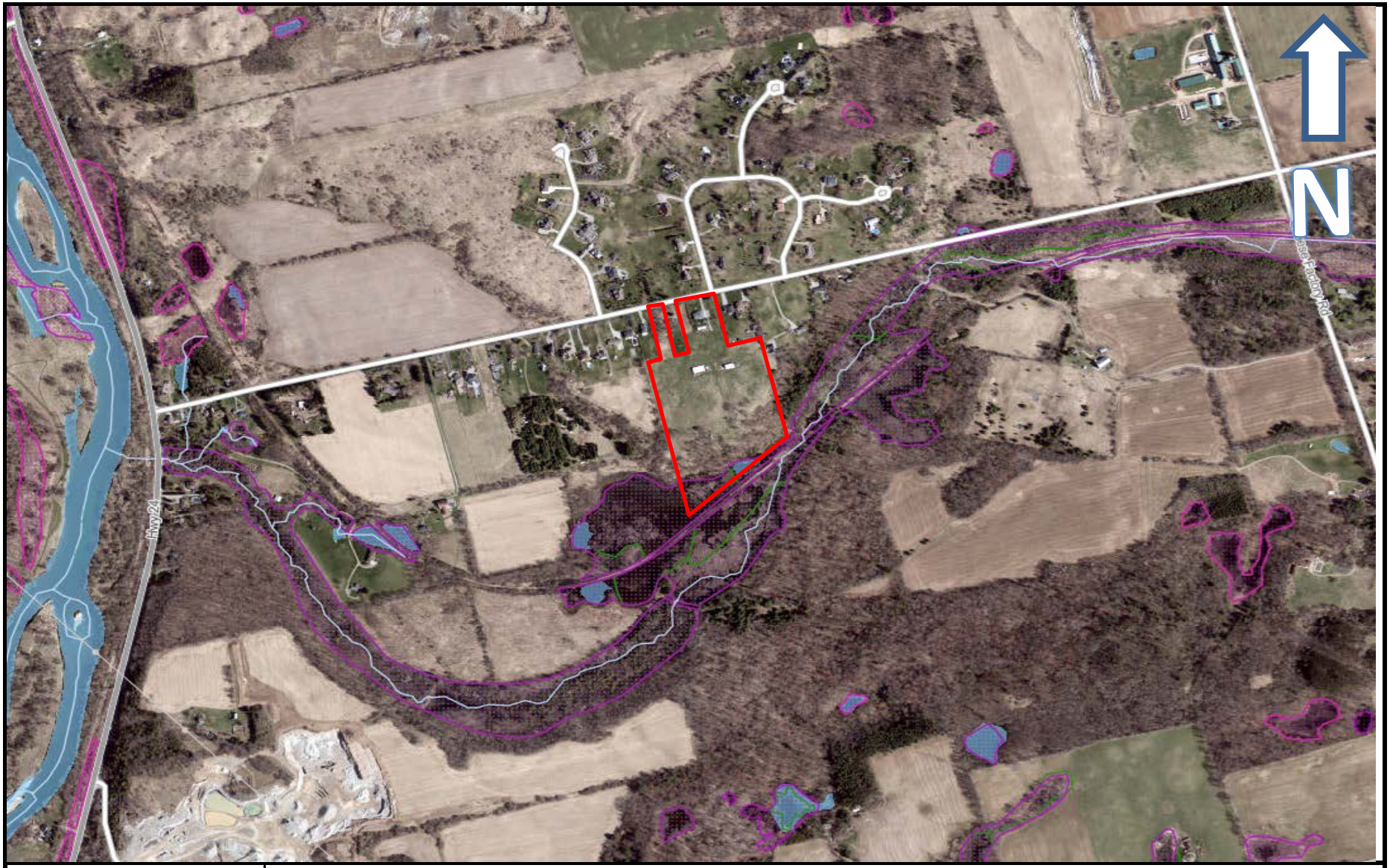
Ontario Geological Survey. 2000. *Quaternary Geology of Southern Ontario*. Online mapping.

Freeze, R.A. and J.A. Cherry. 1979. *Groundwater.* Englewood Cliffs, New Jersey: Prentice-Hall.

