Terra-Dynamics Consulting Inc.
432 Niagara Street, Unit 2 St. Catharines, ON L2M 4W3

June 26, 2024

Mr. Mark VandenBerg
5324 Canborough Road
Wellandport, Ontario
L0R 2J0

Re: Hydrogeological Assessment, Consent (Severance), 5324 Canborough Road, Wellandport, Township of West Lincoln, Ontario

Dear Mr. VandenBerg,

1.0 Introduction, Background Information and Purpose

Mr. VandenBerg retained Terra-Dynamics Consulting Inc. (Terra-Dynamics) to complete a Hydrogeological Assessment to assess sewage impacts for a proposed residential consent (land severance) from 5324 Canborough located in the Hamlet of Wellandport, Township of West Lincoln (referred to herein as the Site) (Township, 2024) (refer to Figure 1). The consents consist of Part 1 which contains the existing dwelling with a lot size of 0.40 hectares (1.0 acre) and Part 2 which is approximately 0.73 hectares (1.8 acre) in size (refer to Appendix A, Russel Technical Services, 2024). This assessment's purpose is to assess the risk to groundwater supplies from the reduction in the size of Part 1 and its existing infrastructure, as well as the new private sewage system proposed for Parcel 2. The hydrogeological assessment is required by the Township of West Lincoln (Township), and Niagara Region, as the proposed lots are smaller than 1 hectare (Township, 2019, Niagara Region, 2022, respectively). The purpose of the assessment is to satisfy relevant municipal policies including:

1. Township of West Lincoln policy 18.13.5 Hamlet Settlement Area

   "The minimum lot size for lots created in a Hamlet designation shall be approximately 1.0 hectare as required to satisfy the Township Building Department and Part 8 of the Ontario Building Code for long term operation of a waste disposal system, unless a hydrological assessment determines that a smaller lot size will be adequate to accommodate private water and sewage treatment facilities."

2. Niagara Region Official Plan 2022 policy 4.1.9.2(b):

   " ...the minimum size of the proposed and retained lots shall each be 1 hectare unless it is determined through a hydrogeological study, that considers potential cumulative impacts, that a smaller size lot will adequately accommodate private water and sewage treatment facilities for long-term operation but not be less than 0.4 hectares..."

2.0 Methodology

Terra-Dynamics began the assessment once confirmation of the appropriateness of the Terms of Reference was received from Niagara Region (Niagara Region, 2024) and the Township of West Lincoln

(Township of West Lincoln, 2024). Our work program (as per the Terms of Reference) included the following components, described below.

2.1 Description of Geologic and Hydrogeologic Setting

The Site's geologic and hydrogeologic settings were described using published information to assess the aquifer's vulnerability and sensitivity, which included the following:

i. MECP water well records (refer to Figure 2, Appendix B);
ii. Ontario Geological Survey (OGS) nearby continuous boreholes (Figure 1, Burt, 2020, Appendix D);
iii. Available soil mapping and geologic golden spike boreholes (refer to Figure 1 and Appendix D); and
iv. Niagara Peninsula Source Protection Area Assessment Report (NPCA, 2013).

2.2 Water Well and Sewage System Survey

A water well and sewage system survey questionnaire, and explanation letter pertaining to the need for the survey, was mailed to neighbouring properties in March of 2024. A total of eight developed properties were identified within 100 metres of the Site that could receive a survey by mail. A copy of the questionnaire and information letter is provided in Appendix C.

2.3 Site Visit

The Site was visited by Terra-Dynamics on April 9, 2024, to assess site conditions and to complete the following (i) evaluation of any on-site or nearby private water supply wells, (ii) hand-augering at two locations to determine shallow soil conditions on-site, and (iii) submission of one representative soil sample for laboratory grain-size analyses.

2.4 Water Well Record Search and Documentation

Water well records located within 500 metres of the Site were mapped out using the Ministry of the Environment Conservation and Parks (MECP) water well records database. The locations of these water well records are provided on a map (refer to Figure 2) and well log information is summarized in Section 3.1 and included in Appendix B.

2.5 Assessment of Impact on Water Resources

The potential sewage effluent impacts to the groundwater flow regime and private wells were assessed using the provincial procedure D-5-4 (MECP, 1996a). As the new lot development will be provided potable water via cistern, this report does not include a water supply assessment (MECP, 1996b), and it is recommended that a development agreement be implemented that will indicate water supply by cistern only. There is currently an existing cistern and septic at the existing property on Parcel 1 (refer to Figure 4).

3.0 Hydrogeological Assessment

3.1 Ministry of Environment, Conservation and Parks (MECP) Water Well Records

MECP water well records located within 500 m of the Site were reviewed and three records were identified (refer to Figure 2 and Appendix B). The well records indicate that water is taken from the bedrock aquifer which is identified in the records as limestone, although it is Salina Formation dolostone, shale and gypsum (refer to Section 4.2). The thickness of the overlying clay is recorded as between 25.3 and 33.5 metres below ground surface (83 to 110 feet) (refer to Figure 3). The closest water well record is located approximately 100 m to the east (Water Well Record (WWR) #3800419).

The well records date from 1961 to 2020 and indicate that the wells were constructed primarily for domestic or farm water supply purposes. All the water well records indicate that the well casings extended to bedrock, and general water quality observations by the water well contractors described the water as fresh and/or sulphurous (refer to Appendix B).

3.2 Water Well and Sewage System Results

A water use and septic system survey was mailed in March, 2024 to the eight developed parcels located within 100 m of the Site (refer to Figure 2, Table 1, and Appendix C). No responses were received as of June 12, 2024, which is over 2 months since the mail-out. A low response rate is not uncommon in this type of assessment and does not impact the efficacy of the findings.

Table 1: Summary of Water Well Survey Results

Address	Comments
5340 Canborough Road	No response received
5336 Canborough Road	No response received
5316 Canborough Road	No response received
5294 Canborough Road	No response received
5298 Beavercreek Crescent	No response received
5304 Beavercreek Crescent	No response received
5335 Canborough Road	No response received
5344 Canborough Road	No response received

4.0 Physical Setting

The Site topography is classified by Agriculture Canda (2024) as slope class A (little or no slope) to the south towards the Welland River, with a ground surface elevation ranging between 179 and 177 metres above sea level (m ASL) (refer to Figure 2). The Site is within the Welland River watershed, however, there are no mapped watercourses on the Site (refer to Figure 2). There are also no tile drains mapped for the Site (OMAFRA, 2024). No watercourses or waterbodies were observed during the site visit on April 9, 2024. The site plan (refer to Appendix A) displays "NPCA Regulated Lands" in the southwest portion of the property on the proposed Parcel 2, the available online mapping from the NPCA

Watershed Explorer indicates that this line designates a "Top of Slope Allowance" as noted in Appendix A.

4.1 Soils

The Site is located on the Haldimand Clay Plain physiographic region (Chapman and Putnam, 1984). The soil for the Site is mapped as Brantford soil (i.e mainly lacustrine silty clay) and the adjacent lands immediately to the south are mapped as modern alluvium (i.e. fine-textured floodplain deposits) (OMAFRA, 2024) (refer to Appendix D). Brantford soils are classified as moderately to poorly drained silty clay overlying glaciolacustrine silty clay parent material (OMAFRA, 1989). Brantford soils are associated with Beverly Soils and are depicted as such below in Figure 5 (OMAFRA, 1989).

The soils on the Site have been assigned a Hydrologic Soil Group C characterized as moderately fine to fine textured with slow infiltration rates (OMAFRA, 2024) (refer to Appendix D).

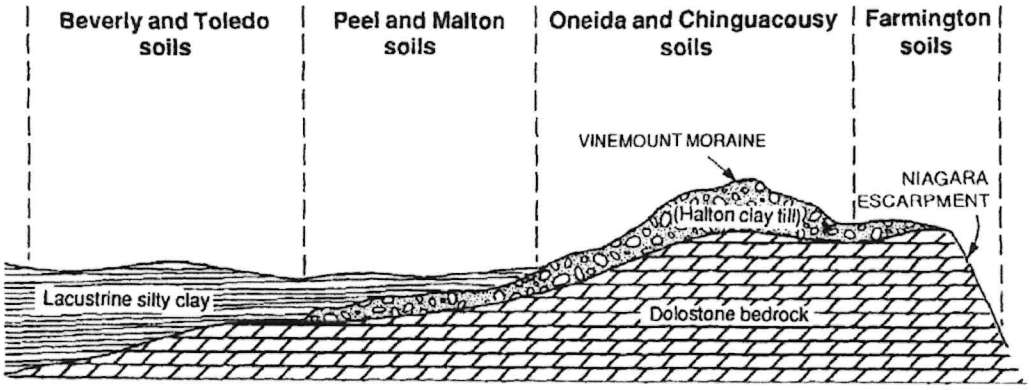

Figure 5 – Schematic cross-section showing the relationship of soils on the Haldimand Clay Plain (OMAFRA, 1989)

Soil samples were collected by hand-auger at each of the two Parts (Figure 2) on April 9, 2024, and one representative sample, HA-1 was submitted for laboratory grain-size analyses (Appendix D). This sample was collected from below 80 cm depth and is compared to Horizon C values for the mapped soil types (Table 2).

Table 2 – Horizon C Grain-size Analyses Summary

Soil Name/Location	Gravel%	Sand%	Silt%	Clay%	Texture[1]
Brantford Soil[2]	0	6	45	49	Silty Clay
HA-1	0	3	35	65	Silty Clay

Note: [1] - Texture as per Fetter (1994), [2] - Kingston and Presant, 1989

4.2 Overburden geology

The surficial geology of the Site is mapped as clay and silt associated with fine-textured glaciolacustrine deep water deposits (refer to Figure 2) (OGS, 2003), and the overburden was regionally mapped as 28 metres thick at the Site (NPCA, 2013). This correlates well with the hydrogeologic section provided on Figure 3, as the depth to bedrock at the Site was approximately between 25.3 and 33.5 metres based on previously mentioned nearby water well records (refer to Section 3.1).

4.3 Bedrock Geology

The underlying bedrock is mapped as the Salina Formation shale, dolostone and gypsum (Armstrong and Dodge, 2007). The bedrock topography dips regionally to the south (NPCA, 2013), and is at approximately 152 m ASL beneath the Site based on available mapping and nearby water well records (refer to Section 3.1, Appendix B, and Figure 3).

4.4 Hydrogeologic Setting

4.4.1 Overburden Aquitard and Water Table

The Site is in mid-way between Ontario Geological Survey (OGS) boreholes BH07-NP-2014, BH29-NP-2014, BH34-NP-2014, and BH90-NP-2014 (Burt, 2020, Appendix D) (refer to Figure 1). These boreholes identify the uppermost clay and silt as the Upper Whittlesey Aquitard overlying the silt/clay diamicton of the Upper Halton, Lower Whittlesey, and Wentworth Aquitards (Burt, 2020) (refer to Appendix D). This is consistent with the classification of this upper glaciolacustrine unit as an overburden aquitard by Gartner Lee Limited (GLL), with the hydraulic conductivity of this silty clay aquitard expected to be $7x10^{-7}$ m/s or less (GLL, 1987).

