October 18, 2024 Report No. 230114-H1

The Cellular Connection Ltd.
514504 2nd Line
Amaranth, Ontario
L0N 1L0

Attention: Mr. Stuart Turk, Owner

HYDROGEOLOGICAL INVESTIGATION REPORT FOR PROPOSED RESIDENTIAL SUBDIVISION 514504 2ND LINE, AMARANTH, ONTARIO

Prepared for:

The Cellular Connection Ltd.

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1.0 INTRODUCTION

Canada Engineering Services Inc., (CESI) was retained by Mr Stuart Turk of The Cellular Connection Ltd., owner of the property located at 514504 2nd Line, in Amaranth, Ontario, to carry out a Hydrogeological Study for the subject property. It was understood that the owner is proposing to construct roadways with services and 24 additional two-storey residential dwellings with single basement levels on the subject property.

CESI carried out a geotechnical investigation (Report Number 230114-G1, dated November 20, 2023) concurrently with this hydrogeological investigation for the same site. Data presented in this report combined with a desktop study, literature research, data from government entities online database, Ontario Geological Survey database and field work completed for this project, provided the basic resources used in carrying out this assessment.

1.1 Scope of Work

1. Research and document the geological history of the site, the hydrogeological setting of the site and surroundings, and the watershed of the site.

2. Establish soil profiles, underlying bedrock where encountered, groundwater levels and flow characteristics, including flow directions and hydraulic gradients of the site.

3. Research and document available water well records, particularly of wells actively in use that could be affected by de-watering at the site.

4. Determine site topography and surficial drainage patterns/directions.

5. Establish the nearest surface water bodies, such as rivers, creeks, and/or lakes present around the subject site and their approximate distance from the site.

6. Install monitoring wells and conduct in-situ conductivity tests.

7. Carry out water quality testing and compare against the Dufferin County sewer use standards and make recommendations for handling any exceedances, if de-watering is expected to be needed.

8. Calculate estimated permanent and temporary de-watering volumes and impact of site de-watering on the surrounding properties and buildings.

9. Assess whether the volume of water to be extracted and discharged meets or exceeds the permitted volumes by the Ministry of Environment, Conservation and Parks (MECP), Dufferin County standards, and the Township of Amaranth Standards and/or By-laws.

10. Carry out and prepare the hydrogeological review in accordance with the following regulations:

    1. The Ontario Water Resources Act;

    2. Ontario Regulation 347/04;

    3. Dufferin County Sewer Use Bylaw

11. Carry out percolation tests and determine the percolation rates available through the surficial soils at the site, as well their hydraulic conductivities.

12. Present the findings in the hydrogeological report.

1.2 Project Data

The proposed development is a residential subdivision with residential dwellings, and service roads on vacant land located at 514504 2nd Line, in the Township of Amaranth. The proposed residential subdivision comprise of 24 two-storey residents in total, each with one level of basement. The total area of the site is 33 hectares.

The ground elevation of the site area, as referenced to the Topograhic Survey Drawing by Schaeffer Dzaldov Purcell Ltd., dated September 12, 2023, ranges from 484.5 masl to 496.0 masl. The ground surface over the site is undulating and the proposed house lots are expected to be at various elevations, following the topography of site.

The finished floor of the basements of the proposed houses were assumed to be a maximum of 3.0 m below the existing ground floor elevations and the footings are assumed to be a maximum of 300 mm below the finished floor level of the basements. Assuming this, the excavations are expected to be 3.3 m below the existing ground level elevations. Hence, the deepest level of excavation is assumed to be 3.3 m below the assumed ground floor levels.

One aquifer was found at the site in the silt and clay till layer, which is relatively at shallow depth for most of the site area. The basement of most of the proposed residential houses are expected to intercept this aquifer layer and thus, de-watering will be required.

1.3 Site Description

The site is located at 514504 2nd Line, in Amaranth, Ontario. The subject property is mostly vacant and grass covered with one residential building on site. There are storm water ponds on the north, central and south side of the subject property.

The site is located in a developed rural residential area with some agricultural lands. It is bounded by residential dwellings on the north and east sides and vacant lands on the south and west sides. Further east and south beyond 2nd Line and the vacant plot of land are residential dwellings. The subject property has a mildly undulating topography with an overall gentle slope toward the south and east. The existing building on site is on an elevated area with mild slopes all around. There is a gravel driveway from the building toward 2nd Line, which slopes down towards the south and the southeast.

1.4 Property Ownership

The subject property is owned by The Cellular Connection Ltd., and the owner is Mr. Stuart Turk. The contact information of Mr. Turk is as follows:

Mr. Stuart Turk
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1.5 List of Reports Reviewed

1. Canada Engineering Services Inc., Report titled: Geotechnical Investigation Proposed Residential Subdivision 514504 2nd Line, Amaranth, Ontario, Report Number 230114-G1, dated November 20, 2023.

2.0 HYDROGEOLOGICAL DATA

2.1 Physical Setting

According to the Ontario Geological Survey, the site area lies in the Horseshoe Moraines (Unit 5) physiographic region (Chapman, L.J. and Putnam, D.F. 2007. The physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release - Data 228 ISBN 978-1-4249-5158-1). The physiographic landforms consist of Till Pains (Drumlinized). The physiographic region and landforms of the site area are shown in Drawing Numbers 3 and 4 in Appendix B.

2.2 Water Bodies, Aquifers, Aquitards and Areas of Natural Significance

The site area shares two watersheds. The north portion of the site belongs to the *Nottawasaga River Watershed* and the south portion of the site belongs to the Upper *Grand River Watershed*. The tributaries of the Nottawasaga River flows towards the east and the northeast, whereas the tributaries of the Upper Grand River flows towards the southwest. The surface drainage and the watersheds of the site and surrounding areas are shown in Drawing Numbers 5 and 6 in Appendix B.

The site consists of 5 stormwater ponds, one on the north portion, two at the centre and two at the southern portion of the site. The stormwater ponds are to remain as a part of the proposed subdivision. Another comparatively large pond exists to the north of the site.

The north portion of the site lies within the boundaries of *Nottawasaga Valley Conservation Authority* and *Nottawasaga Valley Source Protection Area.* The southern portion of the site lies within the boundary of *Grand River Conservation Authority* and *Grand River Source Protection Area*. The boundary of the Conservation Authorities and their respective regulated area on site are shown in Drawing Numbers 7, 8 and 9 in Appendix B.

According to maps published by the *Ontario Ministry of Environment, Conservation and Parks (MECP)*, the site area does not lie within *Wellhead Protection Area*, *Significant Groundwater Recharge Area*, *Issue Contributing Area* or *Highly Vulnerable Aquifer Zone.* However, the southern portion of the site lies within *Intake Protection Zone 3*. The MECP maps showing the area of natural significance regarding groundwater and surface water are shown in Drawing Numbers 10 and 11 in Appendix B.

There was one aquifer found at the site in the silt and clay till layer at various depths throughout the site. Most of the proposed houses with one level of basement are expected to intercept this aquifer layer.

2.3 Topography

A topographic map of the site and surroundings is shown in Appendix A. The site has an undulating topography with a high ground at the centre and northwest portions and low grounds on the northeast and south portion of the site. The overall slope of the site area is towards the east and the southeast. The ground level elevations range from 484.5 masl to 496.0 masl.

2.4 Geology of Site and Surrounding

As published by the Ontario Geological Survey, OGS Earth, the bedrock of the site area consists of Armabel Formation (unit 56c). The lithology of this unit consists of sandstone, shale, dolostone, siltstone (Ontario Geological Survey 2011. 1:250 000 scale, Bedrock Geology of Ontario; Ontario Geological Survey, Miscellaneous Release - Data 126 - Revision 1).

The Quaternary geology of the site, as published by the Ontario Geological Survey, belongs to the Tavistock Till (unit 5) sandy silt to silt matrix, silty clay matrix in the south and in the north, moderate to high carbonate content, clast content decreases from moderate to poor northward (Ontario Geological Survey 2000. Quaternary geology, seamless coverage of the Province of Ontario; Ontario Geological Survey, Data Set 14). The surficial geology consists of Glaciolacustrine-derived silty to clayey till (unit 5d).

The geological maps of the site and surrounding areas are shown in Drawing Numbers 13 and 14 in Appendix B.

2.5 Site Specific Geology

From the borehole and hydrogeological investigation conducted by CESI, the stratigraphy of the site consists of the following soil from top to bottom of the boreholes, with some layer appearing in some of the boreholes and not in the others.

Topsoil
Sandy Silt
Peat
Silty Sand Till
Silt and Clay Till
Silty Sand Till

3.0 HYDROGEOLOGICAL INVESTIGATION

The field work for the boreholes was carried out with a track-mounted drill rig with solid stem augers on October 18, 19 and 20, 2023 and was supervised by an engineer from our office. A total of ten boreholes was put down at the site. Monitoring wells were installed to the bottoms of all the deeper boreholes (Borehole Numbers 1, 3, 6, 7 and 10). From the boreholes, soil samples were taken at 500 mm intervals between ground surface and a depth of 3.0 m and thereafter at 1.5 m intervals to the termination of the boreholes. The samples were taken by means of a split-spoon sampler, in accordance with the requirements of the Standard Penetration Test, (CSA test specifications A119.1).

The ten boreholes were put down at the site to a depth of 9.4 m, 5.0 m, 9.6 m, 5.0 m, 5.0 m, 9.6 m, 9.6 m, 5.0 m, 5.0 m and 9.4 m in Borehole Numbers 1 to 10 respectively.

Where practical, field penetrometer readings were taken on the samples from the boreholes to determine the different bearing values of the soils encountered. The approximate bearing pressure values of these are recorded on the borehole logs in the soils description columns. Monitoring wells were installed in Borehole Numbers 1, 3, 6, 7 and 10 to measure groundwater levels.

All samples taken were brought back to our laboratory where moisture content tests, grain size analyses and further visual observations were carried out. Our field and laboratory findings are plotted on the Borehole Log Numbers 1 to 10 and the grain size analysis results are shown on Figure Number 1 and 2 in Appendix B.

3.1 SOIL DESCRIPTION

Details of the soils found in each borehole are as follows:

3.1.1 Top soil

A layer of topsoil was encountered at the surfaces of Borehole Numbers 1, 2, 4, 5, 6, 7, 8, 9 and 10. This layer consisted of a dark grey to grey silty sand, some organics. It was wet and in a loose state and varied in thickness from 100 mm to 900 mm thick.

3.1.2 Silty Sand Fill

A layer of silty sand was encountered at the surface of Borehole Number 3. This layer was brown in colour, was wet and in a compact state down to a depth of 0.76 m below ground surface. This layer was also encountered in Borehole Number 10 below the surficial topsoil layer, however it also consisted of varved clay interbedded within the silty sand, down to a depth of 3.4 m below ground surface.

3.1.3 Peat

A layer of peat was found below the silty sand layer in Borehole Number 3. This layer was black in colour, was wet and in a loose state down to a depth of 0.9 m below ground surface.

3.1.4 Silty Sand Till

Below the topsoil layer in Borehole Numbers 7 and 9 was a layer of silty sand till, some clay, trace gravel. This layer was moist and in a dense state down to a depth of 2.2 m and 1.5 m in Borehole Numbers 7 and 9 respectively. Penetrometer readings taken on samples recovered in the boreholes varied from 300 kPa to 450 kPa.

3.1.5 Silt and Clay Till

Below the topsoil layer in Borehole Numbers 1, 4, 5, 6 and 8, below the silty sand till in Borehole Numbers 2, 7 and 9 and below the peat and silty sand layer in Borehole Numbers 3 and 10, was a layer of silt and clay till, trace to some sand, trace gravel. This layer was mottled grey-brown in colour, was moist to wet and in a stiff to very stiff state down to depths of 4.6 m, 6.1 m in Borehole Numbers 1, 7 respectively and extended down to the bottoms of Borehole Numbers 2, 3, 4, 5, 6, 8, 9 and 10. Penetrometer readings taken on samples recovered in the boreholes varied from 75 kPa to 450 kPa.

3.1.6 Silty Sand Till

Below the silt and clay till layer in Borehole Numbers 7 was a layer of silty sand till, some clay, trace gravel. This layer was moist and in a very dense state down to the bottom of Borehole Number 7. Penetrometer readings taken on samples recovered in the boreholes were greater than 450 kPa.

Detailed borehole logs are shown on Borehole Log Numbers 1 to 10, while their locations are shown on Drawing Number 2 in Appendix "B".

3.2 PERCOLATION TESTS AND T-TIME DETERMINATIONS

Percolation tests were conducted in two boreholes (P1 and P2) drilled down to a depth of 1.5 m. Percolation rate or T- Time is defined as the rate at which treated wastewater will be absorbed into the soil or as the number of minutes it takes for the water level to fall one centimeter in a hole drilled into a soil and filled with water.

The boreholes were put down with a truck-mounted drill rig down to a depth of 1.5 m in both percolation holes P1 and P2 respectively**.** The soils found consisted of a brown silt and clay till and extended down to the bottoms of the percolation holes.

A few inches of gravel was placed at the base of each of these holes. The holes were then filled with water and the drops in water levels monitored and recorded. In each case, the test was terminated when three consecutive drops in water levels monitored over consecutive 30 minute periods were within 10% of each other or where the water level virtually ceased to drop over an extended period of time. Using the rates of drops of the water levels, the rates of percolation or T-Time were calculated. From the percolation rates, the hydraulic conductivity of the soils were extrapolated and the results are as follows:

Table No. 1

Percolation Hole No.	Hydraulic Conductivity (cm/sec)	Percolation "T" Time (min/cm)
P1	2.04×10^{-3}	8.18
P2	1.0×10^{-7}	over 50

The locations of the percolation test holes are shown on Drawing Number 2 in Appendix B.

4.0 GROUNDWATER

During the drilling of the boreholes some water seepage was obtained from the boreholes within the silt and clay till and silty sand till layers. Monitoring wells were installed in deep boreholes. The depth of water level varied from 0.97 mbgl to 5.65 mbgl throughout the site. The groundwater seems to follow surface topography of the site and flows outward from the center of the site towards its surroundings. The groundwater flow direction obtained from the latest water level readings taken in the monitoring wells on site on November 29th 2023, are shown in Drawing Number 12 in Appendix B. The general flow direction is towards the north from the center of the site.

4.1 Monitoring Well Installation Data

Five monitoring wells were installed in Borehole Numbers 1, 3, 6, 7 and 10. All five monitoring wells consisted of a 3.1 m screen with a 50-mm internal diameter. The screens were connected to PVC pipe risers, also with internal diameters of 50 mm. The wells were backfilled with sand up to a depth of 3.6 m above the base of the screens and then with bentonite pellets. All monitoring wells installed were raised above the ground level and protected by a metal casing with a lock, which could be opened and closed for future water level readings. The locations of the wells are shown on Drawing Number 2 in Appendix B. The surface elevations of the monitoring wells were taken off the topographic survey drawing by Schaeffer Dzaldov Purcell Ltd., dated September 12, 2023. Borehole Logs/wells with their locations are shown in Appendix B.

The well identities, their dates of installations, their surface elevations, their depths, their base elevations, with well data are shown in Table Number 2 below:

Table Number 2

Borehole/ Monitoring Well	Date of Installation	Surface Elevation (masl)	Depth of monitoring wells (m)	Elevation of base of wells (m)	Length of Well Screen (m)	Length of Sand Backfill (m)
BH 1	Oct 18, 2023	490.2	9.14	481.06	3.1	3.6
BH 3	Oct 20, 2023	485	9.14	475.86	3.1	3.6
BH 6	Oct 19, 2023	490.15	9.14	481.01	3.1	3.6
BH 7	Oct 19, 2023	490.45	9.14	481.31	3.1	3.6
BH 10	Oct 20, 2023	487.9	4.27	483.63	3.1	3.6

4.2 Dates of Water Level Readings, Depths and Elevations

Water levels were taken on the following dates and their depths and elevations are recorded in Table Number 3 below.

Table Number 3

Borehole Number / MW	Date of Reading	Depth of Water Level (m)	Elevation of Water Level (m)	Remarks
BH 1	October 18, 2023	6.28	483.92	
	November 3, 2023	5.81	484.39	
	November 17, 2023	5.73	484.47	
	November 29, 2023	5.65	484.55	Highest Water Level
BH 3	October 20, 2023	8.53	476.47	
	November 3, 2023	1.09	483.91	
	November 17, 2023	0.4	484.6	Highest Water Level
	November 29, 2023	0.97	484.03	
BH 6	October 19, 2023	8.53	481.62	
	November 3, 2023	2.61	487.54	
	November 17, 2023	2.5	487.65	Highest Water Level
	November 29, 2023	2.64	487.51	
BH 7	October 19, 2023	dry	-	
	November 3, 2023	3.9	486.55	
	November 17, 2023	3.32	487.13	
	November 29, 2023	2.99	487.46	Highest Water Level
BH 10	October 20, 2023	2	485.9	
	November 3, 2023	1.38	486.52	
	November 17, 2023	0.88	487.02	Highest Water Level
	November 29, 2023	1.02	486.88	

4.3 Ground Water Sampling and Testing

Any groundwater from the excavation for the proposed houses with one level of basement is to be managed on-site, discharging the groundwater into the stormwater ponds existing on site. As no groundwater will be discharged into the sewers or river/creeks, swales, and is to be managed on-site, no groundwater testing was done against any sewer bylaw.

4.4 Surrounding Well Records

A MECP Well Records Search was conducted within the 500m distance of the site and a total of 11 well records were found. The locations of these wells around the site are shown in Drawing Number 15 in Appendix B. Most of these wells are currently used for domestic water supply purpose. The MECP well Ids, their UTM coordinates, statuses, bottom depths of the wells, ground elevations, bedrock elevations, dates drilled and the average static water levels of these wells are shown in Table Number 5 below.