Ontario Ministry of the Environment and Energy. 1995. *Hydrogeological Technical Information Requirements for Land Development Applications.*

APPENDIX A: DRAWINGS

Drawing 1 – Location Plan
Drawing 2 – Site Plan
Drawing 3 – OSPIA Mapping



LEGEND

Subject Property

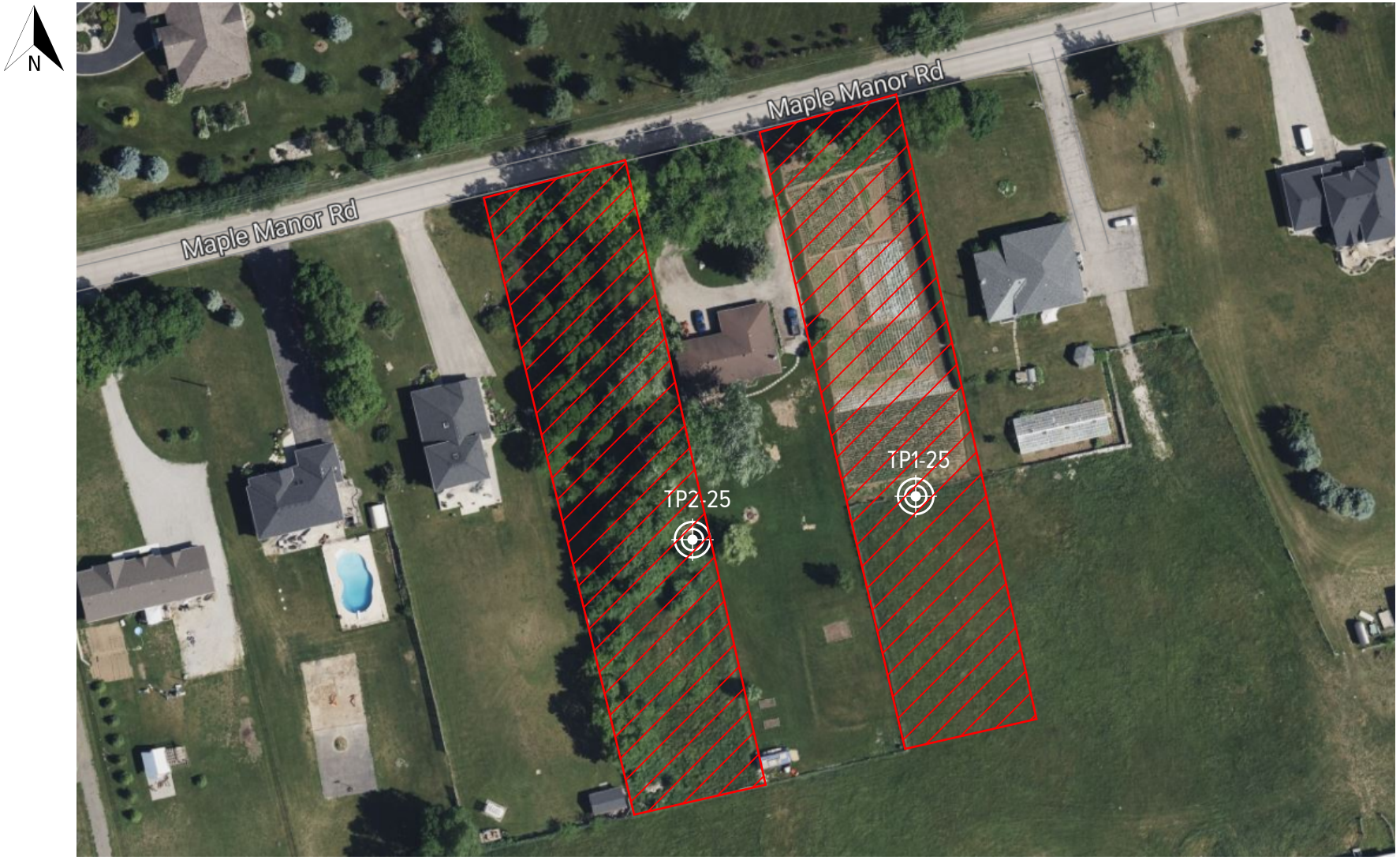
imagery from GRCA © 2025

Drawing 1 - Location Plan and MECP WWRs

1231 Maple Manor Road, Township of North Dumfries

HCS HYDROGEOLOGY CONSULTING SERVICES INC

Drawn:	CFH
Date:	24-May-25



GRIT ENGINEERING INC

133 REGENT STREET
STRATFORD, ON N5A 3W2
www.gritengineering.ca

Legend:

