



Terra-Dynamics Consulting Inc.

432 Niagara Street, Unit 2 St. Catharines, ON L2M 4W3

September 11, 2023

Mr. Edmund Jang
821E-278 Buchanan Drive
Markham, ON L3R 6J1

Re: Hydrogeological Study– Part of Lot 7, Concession 9, Clinton Township,
Spring Creek and Tintern Roads, Town of Lincoln, ON

Dear Mr. Jang,

1.0 Introduction, Background Information and Purpose

Terra-Dynamics Consulting Inc. were retained to complete a Hydrogeological Study of sewage impacts to support a series of consents, or severances, of Part of Lot 7, Concession 9, Clinton Township, Spring Creek and Tintern Roads (the Site, Figure 1). The Site is 6.59 hectares (ha) and as documented in this study each consent can be a minimum of 0.4 hectares (1.0 acre) in size. The hydrogeological study assessed the risk to groundwater supplies from new private sewage systems. The new lots will be supplied potable water via cisterns. The hydrogeological study is a requirement of the Town of Lincoln and Niagara Region:

Town of Lincoln Official Plan Policy 2.2.4(b) (Town, 2018):

(ii) New lots shall be a minimum of 1 hectare unless it is determined through a hydrogeological study that a smaller lot size will adequately accommodate a private water supply and sustainable private services. In all cases, a minimum of 0.4 hectares of useable lot area for sustainable private services shall be provided.

(iii) All development must have an adequate private water supply and be suitable for private waste disposal in accordance with the requirements of the Region and/or the Ministry of the Environment

Niagara Official Plan Policy 4.1.9.2(b) [Niagara Region, 2022]:

...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...

The following documents the hydrogeological study of the Site.

2.0 Methodology

The following methodologies were used to investigate the Site:

- A. Submission of a Hydrogeological Study Terms of Reference to Niagara Region and the Town of Lincoln (Town).

- B. Evaluation of Ministry of Environment, Conservation and Parks (MECP) water well and Ministry of Natural Resources and Forestry (MNRF) well records located within 200 metres of the Site.
- C. A Site visit to observe existing site conditions and collect two shallow soils samples by hand-auger.
- D. Mailing of a water use survey to properties within 100 m of the Site.
- E. Assessment of geological information using regional mapping of elevation, sediments/overburden and bedrock.
- F. Preparation of a description of the hydrogeological setting using physical/geological information.
- G. Assessment of the aquifer vulnerability completed using (a) provincial procedure D-5-4 (MECP, 1996) and (b) groundwater vulnerability procedures described by the Niagara Peninsula Source Protection Authority (NPSA) (NPCA, 2013).

Terra-Dynamics Consulting Inc. began the assessment once confirmation of the appropriateness of the Terms of Reference was received from Niagara Region (2023) and the Town (2023).

As the new lots will be provided potable water via cisterns, this report does not include a water supply assessment (MECP, 1996b), but a development agreement is recommended to be implemented that will indicate water supply by cisterns only.

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

MECP Water Well Records (WWRs) within 200 m of the Site were reviewed and five records identified. A sixth record was also added outside 200 m to the northeast in order to assist with characterizing the physical setting (Figure 2 and Appendix A). Of note, it was determined that one of the wells is actually located 120 m away from the Site (WWR 7051423) according to the water well contractor map and was misplotted by the MECP but corrected on our Figure 2.

The date of drilling of the water wells ranged from 1952 to 2007. The six water well records were constructed to take water from the bedrock aquifer and were reported to contain fresh water at a moderate supply rate, with the average rate being 6 Imperial gallons per minute (l/gpm). Clay was noted in each WWR protecting the bedrock aquifer with an average clay thickness of 16.3 metres. This clay aquitard protects the bedrock aquifer from water quality impacts at surface.

Additional details can be found below in Table 1: Summary of Water Well Records. There are no water wells at the site according to the MECP database, and none were observed during the site visit on June 19, 2023.

Table 1: Summary of Water Well Records

WWIS	Year Constructed	Bedrock Depth (mBGS)	Static Water Level (mBGS)	Finished Well Depth (mBGS)	Depth into Bedrock (m)	Rated (lgpm)	Water Quality	Aquifer	Purpose
3803955	2001	15.2	6.7	22.3	7.0	5	Fresh	Bedrock	Public supply
3802468	1977	14.0	7.6	17.4	3.4	8			Domestic supply
7051423	2007	20.7	9.1	32.9	12.2	3			Public supply
3801870	1969	16.5	9.8	24.1	7.6	4			Domestic supply
3803284	1989	16.2	5.5	18.9	2.7	10			Domestic supply
3800400	1952	15.2	8.2	19.8	4.6	3			Domestic supply
MEDIAN		15.7	7.9	21.0	5.8	4.5			
Average		16.3	7.8	22.6	6.2	6			

4.0 Water Well and Sewage System Survey Results

A water use and septic system survey was mailed out on June 14, 2023 to the eighteen developed land parcels located within 200 m of the site (Appendix B). Four responses were received, and the results are summarized below in Table 2: Summer of Water Well Survey Results.

Table 2: Summary of Water Well Survey Results

Address	Comments
2884 Tintern Rd	Water supply by cistern
3185 Tintern Rd	No Response
2949 Tintern Rd	No Response
2942 Tintern Rd	Water supply by cistern, also a well of unknown construction details but is only used for garden irrigation, and the well is located east of the home
2913 Tintern Rd	No Response
2908 Tintern Rd	No Response
2880 Tintern Rd	No Response
3981 Spring Creek Rd	No Response
4004 Spring Creek Rd	No Response
4012 Spring Creek Rd	Water supply by cistern
4020 Spring Creek Rd	No Response
4034 Spring Creek Rd	No Response
4042 Spring Creek Rd	No Response
4050 Spring Creek Rd	No Response

Address	Comments
4058 Spring Creek Rd	No Response
4070 Spring Creek Rd	No Response
2943 Campden Rd	No Response
2875 Campden Rd	No Response

5.0 Physical Setting

The Site is fairly flat with a ground surface elevation of between 181 and 178 metres above sea level (m ASL) that slopes from the south to the northwest (Figure 2).

The Site is within the Spring Creek Watershed, which is within the Twenty Mile Creek Watershed with drainage to the northwest, i.e., towards Spring Creek (Figure 2, AquaResource Inc. and NPCA, 2009). The watercourses on-site are almost entirely mapped as ephemeral and constructed for agricultural drainage (Figure 2, NPCA, 2017).

No gas wells are mapped at the Site (Oil, Gas and Salt Resources Library, 2023).

5.1 Soils

The soils are mapped as a combination of Beverly and Onedia Phase clayey soils across the site (Figure 5). The soils are associated with glaciolacustrine silty clays and are poorly to imperfectly drained, and slowly to moderately permeable with moderate to high surface water runoff (Ontario Ministry of Agriculture and Food (and Rural Affairs) (OMAFRA), 1989). The hydrologic soil group for the Beverly and Onedia soils are group C (Table 2). No tile drainage is mapped at the Site (OMAFRA, 2023).

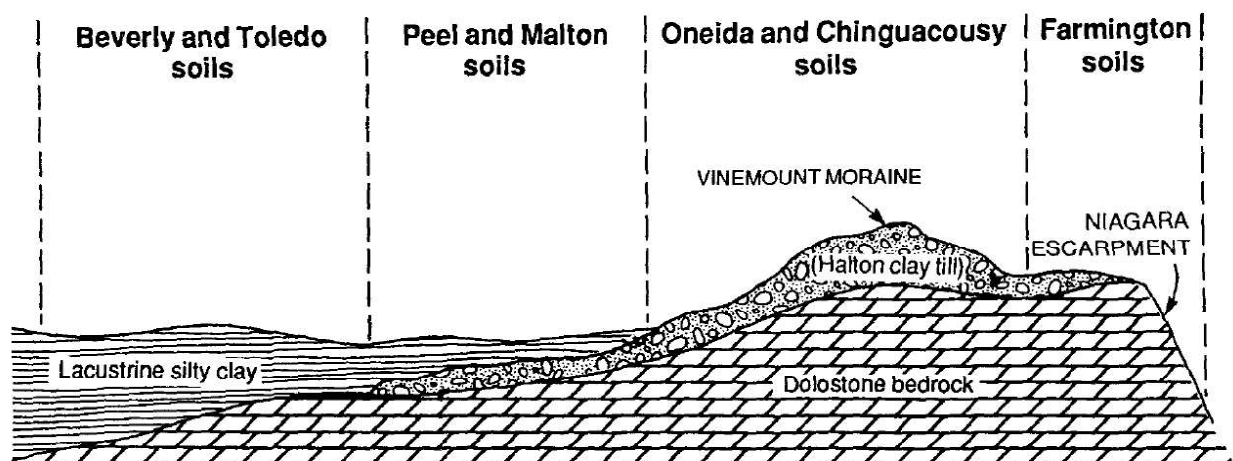


Figure 5 – Schematic cross-section showing the relationship of soils of Vinemount Moraine between the Haldimand Clay Plain and the Niagara Escarpment

Table 2 - Hydrologic Soil Groups (USDA, 1986)

HSG Group	Soil description
A	sand, loamy sand or sandy loam

HSG Group	Soil description
B	silt loam or loam
C	sandy clay loam
D	clay loam, silty clay loam, sandy clay, silty clay or clay

5.2 Overburden Geology

The Site is regionally located on the Haldimand Clay Plain (Chapman and Putnam, 1984) with the surficial geology mapped as silty clay and is classified as glaciolacustrine deeper water clay and silt (Feenstra, 1984, Figure 4).

A hydrogeological section prepared for the project using the MECP water well records (Section 3.0) shows that greater than 10 metres of low permeability clay underlies the Site (Figure 4).

The local cross-section is consistent with a regional geological section produced by the Ontario Geological Survey (OGS) (Appendix C, G-G', the location shown on Figure 1). Two continuous boreholes, BH34 and BH06, were drilled by the OGS in 2016 approximately 7.5 km southwest and 7.1 km southeast of the Site respectively as part of a 3-D investigation of the overburden sediments of the Niagara Peninsula (Burt, 2016) (Figure 1, Appendix C). The OGS have classified the overburden as a series of aquitards (Burt, 2016).

5.3 Bedrock Geology

The bedrock underlying the overburden is Eramosa Member dolostone of the Lockport Formation (Armstrong and Dodge, 2007). Local water wells were constructed in this bedrock aquifer (refer to Section 3.0). The bedrock topography dips to the east-southeast (NPCA, 2013).

5.4 Hydrogeologic Setting

The Site is underlain by a low permeability overburden aquitard which protects the underlying bedrock aquifer as described below and shown in cross-section (Figure 4). The Site is accordingly mapped as having a low intrinsic susceptibility to groundwater contamination (WHI, 2005) and is correctly not mapped as a Highly Vulnerable Aquifer (HVA) by the Niagara Peninsula Source Protection Authority (NPSPA, 2013).