Table Number 4

MOE Well ID	UTM-X	UTM-Y	STATUS	Purpose		Bottom Depth	Ground Elev	Bedrock Elev	Date Drilled	Average Static Water Level
1701062	566294	4873153	Active	Water Supply	Domestic	42.7	490.2	450.26	15-12-1969	481.65
1703792	566478	4872999	Active	Water Supply	Domestic	36.6	490.5	466.77	18-10-1988	488.11
1704765	566481	4872998	Active	Water Supply	Domestic	54.3	490.5	455.45	05-09-1994	485.93
1703210	566464	4872572	Active	Water Supply	Domestic	41.5	490.2	451.80	29-04-1985	481.67
1701586	566214	4873773	Active	Water Supply	Domestic	77.7	489.8	453.86	04-01-1974	482.21
7407128	566399	4873032	Unknown	Unknown	Unknown	NA	489.9	NA	08-12-2021	NA
7307592	566476	4872363	Active	Water Supply	Domestic	36.0	490.6	454.59	14-06-2017	484.91
7307593	566509	4872381	Abandoned	Industrial	Institutional	24.6	491.3	NA	14-06-2017	NA
1700019	566452	4872558	Active	Water Supply	Domestic	27.4	490.5	466.07	20-08-1958	483.74
1701801	566602	4872477	Active	Water Supply	Domestic	78.3	492.9	455.68	13-11-1974	486.16
1702745	565719	4873576	Active	Water Supply	Domestic	44.8	487.8	465.54	14-01-1981	485.36

The closest of these wells to the edge of the proposed subdivision is Well No. 170162, which is 80 m away from the closest house lot in the proposed subdivision. Maximum radius of influence obtained from all the wells put down at the site is 6.9 m, as calculated in subsection 5.3, Table Number 5. Hence de-watering of the subject site will have zero influence on all the neighbouring wells surrounding the site.

5.0 DE-WATERING ANALYSIS

5.1 Temporary and Permanent De-watering Assessment

The subject site is being proposed as a residential subdivision with houses with one level of basement and service roads. The deepest levels of excavation are expected to be 3.0 m to 5.0 m below existing ground level. The highest level of groundwater was found at various depths ranging from 0.4 m to 5.65 m below ground level in the

monitoring wells installed at the site. Since, the topography of the site is undulating with varying elevations and the proposed house lots are far apart and distributed throughout the site, the de-watering assessment was divided into five zones. This was done to more accurately establish the de-watering volumes for the whole site rather than analyzing the whole site as a single de-watering operation. At this point in time, it is understood that the construction sequence will consist of excavating and building individual homes at different times and therefore we have calculated only the volume of de-watering required for a single home, for each different zone. If perchance, more than one house is to be excavated for construction at the same time, the de-watering volume will have to be multiplied by the number of excavations being undertaken concurrently. See compartments of the whole site into five zones in Appendix A as follows:

Zone A: Around Borehole/Monitoring Well Number 1 - consists of house lot numbers 11, 12, 13, 14, 15, 16 and 17.

Zone B: Around Borehole/Monitoring Well Number 3 - including the house lot numbers 22, 23, 24, 25, 26, 27 and 28.

Zone C: Around Borehole/Monitoring Well Number 7 - including the house lot numbers 7, 8, 9, 10 and 18.

Zone D: Around Borehole/Monitoring Well Number 6 - including the house lot numbers 4, 5, 6, 19, 20 and 21.

Zone E: Around Borehole/Monitoring Well Number 5 - including the house lot numbers 1, 2 and 3.

The proposed residential houses with one level of underground basements are expected to have footings 3 m below ground level. Adding another 0.3 m for the footings, the deepest level of excavation expected is 3.3 mbgl. In all monitoring wells except in Monitoring well Number 1, in Zone A detailed above, the groundwater level is higher than the expected lowest level of excavation. Hence, temporary and permanent dewatering will be required during and after excavation for the house lots in Zones B, C, D and E. No dewatering will be required in Zone A.

If the water level cannot be lowered over the whole site, permanent de-watering around the houses can be achieved by collecting water from weeping tiles placed around the house basement walls and below the basement floors. This water can be directed to sump pits in the basements and then this water can be discharged at a minimum distance of 6 m away from the foundation walls of the houses. This could

result in continually pumping water from sump pits and recirculating back to the surrounding lands.

Alternatively, if de-watering is not carried out on a permanent basis, the house basements will have to be built as a bath tub, with the basement walls and garage floors water proofed and design to resist the highest hydrostatic pressures they will be subjected to.

5.2 Determination of Hydraulic Conductivity - Slug Tests

Rising head Slug Tests were carried out in all monitoring wells installed at the site. A known volume of water was bailed out of each well and rates of rises in water levels were recorded. The water levels recorded against time were plotted in Aquifer Test Pro® developed by Waterloo Hydrogeologic, and the hydraulic conductivities were obtained using the Hvorslev's method.

The hydraulic conductivities obtained for each of the wells tested were as follows:

Borehole/ Monitoring Well 1 – 1.59E-08
Borehole/ Monitoring Well 3 – 4.56E-07
Borehole/ Monitoring Well 6 – 5.37E-08
Borehole/ Monitoring Well 7 – 3.71E-08
Borehole/ Monitoring Well 10 – 1.08E-07

The highest value of hydraulic conductivity was found in Borehole Number 3. N However, since the five zones at the site are widely separated, the individual hydraulic conductivity determined from each zone was used to calculate the de-watering volumes.

See Appendix C for the determination of hydraulic conductivities.

5.3 Radius of Influence

The Sichardt equation was used to calculate the maximum radius of influence of de-watering activity beyond the edge of excavation and it is given by the following formula.

$R_o = 3000(H-h)K^{1/2}$
Where (H-h) is the drawdown and K is the hydraulic conductivity of soil

Since, no dewatering is anticipated in Zone A, this does not apply for construction. Considering only one house lot will be excavated and dewatered at a time, the calculated radii of influence from the edge of excavation for each house lots in Zone B, C, D and E are as follows:

Table No. 5

Zone	Radius of influence due to (m)	
	temporary dewatering	permanent dewatering
Zone A	N/A	N/A
Zone B	6.89	5.87
Zone C	0.56	0.22
Zone D	0.75	0.46
Zone E	2.88	2.39

Since, there are no water supply wells, river/creeks or other areas of natural significance within the radius of influence, no negative impact is anticipated.

5.4 Temporary and Permanent Volume of Water to be Taken from the Site

Theoretically, the groundwater drawdown for a single well, and the volume of water to be extracted can be calculated from the following expressions:

$$Q = 3.14K(H^2 - h_w^2)/Ln(R/r)$$
$$R_o = 3000\ (H-h_w)*K^{0.5}$$
$$r_s = ((a*b)/3.14)^{0.5}\ [\text{when } a/b < 1.5 \text{ and } R_o >> r_s;\quad r = (a+b)/3.14^{0.5}\ ]$$

where:
Q is in (m^3/days) and is the rate of pumping extraction
K is (m/day) and is the hydraulic conductivity
H is in (m) and is depth from water table to depth of assumed impervious base
h_w is in (m) and is the depth of water table above an impervious base after drawdown
r is in (m) and is the equivalent radius of the site
R_o is in (m) and is the radius of influence from the edge of the excavation

R is in (m) and is the radius of influence from the center of site (R_o+r_s)
dH is in (m) is the maximum drawdown
a is in (m) and is the length of the excavation and
b is in (m) and is the width of the excavation

The proposed residential houses are distributed throughout the large area of the site and are at different ground elevations. Hence, the dewatering quantities were calculated around each monitoring well installed at the site, dividing the proposed house lots into Zone A, B, C, D and E as listed in section 5.1. The proposed houses are assumed to have footprint area of 325 m^2, which will be the area of excavation. Average ground floor elevation for the house lots in each zone is taken as the ground elevation of the monitoring wells installed in each zone.

The dewatering calculations in this report assumes that the excavation and dewatering for proposed house lots will be conducted individually at different times. The calculated temporary and permanent volumes of water for a single house lot in each zone are shown in Table 6 below.

Table 6 - Dewatering Volume from Excavation of a Single Individual House Lot

Dewatering Zone	Zone A	Zone B	Zone C	Zone D	Zone E
Temporary Dewatering Quantity (m^3/day)	0	6.02	1.05	0.97	2.38
Temporary Dewatering Quantity with Factor of Safety 1.5 (m^3/day)	0	9.03	1.58	1.46	3.57
Considering 25 mm peak rainfall intensity over the period of 24 hours, additional quantity to be extracted (m^3/day)	8.13	8.13	8.13	8.13	8.13
Total Temporary Dewatering Quantity (m^3/day)	**8.13**	**17.16**	**9.71**	**9.59**	**11.69**
Permanent Dewatering Quantity (m^3/day)	**0**	**8.15**	**1.39**	**1.31**	**3.24**

The detail calculations are shown in Appendix “C”.

If simultaneous excavation and dewatering is conducted in two or more house lots within the same zone, then the dewatering volumes will simply have to be multiplied by the number of house lots that are excavated concurrently.

5.5 Permit to Take Water

The Ministry of Environment, Conservation and Parks will require a permit to take water (PTTW) if the rate of extraction is between 50 m^3/day and 400 m^3/day. It is highly unlikely that all the excavation and dewatering over the site will be conducted at once and hence, the dewatering volume will be well under 50 m^3/day. As such, permit to take water (PTTW) will not be required from MECP. An Environmental Activity Sector Registration (EASR) may be required.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The geotechnical investigation and follow up deep well installation indicated that the site is underlain by a surficial Topsoil, Sandy Silt, Peat, Silty Sand Till, Silt and Clay Till, Silty Sand Till.

The proposed residential development is to consist of residential houses with service roads, on a undeveloped vacant property. The proposed residential houses are expected to have one level of basement 3.0 m below ground floor level and footings another 300 mm below the finished floor level of the houses. Hence, the deepest levels of excavations are expected to be 3.3 m below existing ground levels.

The highest groundwater level observed in monitoring wells installed at site range from 0.4 mbgl to 5.65 mbgl or at elevation 484.55 masl to 487.65 masl. Most part of the proposed development will have excavation depths below the groundwater level. Hence, both temporary and permanent dewatering will be required at this site.

As shown in the map by MECP, part of the northern half of the site is under regulated area by Nottawasaga Valley Conservation Authority and part of southern half of the site is under regulated area by Upper Grand River Conservation Authority. The southern part of the site lies within the Intake Protection Zone 3. The site does not lie within wellhead protection area, significant groundwater recharge area, highly vulnerable aquifer area, or issue contributing area.

There are currently five storm water ponds at the site, which are to be used as storm water management ponds for the proposed development. The same ponds will be used to manage dewatering water from the excavation for the proposed houses on the site.

Due to undulating topography and varying groundwater levels, the site was divided into five zones namely Zone A, B, C, D and E from north to south going from west to east, for dewatering volume calculations. The dewatering volumes are calculated assuming a single individual house lot will be excavated at any single given time. The calculated temporary dewatering volumes considering 25mm maximum daily precipitation for each house lots in Zone A, B, C, D and E are 8.13 m^3/day, 17.16 m^3/day, 9.71 m^3/day, 9.59 m^3/day and 11.69 m^3/day respectively. If perchance one that one excavation is carried out is carried out in any zone, then the volume of excavation will simply have to be multiplied by the number of excavations undertaken in that specific zone.

The calculated permanent dewatering volumes for any single house lot in Zone A, B, C, D and E are 0 m^3/day, 8.15 m^3/day, 1.39 m^3/day, 1.31 m^3/day and 3.24 m^3/day respectively.

There are no water supply wells, streams/creeks within the radius of influence of dewatering activity. The water from the dewatering is to be managed in storm water ponds existing on site. Hence, no negative impact is anticipated to the existing groundwater quality or quantity at site. An experienced de-watering contractor, should be retained to design, install and manage the de-watering system.

8.0 REFERENCES

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Drsicoll F.G., 1986, Groundwater and Wells, Second Edition, Johnson Filtration Systems Inc.

Ministry of Environment Records available through Freedom of Information

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Google Earth. 2023.

Google Maps. 2023.

9.0 GENERAL COMMENTS

It is possible that the soil and water conditions between boreholes are quite different from those found at the borehole locations. Any interpretation of data for areas between boreholes should be viewed with this in mind. The accuracy of our report is limited to the findings at specific borehole locations.

The inspections and reviews of data described above were carried out based on the terms of reference as outlined earlier in this report. It was prepared specifically for the use of the property owner for proposed residential subdivision at 514504 2nd Line, Amaranth, Ontario.

In the course of carrying out this Hydrogeological Assessment, the possibility of obtaining imprecise, partial or incorrect data cannot be totally eliminated but only reduced to an acceptable level. This report was prepared with due care and diligence, and is based on information gathered and professional judgement of the best information available at the time of the investigation.

The Consultant makes no warranty, either expressed or implied, as to the Consultant's findings, recommendations, plans, specifications, or professional advice. The Consultant has endeavored to perform its services in accordance with generally accepted standards of practice in effect at the time of performance.

The Client recognizes that neither the Consultant nor any of the Consultant's subconsultants or subcontractors owes any fiduciary responsibility to the Client.

This report or any part of it by any third party, other than the client to whom it is addressed, Mr. Stuart Turk, is strictly prohibited. Canada Engineering Services Incorporated is not responsible for any damages or losses incurred by any other third party arising from the use of this report or for any decisions or actions by any other third party based on this report.

This report was prepared from limited data. Should there be any design or construction changes that would require a review of the hydrogeological analyses or any questions regarding the hydrogeological aspects of any codes, standards or regulations, then this office should be consulted. This may necessitate a supplementary investigation and report for our recommendations to be reliable.

We trust that this report meets your requirements. Please call the undersigned at 647 829 6151 if you have any questions.

Sincerely,
CANADA ENGINEERING SERVICES INC.

Mahesh Khanal, M. Sc.
Project Manager

Ram Jagdat. P. Eng., QP.
Consulting Engineer.
Principal
email: ram@cesi.ca
cell: 647 829 6151

Appendix “A”

METRIC: DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048.

RESIDENTIAL/FARM

LOT 20, CONCESSION 2

PART 4, PLAN 7R-1830 — PART 3, PLAN 7R-1830 — PART 1, PLAN 7R-1830 PIN 34047-0054

PIN 34047-0171

LOT 20, CONCESSION 2
LOT 19, CONCESSION 2

AGRICULTURAL

PART 5, PLAN 34047 - 0159 7R - 6362

10 — 0.6 Hect. 6003.8 Sq.m.
11 — 0.6 Hect. 6000.2 Sq.m.
12 — 0.6 Hect. 6001.8 Sq.m.
9 — 0.6 Hect. 6000.3 Sq.m.
13 — 0.6 Hect. 6000.3 Sq.m.
8 — 0.6 Hect. 6000.2 Sq.m.
14 — 0.6 Hect. 6148.1 Sq.m.
7 — 0.6 Hect. 6240.34 Sq.m.
15 — 0.7 Hect. 7161.6 Sq.m.
16 — 0.7 Hect. 6966.2 Sq.m.
17 — 0.7 Hect. 6966.3 Sq.m.
23 — 0.7 Hect. 6630.4 Sq.m.
22 — 0.6 Hect. 6001.8 Sq.m.
21 — 0.6 Hect. 6002.5 Sq.m.
20 — 0.6 Hect. 6054.9 Sq.m.
18 — 0.6 Hect. 6000.6 Sq.m.
19 — 0.6 Hect. 6028.5 Sq.m.
24 — 3.61 Hect. 36137.12 Sq.m.
5 — 0.6 Hect. 6007.8 Sq.m.
4 — 0.6 Hect. 6000.0 Sq.m.
3 — 0.6 Hect. 6000.0 Sq.m.
2 — 0.6 Hect. 6000.1 Sq.m.
1 — 0.6 Hect. 6000.3 Sq.m.
6 — 0.86 Hect. 8523.63 Sq.m.
0.35 Hect. 1500.25 Sq.m.

BLOCK 25
NATURAL HERITAGE SYSTEM
4.5 Hect.
45381.9 Sq.m.

BLOCK 28
NATURE TRAIL
1.0 Hect.
10463.5 Sq.m.

BLOCK 28
NATURE TRAIL
1.0 Hect.
10427.3 Sq.m.

BLOCK 27
NATURAL HERITAGE SYSTEM
5.31 Hect.
53131.60 Sq.m.

BLOCK 26
HYDRO EQUIPMENT
0.5 Hect.
5529.22 Sq.m.

ROAD A
ROAD B
BLOCK 29

PIN 34047 - 0053 — PART 2, PLAN 7R-6546 — PART 2, PLAN 7R-6546 (SUBJECT TO EASEMENT AS IN INST. No. AM16728)

PART 3, PLAN 7R-6546 (SUBJECT TO EASEMENT AS IN INST. No. AM16728)

PART 4, PLAN 7R-6546 (SUBJECT TO EASEMENT AS IN INST. No. AM16728)

PART 1, PLAN 7R-6546 (SUBJECT TO EASEMENT AS IN INST. No. AM16728)

PART 2, PLAN 7R-6546 (PIN 34047-0153) (SUBJECT TO EASEMENT AS IN INST. No. AM16728)

PIN 34047-0184 — PART 6, PLAN 7R-6546

PIN 34047-0185 — PART 7, PLAN 7R-6546

EXISTING DRIVEWAY FOR LOT 24

KNOWN AS 2nd LINE
ROAD ALLOWANCE BETWEEN CONCESSIONS 1 AND 2

PART 1, PLAN 7R-6546 (SUBJECT TO EASEMENT AS IN INST. No. AM16728)

PART 2, PLAN 7R-6546 (SUBJECT TO EASEMENT AS IN INST. No. AM16728)

PART 1, PLAN 7R-6546 (SUBJECT TO EASEMENT AS IN INST. No. AM16728)

PART 2, PLAN 7R-6546 (PIN 34047-0148) (SUBJECT TO EASEMENT AS IN INST. No. AM16728)

PART 1, PLAN 7R-6546 (PIN 34047-0148) (SUBJECT TO EASEMENT AS IN INST. No. AM16728)

LOT 18, CONCESSION 2
PART 2, PLAN 7R - 4282
PIN 34047 - 0047

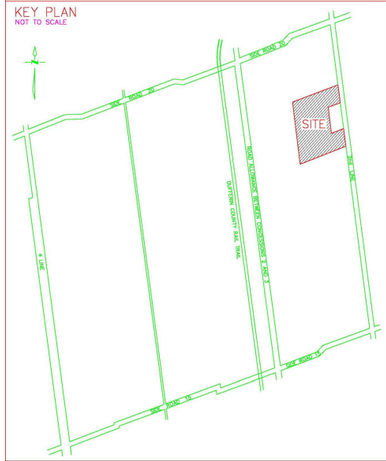
RESIDENTIAL

DRAFT PLAN OF SUBDIVISION

for
PART OF LOT 19
CONCESSION 2
(GEOGRAPHIC TOWNSHIP OF AMARANTH)
TOWNSHIP OF AMARANTH
COUNTY OF DUFFERIN

MARCH 21, 2024

KEY PLAN
NOT TO SCALE



ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51 (17) OF THE PLANNING ACT, R.S.O., 1990

(a) AS SHOWN ON DRAFT PLAN
(b) AS SHOWN ON DRAFT PLAN AND KEY PLANS
(c) AS SHOWN ON DRAFT PLAN
(d) THE LAND IS TO BE USED ACCORDING TO THE SCHEDULE OF LAND USE
(e) AS SHOWN ON DRAFT PLAN AND KEY PLANS
(f) AS SHOWN ON DRAFT PLAN
(g) AS SHOWN ON DRAFT PLAN AND KEY PLANS
(h) MUNICIPAL WATER SUPPLY TO BE MADE AVAILABLE
(i) SOIL IS CLAYEY SILT AND SILTY CLAY TO CLAY
(j) AS SHOWN ON DRAFT PLAN
(k) FULL MUNICIPAL SERVICES TO BE MADE AVAILABLE
(l) SUBJECT TO EASEMENTS AS SHOWN ON THE DRAFT PLAN

SCHEDULE OF LAND USE

SCALE 1:1000
(30X36)

OWNER'S AUTHORIZATION

I AUTHORIZE SCHAEFFER DZALDOV PURCELL LTD. TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO THE CITY OF TORONTO FOR APPROVAL.