STUDY AREA

TEST PIT

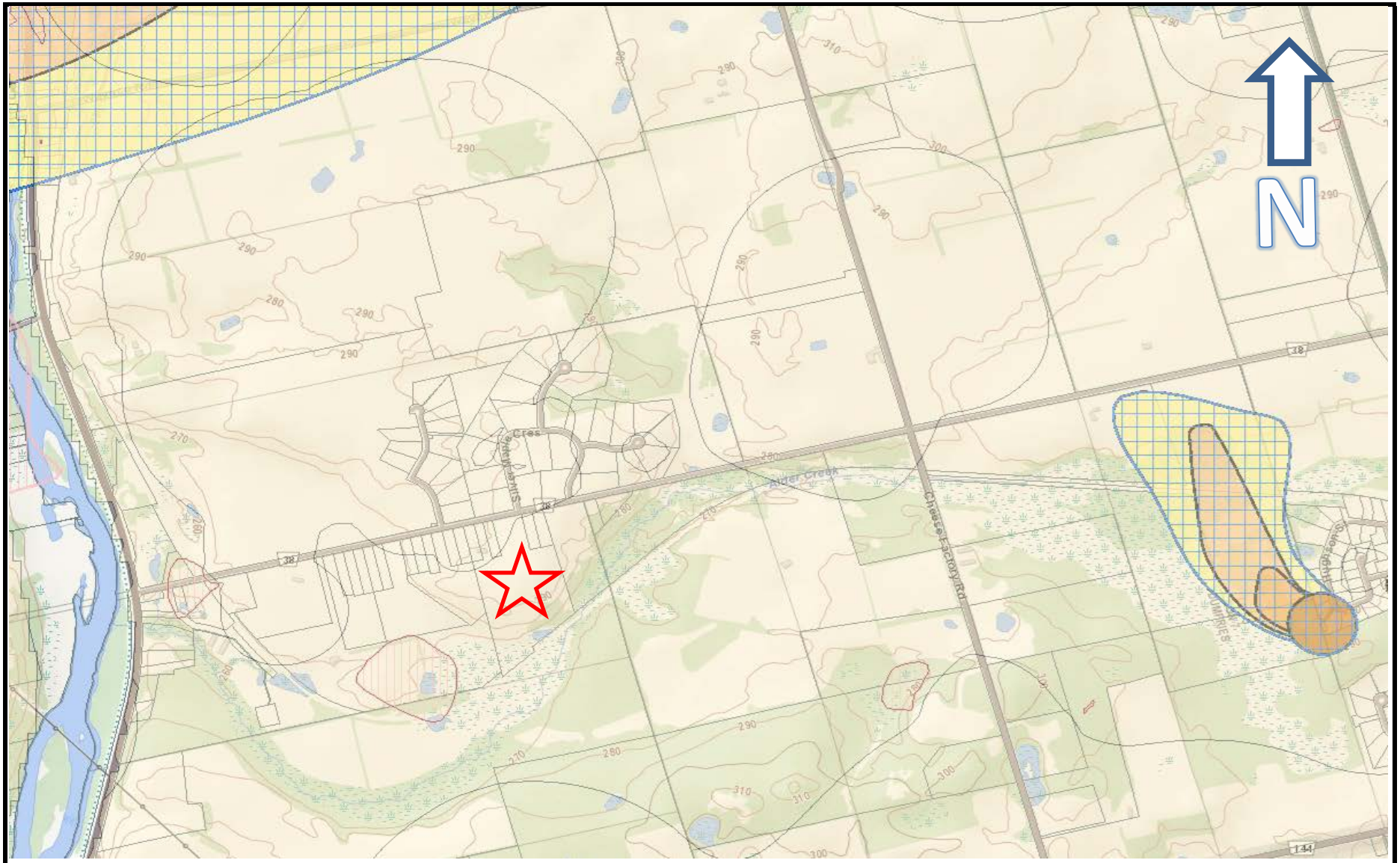
SITE BENCHMARK (BM description)
Elev.=XXX m
Geodetic elevations derived from CANNET NETWORK NAD83 CSRS (2010)

Notes: Not to Scale
Reference: Aerial Imagery from Bing Maps

Project:
GE25-1205-1
NITRATE IMPACT ASSESSMENT
1231 MAPLE MANOR RD TOWNSHIP OF NORTH DUMFRIES, ON

Figure Title:
SITE PLAN
GEOTECHNICAL INVESTIGATION

Figure No: 2



LEGEND

Subject Property

WHPA

HVA

SGRA

imagery from OSPIA © 2025

Drawing 3 - Ontario Source Protection Information Atlas Mapping
1231 Maple Manor Road, Township of North Dumfries