5.4.1 Overburden Aquitard

The surficial silty clay is an overburden aquitard as mapped by Gartner Lee Limited (GLL) (1987) and the OGS (Burt, 2020). The hydraulic conductivity of this silty clay aquitard is expected to be 7×10^{-7} m/s, or less (GLL, 1987). As an aquitard it consists of *"horizons that will not transmit appreciable quantities of water"* (GLL, 1987a).

Two shallow soil samples were collected from the Site (Figure 2) using a hand-auger to a depth of 0.65 m BGS and submitted to a laboratory for grain-size analyses (Appendix D). The Excel-tool HydrogeoSieveXL (Devlin, 2015) was used to process the grain-size analysis to provide a shallow soil hydraulic conductivity estimate of 2×10^{-10} m/s for HA-101 and 1×10^{-9} for HA-102 (Appendix D).

The hydrogeologic section prepared for the Site shows between 15 and 17 metres of clay aquitard underlying the Site and protecting the bedrock aquifer (Figure 4).

Gartner Lee Limited (1987) provided 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 given the low permeability of the aquitard (Haitjema and Mitchell-Bruker, 2005).

5.4.2 Bedrock Aquifer

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..." (Gartner Lee Limited, 1987). The regional potentiometric surface in the bedrock aquifer is mapped at about 176 m ASL with flow towards the southeast (NPSPA, 2013).

5.4.3 Confined Bedrock Aquifer Conceptual Model

The Section 5.0 information is summarized in the schematic below, as a conceptual model for the assessment of potential sewage system impacts to groundwater and private wells (Figure 6).

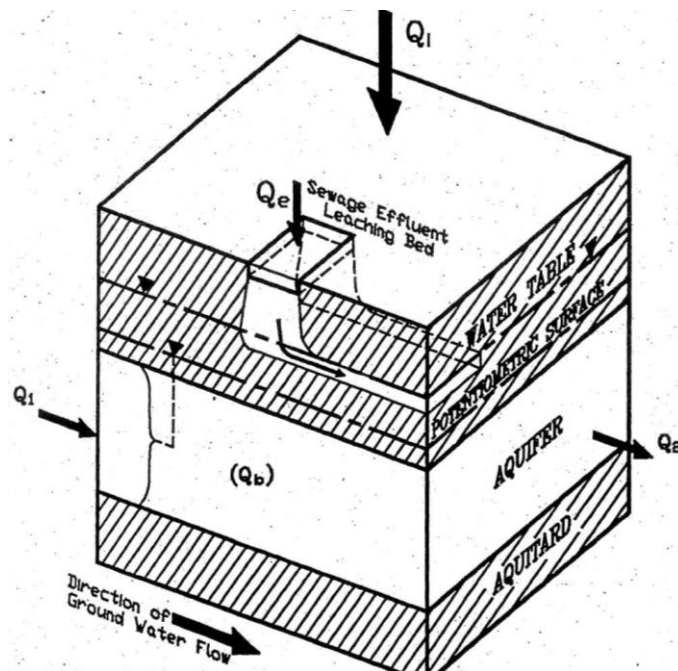


Figure 6 - Confined Aquifer Impact Assessment Subsurface Sewage System (MECP, 1995)

6.0 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.

6.1 System Isolation

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

The Design Guidelines for Sewage Works (MECP, 2008) provides 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 overburden aquitard has a sufficiently low hydraulic conductivity (Section 5.4.1), and mapping of the aquitard thickness shows over 10 metres of material at the Site (Figure 4) extending over 100 metres from the Site.

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

1. The bedrock aquifer has been mapped as having low intrinsic susceptibility (NPCA, 2005); and
2. 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). The *“probable lower physical boundary”* for effluent attenuation is expected to be 2-4 metres below ground surface within the Whittlesey Aquitard given the depths of oxidization identified nearby by the OGS at BH06-NP-2014 and BH34-NP-2014 (Appendix C).

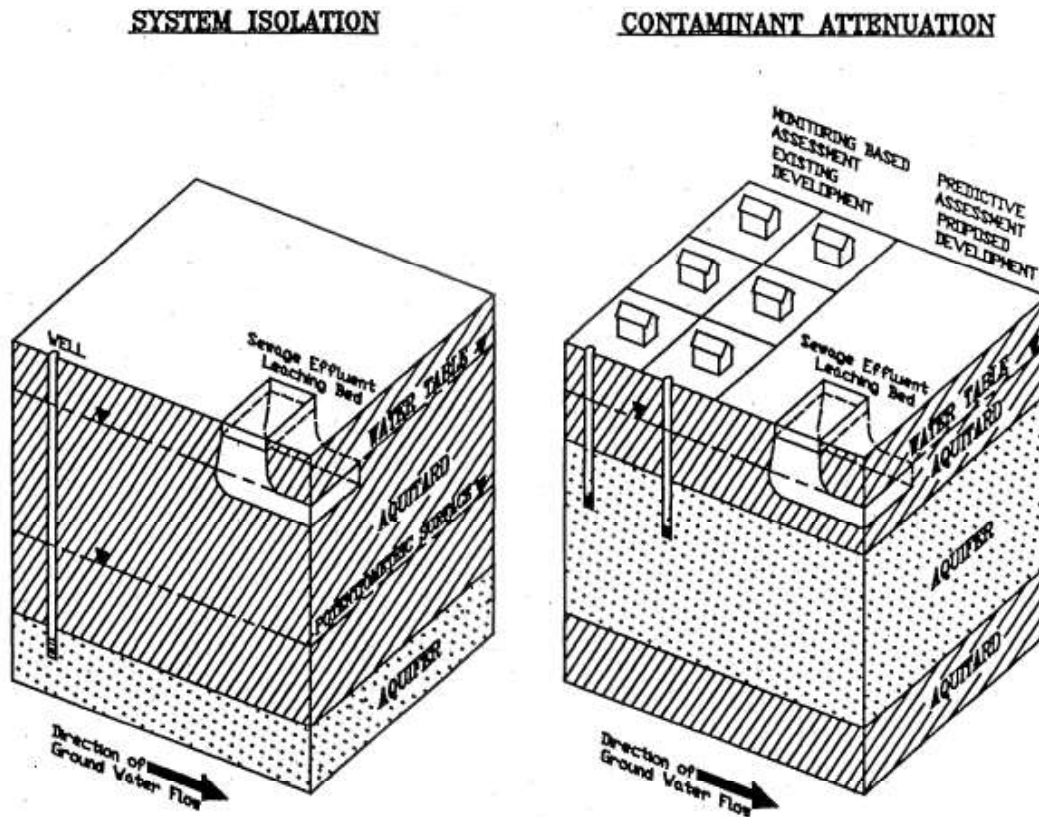


Figure 7 – Water Quality Assessment Process (MECP, 1995)

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). In this case that density is a minimum of 4,047 m² or 1.0 acre (Town of Lincoln, 2018).

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)

6.2 Sewage System Effluent Disposal Location Considerations

Sewage system effluent disposal locations (e.g. raised leaching or filter bed) should be a minimum of 15 m from the future water supply cisterns

7.0 Conclusions and Recommendations

7.1 Conclusions

The following conclusions are provided:

1. The Site is on the Haldimand Clay Plain, recognized as a regional aquitard that does '*not transmit appreciable quantities of water*';
2. The silty clay aquitard beneath the Site has sufficiently low permeability, is greater than 10 m in thickness, and extends greater than 100 m from the Site and is a low permeability environment.
3. The bedrock aquifer is hydrogeologically isolated from the existing and proposed sewage disposals systems by the underling silty clay aquitard.
4. No potable water supplies have been identified off-site exerting Part 8 Ontario Building Code set-backs on proposed sewage disposal systems; and
5. 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). In this case that density is a minimum of 4,047 m² or 1.0 acre (Niagara Region, 2022).
6. There were no hydrogeological-based impediments to site development as long as the following recommendations are implemented.

7.2 Recommendations

The following recommendations are provided for your consideration:

1. Lots on private sewage systems and cisterns may be sustainability created on lot areas of 4,047 m² (1 acre) as long as Ontario Building Code set-backs are met;
2. The design of the Site layout can be completed during the Building Permit stage and will need to ensure minimum 15 m set-backs from the water supply cisterns and the sewage disposal systems; and
3. A development agreement should be completed with the Township indicating water supply will be a cistern(s).

We trust this information is sufficient to 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



Jayme D. Campbell, P. Eng.
Senior Water Resource Engineer

Attachments

Figure 1 – Location of Site
Figure 2 – Regional Information
Figure 3 – Surficial Geology
Figure 4 – Hydrogeologic Section

Appendix A – Water Well Records
Appendix B – Water Well and Septic System Survey
Appendix C – Supporting Information
Appendix D - Hydraulic Conductivity Analyses