STUART TURK
THE CELLULAR CONNECTION LTD.

DATE

SURVEYOR'S CERTIFICATE

I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED AS SHOWN ON THIS PLAN AND THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DAN DZALDOV
ONTARIO LAND SURVEYOR

DATE

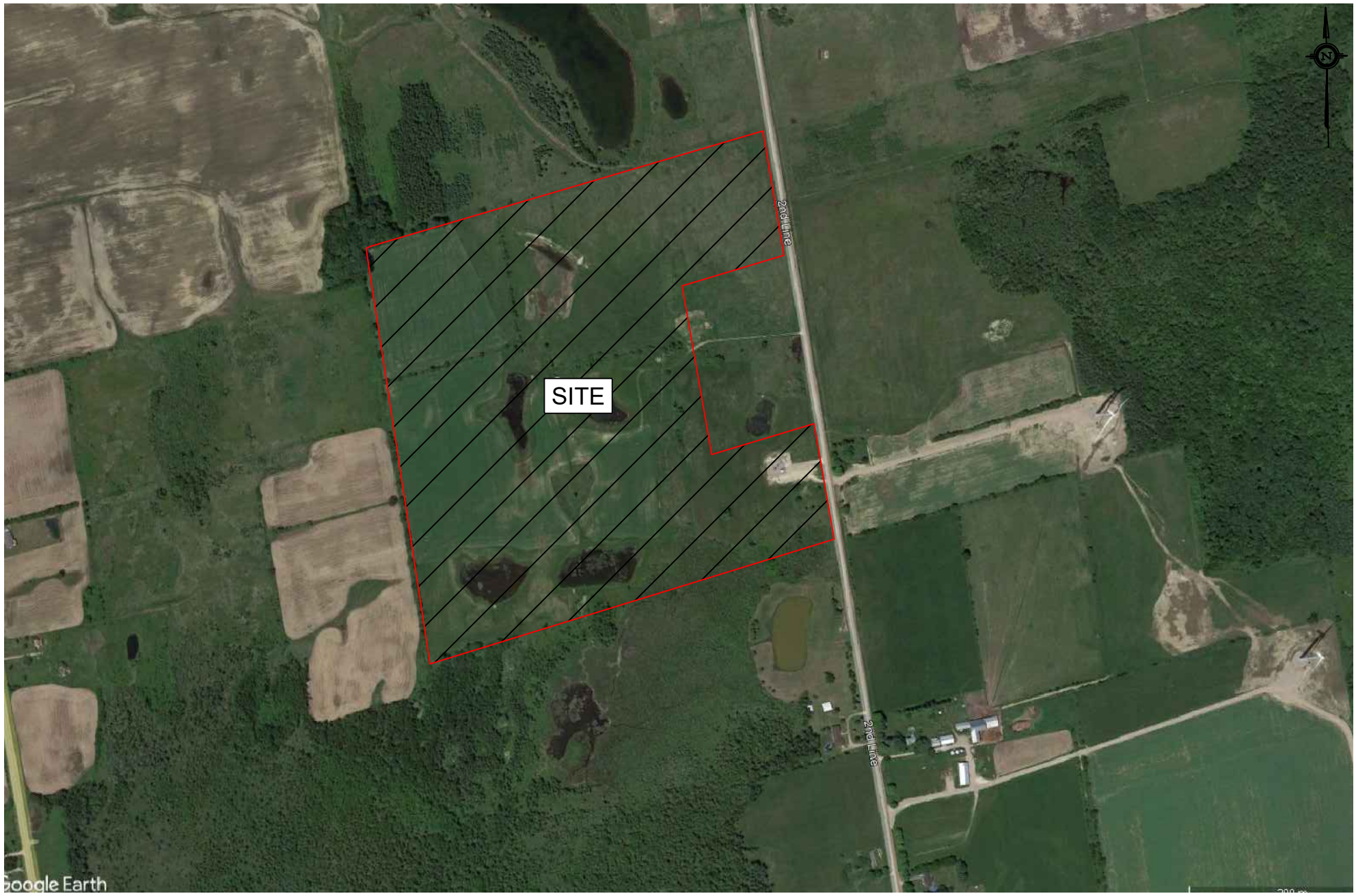
SCHAEFFER DZALDOV PURCELL LTD.
ONTARIO LAND SURVEYORS
64 JARDIN DRIVE CONCORD, ONTARIO L4K 3P3 TEL.(416)987-0101

DRAWN ACAD/SL | CHECKED | SCALE 1:1000 | JOB NO. 23-313-01C

October 11, 2024

APPENDIX B

KEYPLAN, BOREHOLE LOCATIONS, DRAINAGE MAP, GEOLOGICAL MAPS BOREHOLE LOGS, GRAIN SIZE ANALYSIS



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39 DAVISBROOK BOULEVARD
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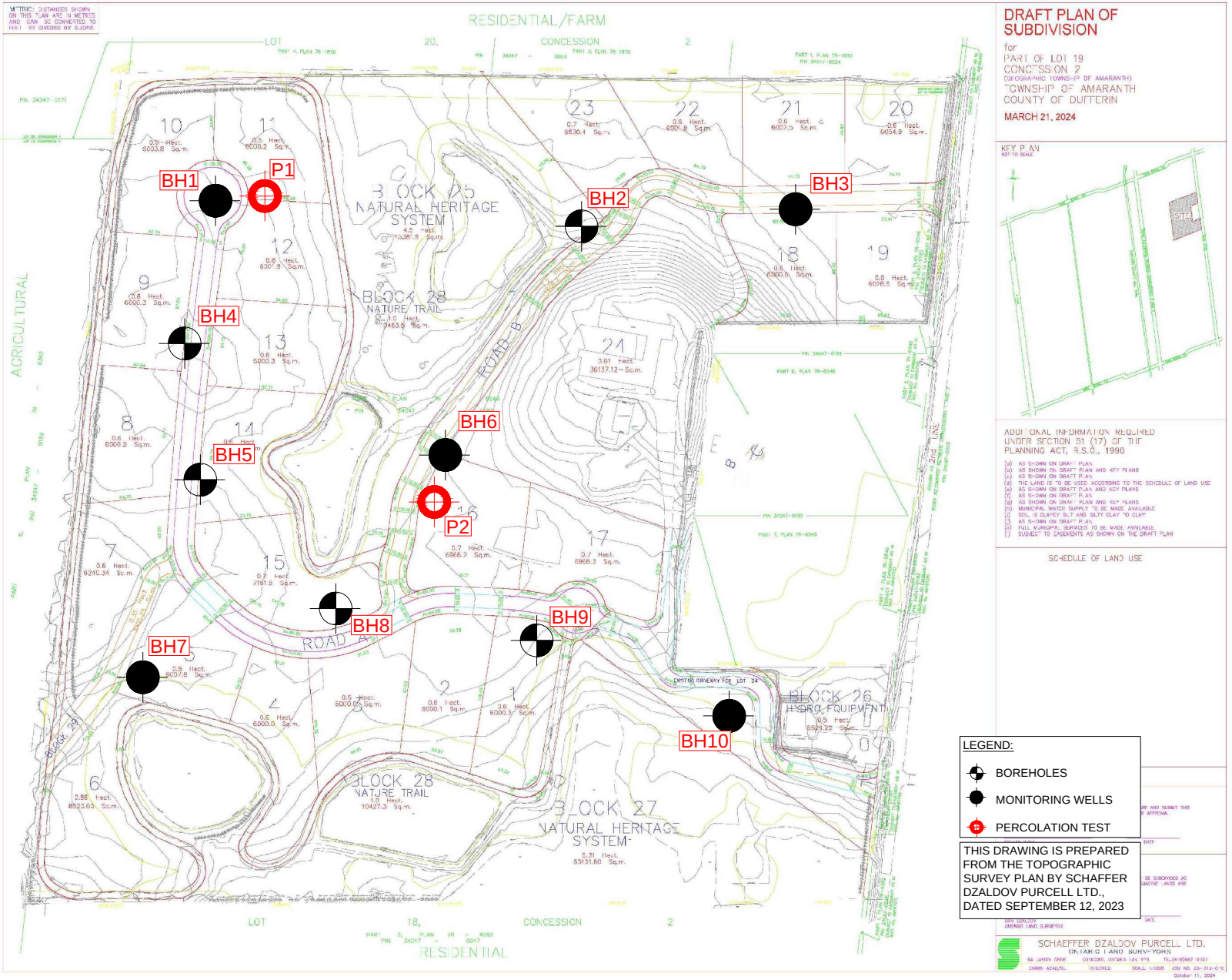
E-mail address: cesi@cesi.ca



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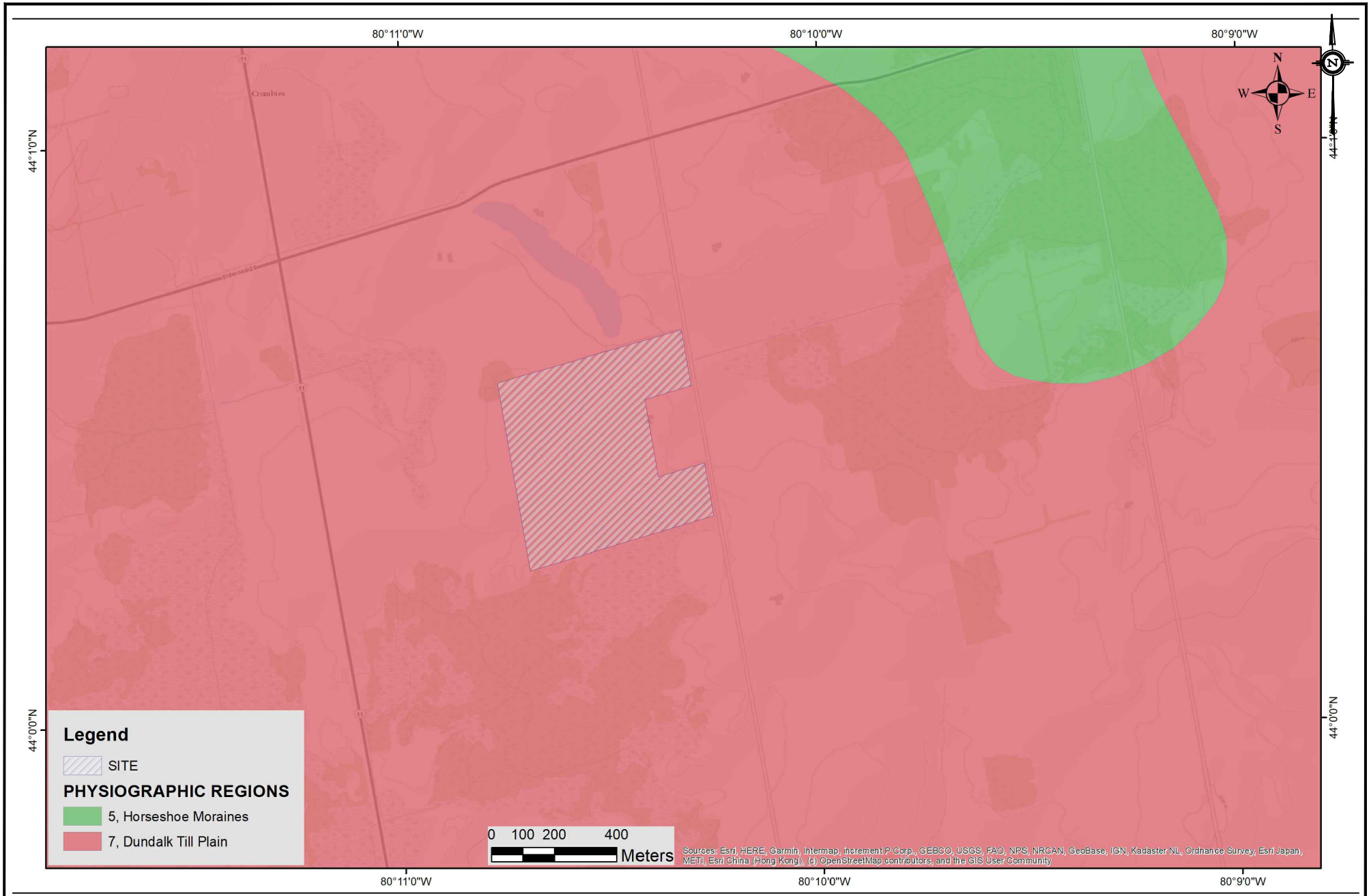

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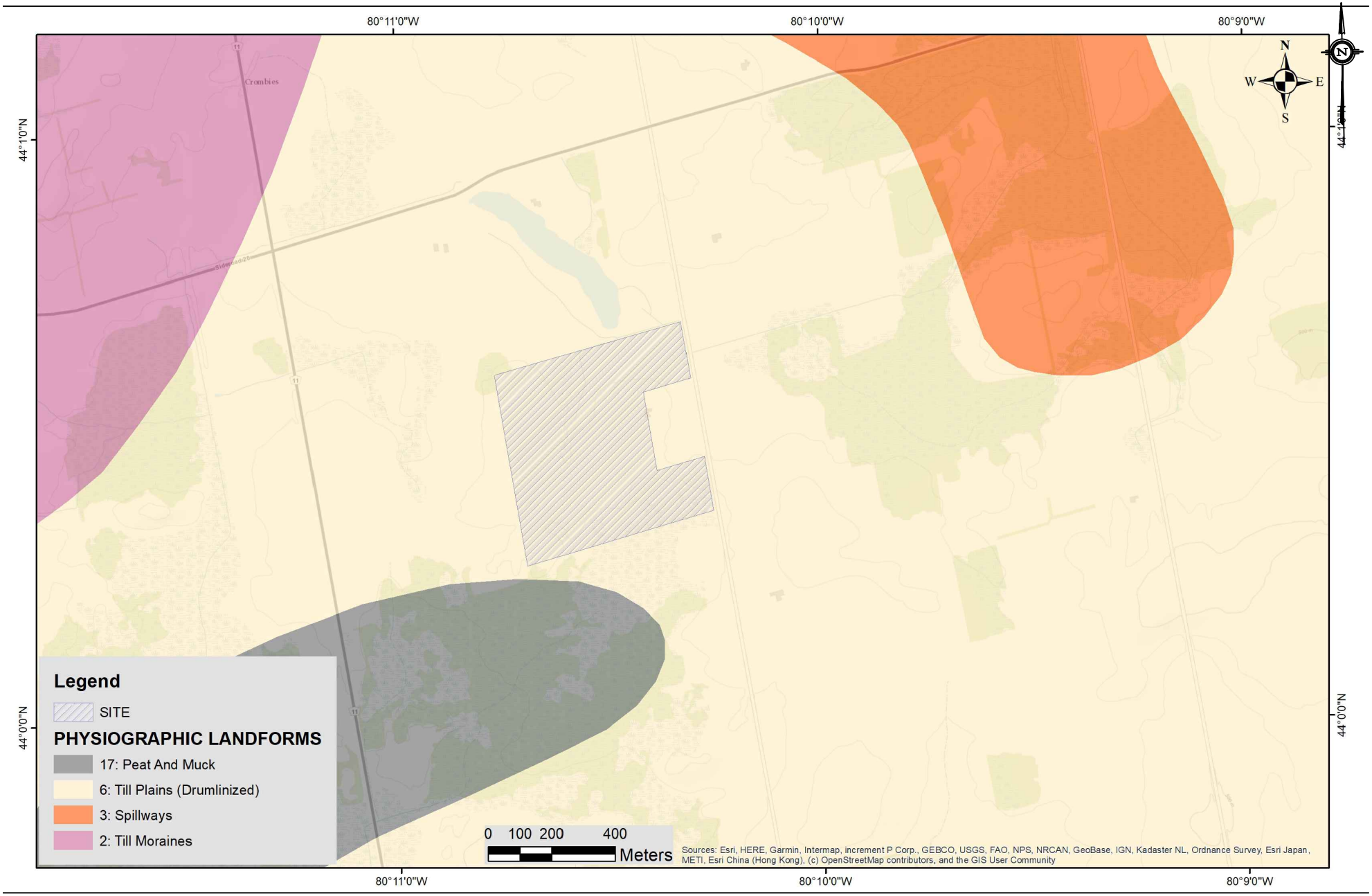