HCS HYDROGEOLOGY CONSULTING SERVICES INC

Drawn:	CFH
Date:	24-May-25

APPENDIX B: MECP WATER WELL RECORDS

Water Well Records

May 27, 2025

4:43:30 PM

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
NORTH DUMFRIES TOWNS	17 556899 4795716 W	2022-09 7557						7435972 (Z388622) A356415 P	
NORTH DUMFRIES TOWNS	17 557371 4795639 W	2020-06 7343	6.25 6.11	FR 0097	73/81/7/6:0	DO	0096 8	7366062 (Z331020) A289368	BLCK LOAM 0001 BRWN SAND 0096 GREY GRVL SAND 0105 GREY CLAY 0107
NORTH DUMFRIES TOWNS	17 556984 4795716 W	2004-06 4207	6.26 5.11	FR 0226	81/95/24/1:0	DO		6509749 (Z08342) A008215	BRWN CLAY STNS GRVL 0030 GREY SAND STNS CLAY 0131 GREY LMSN 0230
NORTH DUMFRIES TOWNS	17 556964 4795554 W	2018-03 6776						7307217 (Z159242) A139020	
NORTH DUMFRIES TOWNS	17 556966 4795615 W	2016-03 7090	6	FR 0134	73/76/25/1:0	DO	0134 12	7261515 (Z230410) A176931	BLCK LOAM LOAM 0001 BRWN CLAY STNS 0005 BRWN SAND GRVL DRY 0126 GREY CSND SAND CMTD 0146 BLUE LMSN 0146
NORTH DUMFRIES TOWNS	17 556655 4795520 W	2010-06 4207	6.25 6.11	UT 0103	46/55/12/:	DO		7152449 (Z113518) A098946	BRWN STNS GRVL CLAY 0045 BRWN FSND SILT 0100 GREY LMSN 0105
NORTH DUMFRIES TOWNS	17 556685 4795525 W	2010-08 4207	6.25 6.11	UT 0103	35/43/10/:	DO		7152431 (Z113523) A098948	BRWN SAND STNS BLDR 0040 GREY SAND SILT GRVL 0095 GREY LMSN 0105
NORTH DUMFRIES TOWNS	17 556659 4795903 W	2022-09 7557						7435974 (Z388623) A356414 P	
NORTH DUMFRIES TOWNS 05 001	17 556825 4795957 W	2006-06 4207	6.26	0143	79/80/11/1:0	DO		6510726 (Z42713) A038273	BRWN CLAY STNS GRVL 0140 GREY LMSN 0143
NORTH DUMFRIES TOWNS 05 001	17 556825 4795916 W	2006-06 4207	6.26	FR 0144	82/82/11/1:0	DO		6510724 (Z42711) A038274	CLAY STNS GRVL 0142 GREY LMSN 0145
NORTH DUMFRIES TOWNS 07 003	17 556832 4795568 W	2006-06 4005	5.98	0122	50/58/12/1:0	DO	0120 5	6510735 (Z37876) A034312	BRWN SAND 0017 GREY GRVL 0050 BRWN SAND GRVL 0062 BRWN CLAY 0120 GREY LMSN 0125
NORTH DUMFRIES TOWNS 08 001	17 556967 4795788 W	2005-11 4207	6.26 5.11	FR 0243	75/78/9/1:0	DO		6510388 (Z31388) A029268	BRWN CLAY GRVL STNS 0132 GREY LMSN 0245
NORTH DUMFRIES TOWNS 08 001	17 556944 4795946 W	2005-08 7154	2.46	0156	74/91/15/2:0	DO		6510221 (Z35585) A030085	BRWN STNS SILT 0044 GREY CLAY STNS 0134 GREY LMSN 0160