8.0 References

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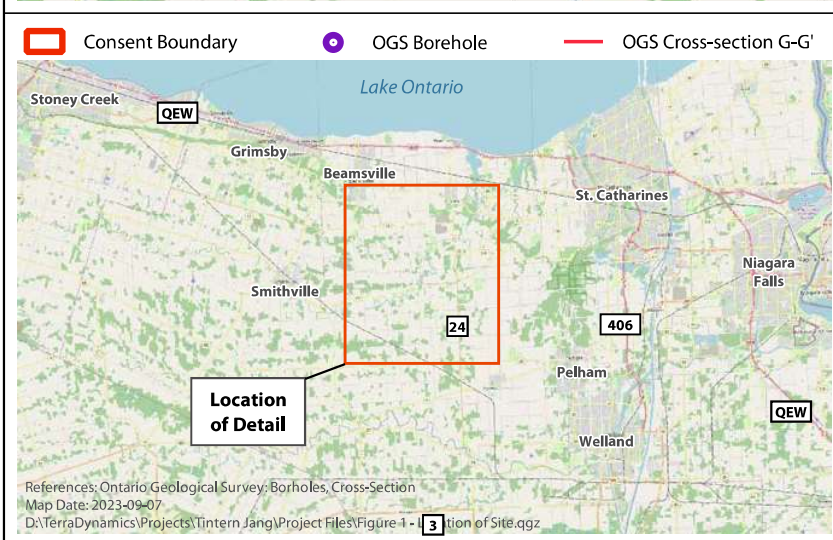
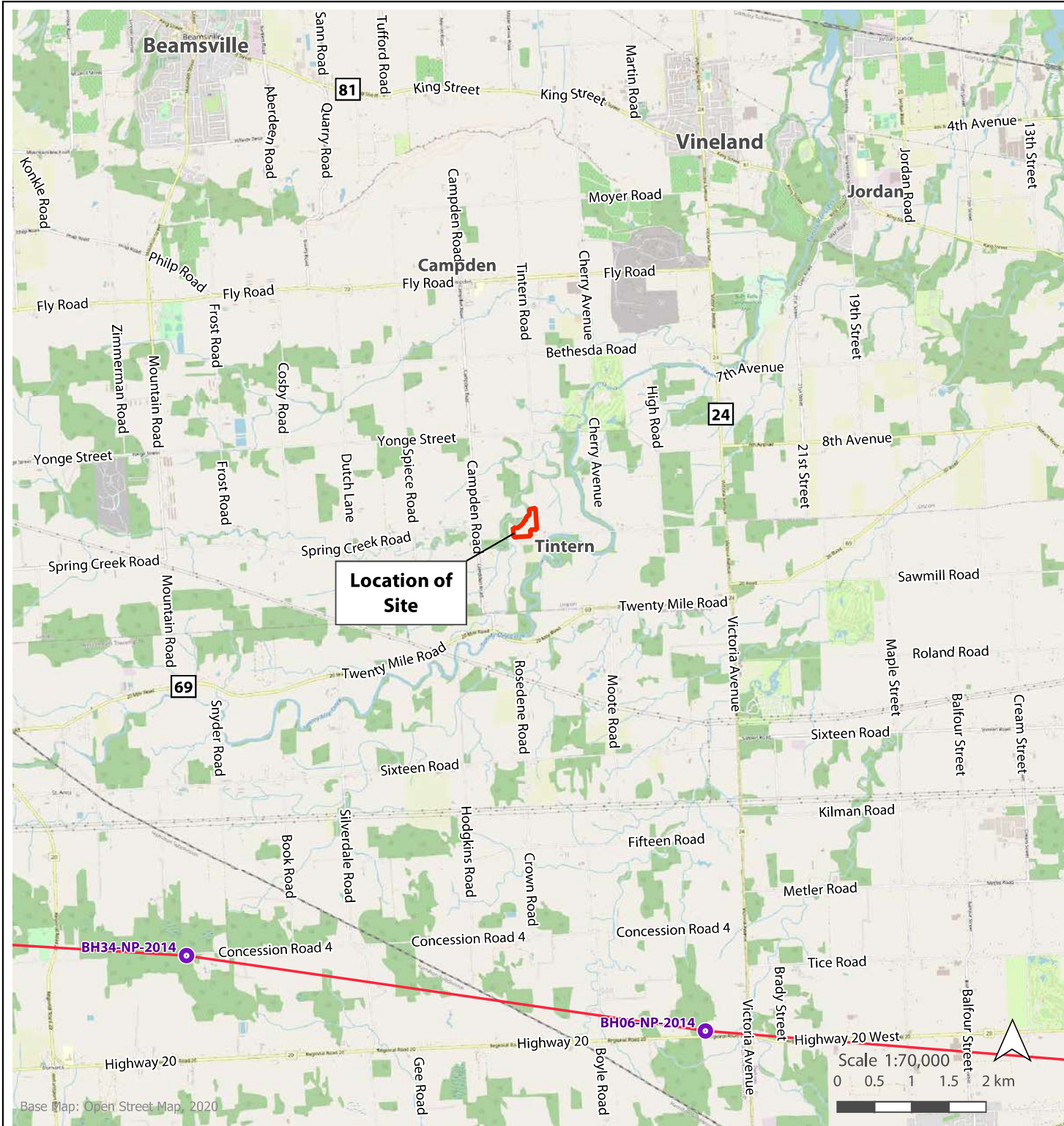
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Figures



Consent Boundary OGS Borehole OGS Cross-section G-G'	
Location of Site	
Hydrogeological Study	
TDC Terra-Dynamics Consulting Inc.	
Prepared for: Edmund Jang	Figure 1



MECP Water Well Record

Hand Auger

Line of Hydrogeologic Cross-Section A-A'

Contour (1m)

Existing Parcel Boundary

Consent Boundary

100m Buffer of Site

Watercourses

Permanent

Ephemeral

Waterbody

Subwatershed Boundary
(Spring Creek and
Twenty Mile Creek)

Regional Information

Hydrogeological Study



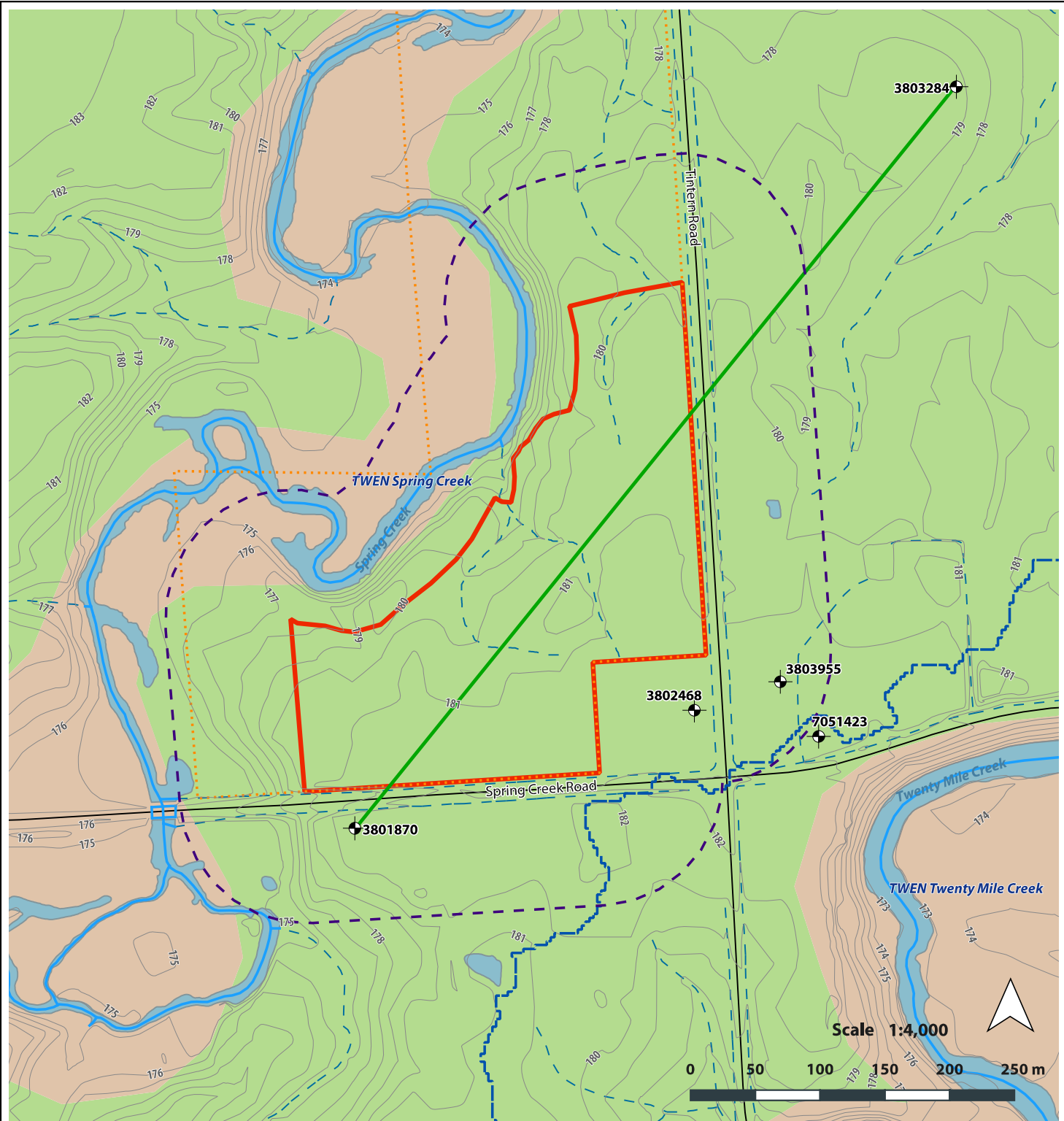
Terra-Dynamics Consulting Inc.

**Prepared for:
Edmund Jang**

Figure 2

References: Ministry of Environment, Conservation and Parks: Drilled Water Wells, 2020. Niagara Region: Orthoimagery, 2015. Niagara Peninsula Conservation Authority: Watercourse, 1:2000. Waterbody 1:2000, Subwatershed 1:2000, Contours (1m) 2020.

Map Date: 2023-09-06 D:\TerraDynamics\Projects\Tintern Jang\Project Files\Figure 2 - Regional Information.ggz



MECP Water Well Record

Existing Parcel Boundary

Consent Boundary

100m Buffer of Site

Subwatershed Boundary

(Spring Creek and
Twenty Mile Creek)

Contour (1m)

Waterbody

Watercourses

Permanent

Ephemeral

Surficial Geology

Silty Clay

Silty Sand

Surficial Geology

Hydrogeological Study



Terra-Dynamics Consulting Inc.

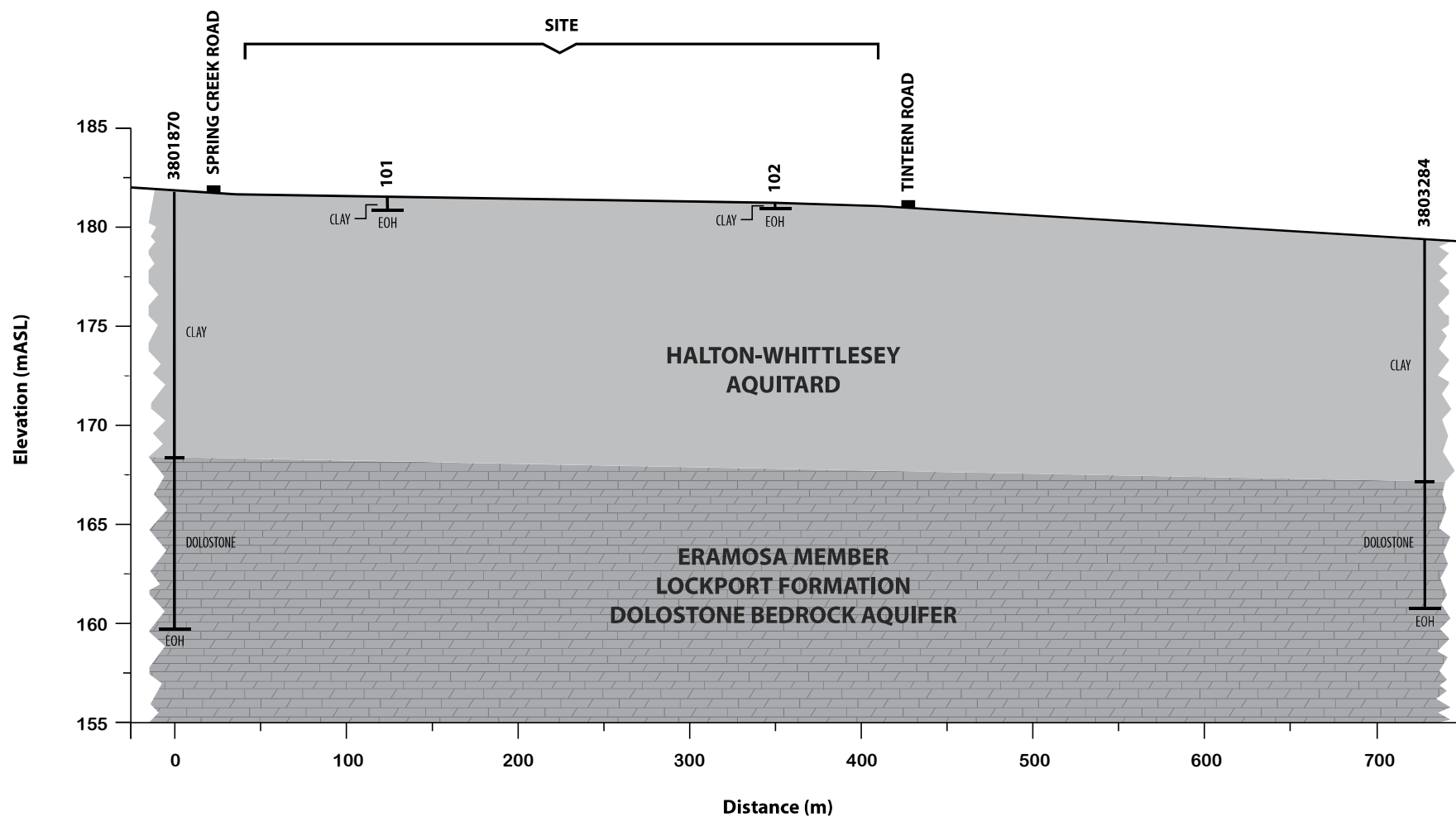
Prepared for:
Edmund Jang

Figure 3

SOUTHWEST

A

A' NORTHEAST



Hydrogeologic Cross-Section A-A'

Hydrogeological Study



Terra-Dynamics Consulting Inc.