Two shallow soil samples were collected from the Site using a hand-auger during the April 9, 2024 site visit (Section 4.1) One of these samples, HA-1, which was collected from a depth of 0.80 m BGS, was submitted for laboratory grain-size analyses (Appendix D). The Excel-tool HydrogeoSieveXL (Devlin, 2015) was used to process the grain-size analyses to provide a shallow soil hydraulic conductivity estimate of $6x10^{-11}$ m/s for HA-1 (Appendix D). This result is within published ranges for clay (Fetter, 1995).

Gartner Lee Limited (1987) provides a good description of the expected water table conditions within the overburden aquitard:

> *"Detailed studies indicate that the water table fluctuates over the weathered/fractured upper two to three metres of the glaciolacustrine silts and clays comprising the overburden aquitard...flow in this shallow zone responds to daily climatic changes such that, during precipitation, the open fractures from weathering will quickly fill with water. The bulk of the discharge will then occur locally in swales that carry intermittent surface water .... The remainder will go to depth to recharge the ground water system."*

Groundwater flow in the overburden aquitard is expected to follow topography to the southeast (refer to Figure 2) while being limited in velocity by the low hydraulic conductivity (Haitjema and Mitchell-Bruker, 2005).

This overburden aquitard is protecting the underlying bedrock aquifer. The thickness of the low permeability overburden materials has been mapped between 25.3 and 33.5 metres at and around the Site as summarized in the hydrogeologic section provided on Figure 3 and in the OGS borehole information provided in Appendix D (Burt, 2020), which shows this overburden aquitard protecting the bedrock (Salina Formation) aquifer from land use activities (i.e. private sewage disposal) at ground surface.

4.4.2 Bedrock Aquifer and Groundwater Flow

The uppermost part of the bedrock is an aquifer where weathered, having *"...a higher hydraulic conductivity than the same formation at depth...attributed to weathering of the bedrock surface..."* (GLL, 1987). The potentiometric surface of the bedrock aquifer is approximately 175-173.6 m ASL (refer to Figure 3) with regional flow towards the northwest (NPCA, 2013). Water quality in the Salina Formation bedrock aquifer has been measured to have several water quality treatment challenges including hydrogen sulphide, sodium, sulphate, chloride, iron and manganese above Ontario Drinking Water Quality Aesthetic Objectives (Campbell and Burt, 2016).

4.4.3 Confined Bedrock Aquifer Conceptual Model

The Section 4.0 information is summarized in the schematic below, as a conceptual model for the assessment of potential sewage system impacts to groundwater and private wells (refer to Figure 5).

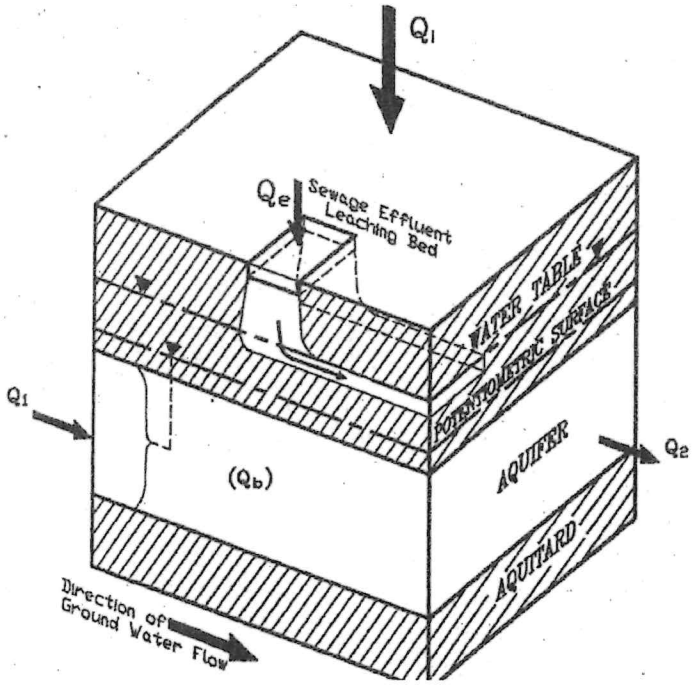

Figure 6 - Confined Aquifer Impact Assessment Subsurface Sewage System (MECP, 1995)

5.0 Assessment of Potential Sewage Impacts

Provincial Procedure D-5-4 (MECP, 1996) provides an assessment process for assessing the groundwater impact potential of private sewage systems. The purpose of the assessment process *"is to ensure that the combined effluent discharges from all the individual on-site sewage systems in a development will have a minimal effect on the groundwater and the present or potential use of the adjacent property"* (MECP, 1996).

This assessment process involves two main steps: (i) consideration of system isolation and (ii) contaminant attenuation, as visualized below in Figure 7.

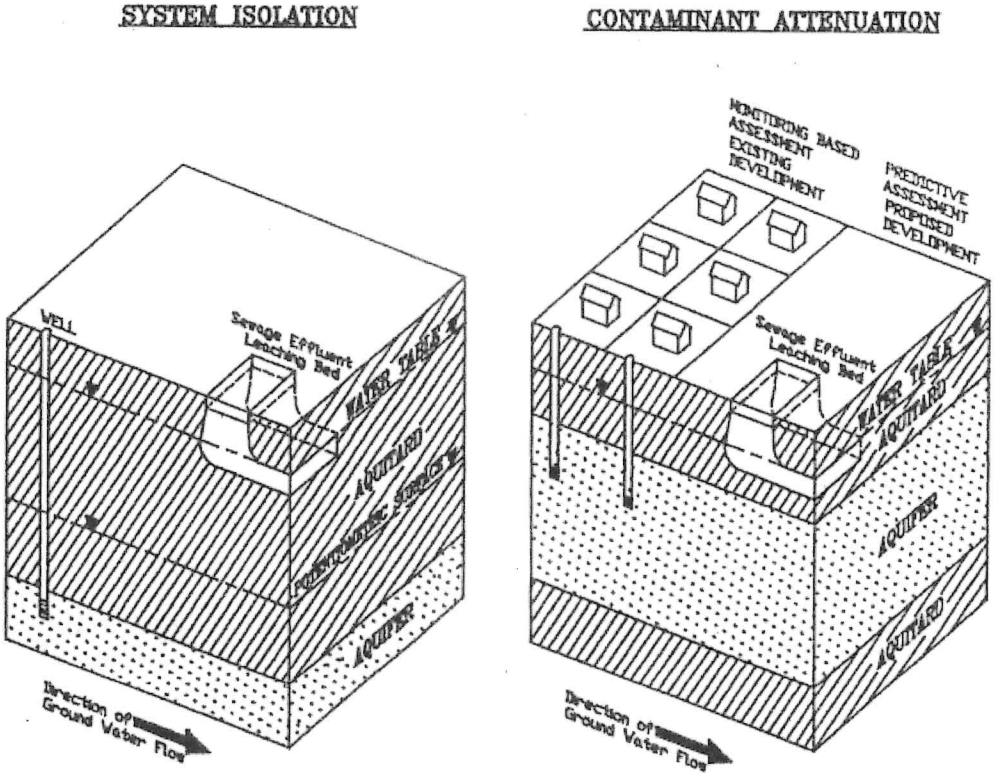

Figure 7– Water Quality Assessment Process (MECP, 1995)

5.1 System Isolation

As stated in Provincial Procedure D-5-4:

> *"Developments will normally be considered as low risk where it can be demonstrated that sewage effluent is hydrogeologically isolated from ... supply aquifer(s)"* (MECP, 1996).

The Design Guidelines for Sewage Works (MECP, 2008) provide criteria for evaluation of sewage system isolation from the underlying bedrock aquifer:

> *"Where it can be shown that the uppermost subsurface unit(s) at an infiltration facility have a vertical hydraulic conductivity of 10^{-5} cm/sec* (10^{-7} m/sec) *or less, is at least 10 metres (33 feet) thick and extends at least 100 m (330 ft) downgradient of the infiltration area, attenuation calculations may not be required."*

The surficial aquitard has a sufficiently low hydraulic conductivity (Section 4.3.1), and mapping of the aquitard thickness shows over 10 metres of material at the Site (refer to Section 4.1 and Figure 3).

Consequently, private sewage servicing of the proposed severance is (i) a low risk to the water supply aquifer, and (ii) nearby water supply wells, because the Site is hydrogeologically isolated from the bedrock aquifer. This conclusion is based upon the following:

- The bedrock aquifer has been mapped as having low intrinsic susceptibility (WHI, 2005); and
- The thickness and extent of the underlying aquitard is greater than the 10 m MECP criterion for hydrogeologic isolation.

As there is considerable consistent documentation confirming these conditions at the Site, no new collection of geologic information is required.

Further responding to the guidance of Provincial Procedure D-5-4 under Step 2, it is worth noting that the effluent will infiltrate into the surficial clay and silt soils, become anaerobic, and consequently denitrify (Robertson et al, 1996). No sewage effluent will enter the water supply aquifer, hence *"the lot density of the proposed development may be dictated by... the need for sewage system replacement areas... and by the minimum distances... as defined by Ontario Regulations..."* (MECP, 1996).

Consequently, no Step 3 contamination attenuation calculations are required to be completed, because:

> *"...where it has been demonstrated that the sewage effluent will not enter supply aquifers, the lot density of the proposed development may be dictated by factors such as the need for sewage system replacement areas, and by the minimum distances between individual on-site beds and wells* (or cisterns)*, as defined by Ontario Regulations..."* (MECP, 1996)

5.2 Sewage System Effluent Disposal Location Considerations

Future sewage system effluent disposal locations (e.g. raised leaching or filter bed) are constrained by a series of Part 8 Ontario Building Code set-backs including at least 15 metres from a cistern (referred to as a reservoir in the code) (Refer to Figure 4). In addition, the current septic bed for the dwelling on Part 1 exerts a set-back for the future cistern on Part 2.

No water supplies have been identified outside of the Site within 30 metres. Therefore, there is no reason to exert external building code set-backs on the proposed severances.

6.0 Conclusions and Recommendations

6.1 Conclusions

The following conclusions are provided:

1. The existing residence (Part 1) and the proposed consent (severance, Part 2) are isolated from the underlying water supply aquifer; and

2. There are no hydrogeological-based impediments to site development as long as the following recommendations are implemented.