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
NORTH DUMFRIES TOWNS 08 002	17 557128 4795844 W	2005-05 2663	6.25	FR 0164	79/96/20/1:	DO		6510099 (Z28940) A017758	BRWN CLAY SAND GRVL 0002 BRWN CLAY STNS 0060 BLDR 0061 BRWN CLAY CLAY STNS 0135 BLDR 0136 BRWN CLAY STNS 0146 GREY LMSN FCRD 0148 GREY LMSN 0164
NORTH DUMFRIES TOWNS 08 002	17 557125 4795838 W	2005-04 2663			71///:			6510100 (Z28941) A	
NORTH DUMFRIES TOWNS CON 07 008	17 557225 4795694 W	1999-05 4207	6.25	FR 0104	93/97/10/1:0	DO		6508656 (201157)	BRWN CLAY STNS BLDR 0101 GREY GRVL 0104
NORTH DUMFRIES TOWNS CON 07 008	17 557457 4795755 W	1988-08 4207	6 6	FR 0165	78/160/100/1:0	DO		6506411 (37239)	BRWN CLAY STNS 0060 GREY GRVL SAND 0100 GREY CLAY SILT SOFT 0160 GREY GRVL CLAY 0164 BLUE LMSN 0165
NORTH DUMFRIES TOWNS CON 07 008	17 557411 4795735 W	1988-08 4207	6 6	FR 0174	80/175/75/1:0	DO		6506412 (37240)	BRWN CLAY STNS 0065 GREY GRVL CLAY 0080 GREY GRVL SAND 0115 GREY CLAY SILT 0166 GREY GRVL CLAY STNS 0170 GREY LMSN 0175
NORTH DUMFRIES TOWNS CON 08 008	17 557442 4795984 W	2004-06 1737	6	FR 0175 FR 0191	86//8/1:0	DO		6509781 (Z11613) A011533	BRWN GRVL 0024 BRWN SAND 0087 BRWN GRVL 0094 GREY TILL 0170 GREY LMSN 0194
NORTH DUMFRIES TOWNS CON 08 008	17 557290 4796020 W	2004-07 4207	6.26	FR 0125	74/75/24/1:0	DO		6509746 (Z08322) A008251	BRWN CLAY STNS GRVL 0023 GREY SILT STNS GRVL 0118 GREY GRVL 0125
NORTH DUMFRIES TOWNS GR E 07 003	17 557144 4795663 W	1969-05 5417	6	FR 0099	89/94/11/1:0	DO		6503040 ()	BRWN MSND GRVL STNS 0100
NORTH DUMFRIES TOWNS GR E 07 003	17 556724 4795523 W	1967-01 4208	6 6	FR 0152	80/85/20/1:0	DO		6500691 ()	STNS CLAY MSND 0015 GRVL CLAY MSND 0077 HPAN 0085 FSND 0149 ROCK 0155
NORTH DUMFRIES TOWNS GR E 07 003	17 556714 4795473 W	1972-06 5417	6	FR 0104	38/48/25/1:0	DO		6503669 ()	BRWN SAND GRVL STNS 0040 GREY CLAY SAND 0060 BRWN SAND 0097 GREY LMSN 0105
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NORTH DUMFRIES TOWNS GR E 07 003	17 557370 4795633 W	2020-06 7343				DO		7366061 (Z331021) A	BLCK LOAM 0001 BRWN SAND 0096 GREY GRVL 0102 GREY CLAY 0105
NORTH DUMFRIES TOWNS GR E 07 003	17 557052 4795628 W	1997-07 4207	6	FR 0119	67/110/50/1:0	DO		6508146 (174382)	BRWN CLAY STNS 0045 GREY CLAY GRVL STNS 0116 GREY GRVL 0119
NORTH DUMFRIES TOWNS GR E 07 007	17 556869 4795557 W	2004-05 4005	5.98		68/69/7/1:0	DO		6509652 (Z07817) A007725	BRWN CLAY SNDY BLDR 0022 BRWN CLAY SNDY GRVL 0045 GREY GRVL SAND 0080 GREY SAND 0118 GREY GRVL SAND 0124
NORTH DUMFRIES TOWNS GR E 08 001	17 557360 4795806 W	1988-10 4207	6	FR 0128	104/128/10/1:0			6506497 (37025)	BRWN CLAY STNS BLDR 0020 GREY CLAY STNS BLDR 0105 GREY SILT CLAY STNS 0124 GREY GRVL 0128
NORTH DUMFRIES TOWNS GR E 08 001	17 557564 4795823 W	1957-09 2414	4 4	FR 0090	52/54/12/3:30	DO		6500714 ()	CLAY BLDR 0010 GRVL 0040 MSND 0060 CLAY BLDR 0084 BRWN ROCK 0100
NORTH DUMFRIES TOWNS GR E 08 001	17 556912 4796070 W	2004-09 4207	6.26	FR 0136	71/73/16/1:0	DO		6509837 (Z19627) A008235	BRWN CLAY STNS GRVL 0066 GREY SILT CLAY STNS 0130 GREY LMSN 0137