**Prepared For:
Edmund Jang**

Figure 4

Appendix A
Water Well Records

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED

2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11

3803284

MUNICIPAL

380.02

CON

|CON

100

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLKCK., TRACT., SURVEY ETC.	LOT
LINCOLN	PALMTO H	9	6
PRIVILEGE LAND		DATE COMPLETED	48-53
		DAY 24 MO 8 YR 88	
NAMING	RC	ELEVATION	RC
		BASIN CODE	II III IV

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

[illegible]

31

32

41	WATER RECORD			
WATER FOUND AT - FEET		KIND OF WATER		
56	10-13	1 ☒ FRESH 2 ☐ SALTY	3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS	10
	15-18	1 ☐ FRESH 2 ☐ SALTY	3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS	15
	20-23	1 ☐ FRESH 2 ☐ SALTY	3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS	20
	25-28	1 ☐ FRESH 2 ☐ SALTY	3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS	25
	30-33	1 ☐ FRESH 2 ☐ SALTY	3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS	30

CASING & OPEN HOLE RECORD				
INSIDE DIAMETER INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET	
			FROM	TO
6 1/4	☐ STEEL ☒ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC	18.8	53	62
17-18	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC	18		20-21
24-25	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC	24		27-31

SCREEN	SIZE(S) OF OPENING (SLOT NO.)	31-33	DIAMETER	34-38	LENGTH	39-41
	INCHES			FEET		
	MATERIAL AND TYPE		DEPTH TO TOP OF SCREEN		41-44	
					FEET	

61		PLUGGING & SEALING RECORD	
DEPTH SET AT - FEET		MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)	
FROM	TO		
10-13	14-17		
18-21	22-25		
26-29	30-33	50	

PUMPING TEST	PUMPING TEST METHOD		10	PUMPING RATE		11-14	DURATION OF PUMPING	
	☐ PUMP ☐ BAILER			20 GPM		1	15-16 HOURS 17-18 MINS	
	STATIC LEVEL	WATER LEVEL END OF PUMPING	25	WATER LEVELS DURING		☐ PUMPING ☒ RECOVERY		
	19-21	22-24	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES		
	18 FEET	30 FEET	26-28 FEET	29-31 FEET	33-34 FEET	35-37 FEET		
IF FLOWING GIVE RATE		30-41	PUMP INTAKE SET AT		WATER AT END OF TEST		42	
		GPM			☒ CLEAR ☐ CLOUDY			
RECOMMENDED PUMP TYPE			RECOMMENDED PUMP SETTING	43-45	RECOMMENDED PUMPING RATE	46-48		
☐ SHALLOW ☐ DEEP			45	FEET	10	GPM		
50-53								

LOCATION OF WELL

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

W ————— E

SPRING CREEK RD

FINTERN RD

100' WELL

20247

S

DRILLERS REMARKS

FINAL STATUS OF WELL	54	1 ☐ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL	6 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED POOR QUALITY 7 ☐ UNFINISHED 9 ☐ DEWATERING
	55-56	1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER	5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED
WATER USE			
METHOD OF CONSTRUCTION	57	1 ☐ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☒ ROTARY (AIR) 5 ☐ A/R PERCUSSION	6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

CONTRACTOR	NAME OF WELL CONTRACTOR	WELL CONTRACTOR'S LICENSE NUMBER
	FIELD WELL DRILL	62123
	ADDRESS	
	RIVINELAND	
	NAME OF WELL TECHNICIAN	WELL TECHNICIAN'S LICENSE NUMBER
	MARSHALL FIELD	7-0365
	SIGNATURE OF TECHNICIAN/CONTRACTOR	SUBMISSION DATE
	MARSHALL FIELD	DAY _____ MO _____ YR _____

OFFICE USE ONLY	DATA SOURCE	59 CONTRACTOR	59-62	DATE RECEIVED	53-58	5
	21 23		FEB 10 1989			
	DATE OF INSPECTION	INSPECTOR				
	REMARKS					
	WDE CSS.ES					

3301870
30⁷/34



Water management in Ontario

The Ontario Water Resources Commission Act

WATER WELL RECORD LINCOLN

County or District LINCOLN Township Clinton Village Clinton City Clinton
Date completed 19 Mar. 69
(day) (month) (year)
Address Tintern.

Casing and Screen Record

Inside diameter of casing 6 1/4 in.
Total length of casing 55 ft.
Type of screen _____
Length of screen _____
Depth to top of screen _____
Diameter of finished hole 6 in.

Pumping Test

Static level 32 ft.
Test-pumping rate 4 G.P.M.
Pumping level 65 ft.
Duration of test pumping 4 hrs.
Water clear or cloudy at end of test clear.
Recommended pumping rate 3 G.P.M.
with pump setting of 75 feet below ground surface

Well Log

Overburden and Bedrock Record

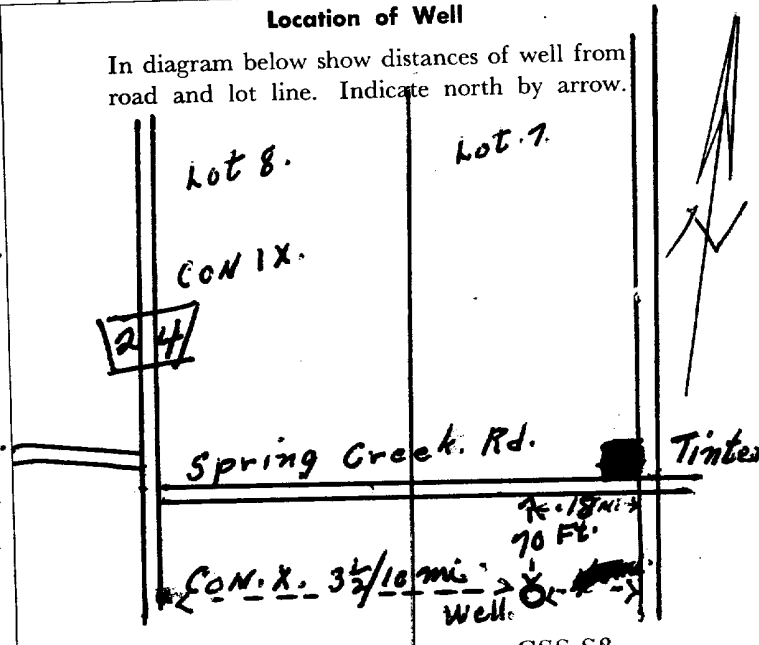
	From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
<u>Brown Clay</u>	<u>0.</u>	<u>22.</u>	<u>56 & 76</u>	<u>fresh.</u>
<u>Blue Clay</u>	<u>22.</u>	<u>54.</u>	<u>57.</u>	
<u>Gray limestone</u>	<u>54.</u>	<u>79.</u>		

Water Record

For what purpose(s) is the water to be used? House.
Is well on upland, in valley, or on hillside? hillside.
Drilling or Boring Firm Frank Merritt
Address R.R. #1. Smithville, Ont.
Licence Number 3341.
Name of Driller or Borer Frank Merritt
Address R.R. #1. Smithville, Ont.
Date Mar. 19/69.
Frank Merritt
(Signature of Licensed Drilling or Boring Contractor)

Location of Well

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





WATER WELL RECORD

30m 3d

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

11 3802468.

MUNICIP. 38002 CON. CEN 09

COUNTY OR DISTRICT LINCOLN	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE CLINTON	CON. BLOCK, TRACT, SURVEY, ETC. IX	LOT 007				
TOWN OF LINCOLN							
RIVERLAND, ONT.		DATE COMPLETED JUNE 1978					
DAY 10 MONTH JUNE YEAR 78							
THING	RC	ELEVATION	RC	BASIN CODE	II	III	IV
333631	4	+0.06	2	74	JUN 17, 1977	285	

3802468 17 628432 4773421 4 604 2 24 JUN 17, 1977 285

LIST OF OVERDRUMMER AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

[illegible]

31	0018605	0046205	0057215			
32						

10		14 15		21	
41		WATER RECORD			
WATER FOUND AT - FEET		KIND OF WATER			
0055		10-13	1 ☒ FRESH	3 ☐ SULPHUR	14
		2 ☐ SALTY	4 ☐ MINERAL		
15-18		1 ☐ FRESH	3 ☐ SULPHUR	15	
		2 ☐ SALTY	4 ☐ MINERAL		
20-23		1 ☐ FRESH	3 ☐ SULPHUR	24	
		2 ☐ SALTY	4 ☐ MINERAL		
25-28		1 ☐ FRESH	3 ☐ SULPHUR	21	
		2 ☐ SALTY	4 ☐ MINERAL		
30-33		1 ☐ FRESH	3 ☐ SULPHUR	34	
		2 ☐ SALTY	4 ☐ MINERAL		

CASING & OPEN HOLE RECORD				
INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET	
			FROM	TO
51 ~~64~~ 06	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE	12 3 1/8	0	0047 57
17-18	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE	19		20-23
24-25	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	26		27-30

SCREEN	SIZE (S) OF OPENING (SLOT NO.)	31-33	DIAMETER	34-38	LENGTH	39-41
			INCHES		FEET	
	MATERIAL AND TYPE		DEPTH TO TOP OF SCREEN		41-44	
					FEET	

61		PLUGGING & SEALING RECORD		
DEPTH SET AT - FEET		MATERIAL AND TYPE	CEMENT GROUT, LEAD PACKER, ETC.)	
FROM	TO			
10-13	14-17			
18-21	22-25			
26-29	30-33	80		

71 PUMPING TEST	PUMPING TEST METHOD		10	PUMPING RATE		11-14	DURATION OF PUMPING	
	☐ PUMP 2 ☒ BAILER			0010 GPM		02 ¹⁵ ~~15~~ ⁰⁰ ~~00~~ HOURS		17-18 MINS
	STATIC LEVEL		WATER LEVEL END OF PUMPING		25 WATER LEVELS DURING		1 ☐ PUMPING 2 ☒ RECOVERY	
	19-21	22-24	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES		
	025	050	025 ²⁴	025 ²⁹⁻³¹	025 ³²⁻³⁴	025 ⁵⁵⁻³⁷		
	FEET	FEET	FEET	FEET	FEET	FEET		
IF FLOWING, GIVE RATE		38-41	PUMP INTAKE SET AT			WATER AT END OF TEST		42
			GPM		FEET	1 ☐ CLEAR 2 ☒ CLOUDY		
RECOMMENDED PUMP TYPE			RECOMMENDED PUMP SETTING		43-45	RECOMMENDED PUMPING RATE		46-49
☐ SHALLOW ☒ DEEP			055 FEET			0008 GPM		
50-53			GPM / FT. SPECIFIC CAPACITY					

FINAL STATUS OF WELL	54 1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL	5 ☐ ABANDONED, INSUFFICIENT PUMP 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED
WATER USE	55-56 1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER	5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED
METHOD OF DRILLING	57 1 ☒ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION	6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

LOCATION OF WELL 2873

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

Lot. 7

Well No. 1

50 ft.