6.2 Recommendations

The following recommendations are provided for your consideration:

1. A private sewage system and cistern may be sustainability created on the consent area (Part 2) of 0.73 ha (1.8 acre) as long as Ontario Building Code set-backs are met; and

2. A development agreement should be completed indicating that the water supplies will be by cistern.

We trust this information is sufficient for your present needs. Please do not hesitate to contact the undersigned if you have any questions.

Yours truly,
TERRA-DYNAMICS CONSULTING INC.

Briar MacIntyre, B.Sc., P.Geo.
Environmental Geologist

Attachments
Figure 1 - Location of Site
Figure 2 – Regional Details
Figure 3 – Hydrogeologic Cross-Section
Figure 4 - Site Details
Appendix A – Site Plan
Appendix B – MECP Water Well Records
Appendix C – Water Use and Septic System Survey
Appendix D – Supporting Information

7.0 References

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Terra- Dynamics Consulting Inc, 2022. Re: Hydrogeological Study, Consent (Severance), 5274 Canborough Road, Wellandport, Township of West Lincoln, Ontario

Township of West Lincoln, 2024. Re: Proposed Hydrogeology Study Terms of Reference, 5423 Canborough Road, Welland Port, Township of West Lincoln. Email from M. Etzl (Senior Planner) to Briar MacIntyre (Terra-Dynamics Consulting Inc.).

Township of West Lincoln, 2024. Record of Pre-Consultation, Meeting Date February 1, 2024, Property Address: 5324 Canborough Road, Wellandport.

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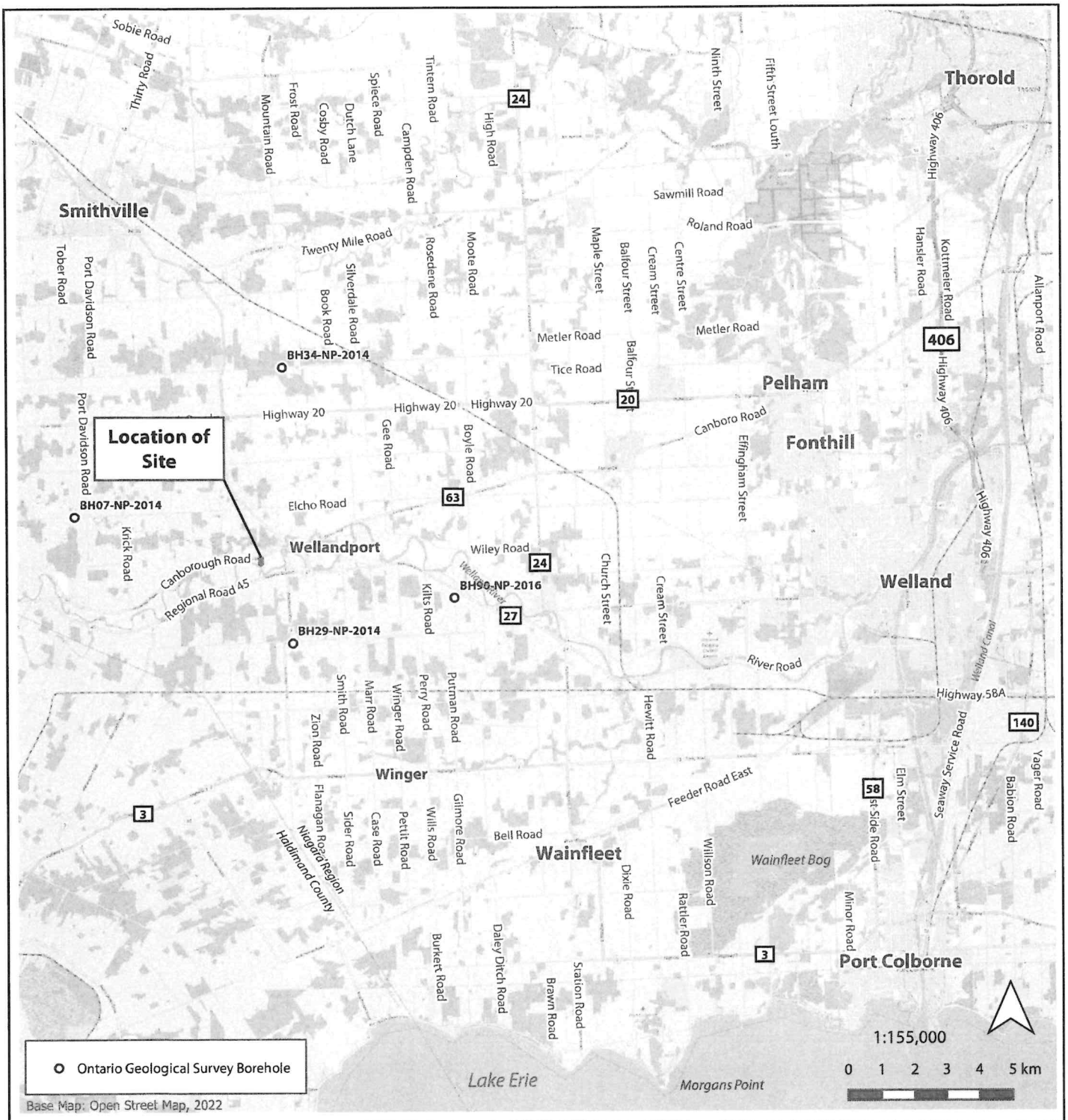
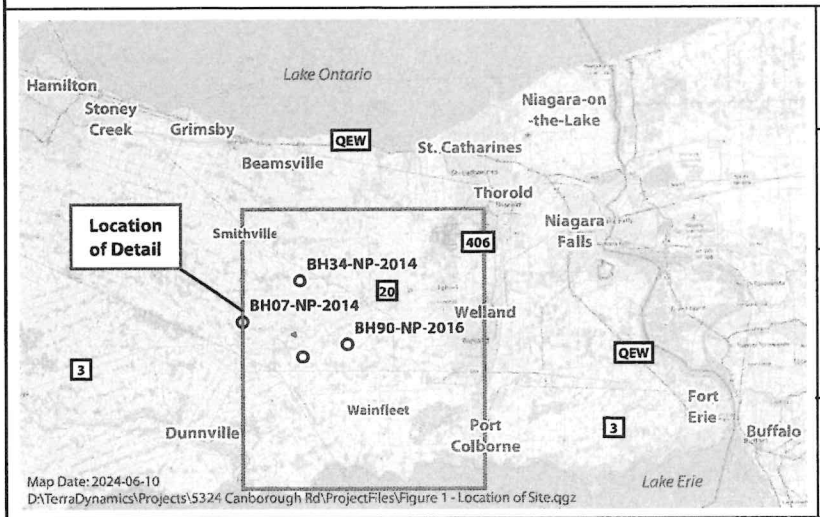
Figures





Location of Subject Lands

5324 Canborough Road, Wellandport, ON
Hydrogeological Assessment

TDC **Terra-Dynamics Consulting Inc.**

Prepared for:	Figure 1
Mark VandenBerg	

MECP Water Well Records Within 500m of Site

Hand Auger Locations

Contour (1m)

Line Of Hydrogeologic Cross-Section A-A'

Site

Proposed Consents

100m Buffer for Water Well Survey

Watercourse

Waterbody

Subwatershed Boundary

Surficial Geology

Clay and silt

Clay, silt, sand and gravel, with organic matter

Regional Setting

5324 Canborough Road, Wellandport, ON
Hydrogeological Assessment

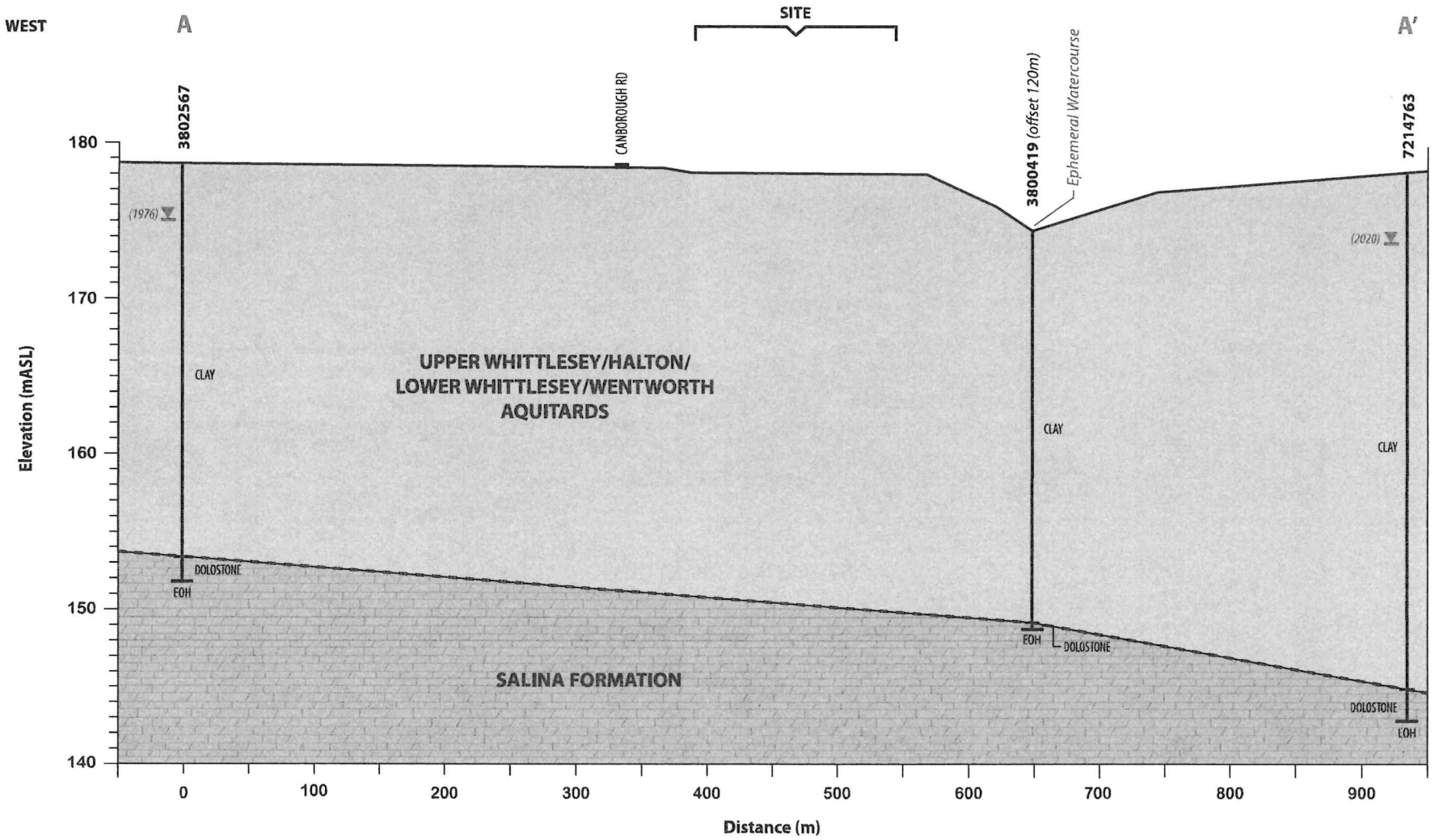
Terra-Dynamics Consulting Inc.