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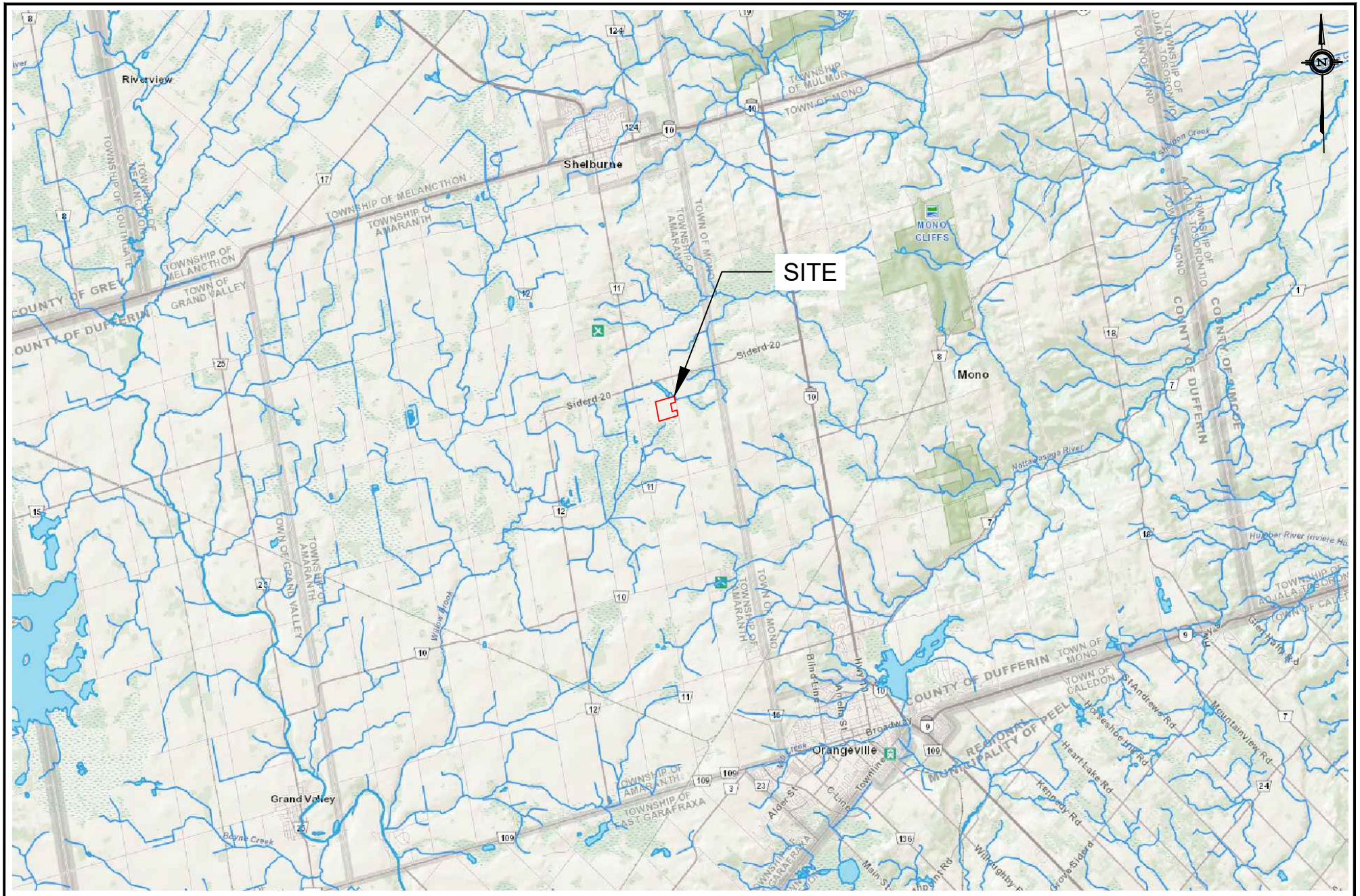

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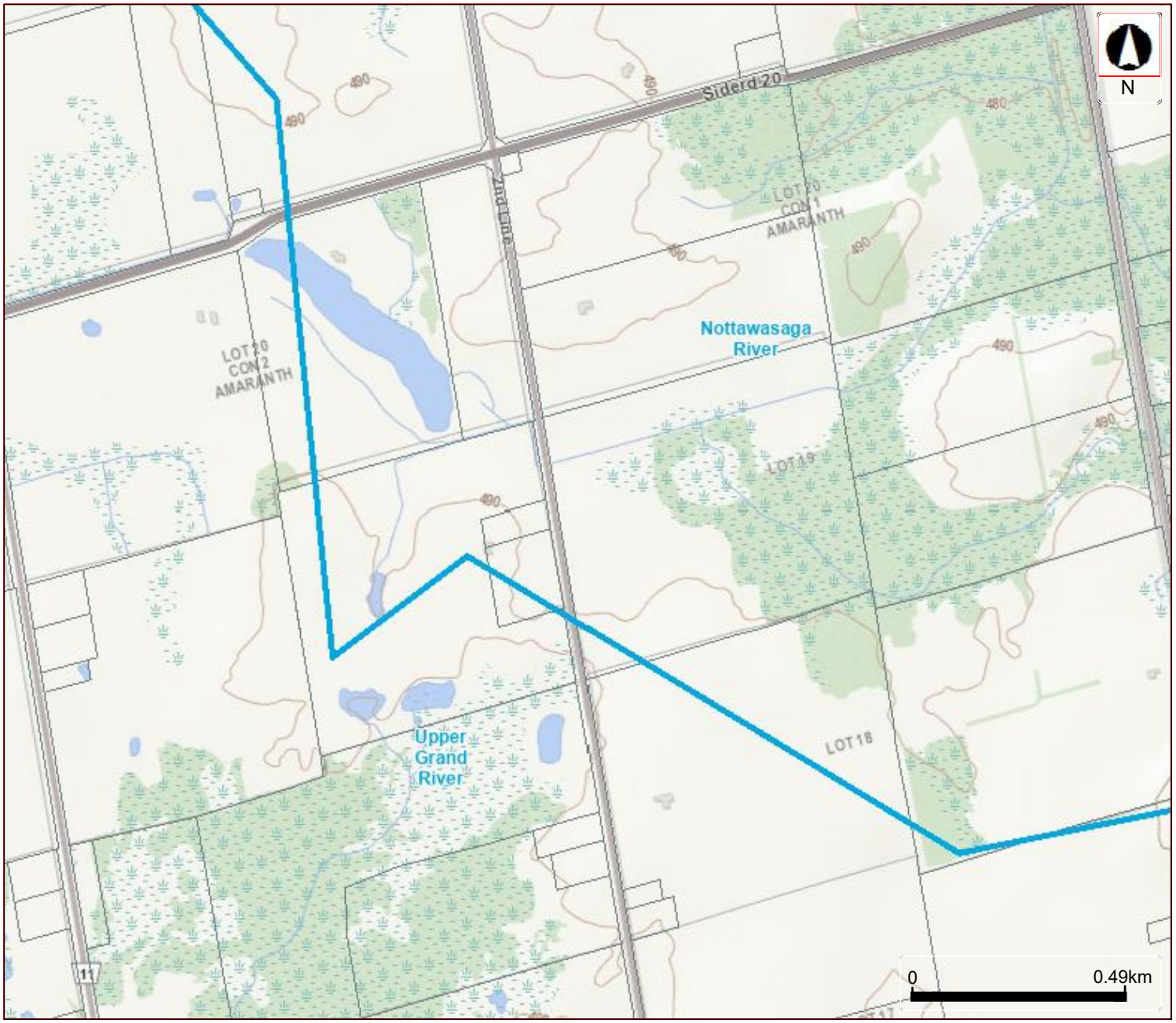

Legend

- Tertiary
- Assessment Parcel

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 Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

CLIENT:	PROJECT:	TITLE:	SCALE:	DATE:
THE CELLULAR CONNECTION LTD. 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	HYDROGEOLOGICAL INVESTIGATION 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	WATERSHED OF SITE AND SURROUNDING	AS SHOWN	JAN / 2024
			DRAWING NO: 6	PROJECT NO 230114

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Legend

- Source Protection Areas
- Conservation Authority
- Assessment Parcel

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CLIENT:	PROJECT:	TITLE:	SCALE:	DATE:
THE CELLULAR CONNECTION LTD. 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	HYDROGEOLOGICAL INVESTIGATION 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	MECP CONSERVATION AUTHORITY AND SOURCE PROTECTION AREA BOUNDARY	AS SHOWN	JAN / 2024
			DRAWING NO: 7	PROJECT NO 230114

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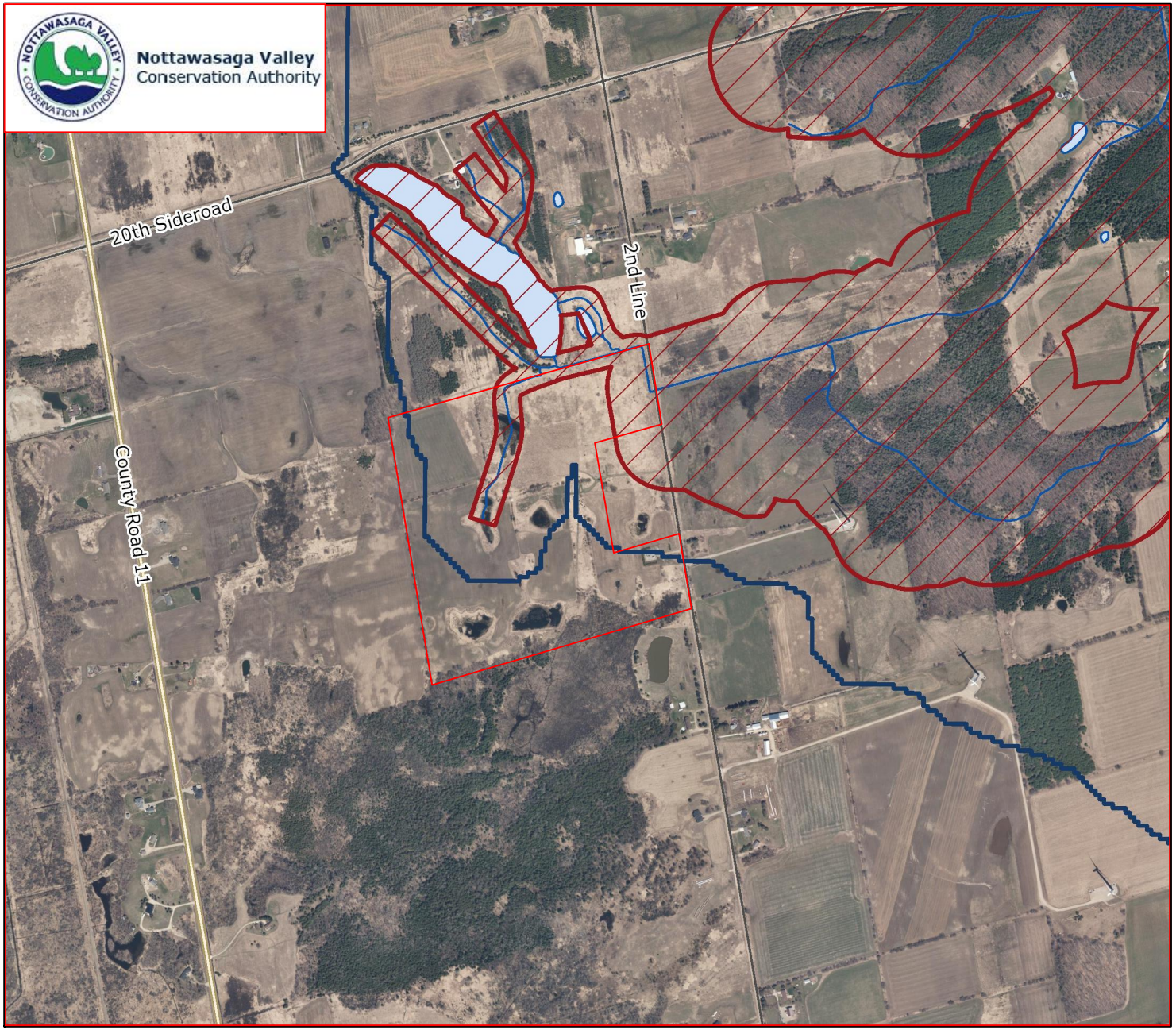

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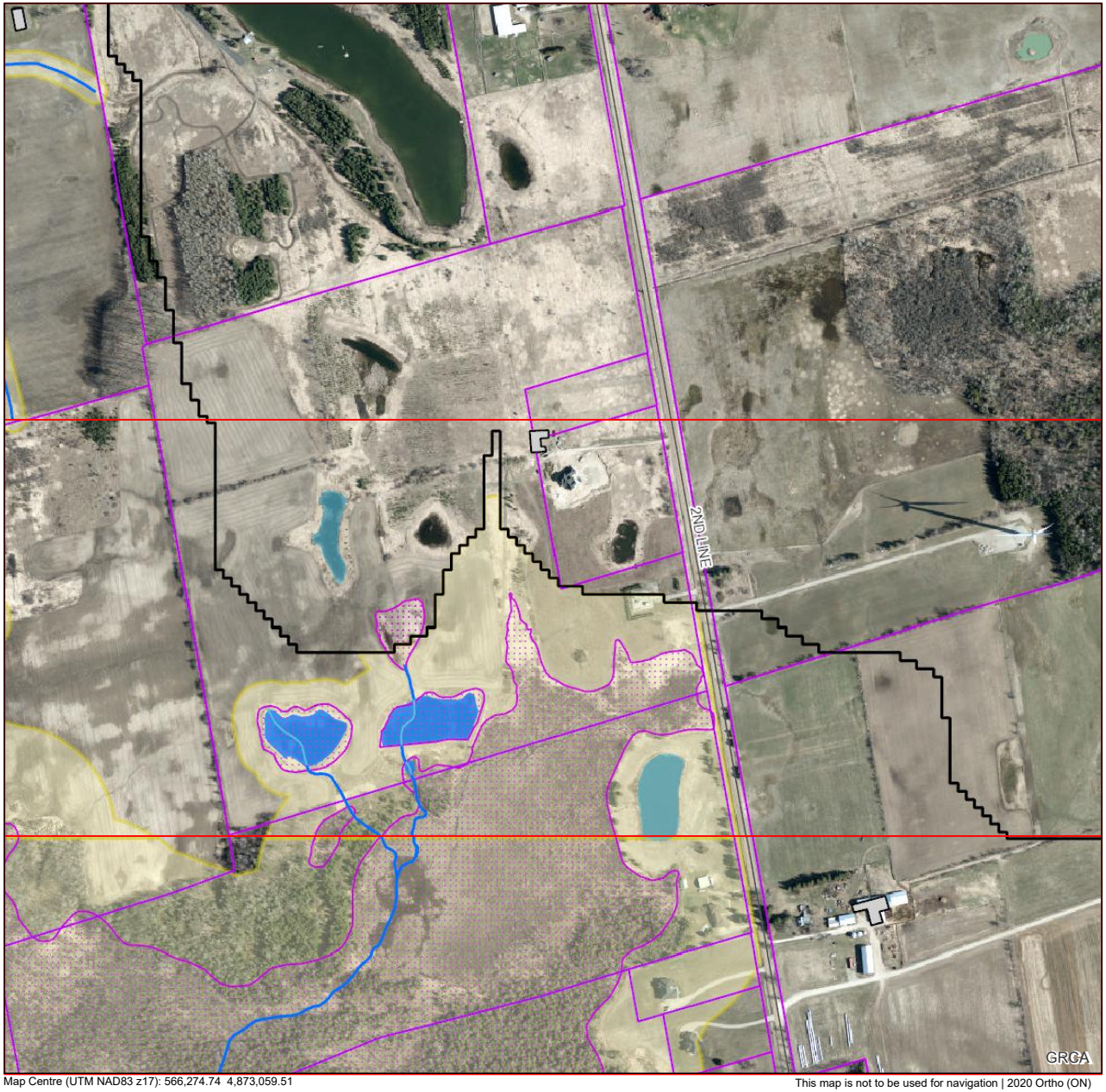

Map Centre (UTM NAD83 z17): 566,274.74 4,873,059.51

This map is not to be used for navigation | 2020 Ortho (ON)

Grand River Conservation Authority

Date: Dec 07, 2023

Grand River Conservation Authority Regulated Area

Legend

- Regulation Limit (GRCA)
- Regulated Watercourse (GRCA)
- Regulated Waterbody (GRCA)
- Wetland (GRCA)
- Floodplain (GRCA)
  - Engineered
  - Estimated
  - Approximate
  - Special Policy Area
- Slope Valley (GRCA)
  - Steep
  - Oversteep
  - Steep
- Slope Erosion (GRCA)
  - Oversteep
  - Toe
- Lake Erie Flood (GRCA)
- Lake Erie Shoreline Reach (GRCA)
- Lake Erie Dynamic Beach (GRCA)
- Lake Erie Erosion (GRCA)
- Parcel - Assessment (MPAC/MNRF)

This legend is static and may not fully reflect the layers shown on the map. The text of Ontario Regulation 150/06 supercedes the mapping as represented by these layers.

The source for each data layer is shown in parentheses in the map legend. For a complete listing of sources and citations go to: https://maps.grandriver.ca/Sources-and-Citations.pdf

0 40 80 160 240 Metres

NAD 1983 UTM Zone 17N

Scale: 6,760

N

CLIENT:
THE CELLULAR CONNECTION LTD.