60 ft.

CON. IX

CON. X

Spring Creek Rd.

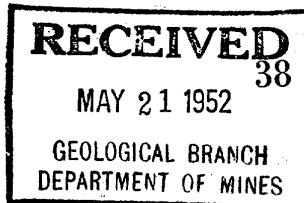
Tinterm Rd.

Lot. 8

DRILLERS REMARKS:

CONTRACTOR	NAME OF WELL CONTRACTOR		LICENCE NUMBER
	Frank Merritt		3608
	ADDRESS		
	RR 1 Smithville, Ont.		
	NAME OF DRILLER OR BORER		LICENCE NUMBER
	Same		
	SIGNATURE OF CONTRACTOR	SUBMISSION DATE	
	Frank Merritt	DAY 10 MO. JUNE YR 75	

OFFICE USE ONLY	DATA SOURCE	1	CONTRACTOR	3608	59-62	DATE RECEIVED	2 307 75	63-68
	DATE OF INSPECTION			INSPECTOR				
	REMARKS:						P	WI
	CSS.S8							



No. 400

The Well Drillers Act

Department of Mines, Province of Ontario

Water Well Record

Con. X Lot 6 Pt. Lot

Aeres

Date Completed Jan. 6, 1975 Cost of Well (not including pump)

Pipe and Casing Record

Pumping Test

Casing diameter(s)	6 1/4	Date	
Length(s) of casing(s)	50	Developed Capacity	
Length of screen		Duration of Test	
Type of screen		Pumping Rate	3 gal per minute
Type of pump		Drawdown	Barley feet
Capacity of pump		Static level of completed well	27'
Depth of pump setting		Is well a gravel-wall type?	

Water Record

Kind (fresh or mineral)	Depth(s) to Water Horizon(s)	Kind of Water	No. of Feet Water Rises
Quality (hard, soft, contains iron, sulphur etc.)	62	fresh	35
Appearance (clear, cloudy, coloured)			
For what purpose(s) is the water to be used?			
How far is well from possible source of contamination?			
What is source of contamination?			
Enclose a copy of any mineral analysis that has been made of water			

Well Log

Drift and Bedrock Record

From

To

0 ft.

• • • •

Clay
Rock

Location of Well

In diagram below show distances of well from road and lot line

1X
7 6
TENTATIVE
X
200

Situation: Is well on upland, in valley, or on hillside?
Drilling Firm *W. L. Field & Son*
Address *W. L. Field & Son*
Recorded by *W. L. Field* Address *W. L. Field*
Date *May 19-52* Licence Number *96* CSS *S8*

© Queen's Printer for Ontario, 2006

Print only in spaces provided.
Mark correct box with a checkmark, where applicable.

11

3803955

Municipality 38002 Con. 09

LINCOLN

County or District <i>Lincoln</i>	Township/Borough/City/Town/Village <i>Clinton Twp</i>	Con block tract survey, etc. <i>Lot</i>
Address <i>R.R.#1, Vineland</i>		Date completed <i>24 4 2001</i>

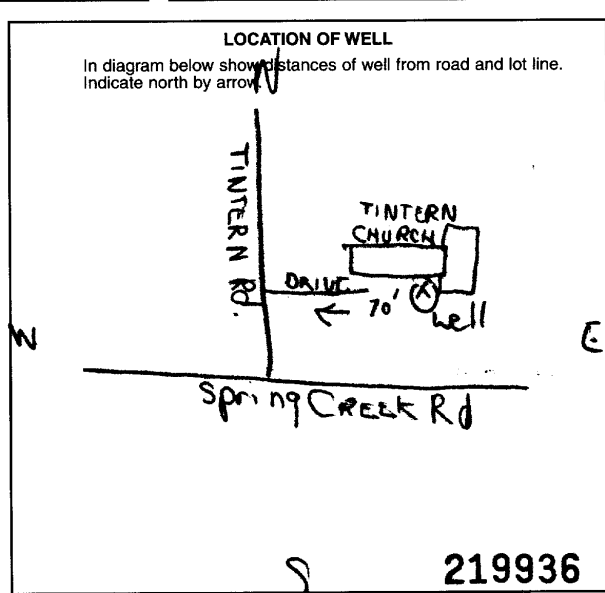
General colour	Most common material	Other materials	General description	Depth - feet	
				From	To
BROWN	clay			0	8
GREY	clay			8	26
GREY	clay	boulders		26	50
Bedrock				50	73

31	32
----	----

41 WATER RECORD Water found at - feet 10-13 68 15-18 20-23 25-28 30-33	51 CASING & OPEN HOLE RECORD Inside diam inches 10-11 188 17-18 6" 24-25	Wall thickness inches 12 188 15 25	Depth - feet From To 10-11 13-16 17-18 20-23 24-25 27-30	61 PLUGGING & SEALING RECORD Sizes of opening (Slot No.) Diameter inches Length feet Material and type Depth at top of screen feet
---	---	---	--	--

71 PUMPING TEST Pumping test method 1 ☐ Pump 2 ☐ Bailor Static level 15-21 22 Water level end of pumping 22-24 If flowing give rate 38-41 Recommended pump type ☐ Shallow ☒ Deep Recommended pump setting 43-45 Recommended pump rate 46-49 5 GPM	Pumping rate 11-14 40 GPM Duration of pumping 15-16 Hours 17-18 Mins
---	--

FINAL STATUS OF WELL 1 ☒ Water supply 2 ☐ Observation well 3 ☐ Test hole 4 ☐ Recharge well 5 ☐ Abandoned, insufficient supply 6 ☐ Abandoned, poor quality 7 ☐ Abandoned (Other) 8 ☐ Dewatering 9 ☐ Unfinished 10 ☐ Replacement well	WATER USE 1 ☐ Domestic 2 ☐ Stock 3 ☐ Irrigation 4 ☐ Industrial 5 ☐ Commercial 6 ☐ Municipal 7 ☒ Public supply 8 ☐ Cooling & air conditioning 9 ☐ Not use 10 ☐ Other
METHOD OF CONSTRUCTION 1 ☒ Cable tool 2 ☐ Rotary (conventional) 3 ☐ Rotary (reverse) 4 ☐ Rotary (air) 5 ☐ Air percussion 6 ☐ Boring 7 ☐ Diamond 8 ☐ Jetting 9 ☐ Driving 10 ☐ Digging 11 ☐ Other	



Name of Well Contractor FIELDWELL DRILLING Address R.R.#1 VINELAND Name of Well Technician Marshall R FIELD Signature of Technician/Contractor	Well Contractor's Licence No. 2123 Well Technician's Licence No. T0365 Submission date day mo yr	Data source 2123 Date received MAY 03 2001 Date of inspection Inspector Remarks CSS.ES1
---	---	--

Appendix B

Water Well and Septic System Survey and Survey Reponses



Terra-Dynamics Consulting Inc.

432 Niagara Street, Unit 2 St. Catharines, ON L2M 4W3

June, 2023

Dear Resident:

On behalf of Edmund Jang, Terra-Dynamics Consulting Inc. is completing a water well survey. This is a survey of properties 100 metres from the proposed consent area as shown on the attached map. We are seeking to map nearby private wells and septic systems as part of a hydrogeologic study to be completed for the Town of Lincoln and Niagara Region. This well and septic system survey is a common recommended component of hydrogeologic, or groundwater studies which informs an understanding of the physical setting and groundwater uses. 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 100 m of the Site (as shown on the attached map).

Participation is voluntary. Participation involves completing the attached questionnaire on your well and/or cistern use, groundwater quantity, quality and your septic system. Please complete it as best as you can, however we would ask if you could respond within a month of receipt of the survey. Please fill out the questionnaire and mail it back to Terra-Dynamics Consulting Inc. in the self-addressed and stamped envelope, or feel free to scan a response and e-mail to jcampbell@terra-dynamics.com. 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.

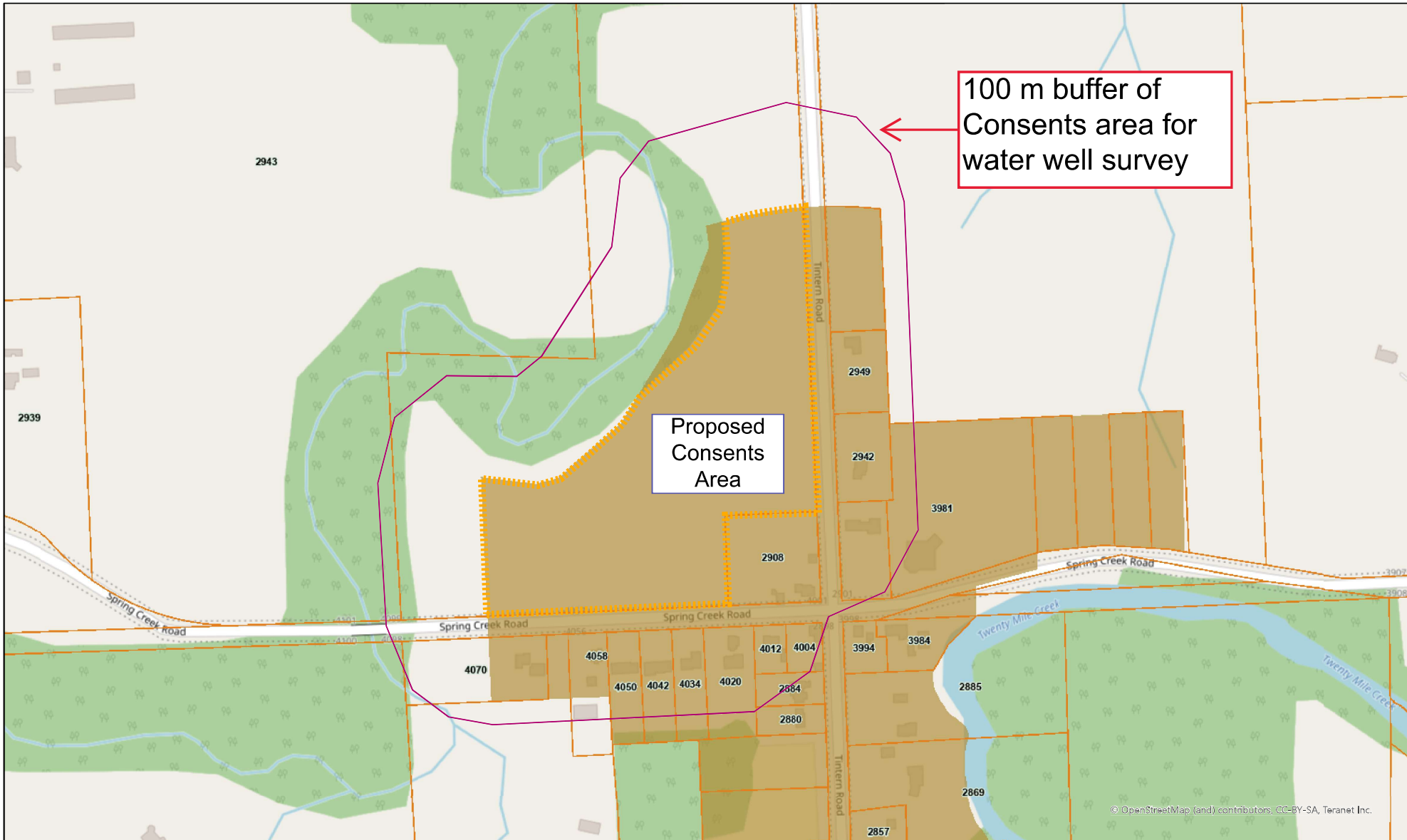
If you have any questions about the questionnaire, please contact Jayme Campbell at 289-407-0915 or via email at jcampbell@terra-dynamics.com.