Prepared for:
Mark VandenBerg

Figure 2

References: Niagara Peninsula Conservation Authority: Contemporary Mapping of Watercourses, 2018; Subwatersheds. Ontario Geological Survey: Surficial Geology. Ministry of the Environment, Conservation and Parks: Water Well Information System Records, 2022.

Map Date: 2024-06-24 D:\TerraDynamics\Projects\5324 Canborough Rd\ProjectFiles\Figure 2 - Regional Setting.qgz



▼ **Well Water Level on date as noted**

EOH **End of Hole**

See Figure 2 for line of cross-section

Hydrogeologic Cross-Section A-A'	
5324 Canborough Road, Wellandport, ON Hydrogeological Assessment	
TDC Terra-Dynamics Consulting Inc.	
Prepared For: Mark VandenBerg	Figure 3

D:\TerraDynamics\Projects\5324 Canborough Rd\ProjectFiles\Figure 3 - Cross Section A-A'ai June 11, 2024

MECP Water Well Record Within 100m of Site

Hand Auger Locations

Contour (1m)

Watercourse

Approximate Location of Septic Bed and Mantle

Septic Bed

Mantle

15m Buffer of Existing Septic

Existing Cistern

15m Buffer of Cistern

Site

Proposed Consents

100m Buffer for Water Well Survey

Site Details

5324 Canborough Road, Wellandport, ON
Hydrogeological Assessment

TDC **Terra-Dynamics Consulting Inc.**

Prepared for:
Mark VandenBerg

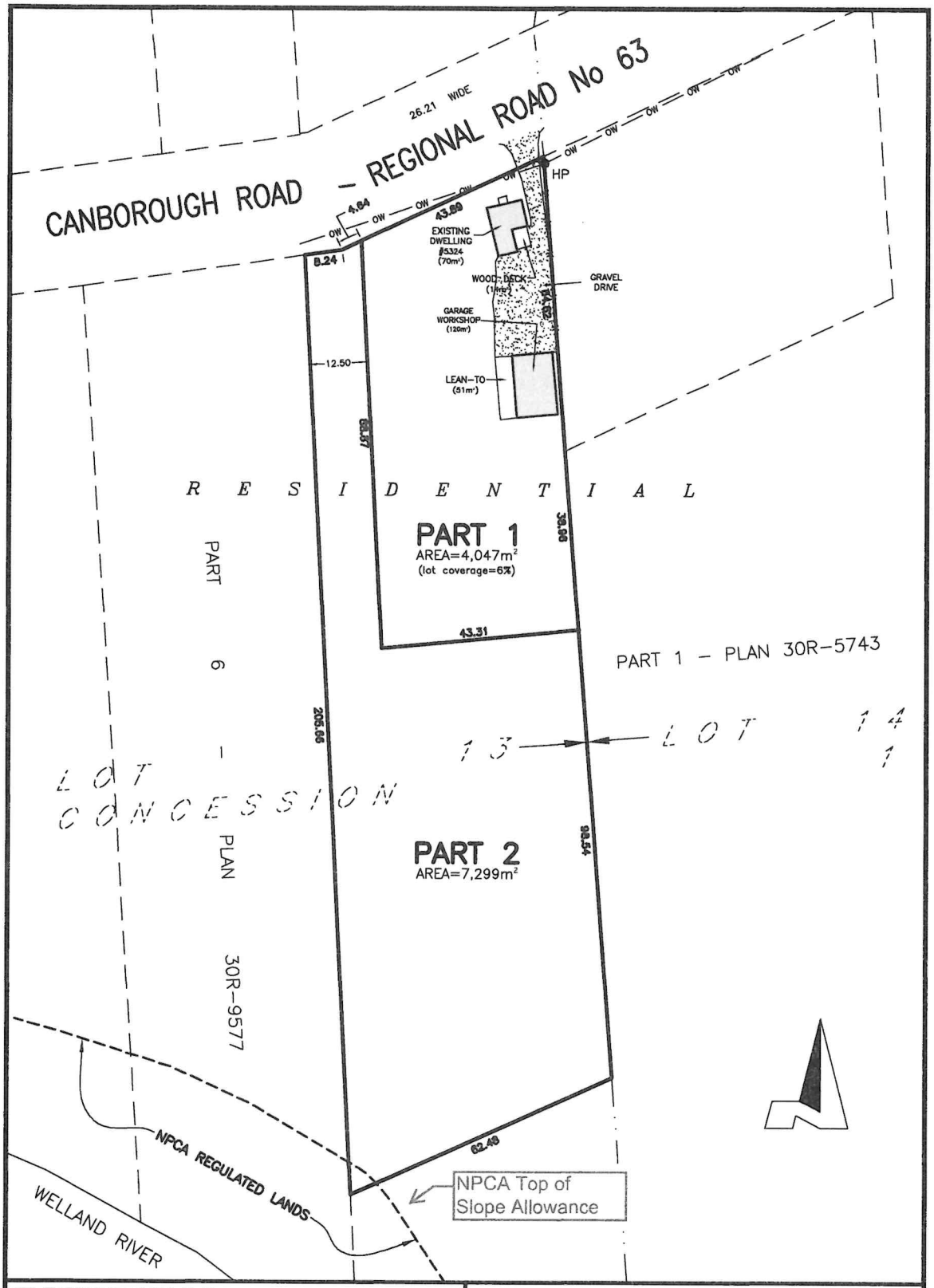
Figure 4

References: Niagara Peninsula Conservation Authority: Contemporary Mapping of Watercourses, 2018; Subwatersheds. Ontario Geological Survey: Surficial Geology. Ministry of the Environment, Conservation and Parks: Water Well Information System Records, 2022.

Map Date: 2024-06-25 D:\TerraDynamics\Projects\5324 Canborough Rd\ProjectFiles\Figure 4 - Site Details.qgz

Appendix A

Preliminary Site Plan



SKETCH

PREPARED FOR SEVERANCE APPLICATION

PART OF LOT 13, CONCESSION 1

GEOGRAPHIC TOWNSHIP OF GAINSBOROUGH

IN THE

TOWNSHIP OF WEST LINCOLN

REGIONAL MUNICIPALITY OF NIAGARA

SCALE 1 : 1000 (METRIC)

NOTE: THIS SKETCH IS PREPARED FROM COMPILED AND CALCULATED INFORMATION, NOT FROM AN ACTUAL SURVEY.
ALL MEASUREMENTS ARE +/- MEASUREMENTS.
DO NOT SCALE FROM THIS DRAWING.

CAUTION: THIS IS NOT A PLAN OF SURVEY AND SHALL NOT BE USED EXCEPT FOR THE PURPOSE INDICATED IN THE TITLE BLOCK.

"THIS IS NOT AN ORIGINAL COPY UNLESS EMBOSSED WITH SEAL"

DONALD G. CHAMBERS, B. Sc., O.L.S.

CHAMBERS AND ASSOCIATES SURVEYING LTD
12 THOROLD ROAD EAST
WELLAND ONTARIO
L3C 3T2
(905) 735-7841 / 735-7844
FAX (905) 735-7333
www.casl-surveying.com

DATE MARCH 21, 2024 FILE No 24-11 (24011_SEV)

Appendix B

Water Well Records

UTM Z E
R N
Elev. F
Basin 24

GROUND WATER BRANCH
38 No. 419
JAN 5 1961
ONTARIO WATER RESOURCES COMMISSION

The Ontario Water Resources Commission Act, 1957

Con 1
Lot 14

WATER WELL RECORD

WEST LINCOLN

County or District Lincoln Township, Village, ~~Town or City~~ Gainsboro

[redacted] te completed 20 (day) Dec (month) 60 (year)

[redacted] dress Wellandport

Casing and Screen Record

Inside diameter of casing 5"
Total length of casing 83'
Type of screen —
Length of screen —
Depth to top of screen —
Diameter of finished hole 5"

Pumping Test

Static level Flows
Test-pumping rate 10 G.P.M.
Pumping level 5"
Duration of test pumping 30 min
Water clear or cloudy at end of test Clear
Recommended pumping rate 10 G.P.M.
with pumping level of 5"

Well Log — Water Record

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	No. of feet water rises	Kind of water (fresh, salty, sulphur)
Clay	0'	83'			
Limestone	83'	84'	84'	84'	some sulphur

For what purpose(s) is the water to be used?
Farm purposes

Is well on upland, in valley, or on hillside?
valley

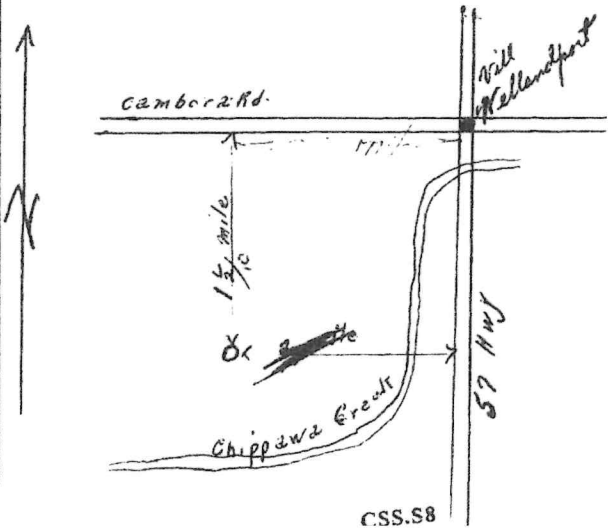
Drilling Firm Frank Merritt
Address R. R. 1, Smithville, Ont.