514504 LINE 2,
AMARANTH, ONTARIO
L0N 1L0

PROJECT:
HYDROGEOLOGICAL INVESTIGATION

514504 LINE 2,
AMARANTH, ONTARIO
L0N 1L0

TITLE:
GRAND RIVER CONSERVATION AUTHORITY REGULATED AREA AT SITE AND SURROUNDING

SCALE:	DATE:
AS SHOWN	JAN / 2024
DRAWING NO:	PROJECT NO
9	230114

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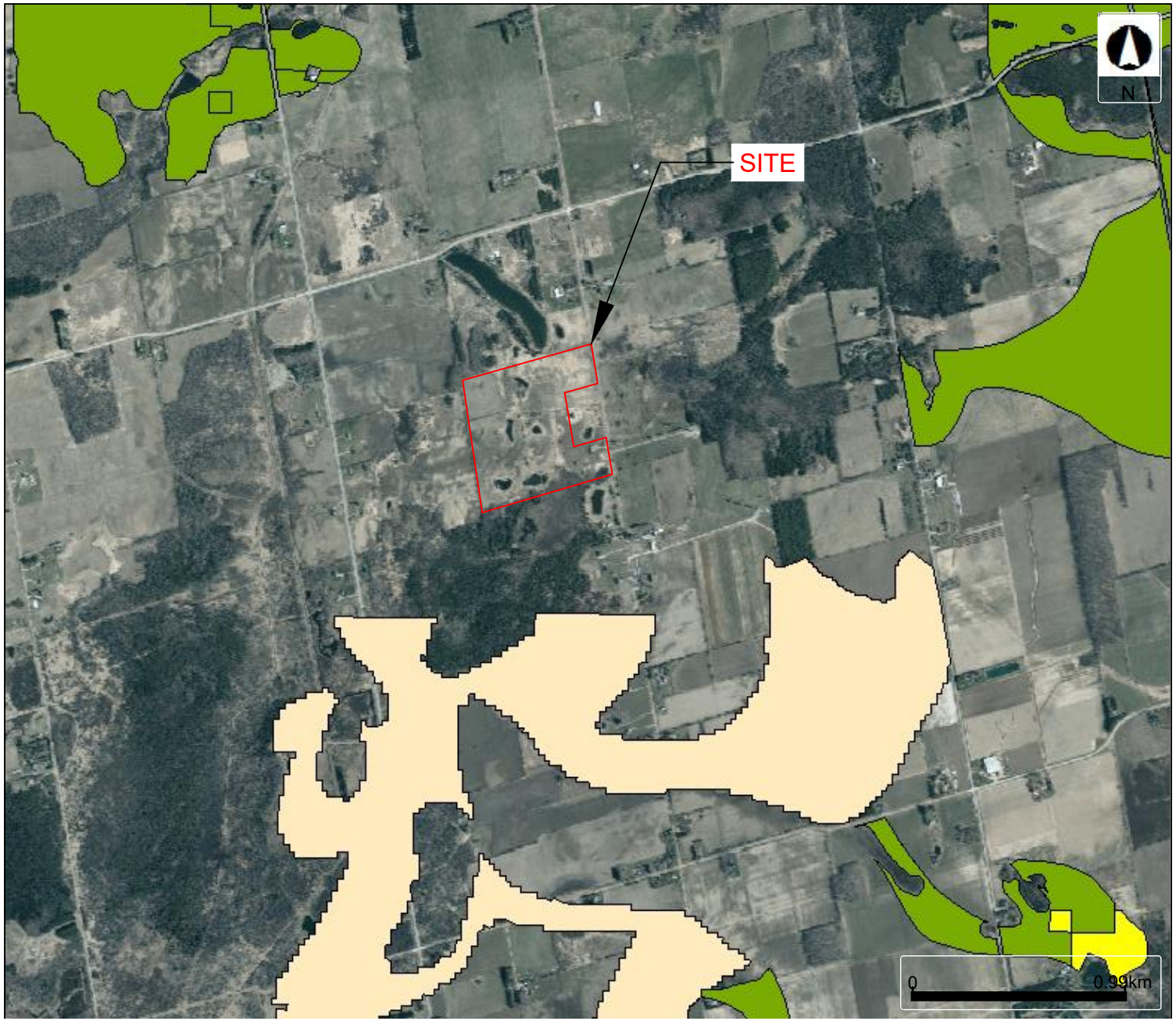

Legend

- Wellhead Protection Area Q2
- Significant Groundwater Recharge Area
  - N/A
  - 0
  - 2
  - 4
  - 6
- Assessment Parcel

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CLIENT:	PROJECT:	TITLE:	SCALE:	DATE:
THE CELLULAR CONNECTION LTD. 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	HYDROGEOLOGICAL INVESTIGATION 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	MECP SIGNIFICANT GROUNDWATER RECHARGE ZONE	AS SHOWN	JAN / 2024
			DRAWING NO: 10	PROJECT NO 230114

CANADA ENGINEERING SERVICES INC.
39 DAVISBROOK BOULEVARD
SCARBOROUGH, ONTARIO M1T 2H6
Ph: 416 492 4000 Fax: 416 492 4001
E-mail address: cesi@cesi.ca

Legend

- Issue Contributing Areas
- Highly Vulnerable Aquifers
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Intake Protection Zone 1
- Event Based Areas
- Intake Protection Zone 2
- Intake Protection Zone 3
- Vulnerable Scoring Area - Groundwater
  - 2
  - 4
  - 6
  - 8
  - 10
- Assessment Parcel

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CLIENT:
THE CELLULAR CONNECTION LTD.

514504 LINE 2,
AMARANTH, ONTARIO
L0N 1L0

PROJECT:
HYDROGEOLOGICAL INVESTIGATION

514504 LINE 2,
AMARANTH, ONTARIO
L0N 1L0

TITLE:
MECP SIGNIFICANT GROUNDWATER SENSITIVE AREAS

SCALE:	DATE:
AS SHOWN	JAN / 2024
DRAWING NO:	PROJECT NO
11	230114

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E-mail address: cesi@cesi.ca

CLIENT:
THE CELLULAR CONNECTION LTD.

514504 LINE 2,
AMARANTH, ONTARIO
L0N 1L0

PROJECT:
HYDROGEOLOGICAL INVESTIGATION

514504 LINE 2,
AMARANTH, ONTARIO
L0N 1L0

TITLE:
GROUNDWATER CONTOUR AND FLOW DIRECTION

SCALE:	DATE:
AS SHOWN	JAN / 2024
DRAWING NO:	PROJECT NO
12	230114

CANADA ENGINEERING SERVICES INC.
39 DAVISBROOK BOULEVARD
SCARBOROUGH, ONTARIO M1T 2H6
Ph: 416 492 4000 Fax: 416 492 4001
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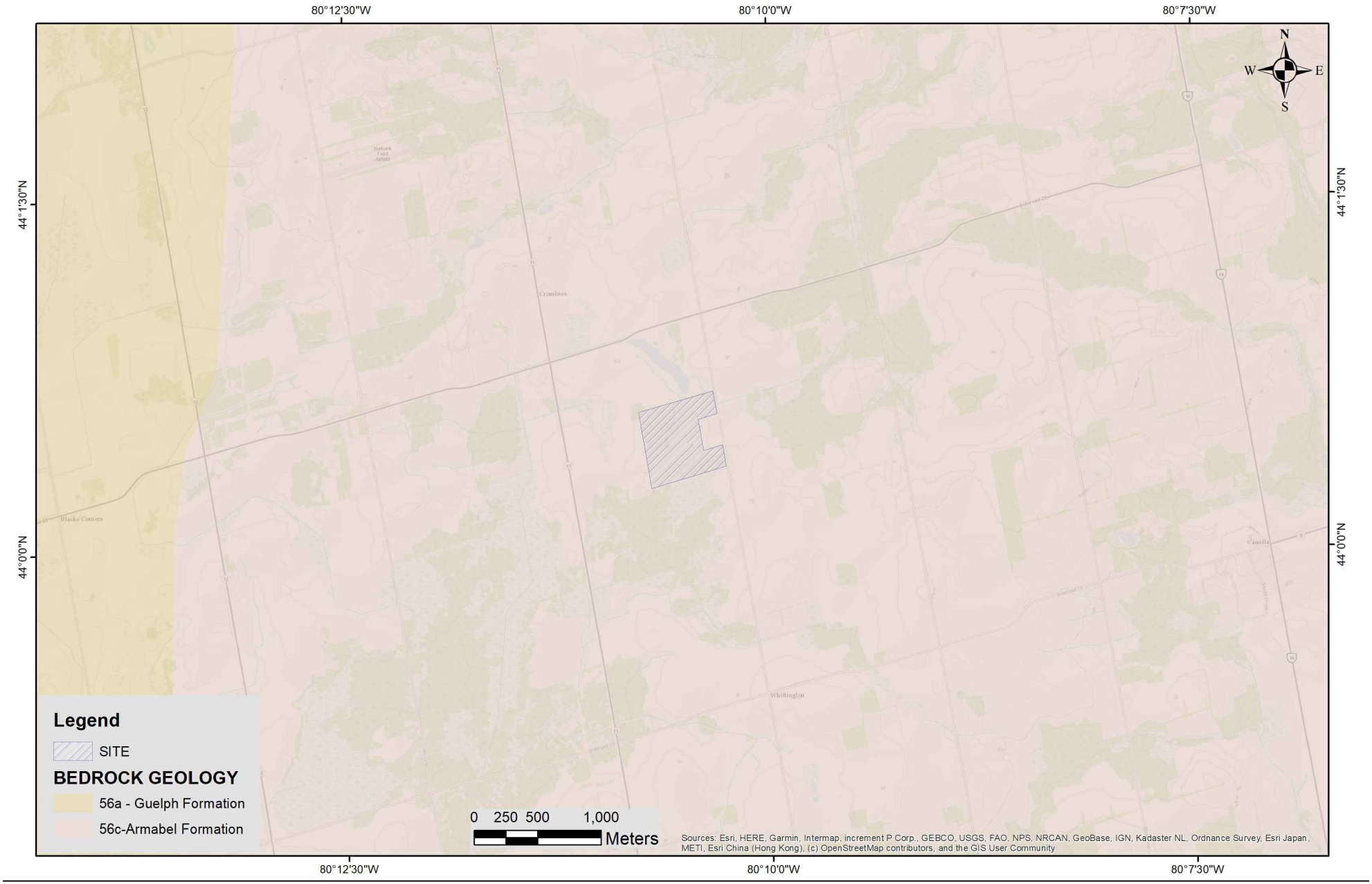
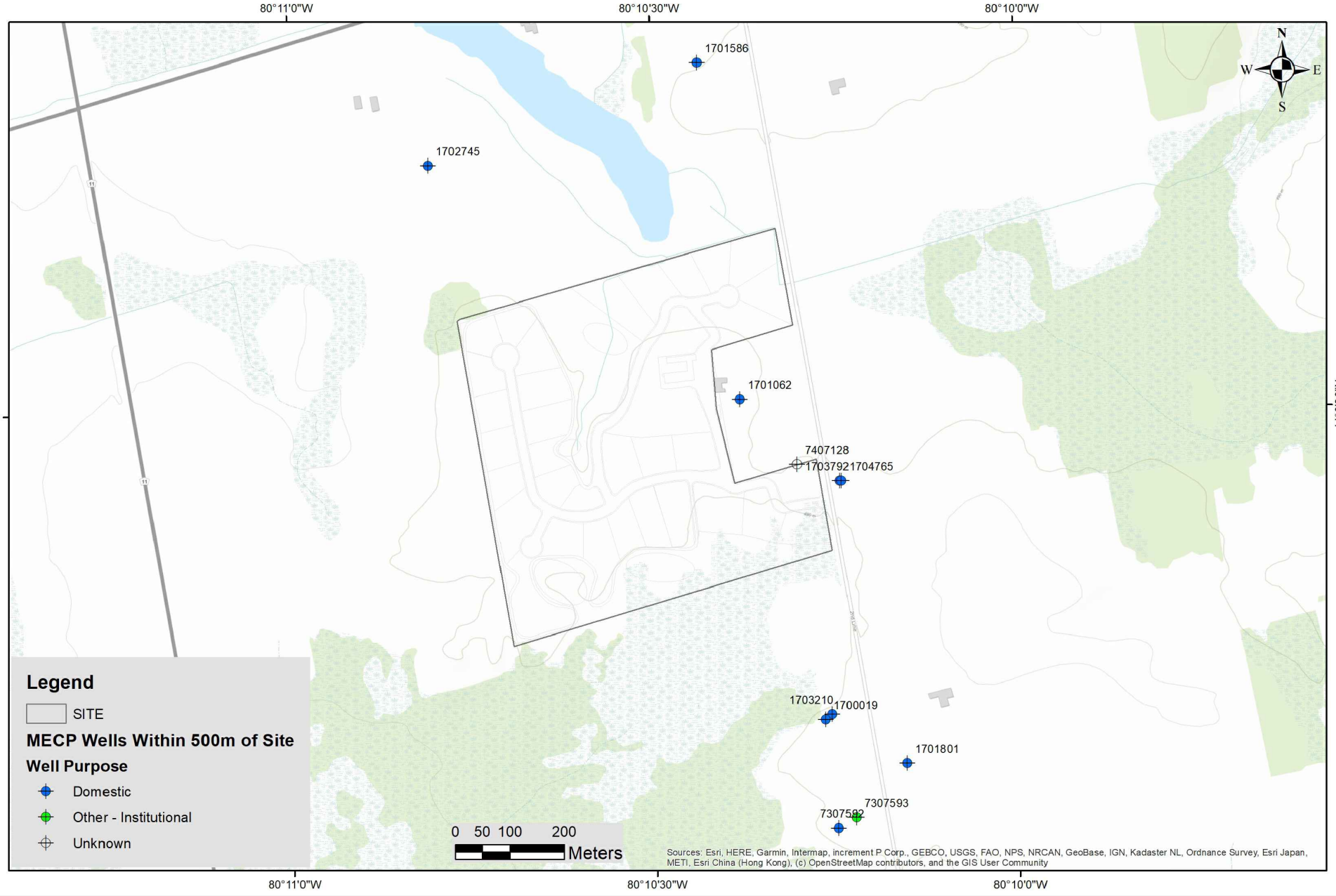


CLIENT: THE CELLULAR CONNECTION LTD. 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	PROJECT: HYDROGEOLOGICAL INVESTIGATION 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	TITLE: BEDROCK GEOLOGY OF THE SITE AND SURROUNDING AREA	SCALE: AS SHOWN DATE: JAN / 2024 DRAWING NO: 13 PROJECT NO 230114	**CANADA ENGINEERING SERVICES INC.** 39 DAVISBROOK BOULEVARD SCARBOROUGH, ONTARIO M1T 2H6 Ph: 416 492 4000 Fax: 416 492 4001 E-mail address: cesi@cesi.ca

CLIENT: THE CELLULAR CONNECTION LTD. 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	PROJECT: HYDROGEOLOGICAL INVESTIGATION 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	TITLE: SURFICIAL GEOLOGY OF SITE AND SURROUNDING	SCALE: AS SHOWN DATE: JAN / 2024 DRAWING NO: 14 PROJECT NO 230114	**CANADA ENGINEERING SERVICES INC.** 39 DAVISBROOK BOULEVARD SCARBOROUGH, ONTARIO M1T 2H6 Ph: 416 492 4000 Fax: 416 492 4001 E-mail address: cesi@cesi.ca



CLIENT: THE CELLULAR CONNECTION LTD. 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	PROJECT: HYDROGEOLOGICAL INVESTIGATION 514504 LINE 2, AMARANTH, ONTARIO L0N 1L0	TITLE: MECP WELLS WITHIN 500 M OF THE SITE	SCALE: AS SHOWN DRAWING NO: 15	DATE: JAN / 2024 PROJECT NO 230114

CANADA ENGINEERING SERVICES INC.
39 DAVISBROOK BOULEVARD
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Ph: 416 492 4000 Fax: 416 492 4001
E-mail address: cesi@cesi.ca

Project No: 230114

Log of Borehole No. 1

Project: Proposed Subdivision

Client: The Cellular Connection Ltd.

Location: 514504 Line 2, Amaranth, Ontario

Technologist: MK

Depth (ft / m)	Description	Depth/Elev.	NUMBER	Sample Type (SS)	Blows/ft	RECOVERY	WELL	Standard Penetration Test (10 20 30 40 50)	Moisture Content % (10 20 30 40 50)
	Ground Surface	490.20							
0 / 0	**TOPSOIL** Grey topsoil, organics, wet, loose	489.90	1	SS	14	50			37.05
1 / 0	**SILT AND CLAY TILL (CL)** Brown silt and clay till, trace to some sand, trace gravel, wet, stiff to very stiff PPR at 0.6 m = 400 kPa PPR at 1.06 m = 400 kPa PPR at 1.8 m = 400 kPa		2	SS	22	100			17.51
2 / 1			3	SS	22	100			23.56
3 / 1	PPR at 2.6 m = 250 kPa		4	SS	13	100			24.83
4 / 2			5	SS	11	100			28.78
5 / 3	PPR at 3.4 m = 200 kPa	485.63							
6 / 4	**SILTY SAND TILL** Brown to grey silty sand till, some clay, some gravel, moist, compact to very dense PPR at 4.9 m = 250 kPa		6	SS	26	100			6.54
7 / 5			7	SS	28	100			8.65
8 / 6	PPR at 6.4 m = 200 kPa								
9 / 7	Turned grey at 7.6 m								
10 / 8	PPR at 7.9 m = 300 kPa		8	SS	100	100			7.95
11 / 9	PPR at 9.3 m > 450 kPa	480.75	9	SS	100	60			8.36
12 / 10	**END OF BOREHOLE** Borehole completely open upon completion Water level upon completion = 6.28 m Water level on November 3, 2023 = 5.81 m PPR = Pocket Penetrometer Reading								

WELL: BENTONITE SEAL; SAND FILL

Drill Method: Track mounted drill rig

Drill Date: October 18, 2023

Hole Size: 150 mm diameter

Canada Engineering Services Inc.
39 Davisbrook Blvd.
Scarborough, Ontario
M1T 2H6

Checked By: RJ

Datum: Geodetic Elevations from Topographic Survey Map by Schaeffer Dzaldov Purcell Ltd., Dated September 12, 2023

Project No: 230114

Log of Borehole No. 2

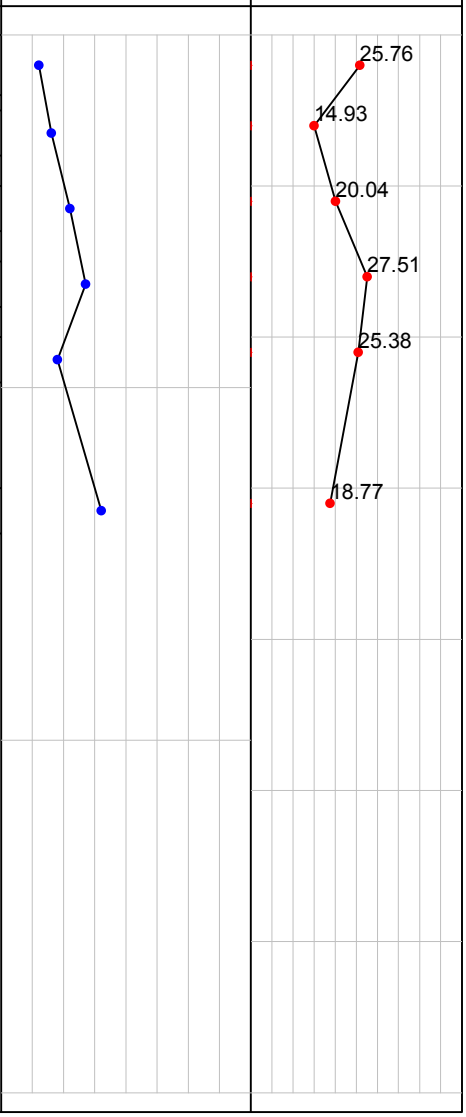
Project: Proposed Subdivision

Client: The Cellular Connection Ltd.