Thank you in advance for your assistance.

Yours truly,

TERRA-DYNAMICS CONSULTING INC.

Jayme D. Campbell, P.Eng.
Senior Water Resource Engineer





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? _____

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.

Jayme Campbell, P. Eng., Senior Water Resource Engineer
404 Queenston Street, St. Catharines, ON L2P 2Y2
289-407-0915



Terra-Dynamics Consulting Inc.

432 Niagara Street, Unit 2 St. Catharines, ON L2M 4W3

WATER WELL SURVEY FORM

Date: June 21/23

Contact Person: [REDACTED]

Property Address: 2884 Tintern

Telephone: [REDACTED]

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? _____



Terra-Dynamics Consulting Inc.

432 Niagara Street, Unit 2 St. Catharines, ON L2M 4W3

WATER WELL SURVEY FORM

Date: June 28, 2023

Contact Person: [REDACTED]

Property Address: 2942 TINTERN RD, VINELAND ON

Telephone: [REDACTED]

Email (if further information requested): [REDACTED]

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? NOT KNOWN

Is your well drilled into rock? ? What is the well casing diameter? ?

Do you know when your well was drilled? APPROXIMATELY @ 1988

Do you know the name of the well driller? NO

Water Well Survey Form

Page 2

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).

NO

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

GARDEN IRRIGATION

Has your well ever run dry? NO

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

YES - HIGH SULPHUR + IRON

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.).

NO

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

NO

3.0 SHALLOW WELL (less than 20 feet of casing)

N/A

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

see attached

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.

Jayme D. Campbell, P. Eng., Senior Water Resource Engineer
432 Niagara Street, Unit 2, St. Catharines, ON L2M 4W3
905-906-2311



-■-
-□-
SIB
IB
I.P.
WIT.
P. B W. F.

SURVEYOR
I CERTIFY THAT
THE FIELD SURVEY
COMPLETED ON
AUGUST 3,
DATE

BEARINGS ARE ASTRONOMIC AND ARE REFERRED TO THE
EASTERLY LIMIT OF TINTERN ROAD AS SHOWN ON
PLAN 30R-474, HAVING A BEARING OF N 2°22' W.



Terra-Dynamics Consulting Inc.

432 Niagara Street, Unit 2 St. Catharines, ON L2M 4W3

WATER WELL SURVEY FORM

Date: July 24 2023

Contact Person: [REDACTED]

Property Address: 4012 Spring Creek Rd

Telephone: [REDACTED]

Email (if further information requested): [REDACTED]

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? _____

Water Well Survey Form
Page 2

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.)

Water Well Survey Form

Page 3

Has your dug well ever run dry?

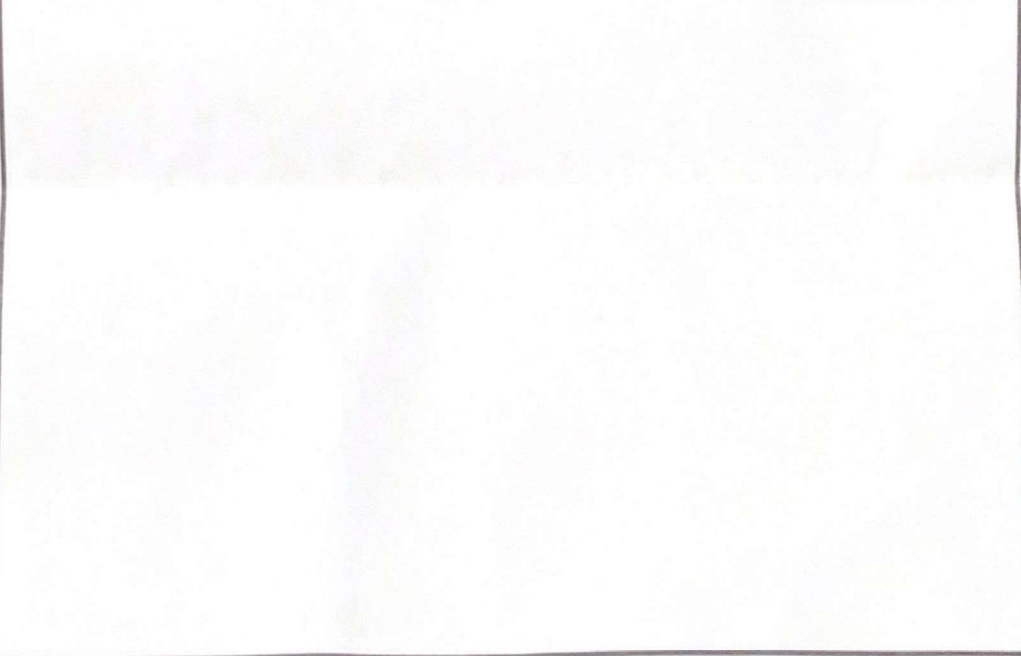
Do you perform regular maintenance on your pump? (i.e. pump service, silt removal)

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



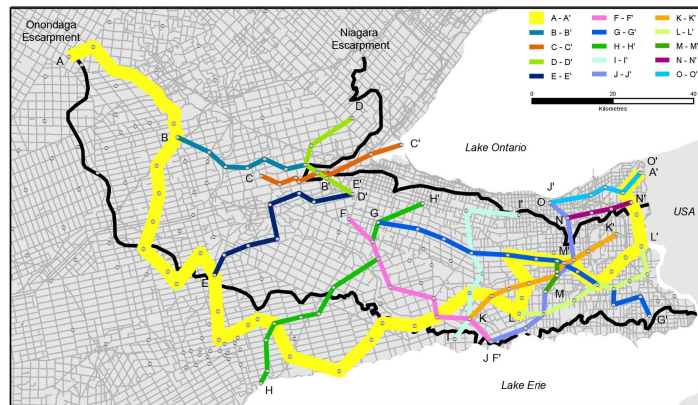
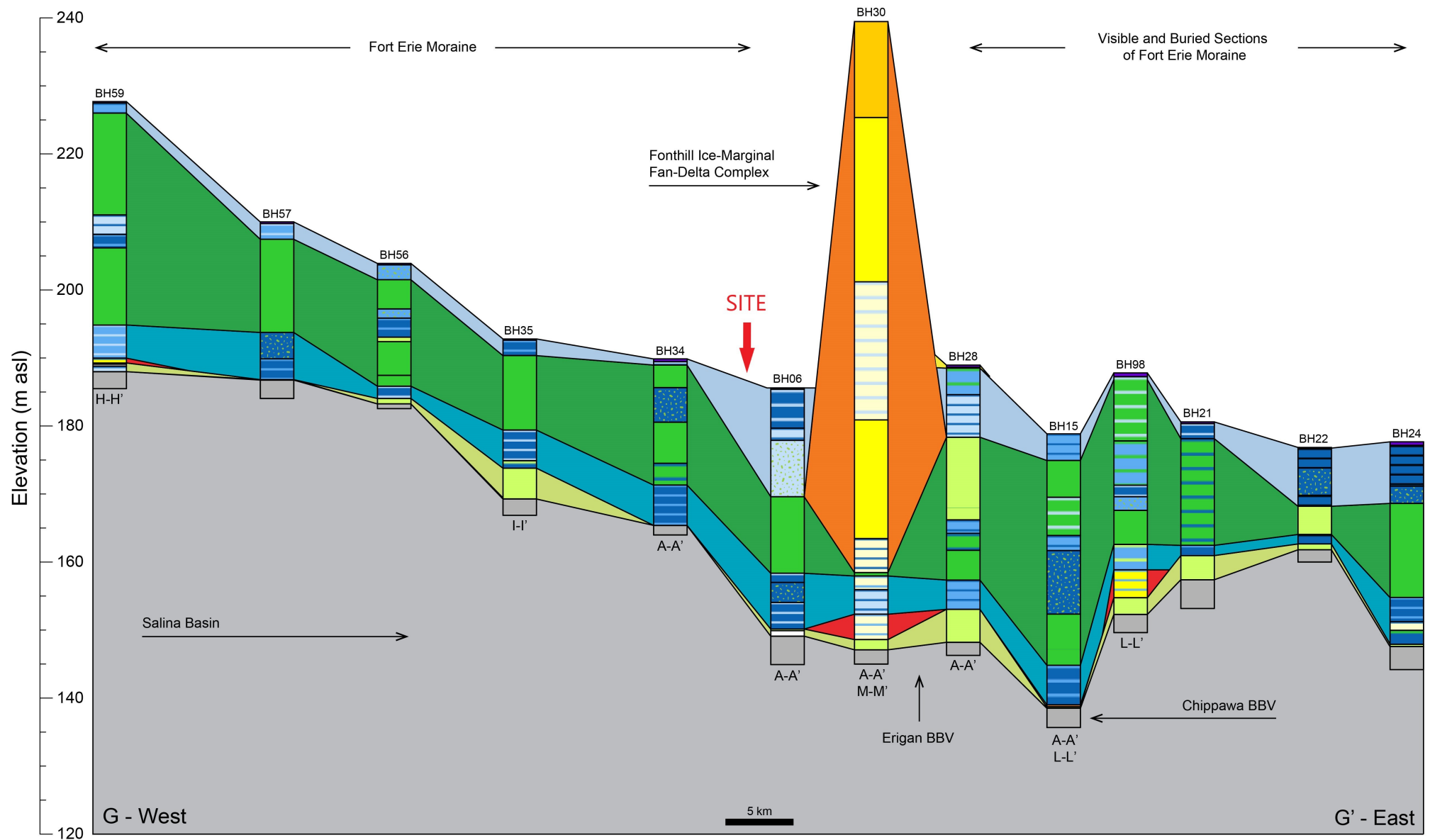
Other Comments: (Use a separate sheet, if required)