Licence Number 443
Name of Driller Frank Merritt
Address R. R. 1, Smithville, Ont.
Date Dec 31 / 60

Frank Merritt
(Signature of Licensed Drilling Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Form 5

CSS.S8

MINISTRY OF THE ENVIRONMENT
The Ontario Water Resources Act

WATER WELL RECORD

30m/30d

Ontario

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 3802567 | MUNICIP. 38003 | CON. CON | 01

COUNTY OR DISTRICT: Niagara
TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: (CS. WNCOLN) Caistorborough
CON., BLOCK, TRACT, SURVEY, ETC.: Con 1
LOT: 013
OWNER (SURNAME FIRST): B.M.C Construction
ADDRESS: 8 Greenwood Ave St. Catherines
DATE COMPLETED: DAY 30 MO 09 YR 76

21 | UTM ZONE 17 | EASTING 622540 | NORTHING 4761980 | PG | ELEVATION 0586 | PG | BASIN CODE 4 24

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
brown	clay		packed	0	20
grey	clay		dense	20	60
brown	clay	gravel	packed	60	83
grey	shale		layered	83	86-6"
grey	limestone			86-6"	87

31 | 0020605791 | 0060205661 | 0083605111791 | 0087217174 | 0087215

32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0086-87	1 FRESH 3 ☒ SULPHUR 4 MINERAL
	1 FRESH 3 SULPHUR 2 SALTY 4 MINERAL
	1 FRESH 3 SULPHUR 2 SALTY 4 MINERAL
	1 FRESH 3 SULPHUR 2 SALTY 4 MINERAL
	1 FRESH 3 SULPHUR 2 SALTY 4 MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. - INCHES	MATERIAL	WALL THICKNESS - INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
06	1 ☒ STEEL 2 GALVANIZED 3 CONCRETE 4 OPEN HOLE	.188	0	86-6
6	1 STEEL 2 GALVANIZED 3 CONCRETE 4 ☒ OPEN HOLE		86-6	87
	1 STEEL 2 GALVANIZED 3 CONCRETE 4 OPEN HOLE			

0087

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER - INCHES	LENGTH - FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN - FEET	

61 PLUGGING & SEALING RECORD

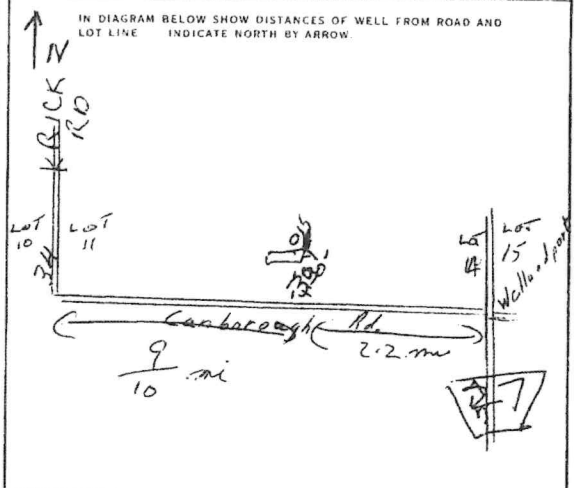
DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: 1 PUMP 2 ☒ BAILER
PUMPING RATE: 0014 GPM
DURATION OF PUMPING: 01 HOURS 00 MINS
STATIC LEVEL: 012 FEET
WATER LEVEL END OF PUMPING: 030 FEET
WATER LEVELS DURING: 1 PUMPING 2 ☒ RECOVERY
15 MINUTES: 012 FEET
30 MINUTES: 012 FEET
45 MINUTES: 012 FEET
60 MINUTES: 012 FEET
IF FLOWING, GIVE RATE: GPM
PUMP INTAKE SET AT: FEET
WATER AT END OF TEST: 1 CLEAR 2 ☒ CLOUDY
RECOMMENDED PUMP TYPE: SHALLOW ☒ DEEP
RECOMMENDED PUMP SETTING: 060 FEET
RECOMMENDED PUMPING RATE: 0012 GPM
GPM./FT. SPECIFIC CAPACITY

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL: 1

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED INSUFFICIENT SUPPLY 6 ☐ ABANDONED POOR QUALITY 7 ☐ UNFINISHED

WATER USE: 01

1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF DRILLING: 1

1 ☒ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: Donald Merritt — LICENCE NUMBER: 3640
ADDRESS: RR#1 Smithville
NAME OF DRILLER OR BORER: Donald Merritt — LICENCE NUMBER: 3640
SIGNATURE OF CONTRACTOR: Donald Merritt — SUBMISSION DATE: DAY 4 MO Oct YR 1976

OFFICE USE ONLY

DATA SOURCE: 1 | CONTRACTOR: 3640 | DATE RECEIVED: 13 10 76
DATE OF INSPECTION: Aug 16/77 | INSPECTOR: MT
REMARKS:
P
WI

CSS.S8

MINISTRY OF THE ENVIRONMENT COPY

FORM 7

Ontario — Ministry of the Environment, Conservation and Parks

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. *(Place Sticker and/or Print Below)* Tag#:A268408

Well Record

Regulation 903 Ontario Water Resources Act

Page ____ of ____

[redacted]

Address of Well Location (Street Number/Name): 5274 Canborough Rd

Township: West Lincoln

Lot: \ Concession: \

County/District/Municipality: Niagara Region

City/Town/Village: Wellandport

Province: Ontario

Postal Code: L0R2J0

UTM Coordinates: NAD 83 Zone 17 Easting 606284 95 Northing 4300179

Municipal Plan and Sublot Number: UTM

Other: 4762257

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	clay			0	4
GREy	clay			4	20
Red	clay			20	110
GREy	limestone		Bedrock	110	116.7

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	21	Bensee1	5 BAGS

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 FARM

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	0	110

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 FARM ☐ Other, specify

Water Details

Water found at Depth (m/ft)	Gas	Other, specify	Kind of Water: Fresh	Untested
108	☐	☐	☐	☒
	☐	☐	☐	☐
	☐	☐	☐	☐

Hole Diameter

Depth (m/ft) From	Depth (m/ft) To	Diameter (cm/in)
0	20	10"
20	116.7	6"

Results of Well Yield Testing

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

If pumping discontinued, give reason: ~

Pump intake set at (m/ft): 65

Pumping rate (l/min / GPM): 10

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 25.1

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

Recommended pump depth (m/ft): 65

Recommended pump rate (l/min / GPM): 10

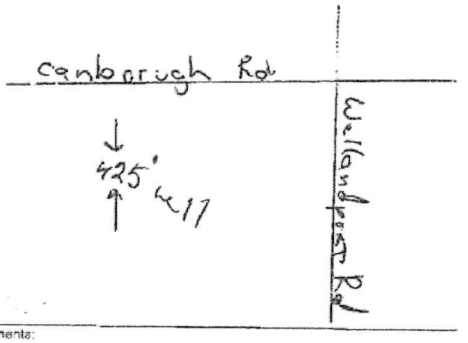
Well production (l/min / GPM): 20

Disinfected? ☒ Yes ☐ No

Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level	15.6		25.1
1	20.1	1	19.2
2	21.9	2	16.2
3	22.5	3	15.6
4	23.0	4	15.6
5	23.2	5	15.6
10	23.8	10	15.6
15	24.1	15	15.6
20	24.3	20	15.6
25	24.5	25	15.6
30	24.6	30	15.6
40	24.9	40	15.6
50	25.0	50	15.6
60	25.1	60	15.6

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: FIELDWELL DRILLING INC

Well Contractor's Licence No.: 7713

Business Address (Street Number/Name): 4622 SPRING Creek Rd

Municipality: VINELAND

Province: ONT

Postal Code: L0R2C0

Business E-mail Address: fieldwelldrilling@gmail.com

Bus. Telephone No. (inc. area code): 9059941434

Name of Well Technician (Last Name, First Name): FIELD MARSHALL

Well Technician's Licence No.: TO365

Signature of Technician and/or Contractor

Date Submitted: 2020/07/14

Well owner's information package delivered ☑ Yes ☐ No

Date Package Delivered: 2020/07/14

Date Work Completed: 2020/06/30

Ministry Use Only

Audit No. Z329623

Received JUL 23 2020

0506E (2018/12)

Ministry's Copy

Appendix C

Well Use & Septic System Survey

Terra-Dynamics Consulting Inc.
432 Niagara Street, Unit 2 St. Catharines, ON L2M 4W3

March 8, 2024

Dear Resident:

On behalf of Mr. Mark VandenBerg Terra-Dynamics Consulting Inc. is completing a water well and septic system survey as part of a Hydrogeological Study of 5324 Canborough Road. This is a survey of properties in the vicinity of 5324 Canborough Road, as shown on the attached map (Site). We are seeking to map nearby private wells in order to ensure protection of water quantity and quality as part of future residential development. This well and septic system survey is a recommended part of a hydrogeologic, or groundwater, study of the subject lands which informs water supplies and septic system designs and locations. This is a standard questionnaire for properties on private services.

The purpose of this survey is to collect information on private or residential water wells, cisterns and septic systems within approximately 100 metres of the Site (as shown by the outline on the attached map). **Participation is voluntary.** Participation involves completing the attached questionnaire on municipal, well and/or cistern use, groundwater quantity, quality and your septic system. Please complete it as best as you can. Please fill out the questionnaire and mail it back to Terra-Dynamics Consulting Inc. in the self-addressed and stamped envelope. The information you provide will be summarized in our report and personal information (e.g. name, address, etc.) will be kept confidential and will not be included in our report.

If you have any questions about the questionnaire, please contact Briar MacIntyre at 905-906-2311 or via email at bmacintyre@terra-dynamics.com.

Thank you in advance for your assistance.

Yours truly,

TERRA-DYNAMICS CONSULTING INC.

B MacIntyre

Briar MacIntyre, P.Geo.
Environmental Geologist

Legend

100m Buffer

Address Points

Water Well and Septic System Survey Area- 100m from 5324 Canborough Rd

0.04 0.08 0.16 0.24 0.32 km

Date: 2024-03-08 Time: 10:06 AM

Terra-Dynamics Consulting Inc.
432 Niagara Street, Unit 2 St. Catharines, ON L2M 4W3

WATER WELL SURVEY FORM

Date:_____

Contact Person:_____

Property Address:_____

Telephone: _____

Email (if further information requested): _____

1.0 GENERAL QUESTIONS

Do you know your drinking water source? Please circle one or more of the following three options:

1.Well (20+ feet casing) 2.Shallow Well (less than 20 feet of casing)
3.Cistern 4. Municipal

Further comments:

_____

_____

Use page 3 or a separate sheet of paper for additional comments.

If your water supply is from a cistern, the rest of the questions do not apply. If you have both a cistern and a well, please complete the well questionnaire (Section 2.0 or 3.0). Please let us know where your place is located either on the supplied map or the area for a sketch on the second last page of this form. Please mail the completed form back to Terra-Dynamics in the provided envelope. Thank you for your assistance.

- If you have a drilled deep well (20+ feet of casing) please complete Sections 2 & 4
- If you have a shallow well (less than 20 feet of casing), please complete Sections 3&4

2.0 DRILLED WELL (greater than 20 feet of casing)

How deep is your well?_____

Is your well drilled into rock?_____What is the well casing diameter?_____

Do you know when your well was drilled?_____

Do you know the name of the well driller?_____

905-646-7931 Fax: 905-935-0397 www.terra-dynamics.com

Do you have a well log? (i.e. a description of the geology encountered when drilling your well and if yes, can you supply a copy or write down the information in the Comments Section).

_____

What is the use of your well water? (i.e. drinking water for house, garden irrigation, etc.)