Engineer: MK

Location: 514504 Line 2, Amaranth, Ontario

Depth (ft / m)	Description	Depth/Elev.	NUMBER	Sample Type (SS)	Blows/ft	RECOVERY
0 / 0	Ground Surface	487.00				
0–3 / 0–1	**TOPSOIL** Grey topsoil, organics, wet, compact	486.09	1	SS	12	100
3–7 / 1–2	**SILTY SAND TILL** Brown to grey silty sand till, some clay, trace gravel, wet, compact PPR at 1.06 m = 300 kPa PPR at 1.8 m = 450 kPa	484.71	2 3	SS SS	16 22	100 100
7–16 / 2–5	**SILT AND CLAY TILL (CL)** Mottled grey-brown silt and clay till, trace to some sand, trace gravel, moist to wet, very stiff PPR at 2.6 m = 400 kPa PPR at 3.4 m = 350 kPa Turned grey at 4.6 m PPR at 4.9 m = 450 kPa	481.97	4 5 6	SS SS SS	27 18 32	100 100 100
16–35 / 5–10	**END OF BOREHOLE** Borehole completely open and dry upon completion PPR = Pocket Penetrometer Reading					



Drill Method: Track mounted drill rig

Drill Date: October 19, 2023

Hole Size: 150 mm diameter

Canada Engineering Services Inc.
39 Davisbrook Blvd.
Scarborough, Ontario
M1T 2H6

Checked By: RJ

Datum: Geodetic Elevations from Topographic Survey Map by Schaeffer Dzaldov Purcell Ltd., Dated September 12, 2023

Project No: 230114

Log of Borehole No. 3

Project: Proposed Subdivision

Client: The Cellular Connection Ltd.

Location: 514504 Line 2, Amaranth, Ontario

Technologist: MK

Depth (ft / m)	Description	Depth/Elev.	NUMBER	Sample Type (SS)	Blows/ft	RECOVERY	WELL	Standard Penetration Test (10 20 30 40 50)	Moisture Content % (10 20 30 40 50)
0 / 0	Ground Surface	485.00							
0–3 / 0–1	**SILTY SAND** Brown silty sand, some clay, wet, compact		1	SS	11	100			24.99
3 / 1		484.24							
3–6 / 1–2	**PEAT** Black peat, wet, loose		2	SS	9	100			24.64
6–10 / 2–3	**SILT AND CLAY TILL (CL)** Mottled brown-grey silt and clay till, trace to some sand, trace gravel, wet, stiff to very stiff PPR at 1.8 m = 300 kPa PPR at 2.6 m = 400 kPa		3	SS	10	100			24.09
			4	SS	13	100			19.46
10 / 3	PPR at 3.4 m = 300 kPa		5	SS	15	100			28.42
15 / 4	PPR at 4.9 m = 400 kPa		6	SS	17	100	BENTONITE SEAL		17.3
20 / 6	PPR at 6.4 m = 75 kPa		7	SS	11	100			15.25
25 / 7	PPR at 7.9 m = 300 kPa		8	SS	60	100	SAND FILL		19.01
30 / 9	PPR at 9.3 m = 400 kPa		9	SS	27	100			19.23
31 / 9		475.40							
32 / 10	**END OF BOREHOLE** Borehole completely open upon completion Water level upon completion = 8.53 m Water level on November 3, 2023 = 1.09 m PPR = Pocket Penetrometer Reading								

Drill Method: Track mounted drill rig

Drill Date: October 20, 2023

Hole Size: 150 mm diameter

Canada Engineering Services Inc.
39 Davisbrook Blvd.
Scarborough, Ontario
M1T 2H6

Checked By: RJ

Datum: Geodetic Elevations from Topographic Survey Map by Schaeffer Dzaldov Purcell Ltd., Dated September 12, 2023

Project No: 230114

Log of Borehole No. 4

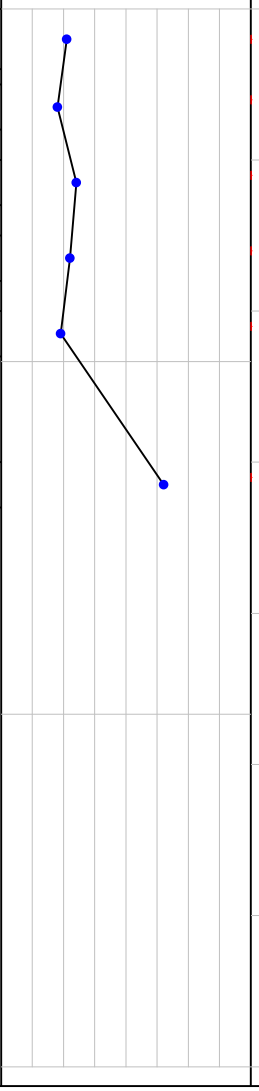
Project: Proposed Subdivision

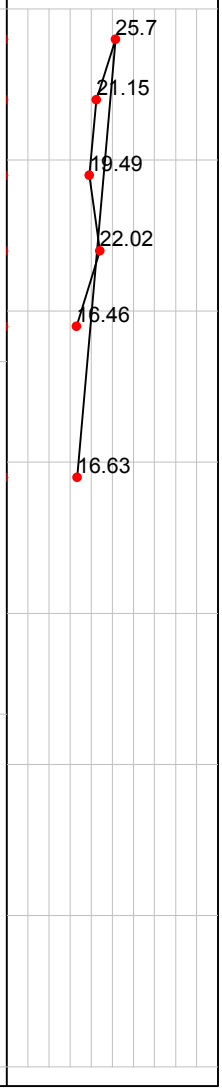
Client: The Cellular Connection Ltd.

Engineer: MK

Location: 514504 Line 2, Amaranth, Ontario

Depth (ft / m)	Description	Depth/Elev.	NUMBER	Sample Type (SS)	Blows/ft	RECOVERY
0 / 0	Ground Surface	490.80				
0 – 1	**TOPSOIL** Grey topsoil, organics, wet, compact	490.50	1	SS	21	100
1 – 3	**SILT AND CLAY TILL (CL)** Mottled grey-brown silt and clay till, trace to some sand, trace gravel, moist to wet, very stiff PPR at 0.6 m = 400 kPa PPR at 1.06 m > 450 kPa PPR at 1.8 m > 450 kPa		2	SS	18	100
2 – 4			3	SS	24	100
4 – 5	PPR at 2.6 m = 350 kPa		4	SS	22	100
5 – 6	PPR at 3.4 m = 350 kPa		5	SS	19	100
6 – 7	Turned grey at 4.6 m PPR at 4.9 m = 450 kPa					
7 – 8		485.77	6	SS	52	100
8 – 10	**END OF BOREHOLE** Borehole completely open and dry upon completion PPR = Pocket Penetrometer Reading					





Drill Method: Track mounted drill rig

Drill Date: October 18, 2023

Hole Size: 150 mm diameter

Canada Engineering Services Inc.
39 Davisbrook Blvd.
Scarborough, Ontario
M1T 2H6

Checked By: RJ

Datum: Geodetic Elevations from Topographic Survey Map by Schaeffer Dzaldov Purcell Ltd., Dated September 12, 2023

Project No: 230114

Log of Borehole No. 5

Project: Proposed Subdivision

Client: The Cellular Connection Ltd.

Engineer: MK

Location: 514504 Line 2, Amaranth, Ontario

Depth (ft / m)	Description	Depth/Elev.	NUMBER	Sample Type (SS)	Blows/ft	RECOVERY	SPT (10 20 30 40 50 60 70)	Moisture Content (% 10 20 30 40)
0 / 0	Ground Surface	490.56						
0–2 / 0	**TOPSOIL** Grey topsoil, organics, wet, compact	490.10	1	SS	19	100		19.34
2–5 / 1	**SILT AND CLAY TILL (CL)** Mottled grey-brown silt and clay till, trace to some sand, trace gravel, moist to wet, very stiff PPR at 0.6 m = 450 kPa PPR at 1.06 m > 450 kPa		2	SS	49	100		22.14
5–6 / 2	PPR at 1.8 m > 450 kPa		3	SS	28	100		16.9
8–9 / 2	PPR at 2.6 m > 450 kPa		4	SS	36	100		20.6
10–11 / 3	PPR at 3.4 m = 450 kPa Turned grey at 3.5 m		5	SS	28	100		25.74
13–15 / 4	PPR at 4.9 m = 450 kPa							
16 / 5		485.53	6	SS	39	100		15.75
17–35 / 5–10	**END OF BOREHOLE** Borehole completely open and dry upon completion PPR = Pocket Penetrometer Reading	479.89						

Drill Method: Track mounted drill rig

Drill Date: October 18, 2023

Hole Size: 150 mm diameter

Canada Engineering Services Inc.
39 Davisbrook Blvd.
Scarborough, Ontario
M1T 2H6

Checked By: RJ

Datum: Geodetic Elevations from Topographic Survey Map by Schaeffer Dzaldov Purcell Ltd., Dated September 12, 2023

Project No: 230114

Log of Borehole No. 6

Project: Proposed Subdivision

Client: The Cellular Connection Ltd.

Location: 514504 Line 2, Amaranth, Ontario

Technologist: MK

Depth (ft / m)	Description	Depth/Elev.	NUMBER	Sample Type (SS)	Blows/ft	RECOVERY	WELL
0 / 0	Ground Surface	490.15					
0 – 1	**TOPSOIL** Grey topsoil, organics, wet, loose		1	SS	16	100	
1 – 2	**SILT AND CLAY TILL (CL)** Mottled brown-grey silt and clay till, trace to some sand, trace gravel, wet, very stiff to hard PPR at 0.6 m = 300 kPa PPR at 1.1 m = 400 kPa PPR at 1.8 m = 400 kPa		2	SS	28	100	
2 – 3	PPR at 2.6 m = 350 kPa		3	SS	22	100	
3 – 4	Turned grey at 3.3 m PPR at 3.4 m = 350 kPa		4	SS	21	100	
4 – 5	PPR at 4.9 m = 350 kPa		5	SS	21	100	
5 – 6	PPR at 6.4 m = 300 kPa		6	SS	23	100	
6 – 7	PPR at 7.9 m = 350 kPa		7	SS	18	100	
7 – 8	PPR at 9.3 m = 300 kPa		8	SS	27	100	
8 – 9		480.55	9	SS	68	100	
9 – 10	**END OF BOREHOLE** Borehole completely open upon completion Water level upon completion = 8.53 m Water level on November 3, 2023 = 2.61 m PPR = Pocket Penetrometer Reading						

WELL: BENTONITE SEAL; SAND FILL

Standard Penetration Test (10 20 30 40 50)

Moisture Content (% — 10 20 30 40 50)

Depth (m)	Moisture Content (%)
0.5	14.06
1.1	22.81
1.7	23.39
2.3	23.42
3.0	25.16
4.0	25.74
5.0	27.1
6.5	14.93
7.5	20.45

Drill Method: Track mounted drill rig

Drill Date: October 19, 2023

Hole Size: 150 mm diameter

Canada Engineering Services Inc.
39 Davisbrook Blvd.
Scarborough, Ontario
M1T 2H6

Checked By: RJ

Datum: Geodetic Elevations from Topographic Survey Map by Schaeffer Dzaldov Purcell Ltd., Dated September 12, 2023

Project No: 230114

Log of Borehole No. 7

Project: Proposed Subdivision

Client: The Cellular Connection Ltd.

Location: 514504 Line 2, Amaranth, Ontario

Technologist: MK

Depth (ft / m)	Description	Depth/Elev.	NUMBER	Sample Type (SS)	Blows/ft	RECOVERY	WELL	Standard Penetration Test (10 20 30 40 50)	Moisture Content % (10 20 30 40 50)
0 / 0	Ground Surface	490.45							
0–2 / 0	**TOPSOIL** Grey topsoil, organics, wet, loose	489.84	1	SS	12	100			28.53
2–7 / 0–2	**SILTY SAND TILL** rey to brown silty sand till, some clay, trace gravel, moist, dense PPR at 1.06 m > 450 kPa PPR at 1.8 m > 450 kPa	488.16	2 3	SS SS	47 42	100 100			9.12 7.07
7–30 / 2–9	**SILT AND CLAY TILL (CL)** Brown to grey silt and clay till, trace to some sand, trace gravel, wet, very stiff to hard PPR at 2.6 m > 450 kPa Turned grey at 3.0 m PPR at 3.4 m > 450 kPa PPR at 4.9 m = 350 kPa PPR at 6.4 m = 200 kPa PPR at 7.9 m> 450 kPa	481.31	4 5 6 7 8	SS SS SS SS SS	32 25 21 17 86	100 100 100 100 100	BENTONITE SEAL SAND FILL		22.26 19.78 20.44 21 12.49
30–33 / 9–10	**SILTY SAND TILL** Grey silty sand till, some clay, trace gravel, moist, very dense PPR at 9.3 m > 450 kPa	480.85	9	SS	62	100			7.38
33–37 / 10–11	**END OF BOREHOLE** Borehole completely open and dry upon completion Water level on November 3, 2023 = 3.90 m PPR = Pocket Penetrometer Reading								

Drill Method: Track mounted drill rig

Drill Date: October 19, 2023

Hole Size: 150 mm diameter

Canada Engineering Services Inc.
39 Davisbrook Blvd.
Scarborough, Ontario
M1T 2H6

Checked By: RJ

Datum: Geodetic Elevations from Topographic Survey Map by Schaeffer Dzaldov Purcell Ltd., Dated September 12, 2023

Project No: 230114

Log of Borehole No. 8

Project: Proposed Subdivision

Client: The Cellular Connection Ltd.

Engineer: MK

Location: 514504 Line 2, Amaranth, Ontario

Depth (ft / m)	Description	Depth/Elev.	NUMBER	Sample Type (SS)	Blows/ft	RECOVERY
0 / 0	Ground Surface	489.74				
0–3 / 0–1	**TOPSOIL** Grey topsoil, organics, wet, compact	488.83	1	SS	10	100
3–7 / 1–2	**SILT AND CLAY TILL (CL)** Mottled grey-brown silt and clay till, trace to some sand, trace gravel, moist to wet, stiff to very stiff PPR at 1.06 m = 300 kPa PPR at 1.8 m = 300 kPa	487.45	2 3	SS SS	11 16	100 100
7–15 / 2–4	**SILTY SAND TILL** Brown silty sand till, some clay, some gravel, wet, dense to compact PPR at 2.6 m > 450 kPa PPR at 3.4 m = 450 kPa	485.17	4 5	SS SS	35 27	100 100
15–16 / 4–5	**SILT AND CLAY TILL (CL)** Grey silt and clay till, some sand, trace gravel, wet, hard PPR at 4.9 m = 450 kPa	484.71	6	SS	36	100
16–35 / 5–10	**END OF BOREHOLE** Borehole completely open upon completion Water level upon completion = 4.26 m PPR = Pocket Penetrometer Reading	479.07				

SPT
10 20 30 40 50 60 70

Moisture Content
% 10 20 30 40

Depth (m)	Moisture Content (%)
0	36.96
1	25.95
2	19.18
3	10.85
4	11.86
5	21.87

Drill Method: Track mounted drill rig

Drill Date: October 19, 2023

Hole Size: 150 mm diameter

Canada Engineering Services Inc.
39 Davisbrook Blvd.
Scarborough, Ontario
M1T 2H6

Checked By: RJ

Datum: Geodetic Elevations from Topographic Survey Map by Schaeffer Dzaldov Purcell Ltd., Dated September 12, 2023

Project No: 230114

Log of Borehole No. 9

Project: Proposed Subdivision

Client: The Cellular Connection Ltd.

Engineer: MK

Location: 514504 Line 2, Amaranth, Ontario

Depth (ft / m)	Description	Depth/Elev.	NUMBER	Sample Type (SS)	Blows/ft	RECOVERY
0 / 0	Ground Surface	489.87				
0–3 / 0–1	**TOPSOIL** Grey topsoil, organics, wet, compact		1	SS	11	100
3–5 / 1–1.5	**SILTY SAND TILL** Brown silty sand till, some clay, some gravel, wet, compact PPR at 1.06 m = 300 kPa	488.35	2	SS	22	100
5–16 / 1.5–5	**SILT AND CLAY TILL (CL)** Grey silt and clay till, some sand, trace gravel, wet, very stiff PPR at 1.8 m = 300 kPa PPR at 2.6 m = 300 kPa PPR at 3.4 m = 300 kPa PPR at 4.9 m = 350 kPa	484.84	3 4 5 6	SS SS SS SS	17 24 21 27	100 100 100 100
16 / 5	**END OF BOREHOLE** Borehole completely open and dry upon completion PPR = Pocket Penetrometer Reading	479.20				

SPT: 10 20 30 40 50 60 70

Moisture Content (%): 10 20 30 40

Depth (m)	Moisture Content (%)
1	15.2
2	16.24
3	18.56
4	17.5
5	17.67
6	23.04

Drill Method: Track mounted drill rig

Drill Date: October 19, 2023

Hole Size: 150 mm diameter

Canada Engineering Services Inc.
39 Davisbrook Blvd.
Scarborough, Ontario
M1T 2H6

Checked By: RJ

Datum: Geodetic Elevations from Topographic Survey Map by Schaeffer Dzaldov Purcell Ltd., Dated September 12, 2023

Project No: 230114

Log of Borehole No. 10

Project: Proposed Subdivision

Client: The Cellular Connection Ltd.