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

Jayme D. Campbell, P. Eng., Senior Water Resource Engineer
432 Niagara Street, Unit 2, St. Catharines, ON L2M 4W3
905-906-2311

Appendix C

Supporting Information

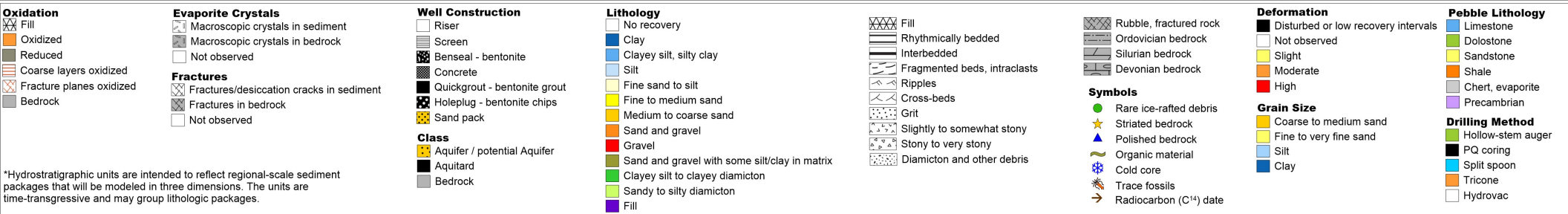


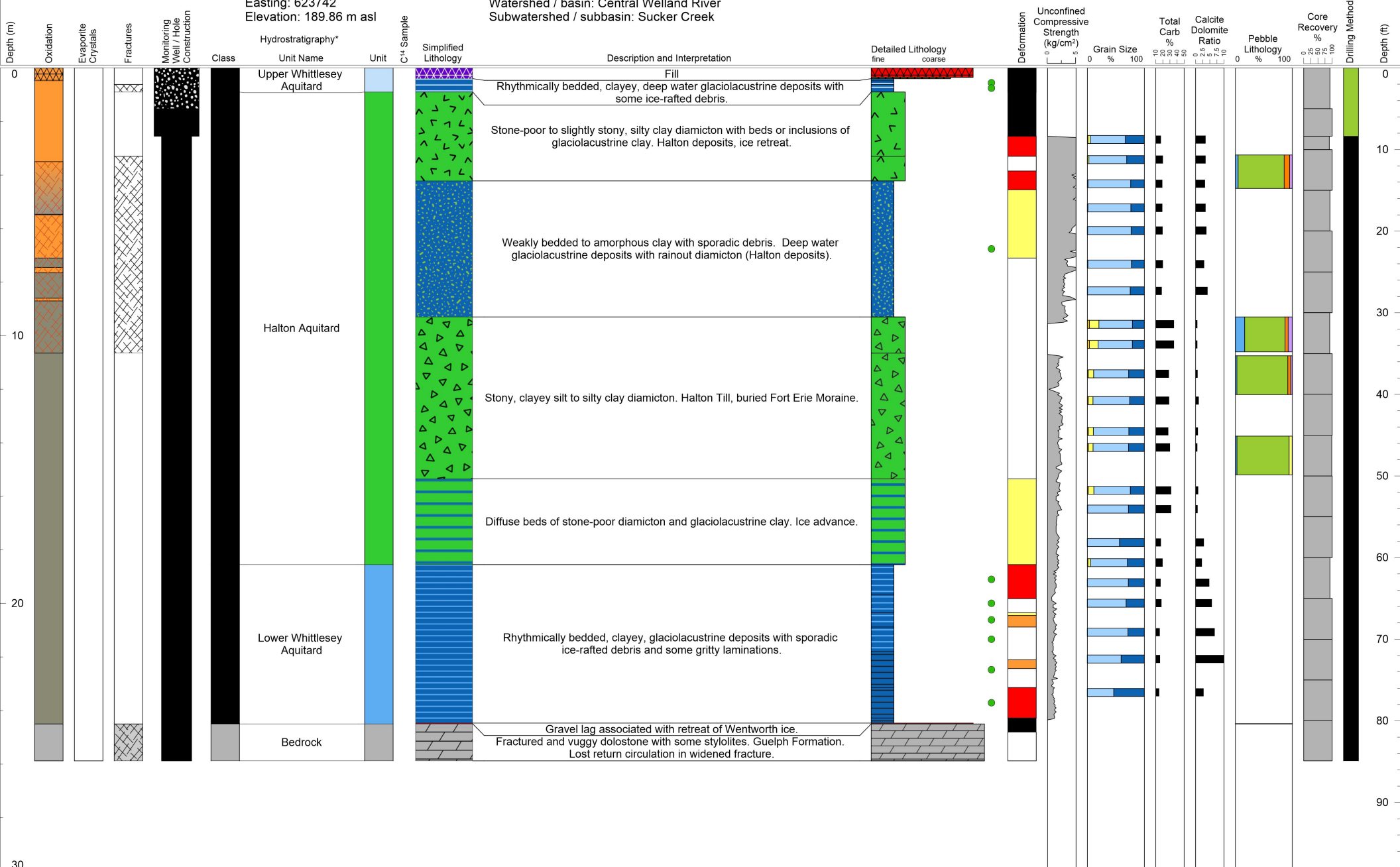
Hydrostratigraphic Units

- 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 Diamict / 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



**Oxidation**

- Fill
- Oxidized
- Reduced
- Coarse layers oxidized
- Fracture planes oxidized
- Bedrock

Evaporite Crystals

- Macroscopic crystals in sediment
- Macroscopic crystals in bedrock
- Not observed
- Fractures**
- Fractures/desiccation cracks in sediment
- Fractures in bedrock
- Not observed

Well Construction

- Riser
- Screen
- Benseal - bentonite
- Concrete
- Quickgrout - bentonite grout
- Holeplug - bentonite chips
- Sand pack
- Class**
- Aquifer / potential Aquifer
- Aquitard
- Bedrock

Lithology

- No recovery
- Clay
- Clayey silt, silty clay
- Silt
- Fine sand to silt
- Fine to medium sand
- Medium to coarse sand
- Sand and gravel
- Gravel
- Sand and gravel with some silt/clay in matrix
- Clayey silt to clayey diamicton
- Sandy to silty diamicton
- Fill

- Fill
- Rhythmically bedded
- Interbedded
- Fragmented beds, intraclasts
- Ripples
- Cross-beds
- Grit
- Slightly to somewhat stony
- Stony to very stony
- Diamicton and other debris

- Rubble, fractured rock
- Ordovician bedrock
- Silurian bedrock
- Devonian bedrock

Symbols

- Rare ice-rafted debris
- Striated bedrock
- Polished bedrock
- Organic material
- Cold core
- Trace fossils
- Radiocarbon (C¹⁴) date

Deformation

- Disturbed or low recovery intervals
- Not observed
- Slight
- Moderate
- High
- Grain Size**
- Coarse to medium sand
- Fine to very fine sand
- Silt
- Clay

Pebble Lithology

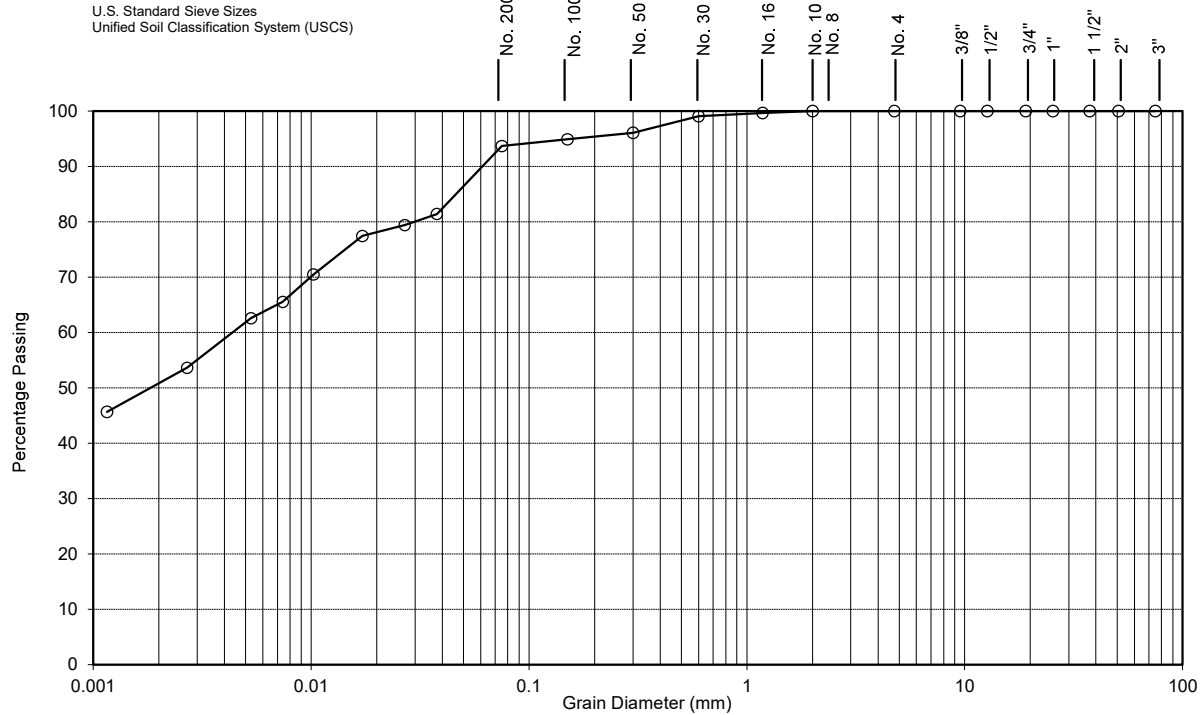
- Limestone
- Dolostone
- Sandstone
- Shale
- Chert, evaporite
- Precambrian
- Drilling Method**
- Hollow-stem auger
- PQ coring
- Split spoon
- Tricone
- Hydrovac

*Hydrostratigraphic units are intended to reflect regional-scale sediment packages that will be modeled in three dimensions. The units are time-transgressive and may group lithologic packages.