_____

Has your well ever run dry? _____

Do you experience problems with taste, colour or odour? (if yes, please explain).

_____

Do you have any water purification systems for your well water? (i.e. water softeners, UV Light for bacteria, Sulphur/Iron Filter for odour or staining, etc.).

_____

Do you perform regular maintenance on your well? (i.e. pump service, silt removal, etc.)

_____

3.0 SHALLOW WELL (less than 20 feet of casing)

What is the well casing material and diameter? _____

What is the expected age of the well? _____

How deep is the well? _____

Does you utilize a jet pump or a submersible pump?_____

Is there problems with water quality (colour, odour, etc.)? Yes_____ No_____

If yes, please explain_____

Do you have any water purification systems for your dug well water? (i.e. water softeners, UV Light for bacteria, Sulphur/Iron Filter for odour or staining, etc.).

_____

Have you ever experienced freeze-up during the winter?_____

What is the use of your shallow dug well water? (i.e. drinking water for house, irrigation, etc.)

_____

Has your dug well ever run dry?

Do you perform regular maintenance on your pump? (i.e. pump service, silt removal)

Additional comments:

4.0 LOCATION MAP

Can you please draw a sketch map of the location of your well(s), septic tank and sewage bed on your property (please show the location relative to buildings and roads).

SKETCH MAP OF WELL(S) and SEWAGE SYSTEM LOCATIONS

Other Comments: (Use a separate sheet, if required)

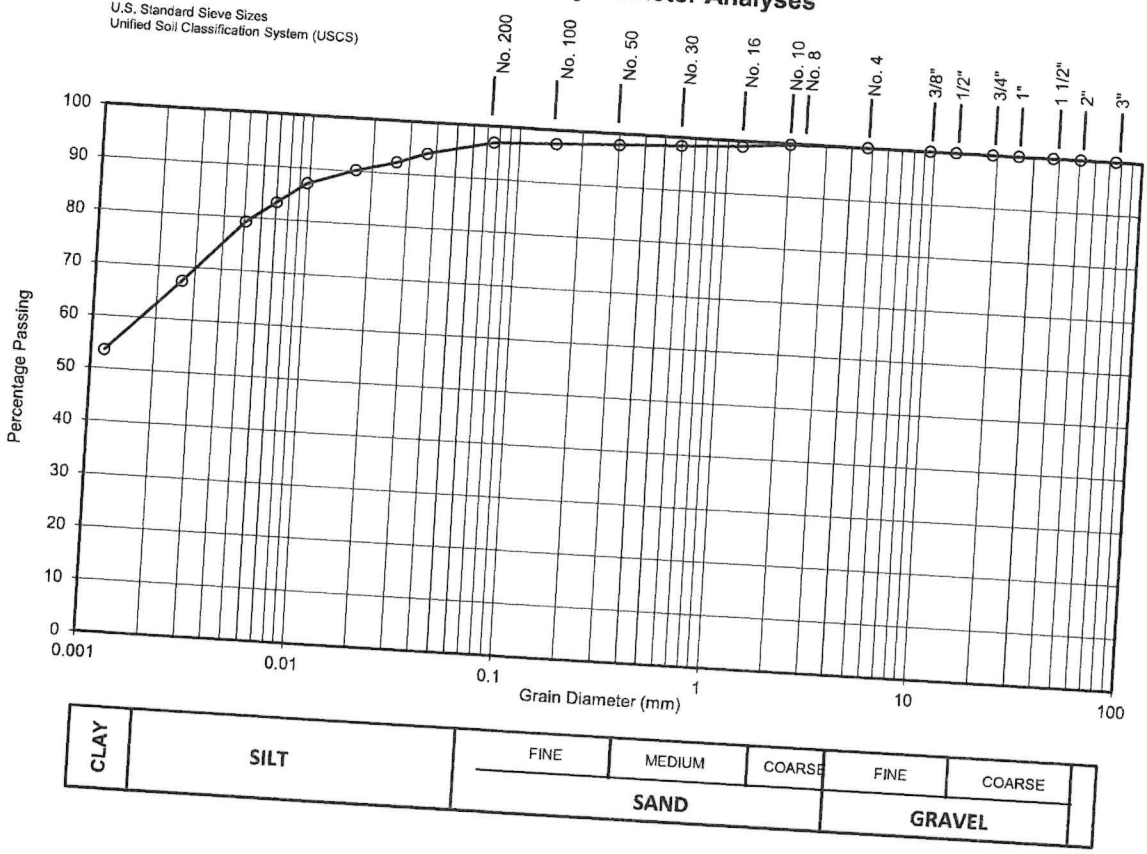
Please mail the completed form back to Terra-Dynamics in the provided envelope.
Thank you for your help.

Briar MacIntyre, P. Geo., Environmental Geologist
432 Niagara Street, Unit 2, St. Catharines, ON L2M 4W3
905-906-2311

Appendix D

Supporting Information

Mechanical & Hydrometer Analyses



Lab No.:	24-156
Borehole No.:	
Sample No.:	HA-1
CLAY [%]:	62
SILT [%]:	35
SAND [%]:	3
GRAVEL [%]:	0
D_{10} (Effective Diam. in mm):	0.0001

Notes: Sampled on April 9, 2024. Sample obtained from the south half of the property. Sample was taken at a depth of 80 cm.

Soil Description: **Brown Silty Clay w/ a trace of Sand**
C.L. - Silty clays, inorganic clays of low to medium plasticity to M.L. - Inorganic silts and very fine sands

Estimated Infiltration Rate [mm/hr] :	< 5	Estimated Permeability, k [cm/s]	10^{-8}
Coefficient of Uniformity C_U:	18.0	Coefficient of Curvature C_C:	0.5

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

5324 Canborough Road, Wellandport ON

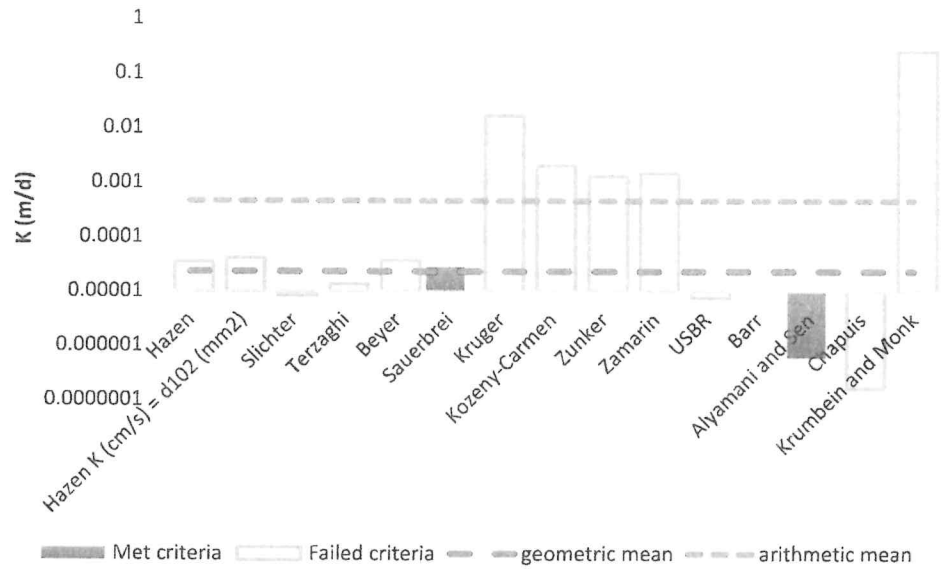
April 2024	Grain Size Analysis No. 1	Project No.: SM 230001-T