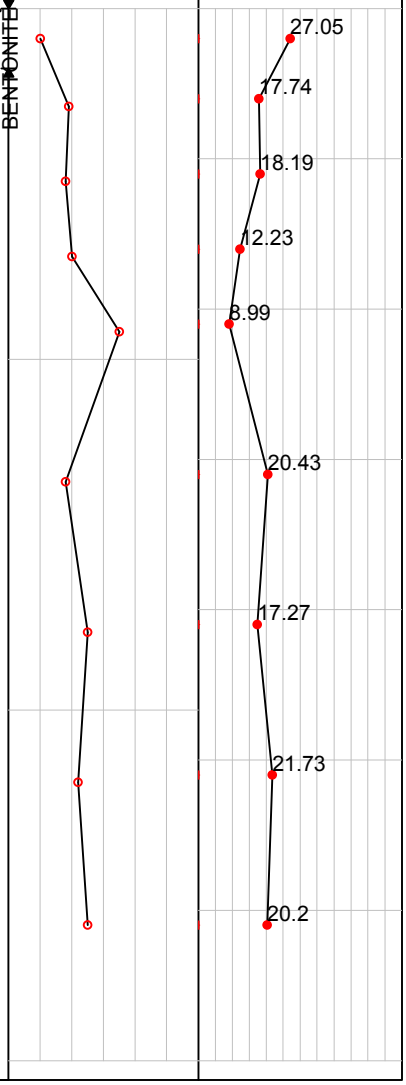
Location: 514504 Line 2, Amaranth, Ontario

Technologist: MK

Depth (ft / m)	Description	Depth/Elev.	NUMBER	Sample Type (SS)	Blows/ft	RECOVERY	WELL
	Ground Surface	487.90					
0 / 0	**TOPSOIL** Grey topsoil, organics, wet, loose	487.60	1	SS	10	100	BENTONITE SEAL
1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 / 11 / 1 / 2 / 3	**VARVED SILTY CLAY AND SILTY SAND** Mottled grey-brown silty clay interbedded with silty sand with gravel sizes, wet, compact PPR at 0.6 m = 150 kPa PPR at 1.06 m = 400 kPa PPR at 1.8 m = 400 kPa PPR at 2.6 m = 400 kPa		2 3 4	SS SS SS	19 18 20	100 100 100	SAND FILL
11 / 12 / 13 / 14 / 15 / 16 / 17 / 18 / 19 / 20 / 21 / 22 / 23 / 24 / 25 / 26 / 27 / 28 / 29 / 30 / 31 / 4 / 5 / 6 / 7 / 8 / 9	**SILT AND CLAY TILL (CL)** Brown to grey silt and clay till, trace to some sand, trace gravel, wet, very stiff PPR at 3.4 m = 200 kPa Turned grey at 4.9 m PPR at 4.9 m = 200 kPa PPR at 6.4 m = 350 kPa PPR at 7.9 m = 300 kPa PPR at 9.3 m > 450 kPa	484.55 478.45	5 6 7 8 9	SS SS SS SS SS	35 18 25 22 25	60 50 60 50 0	
32 / 33 / 34 / 35 / 10	**END OF BOREHOLE** Borehole open up to 2.1 m upon completion Water level upon completion = 2.0 m Water level on November 3, 2023 = 1.38 m PPR = Pocket Penetrometer Reading						

Standard Penetration Test (10 20 30 40 50)

Moisture Content (% — 10 20 30 40 50)



Drill Method: Track mounted drill rig

Drill Date: October 20, 2023

Hole Size: 150 mm diameter

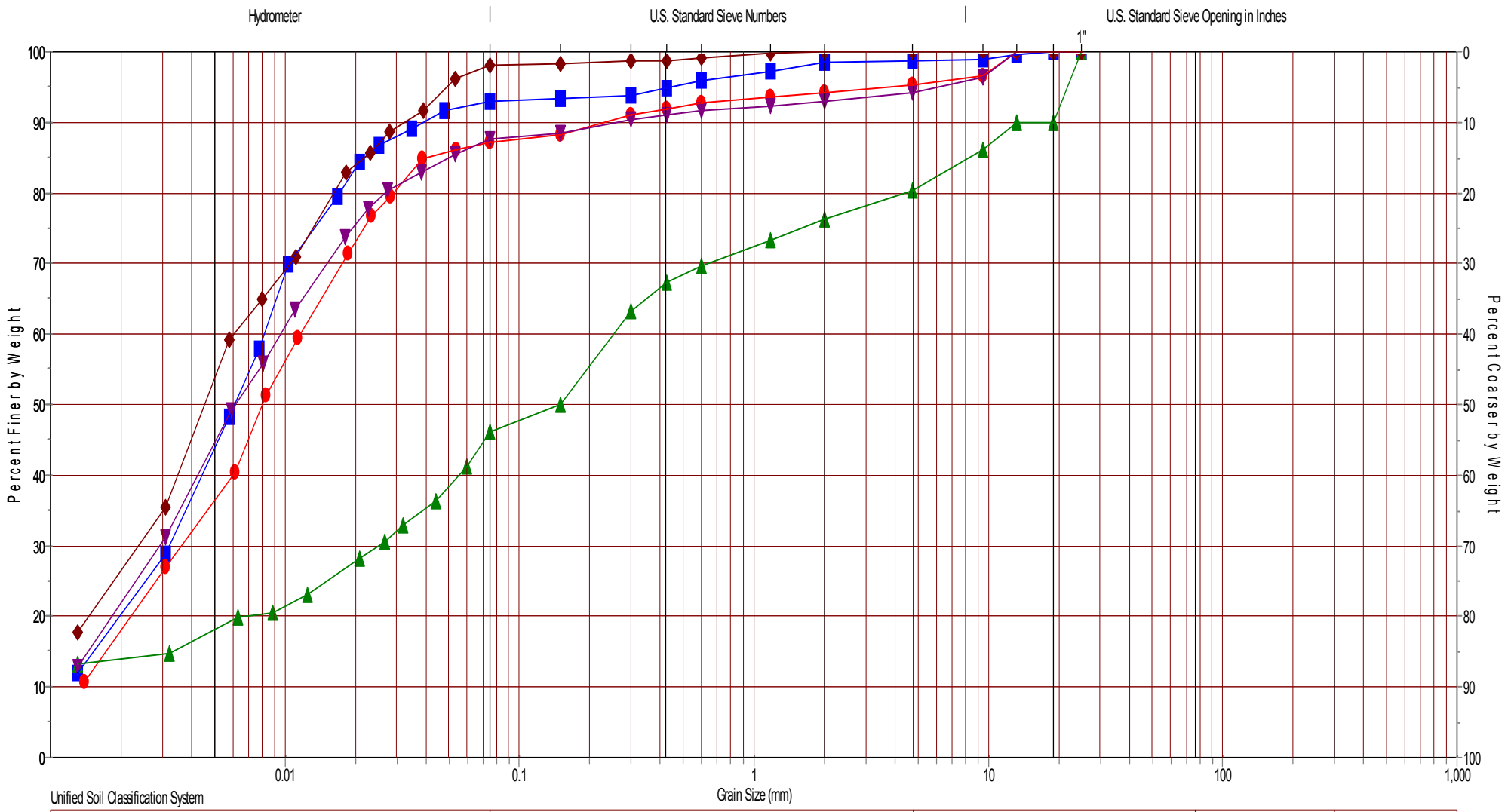
Canada Engineering Services Inc.
39 Davisbrook Blvd.
Scarborough, Ontario
M1T 2H6

Checked By: RJ

Datum: Geodetic Elevations from Topographic Survey Map by Schaeffer Dzaldov Purcell Ltd., Dated September 12, 2023

Figure 1	Project No.: 230114	GRAINSIZE DISTRIBUTION GRAPH
	Location: 514504 Line 2	Tested By: DA
	Client: The Cellular Connection Ltd.	Test Date: 31-Oct-2023

Symbol	Sample No.	% Clay	% Silt	% Fine Sand	% Medium Sand	% Coarse Sand	% Fine Gravel	% Coarse Gravel	% Cobbles
■	BH1 SA3	29.0	64.0	1.1	4.7	0.3	1.3	0.0	0.0
●	BH1 SA5	27.0	60.2	3.9	3.2	1.1	4.8	0.0	0.0
▲	BH1 SA7	14.9	31.3	17.2	13.0	4.1	9.7	10.1	0.0
▼	BH2 SA3	31.1	56.6	2.9	2.6	1.2	5.9	0.0	0.0
◆	BH2 SA4	35.4	62.8	0.5	1.3	0.1	0.0	0.0	0.0

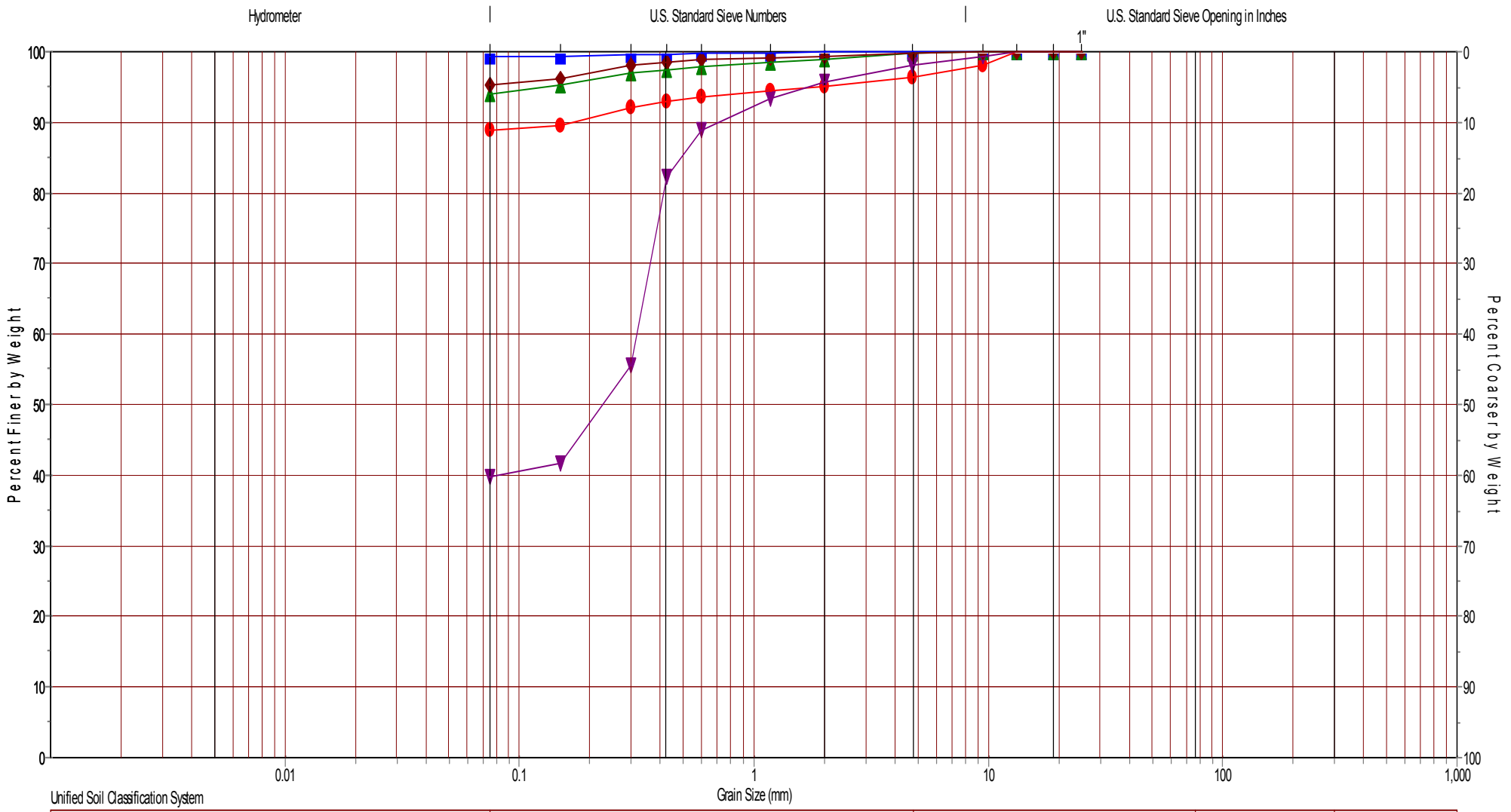


Unified Soil Classification System

SILT or CLAY		SAND			GRAVEL		COBBLES	BOULDERS
Clay	Silt	fine	medium	coarse	fine	coarse		

Figure 2	Project No.: 230114	GRAINSIZE DISTRIBUTION GRAPH
	Location: 514504 Line 2, Amaranth	Tested By: DA
	Client: The Cellular Connection Ltd.	Test Date: 31-Oct-2023

Symbol	Sample No.	% Clay	% Silt	% Fine Sand	% Medium Sand	% Coarse Sand	% Fine Gravel	% Coarse Gravel	% Cobbles
■	BH6 SA5	<99.3	<99.3	0.3	0.4	0.0	0.0	0.0	0.0
●	BH6 SA8	<88.9	<88.9	3.2	3.0	1.2	3.8	0.0	0.0
▲	BH7 SA5	<94.1	<94.1	3.1	2.1	0.9	0.3	0.0	0.0
▼	BH10 SA4	<39.9	<39.9	15.9	40.1	2.4	2.0	0.0	0.0
◆	BH10 SA6	<95.4	<95.4	2.9	1.2	0.4	0.3	0.0	0.0



Unified Soil Classification System

SILT or CLAY		SAND			GRAVEL		COBBLES	BOULDERS
Clay	Silt	fine	medium	coarse	fine	coarse		

CANADA ENGINEERING SERVICES INC

Consulting Engineers - Geotechnical, Environmental and Structural

Atterberg Limits Data Sheet

ASTM D4318-10

Project Name:	Proposed Subdivision	**Date:**	10-Nov-2023
Location:	514504 Line 2, Amaranth	**Tested By:**	MK
Sample No	BH1 SA3	**Test Number:**	1
Sample Depth:	1.5 m		

USCS Soil Classification: SILT AND CLAY TILL, TRACE TO SOME SAND, TRACE GRAVEL

TEST			PLASTIC LIMIT				LIQUID LIMIT			
Variable	NO		1	2	3	4	1	2	3	4
	Var.	Units								
Number of Blows	N	blows					37	30	24	18
Can Number	---	---	4	55	3		22	12	13	9
Mass of Empty Can	M_C	(g)	31.60	31.18	31.04		31.55	31.12	31.43	34.75
Mass Can & Soil (Wet)	M_{CMS}	(g)	35.28	34.12	35.57		42.10	52.71	49.79	58.38
Mass Can & Soil (Dry)	M_{CDS}	(g)	34.64	33.58	34.78		39.59	47.58	45.33	52.45
Mass of Soil	M_S	(g)	3.04	2.40	3.74		8.04	16.46	13.90	17.70
Mass of Water	M_W	(g)	0.64	0.54	0.79		2.51	5.13	4.46	5.93
Water Content	w	(%)	21.1	22.5	21.1		31.2	31.2	32.1	33.5

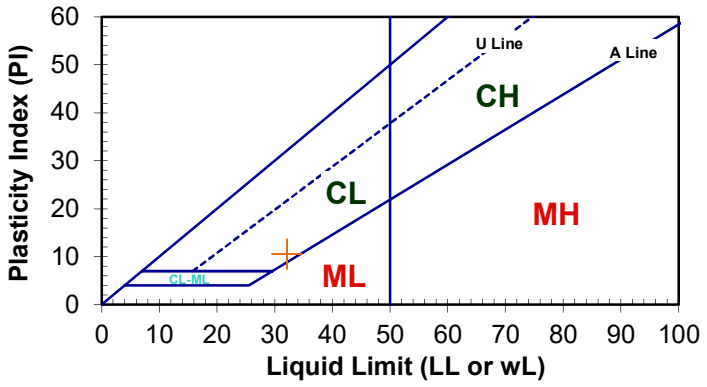
Liquid Limit (LL or w_L) (%):	**32.1**
Plastic Limit (PL or w_P) (%):	**21.6**
Plasticity Index (PI) (%):	**10.5**
USCS Classification:	**CL**

LOW TO MEDIUM PLASTIC CLAY

PI at "A" Line = 0.73(LL-20)

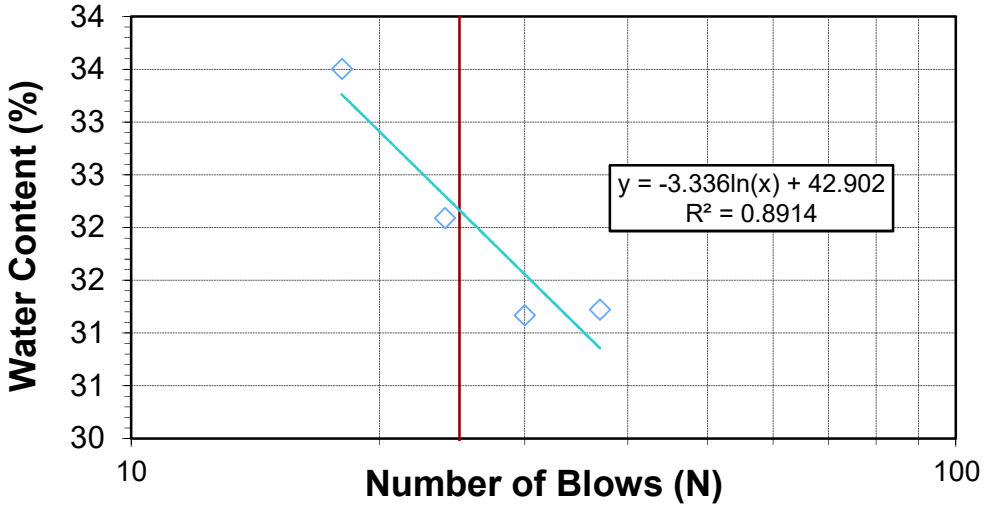
One Point Liquid Limit Calculation:

$LL = w_n (N/25)^{0.12}$



PROCEDURE USED

- ☐ Wet Preperation Multipoint
- ☐ Dry Preperation Multipoint
- ☐ Procedure A Multipoint
- ☐ Procedure B One-Point



GEOTECHNICAL SYMBOLS AND TERMS USED IN BOREHOLE/TEST PIT LOGS

Soil Description

Terminology describing soil types:

Topsoil	-	Mixture of soil and humus capable of supporting good vegetative growth
Peat	-	Fibrous fragments of visible and invisible decayed organic matter
Till	-	Unstratified and unsorted glacial deposit which may include any particle sizes Such as clay, silt, sand, stone, cobbles and boulders
Fill	-	Materials not identified as deposited by natural geological processes

Terminology describing soil structure:

Desiccated	-	Having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	-	Material breaks along plane of fracture
Varved	-	Composed of regular alternating layers of silt and clay
Laminated	-	Alternating layers of beds less than 6 mm thick
Stratified	-	Alternating layers of beds greater than 6 mm thick
Blocky	-	Material can be broken into small and hard angular lumps
Lensed	-	Irregular shaped pockets of soil having different particle size, texture, or colour from materials above and below
Well Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Uniformly Graded		Predominantly one grain size

Soil descriptions and classification are based on the Unified Soil Classification System (USCS) (ASTM D-2488), which classifies soils on the basis of engineering properties. The system divides soils into three major categories: (1) coarse grained, (2) fine-grained, and (3) highly organic. The soil is then subdivided based on either gradation or plasticity characteristics. This system provides a group symbol (eg. SM) and group name (eg. silty sand) for identification. The classification excludes particles larger than 76 mm.