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
NORTH DUMFRIES TOWNS GR E 08 001	17 557166 4795882 W	1987-12 1905	6	FR 0090	72/85/10/8:0	DO		6506266 (02535) A	GREY GRVL BLDR 0050 GREY HPAN BLDR 0087 GREY GRVL SAND 0093
NORTH DUMFRIES TOWNS GR E 08 001	17 557407 4795878 W	1987-09 1905	6	FR 0122	100/105/10/8:0	DO		6506267 (02534)	GREY GRVL CLAY 0040 GREY HPAN BLDR 0100 GREY SAND GRVL BLDR 0125
NORTH DUMFRIES TOWNS GR E 08 001	17 557211 4795769 W	1987-08 1905	6	FR 0137	90/125/10/8:0	DO		6506269 (02538)	GREY GRVL CLAY BLDR 0040 GREY HPAN BLDR 0090 GREY SAND GRVL 0095 GREY HPAN 0130 GREY SHLE LMSN 0140
NORTH DUMFRIES TOWNS GR E 08 001	17 556865 4796096 W	2004-03 4207	6.26	FR 0123	71/72/9/1:0	DO		6509629 (Z08301) A008250	BRWN CLAY STNS GRVL 0123 WHIT LMSN 0124
NORTH DUMFRIES TOWNS GR E 08 001	17 556906 4795740 W	2003-05 6865	6 5 5	UK 0225	94/113/6/1:0	DO		6509369 (253322)	BRWN GRVL SAND 0024 GREY SAND SLTY GRVL 0061 GREY CLAY SLTY SAND 0078 BRWN GRVL SAND 0089 BRWN SAND SLTY 0109 BRWN GRVL SAND 0118 GREY CLAY SAND SNDY 0129 BRWN GRVL SAND 0138 GREY LMSN 0212 LMSN 0261
NORTH DUMFRIES TOWNS GR E 08 001	17 557098 4795974 W	1988-11 4207	6	FR 0108	76/105/20/1:0	DO		6506495 (37012)	BRWN CLAY STNS 0020 BRWN GRVL 0070 BRWN CLAY 0095 BRWN GRVL 0108
NORTH DUMFRIES TOWNS GR E 08 001	17 557120 4795848 W	1989-05 1905	6	FR	91/91/8/24:0	DO		6506568 (32826)	GREY GRVL BLDR 0070 GREY HPAN BLDR 0095 GREY SAND CLAY BLDR 0125 GREY ROCK 0131
NORTH DUMFRIES TOWNS GR E 08 001	17 557493 4795874 W	1989-06 4207	6	UK 0101	77/90/15/1:0	DO		6506596 (42571)	BRWN STNS CLAY 0025 BRWN GRVL SILT CLAY 0095 BRWN GRVL 0101
NORTH DUMFRIES TOWNS GR E 08 001	17 557342 4795920 W	1989-05 4207	6	FR 0133	96/110/15/1:0	DO		6506599 (42581)	BRWN CLAY STNS 0030 BRWN GRVL STNS 0080 BRWN GRVL STNS BLDR 0110 BRWN SILT GRVL 0130 BRWN GRVL 0133
NORTH DUMFRIES TOWNS GR E 08 001	17 557235 4795927 W	1989-03 4207	66	FR 0117	87/115/15/1:0	DO		6506605 (42595)	BRWN SAND CLAY STNS 0030 BRWN CLAY GRVL 0080 BRWN SILT GRVL STNS 0114 GREY GRVL 0117
NORTH DUMFRIES TOWNS GR E 08 001	17 557372 4796035 W	1989-05 4207	6	FR 0115	90/110/15/1:0	DO		6506608 (42579)	BRWN CLAY STNS 0022 BRWN GRVL STNS CLAY 0110 BRWN GRVL 0115
NORTH DUMFRIES TOWNS GR E 08 001	17 557572 4795943 W	1989-10 4207	6	UK 0131	71/130/75/1:0	DO		6506700 (61122)	BRWN CLAY STNS GRVL 0030 BRWN GRVL SAND 0065 GREY GRVL CLAY 0125 GREY GRVL 0131
NORTH DUMFRIES TOWNS GR E 08 001	17 557566 4795931 W	1990-06 4207	6	FR 0129	69/125/75/1:0	DO		6506942 (61091)	BRWN CLAY STNS 0040 BRWN GRVL SAND STNS 0055 BRWN SAND SILT STNS 0085 GREY CLAY SILT GRVL 0125 GREY GRVL 0129
NORTH DUMFRIES TOWNS GR E 08 001	17 557165 4795872 W	1991-06 1737	6 6	FR 0164	83/105/15/5:30	DO		6507124 (099633)	BRWN CLAY BLDR HARD 0044 GREY SAND GRVL HARD 0149 GREY LMSN HARD 0166
NORTH DUMFRIES TOWNS GR E 08 001	17 557057 4795923 W	2000-08 4207	6.25	FR 0093	72/90/15/1:	DO		6508791 (211052)	BRWN SILT STNS 0010 GREY SAND GRVL SILT 0028 GREY GRVL 0093
NORTH DUMFRIES TOWNS GR E 08 001	17 557302 4795819 W	1988-11 4207		FR 0129	99/125/10/1:0	DO		6506494 (37006)	BRWN CLAY STNS BLDR 0105 BRWN CLAY SILT 0125 BRWN GRVL 0129
NORTH DUMFRIES TOWNS GR E 08 016	17 557552 4795980 W	1989-05 4207	6 5	FR 0085	68/75/15/1:0	DO	0077 3	6506607 (42578)	BRWN CLAY STNS 0030 BRWN SAND GRVL CLAY 0075 BRWN SAND 0087
NORTH DUMFRIES TOWNS GR W 07 003	17 557245 4795692 W	1995-06 4207	6	FR 0104	91/104/1/:	DO		6507858 (159291)	BRWN CLAY STNS 0010 BRWN GRVL STNS CLAY 0100 BRWN GRVL SAND 0104