K from Grain Size Analysis Report Date: 09-Apr-24

Sample Name: HA-1, 0.80 m, 5324 Canborough

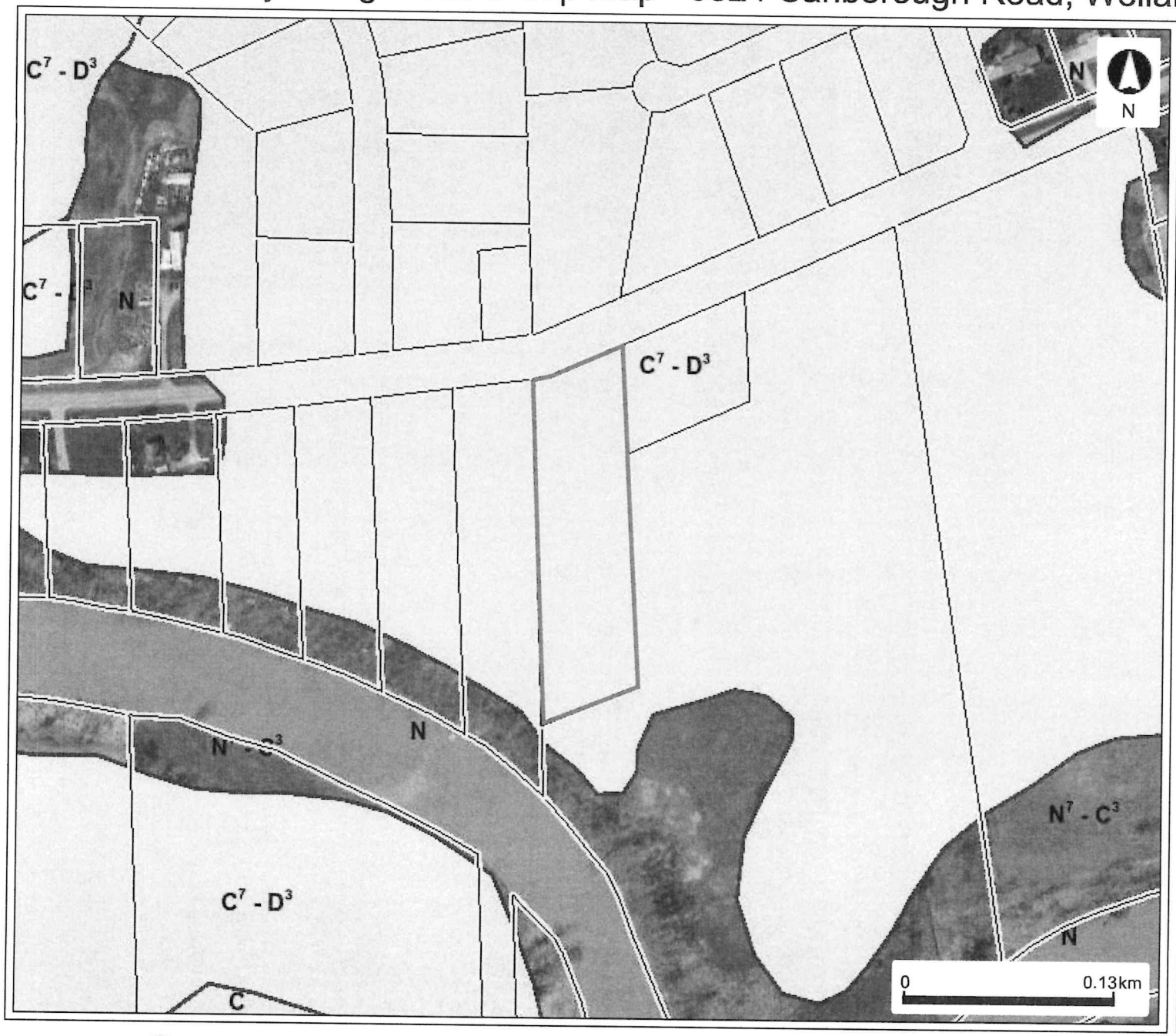
Mass Sample (g): 242.2 T (oC) 20

Poorly sorted clay with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.409E-07	.409E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	.467E-07	.467E-09	0.00	
Slichter	.956E-08	.956E-10	0.00	
Terzaghi	.156E-07	.156E-09	0.00	
Beyer	.426E-07	.426E-09	0.00	
Sauerbrei	.319E-07	.319E-09	0.00	
Kruger	.192E-04	.192E-06	0.02	
Kozeny-Carmen	.237E-05	.237E-07	0.00	
Zunker	.148E-05	.148E-07	0.00	
Zamarin	.172E-05	.172E-07	0.00	
USBR	.871E-08	.871E-10	0.00	
Barr	.112E-07	.112E-09	0.00	
Alyamani and Sen	.702E-09	.702E-11	0.00	
Chapuis	.191E-09	.191E-11	0.00	
Krumbein and Monk	.292E-03	.292E-05	0.25	
Shepherd	.211E-05	.211E-07	0.00	
geometric mean	6.E-09	6.E-11	0.00	
arithmetic mean	1.E-08	1.E-10	0.00	

Hydrologic Soil Group Map - 5324 Canborough Road, Wellandport



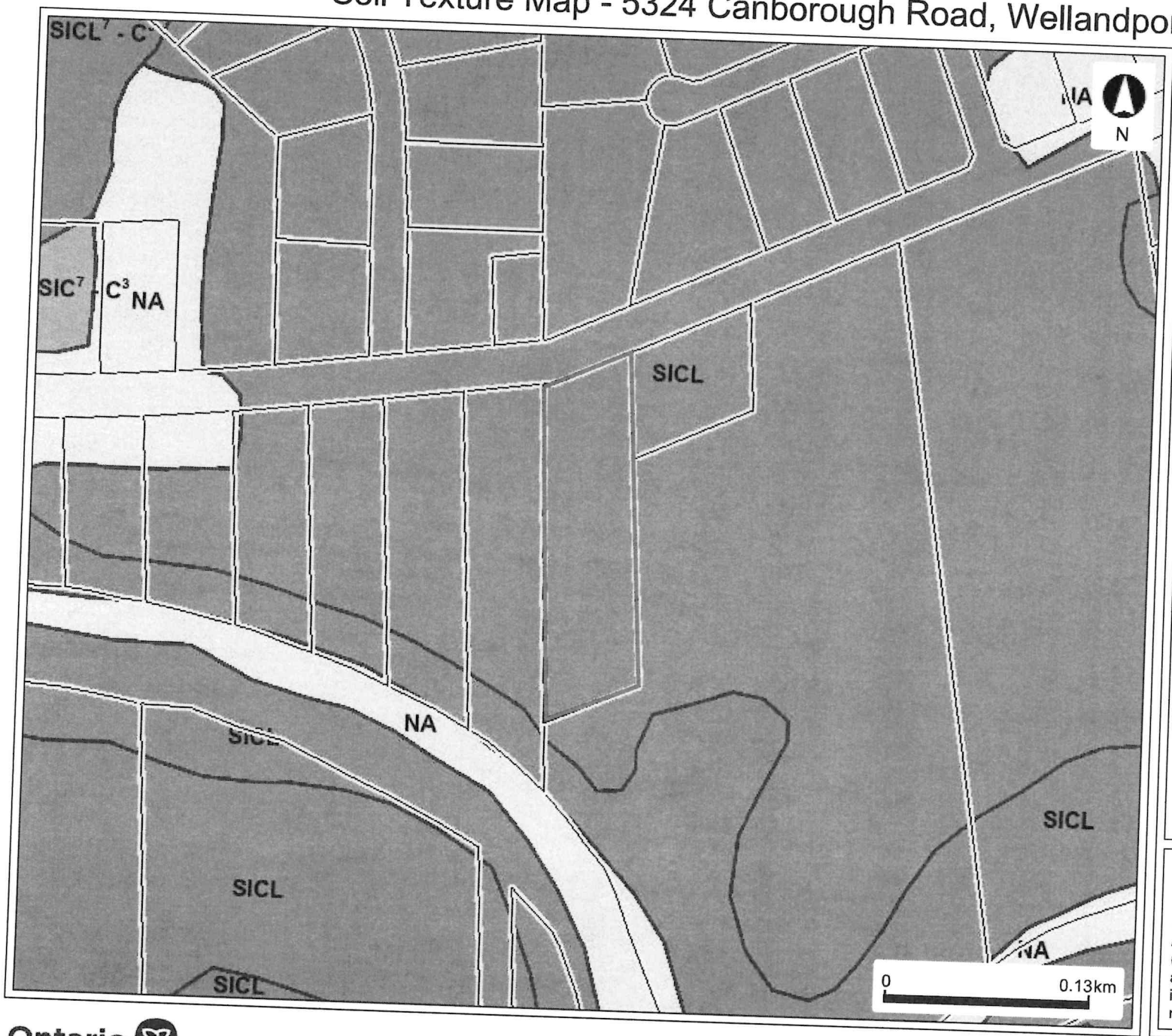
Legend

- Assessment Parcel
- Hydrologic Soil Group
  - A - High
  - B - Moderate
  - C - Slow
  - D - Very Slow
- Site

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Map Created: 6/7/2024
Map Center: 43.00171 N, -79.4899 W

Soil Texture Map - 5324 Canborough Road, Wellandport



Legend

- Assessment Parcel
- Surface Texture
  - <Null>
  - C
  - CL
  - CSL
  - FSL
  - GL
  - GLS
  - GRAV
  - GS
  - GSL
  - L
  - LCS
  - LFS
  - LS
  - FS
  - LVFS
  - ORG
  - R
  - S
  - SIC
  - SICL
  - SIL
  - SL
  - VAR
  - VFSL
  - VSFL
- Site

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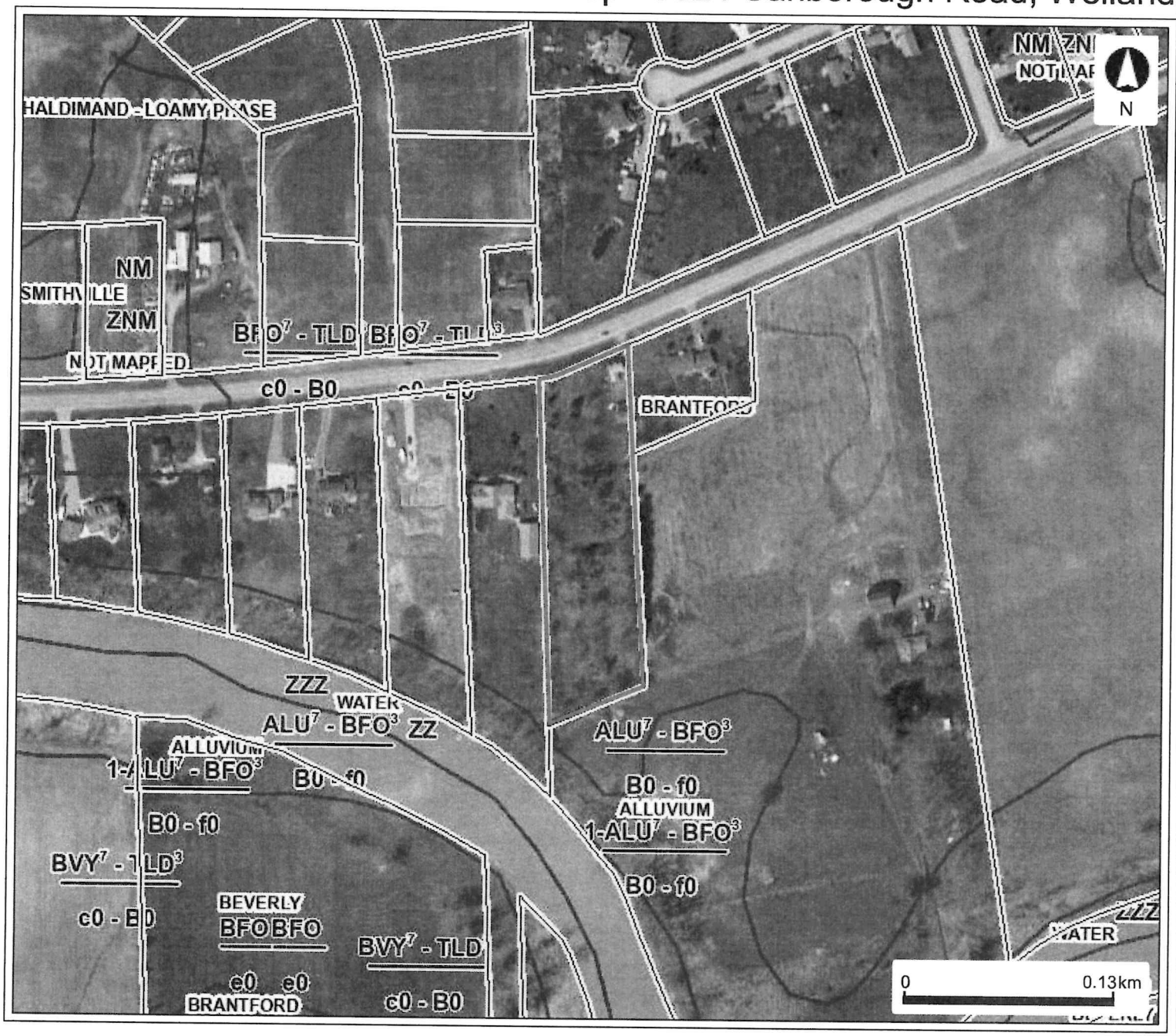
Map Created: 6/7/2024
Map Center: 43.00171 N, -79.48995 W