Appendix D

Hydraulic Conductivity Analyses

Mechanical & Hydrometer Analyses

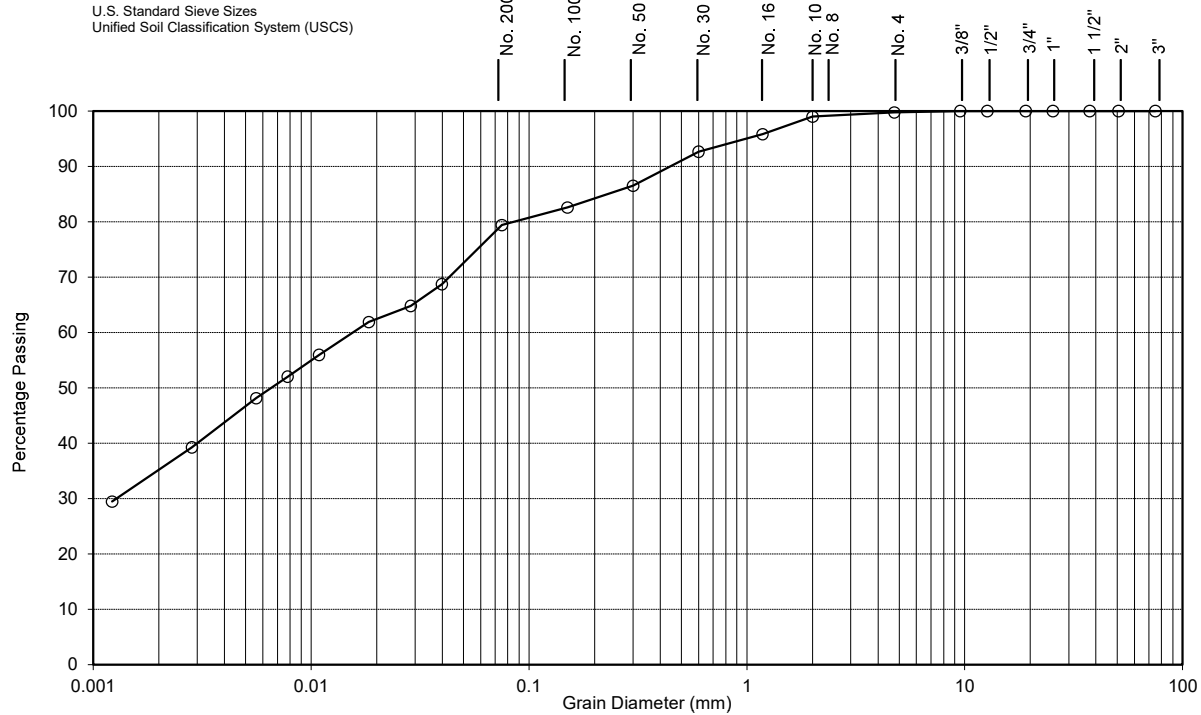


CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

Lab No.:	23-216	Notes: Depth: 66 cm			
Borehole No.:	HA-101				
Sample No.:					
CLAY [%]:	51	Soil Description: Brown Clay and Silt w/ a trace of Sand C.L. - Inorganic clays of low to medium plasticity to M.L. - Inorganic silts and very fine sands			
SILT [%]:	43				
SAND [%]:	6				
GRAVEL [%]:	0	Estimated Infiltration Rate [mm/hr] :	< 5	Estimated Permeability, k [cm/s]	10 ⁻⁹
D ₁₀ (Effective Diam. in mm):	0.00007	Coefficient of Uniformity C _u :	60.0	Coefficient of Curvature C _c :	0.3
SOIL-MAT ENGINEERS & CONSULTANTS LTD.					
Jang - Tintern ON					
June 2023	Grain Size Analysis No. 1			Project No.: SM 230001-T	



Mechanical & Hydrometer Analyses



CLAY	SILT	FINE	MEDIUM	COARSE	FINE	COARSE
		SAND			GRAVEL	

Lab No.:	23-217	Notes: Depth: 65 cm				
Borehole No.:	HA-102					
Sample No.:						
CLAY [%]:	36	Soil Description: Brown Sandy Silt and Clay M.L. - Inorganic silts and very fine sands, clayey silts with slight plasticity, silty or clayey fine sands to C.L. - Inorganic clays of low to medium plasticity				
SILT [%]:	43					
SAND [%]:	21					
GRAVEL [%]:	0	Estimated Infiltration Rate [mm/hr] :		< 5	Estimated Permeability, k [cm/s]	10 ⁻⁸
D ₁₀ (Effective Diam. in mm):	0.0002	Coefficient of Uniformity C _u :		85.0	Coefficient of Curvature C _c :	0.4
SOIL-MAT ENGINEERS & CONSULTANTS LTD.						
Jang - Tintern ON						
June 2023		Grain Size Analysis No. 2		Project No.: SM 230001-T		



K from Grain Size Analysis Report

Date: 19-Jun-23

Sample Name: Jang Tintern HA-101, 0.66 m BGS

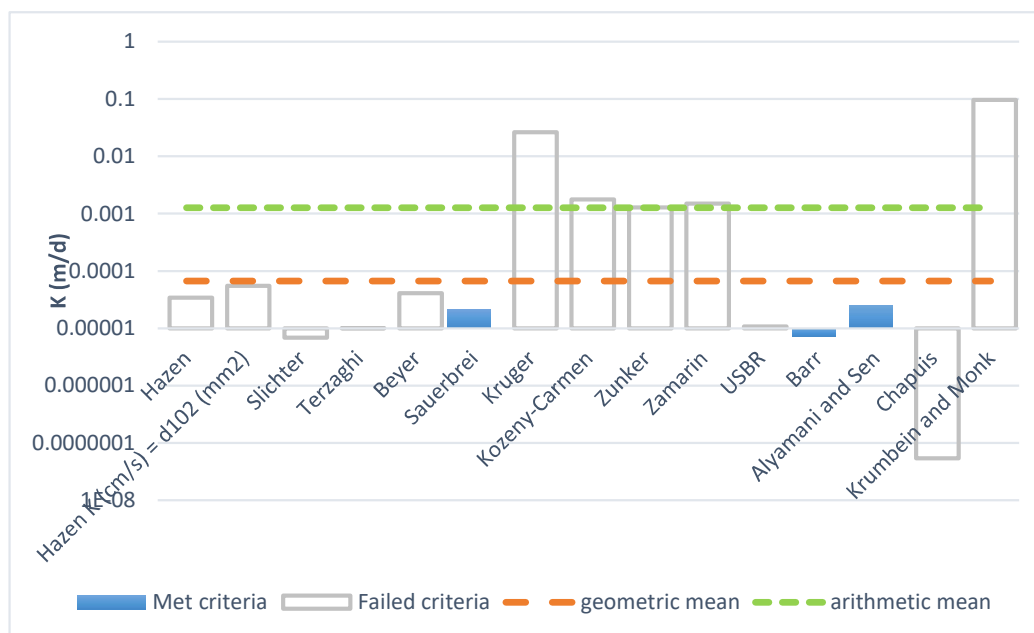
Mass Sample (g):

100

T (oC)

20

Poorly sorted clay with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.396E-07	.396E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	.640E-07	.640E-09	0.00	
Slichter	.797E-08	.797E-10	0.00	
Terzaghi	.117E-07	.117E-09	0.00	
Beyer	.477E-07	.477E-09	0.00	
Sauerbrei	.246E-07	.246E-09	0.00	
Kruger	.306E-04	.306E-06	0.03	
Kozeny-Carmen	.206E-05	.206E-07	0.00	
Zunker	.149E-05	.149E-07	0.00	
Zamarin	.173E-05	.173E-07	0.00	
USBR	.125E-07	.125E-09	0.00	
Barr	.867E-08	.867E-10	0.00	
Alyamani and Sen	.287E-07	.287E-09	0.00	
Chapuis	.625E-10	.625E-12	0.00	
Krumbein and Monk	.111E-03	.111E-05	0.10	
Shepherd	.578E-05	.578E-07	0.00	
geometric mean	2.E-08	2.E-10	0.00	
arithmetic mean	2.E-08	2.E-10	0.00	



K from Grain Size Analysis Report

Date: 19-Jun-23

Sample Name: Jang Tintern HA-102, 0.65 m BGS

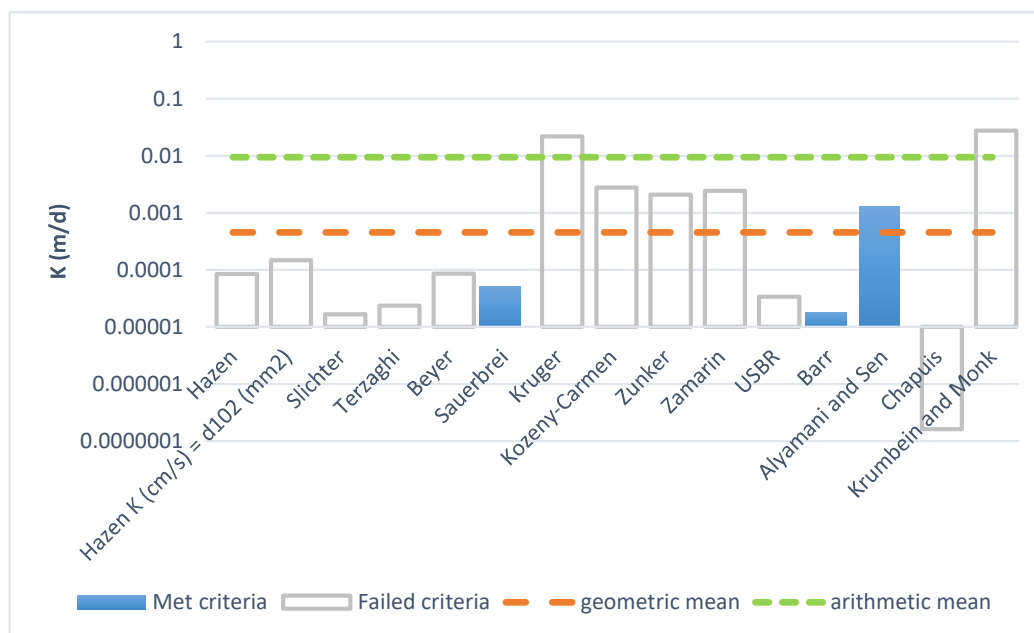
Mass Sample (g):

100

T (oC)

20

Poorly sorted clay with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	.973E-07	.973E-09	0.00	
Hazen K (cm/s) = d ₁₀ (mm)	.172E-06	.172E-08	0.00	
Slichter	.191E-07	.191E-09	0.00	
Terzaghi	.273E-07	.273E-09	0.00	
Beyer	.986E-07	.986E-09	0.00	
Sauerbrei	.583E-07	.583E-09	0.00	
Kruger	.254E-04	.254E-06	0.02	
Kozeny-Carmen	.320E-05	.320E-07	0.00	
Zunker	.242E-05	.242E-07	0.00	
Zamarin	.283E-05	.283E-07	0.00	
USBR	.389E-07	.389E-09	0.00	
Barr	.205E-07	.205E-09	0.00	
Alyamani and Sen	.147E-05	.147E-07	0.00	
Chapuis	.186E-09	.186E-11	0.00	
Krumbein and Monk	.320E-04	.320E-06	0.03	
Shepherd	.422E-04	.422E-06	0.04	
geometric mean	1.E-07	1.E-09	0.00	
arithmetic mean	5.E-07	5.E-09	0.00	