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDYOAPSTONE		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

APPENDIX C: SOIL GRAIN SIZE ANALYSIS

GRIT Engineering Inc., May 2025

Gradation Analysis Report

Project Name	*Nitrate Impact Assessment (1231 Maple Manor Road, North Dumfries, Ontario)*	Project No.:	*GE25-1205-1*
Client	*Danny Carreiro*	Sample ID:	*TP1-25*
Lab No.:	*160*	Depth:	*1.52m*
Sampled By:	*Kyle Hillar*	Date:	*May 5, 2025*

Grain Size Analysis

Sieve Size (mm)	% Passing
53.0	100
37.5	100
26.5	88
19.00	87
13.2	83
9.5	80
4.75	74
2	65
1.18	61.4
0.6	56.6
0.3	49.4
0.15	39.3
0.075	29.2

Hydrometer Analysis

Diameter (mm)	% Passing
0.030	16.0
0.020	13.2
0.017	12.5
0.01	10.2
0.007	8.5
0.005	6.9
0.002	4.8
0.001	3.2

Gradation Proportions %

Gravel	26.5
Sand	44.3
Silt	24.4
Clay	4.8

Soil Description

GRAVELLY SILTY SAND, trace Clay

Effective Particle Size %

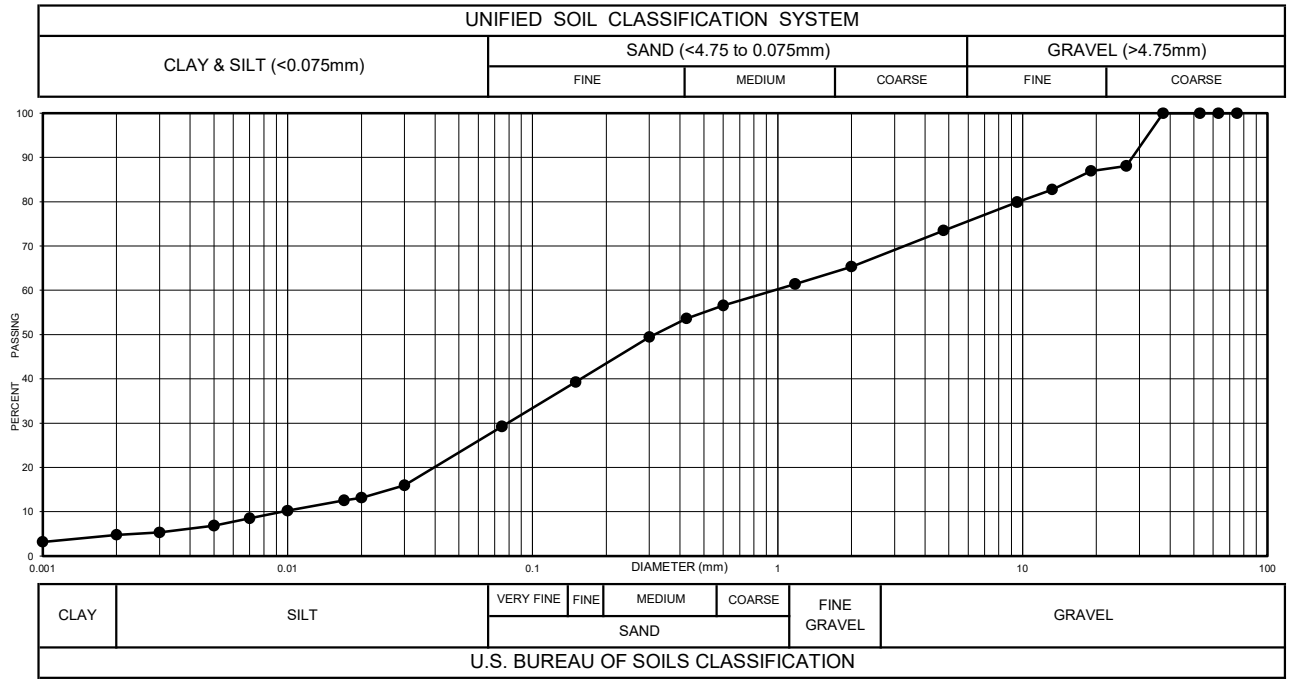
D_{60}	D_{30}	D_{10}
1.007	0.081	0.010

Coefficients

C_u	C_c
105.231	0.678

Estimated T-Time	20 mins/cm