Soil Classification Map - 5324 Canborough Road, Wellandport



Legend

- Assessment Parcel
- Soil Name Label
- Soil Code
- Soil Symbol
- Site

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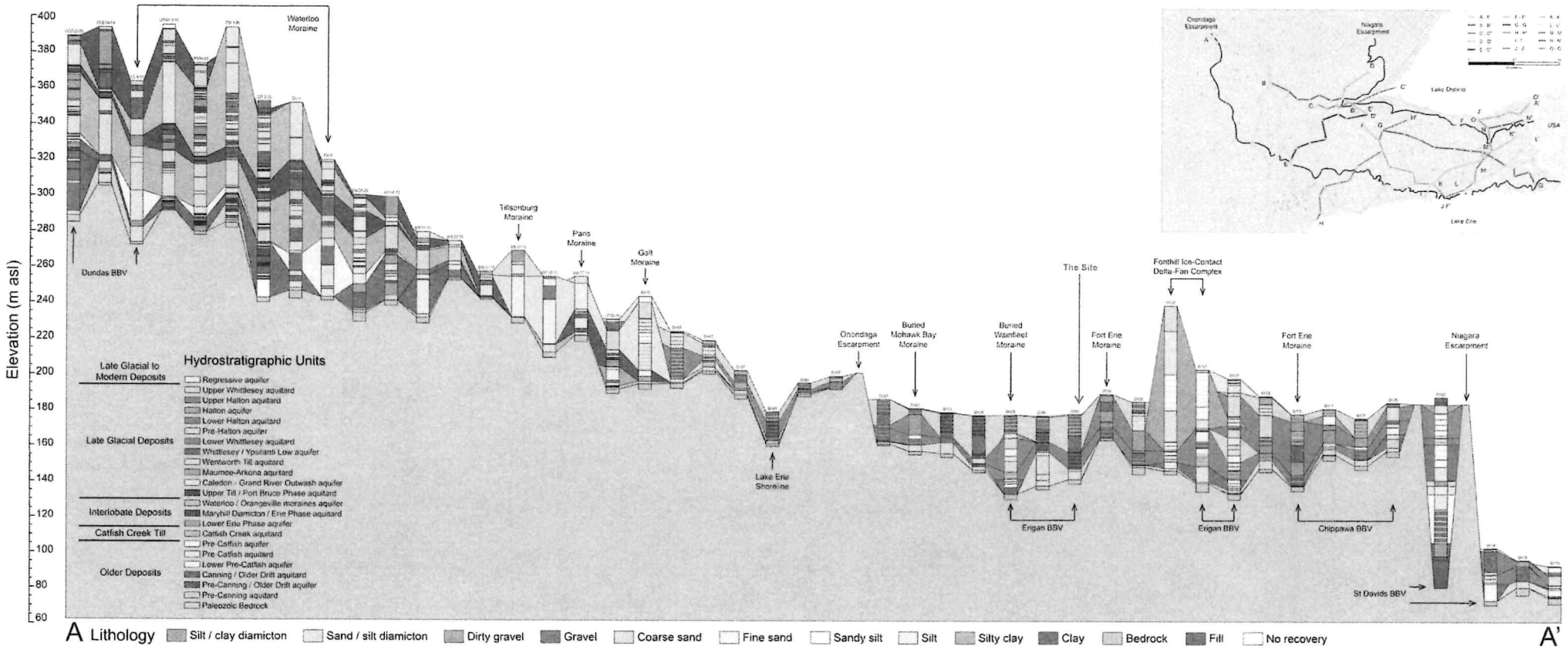
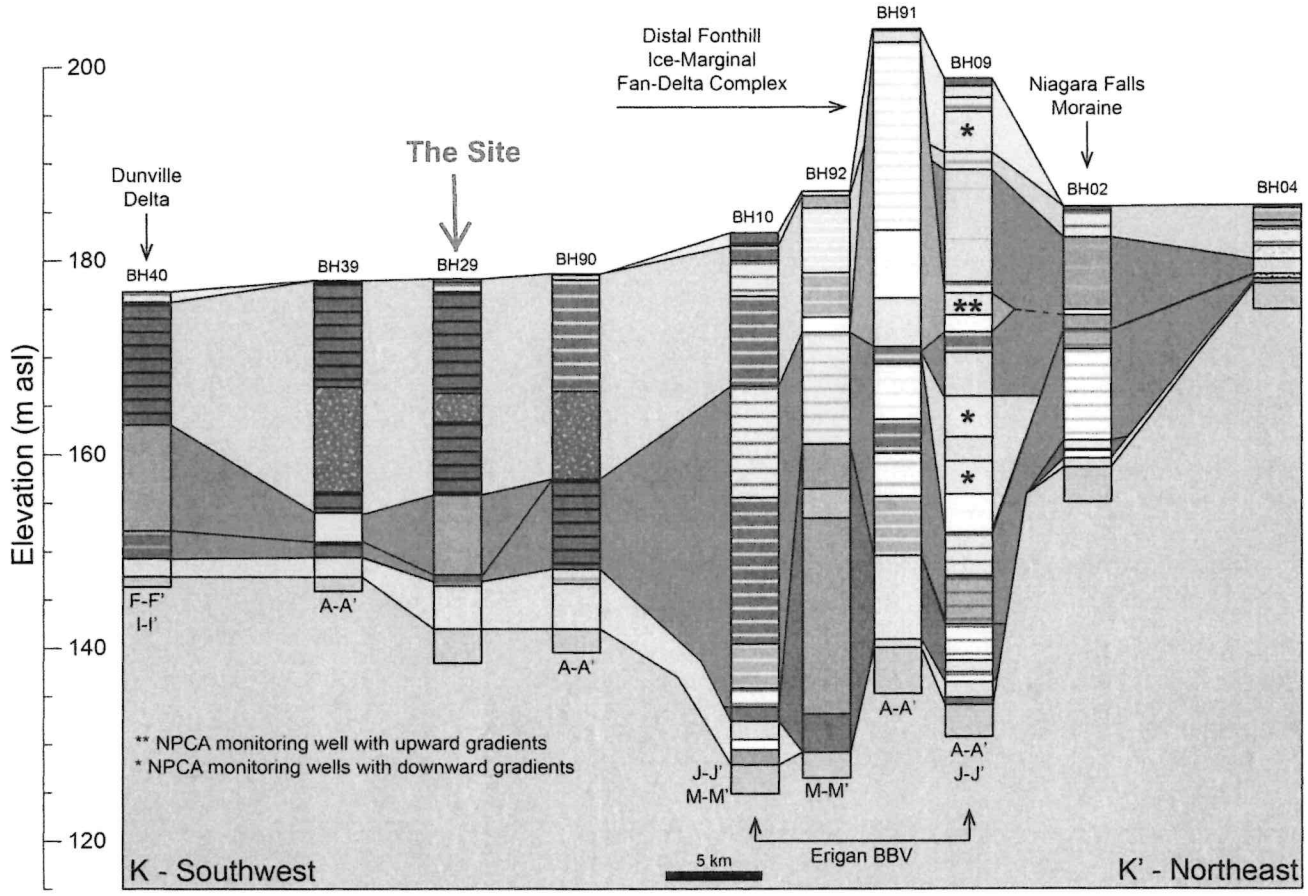
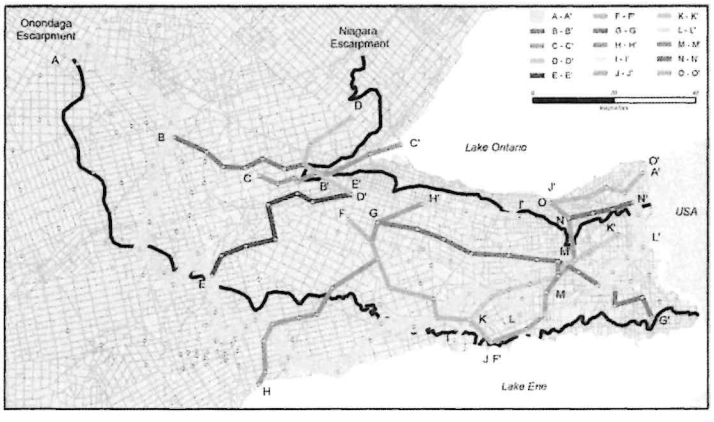
Map Created: 6/7/2024
Map Center: 43.00171 N, -79.48995 W


Elevation (m asl)
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
Waterloo Moraine
Dundas BBV
Tillsonburg Moraine
Paris Moraine
Galt Moraine
Lake Erie Shoreline
Onondaga Escarpment
Buried Mohawk Bay Moraine
Buried Waterloo Moraine
The Site
Fort Erie Moraine
Fonthill Ice-Contact Delta-Fan Complex
Erigan BBV
Erigan BBV
Chippawa BBV
Niagara Escarpment
St Davids BBV
Hydrostratigraphic Units
Late Glacial to Modern Deposits
Regressive aquifer
Upper Whittlesey aquitard
Upper Halton aquitard
Halton aquifer
Lower Halton aquitard
Pre-Halton aquifer
Late Glacial Deposits
Lower Whittlesey aquitard
Whittlesey / Ypsilanti Low aquifer
Wentworth Till aquitard
Maumee-Arkona aquitard
Caledon - Grand River Outwash aquifer
Upper Till / Port Bruce Phase aquitard
Waterloo / Orangeville moraines aquifer
Interlobate Deposits
Maryhill Diamicton / Erie Phase aquitard
Lower Erie Phase aquifer
Catfish Creek Till
Catfish Creek aquitard
Pre-Catfish aquifer
Pre-Catfish aquitard
Lower Pre-Catfish aquifer
Older Deposits
Canning / Older Drift aquitard
Pre-Canning / Older Drift aquifer
Pre-Canning aquitard
Paleozoic Bedrock
A
Lithology
Silt / clay diamicton
Sand / silt diamicton
Dirty gravel
Gravel
Coarse sand
Fine sand
Sandy silt
Silt
Silty clay
Clay
Bedrock
Fill
No recovery
A'





Hydrostratigraphic Units

- Regressive aquifer
- Upper Whittlesey aquitard
- Upper Halton aquitard
- Halton aquifer
- Lower Halton aquitard
- Pre-Halton aquifer
- Lower Whittlesey aquitard
- Whittlesey / Ypsilanti Low aquifer
- Wentworth Till aquitard
- Maumee-Arkona aquitard
- Caledon - Grand River Outwash aquifer
- Upper Till / Port Bruce Phase aquitard
- Waterloo / Orangeville moraines aquifer
- Maryhill Diamicton / Erie Phase aquitard
- Lower Erie Phase aquifer
- Catfish Creek aquitard
- Pre-Catfish aquifer
- Pre-Catfish aquitard
- Lower Pre-Catfish aquifer
- Canning / Older Drift aquitard
- Pre-Canning / Older Drift aquifer
- Pre-Canning aquitard
- Paleozoic Bedrock

Lithology

- Silt / clay diamicton
- Sand / silt diamicton
- Dirty gravel
- Gravel
- Coarse sand
- Fine sand
- Sandy silt
- Silt
- Silty clay
- Clay
- Ice-rafted debris
- Rhythmic bedding
- Bedrock
- Fill
- No recovery