Particle Size Distribution LS 702



Comments

Reviewed By: _____

Kyle Hillar, C. Tech

Gradation Analysis Report

Project Name	*Nitrate Impact Assessment (1231 Maple Manor Road, North Dumfries, Ontario)*	Project No.:	*GE25-1205-1*
Client	*Danny Carreiro*	Sample ID:	*TP2-25*
Lab No.:	*159*	Depth:	*1.52m*
Sampled By:	*Kyle Hillar*	Date:	*May 5, 2025*

Grain Size Analysis

Sieve Size (mm)	% Passing
53.0	100
37.5	100
26.5	77
19.00	75
13.2	69
9.5	65
4.75	57
2	48
1.18	44.0
0.6	39.4
0.3	33.5
0.15	25.9
0.075	19.0

Hydrometer Analysis

Diameter (mm)	% Passing
0.030	8.9
0.020	8.5
0.017	7.6
0.01	6.1
0.007	5.3
0.005	4.5
0.002	2.9
0.001	2.0

Gradation Proportions %

Gravel	43.5
Sand	37.5
Silt	16.0
Clay	2.9

Soil Description

GRAVEL and SAND, some Silt, trace Clay

Effective Particle Size %

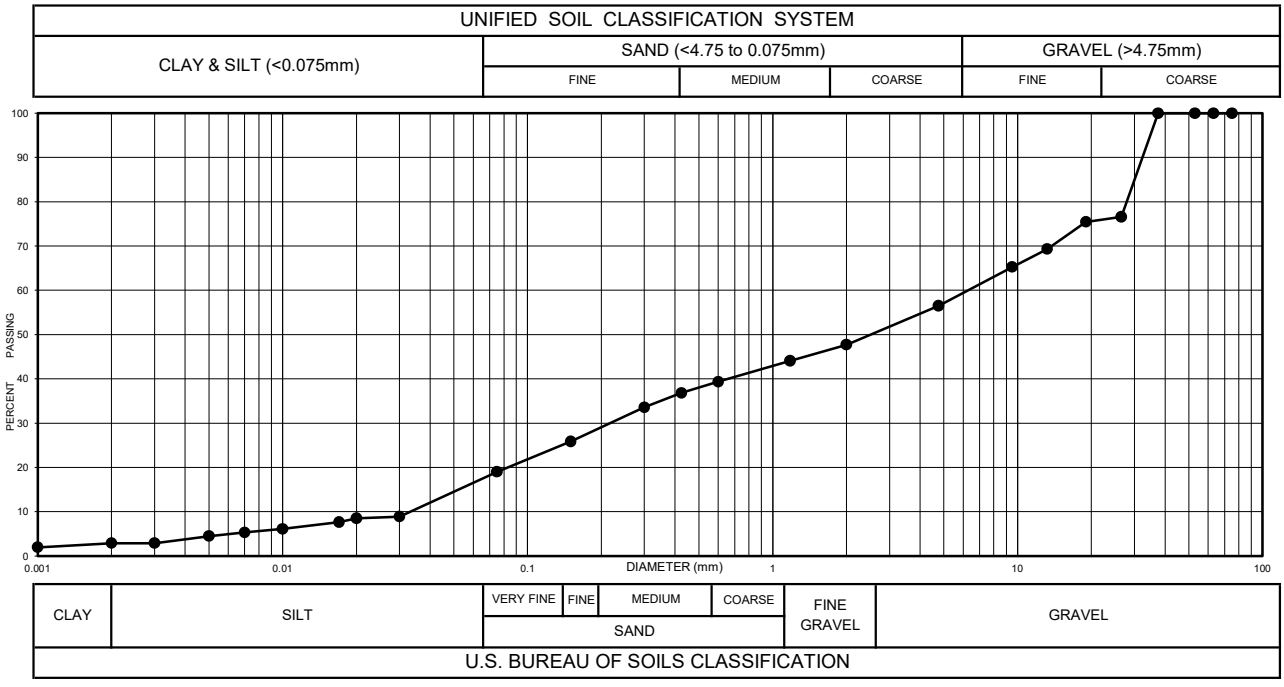
D_{60}	D_{30}	D_{10}
6.635	0.231	0.035

Coefficients

C_u	C_c
190.482	0.230

Estimated T-Time	12 mins/cm

Particle Size Distribution LS 702



Comments

Reviewed By: _____

Kyle Hillar, C. Tech