Terminology describing materials outside the USCS, (eg. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

Trace	- Trace sand, trace silt, etc.	Less than 10%
Some	- Some sand, some silt, etc.	10 - 20%
Adjective	- Gravelly, sandy, silty, clayey, etc.	20 - 30%
“And”	- and gravel, and silt, etc.	> 35%
Noun	- Gravel, Sand, Silt, Clay	> 35% and main fraction

The standard terminology to describe cohesionless soils includes the compactness as determined by the Standard Penetration Test “N” -value.

Compactness	**“N” Value**
Very Loose	< 4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	> 50

GEOTECHNICAL SYMBOLS AND TERMS USED IN BOREHOLE/TEST PIT LOGS

The standard terminology to describe cohesive soils includes consistency, which is based on undrained shear strength as measured by in-situ vane tests, penetrometer tests, unconfined compression tests or similar field and laboratory analysis. Standard Penetration Test "N" values can also be used to provide an approximate indication of the consistency and shear strength of fine grained, cohesive soils.

Consistency	Undrained Shear Strength (kPa)	"N" Value	Field Identification
Very Soft	< 12.5	< 2	Easily penetrated several cm by the fist
Soft	12.5 - 25	2 - 4	Easily penetrated several cm by the thumb
Firm	25 - 50	4 - 8	Can be penetrated several cm by the thumb with moderate effort
Stiff	50 - 100	8 - 15	Readily indented by the thumb but penetrated only with great effort
Very Stiff	100 - 200	15 - 30	Readily indented by the thumb nail
Hard	> 200	> 30	Indented with difficulty by the thumbnail

Note: "N" Value - The Standard Penetration Test records the number of blows of a 140 lb (64 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler 1 foot (305 mm). For split spoon samples where full penetration is not achieved, the number of blows is reported over the sampler penetration in millimeters (eg. 50/75).

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:

Asphalt Concrete Topsoil Fill Peat Clay Silt Sand Gravel

WATER LEVEL MEASUREMENTS

Open Borehole or Test Pit

Monitoring Well, Piezometer or Standpipe

SAMPLE TYPE

SS Split spoon sample (obtained from the Standard Penetration Test)

AS Auger sample

ST Thin Wall Sample or Shelby Tube

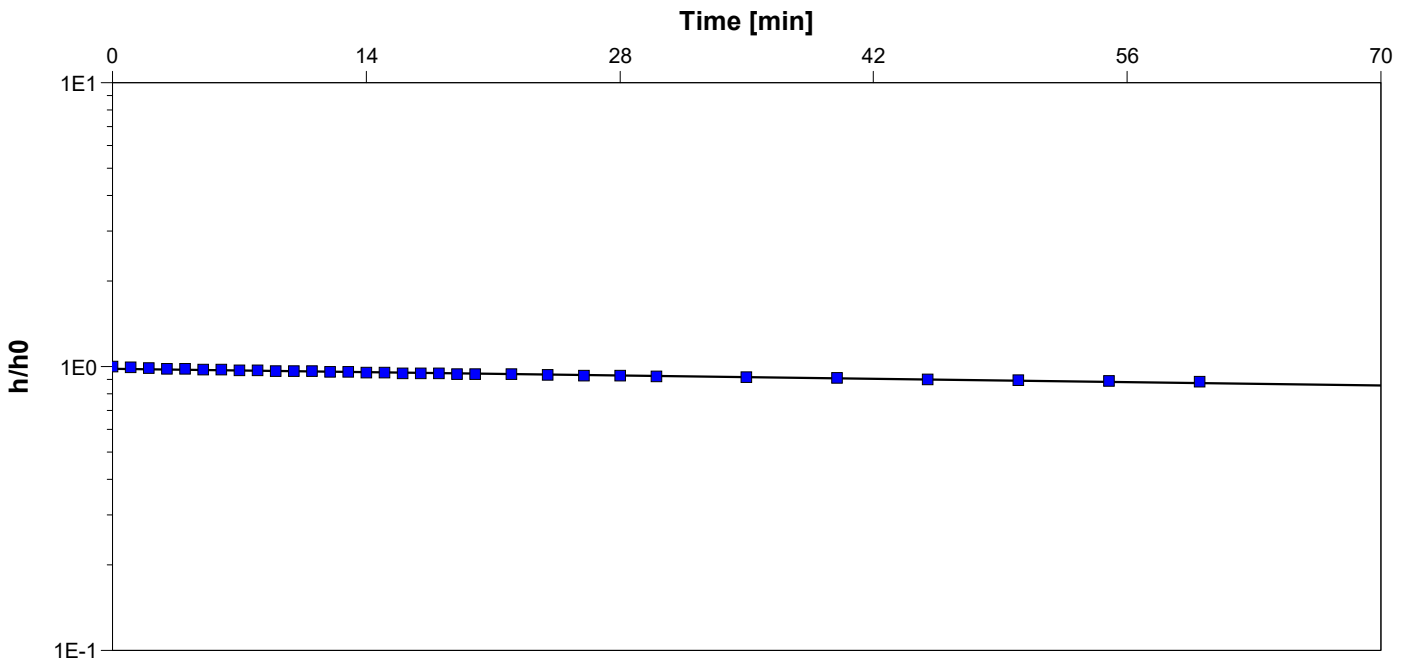
VS Shovel sample

APPENDIX C

HYDRAULIC CONDUCTIVITY AND DEWATERING CALCULATIONS

Canada Engineering Services Inc. 39 Davisbrook Blvd. Toronto, Ontario M1T 2H6	**Slug Test Analysis Report**
	Project: Proposed Subdivision
	Number: 230114
	Client: The Cellular Connection Ltd.

Location: 514504 Line 2, Amaranth	Slug Test: Slug Test 1	Test Well: BH1
Test Conducted by: MK		Test Date: 03-Nov-2023
Analysis Performed by: MK	BH1	Analysis Date: 06-Nov-2023
Aquifer Thickness:		

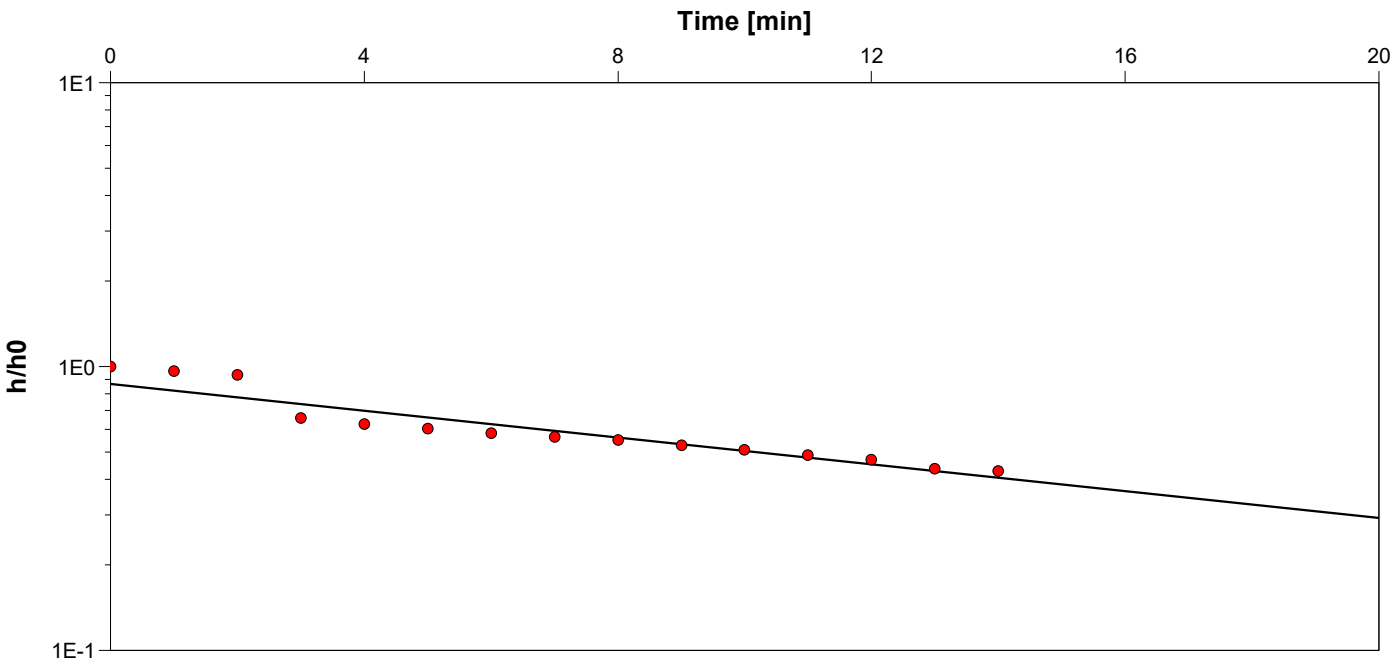


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH1	1.59×10^{-8}	

Canada Engineering Services Inc. **39 Davisbrook Blvd.** **Toronto, Ontario** **M1T 2H6**	**Slug Test Analysis Report** Project: Proposed Subdivision Number: 230114 Client: The Cellular Connection Ltd.

Location: 514504 Line 2, Amaranth	Slug Test: Slug Test 2	Test Well: BH3
Test Conducted by: MK		Test Date: 03-Nov-2023
Analysis Performed by: MK	BH3	Analysis Date: 06-Nov-2023
Aquifer Thickness:		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH3	4.56×10^{-7}	

Canada Engineering Services Inc.
39 Davisbrook Blvd.
Toronto, Ontario
M1T 2H6

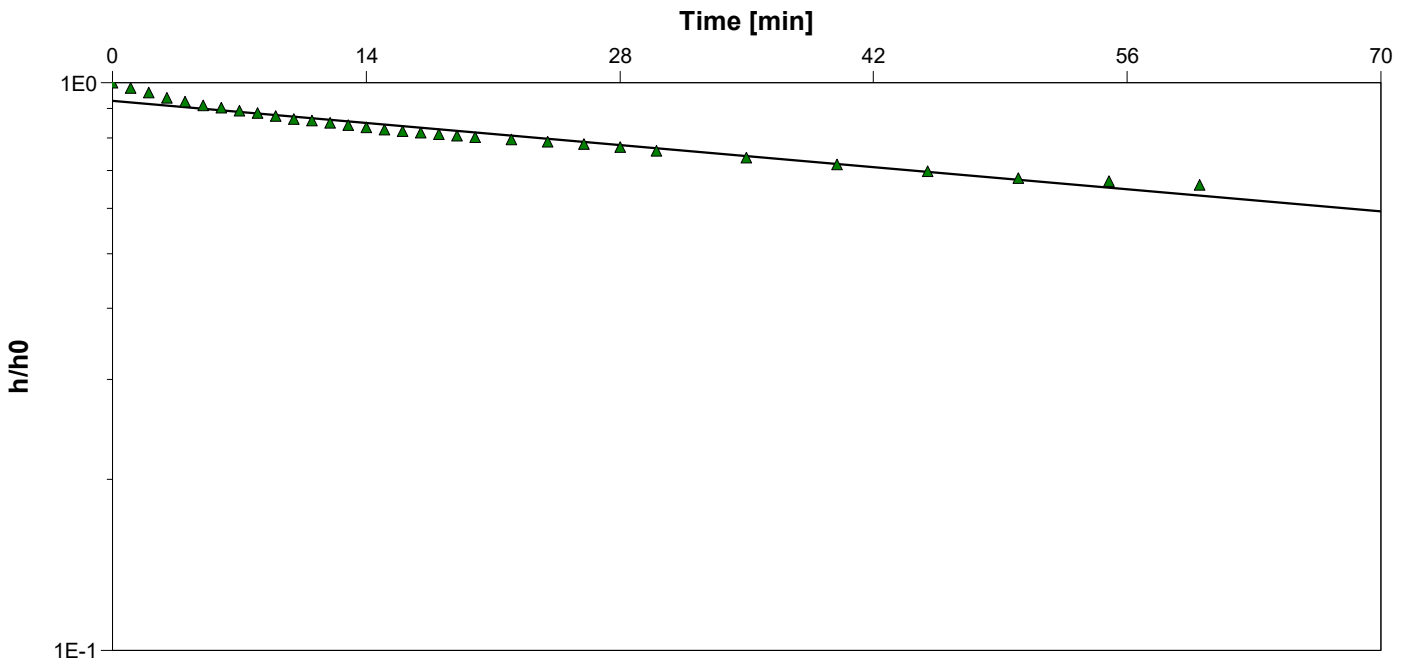
Slug Test Analysis Report

Project: Proposed Subdivision

Number: 230114

Client: The Cellular Connection Ltd.

Location: 514504 Line 2, Amaranth	Slug Test: Slug Test 3	Test Well: BH6
Test Conducted by: MK		Test Date: 03-Nov-2023
Analysis Performed by: MK	BH6	Analysis Date: 06-Nov-2023
Aquifer Thickness:		

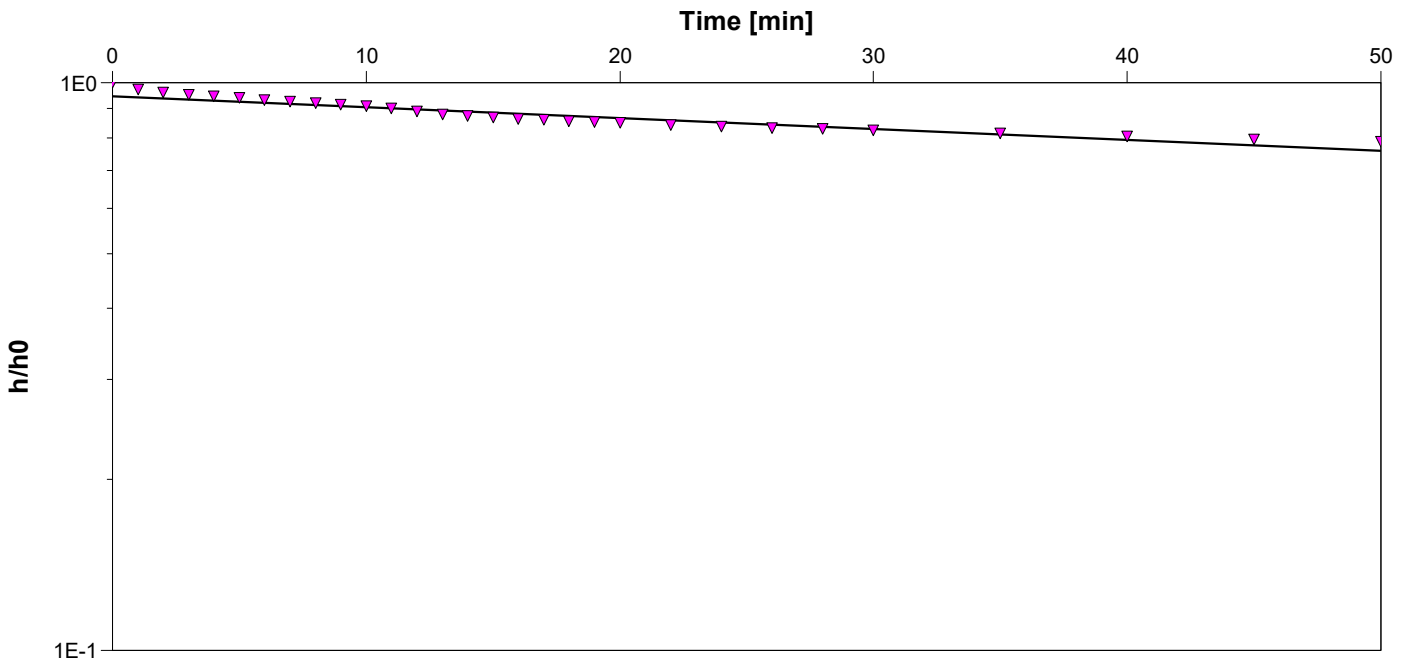


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH6	5.37×10^{-8}	

Canada Engineering Services Inc. 39 Davisbrook Blvd. Toronto, Ontario M1T 2H6	**Slug Test Analysis Report**
	Project: Proposed Subdivision
	Number: 230114
	Client: The Cellular Connection Ltd.

Location: 514504 Line 2, Amaranth	Slug Test: Slug Test 4	Test Well: BH7
Test Conducted by: MK		Test Date: 03-Nov-2023
Analysis Performed by: MK	BH7	Analysis Date: 06-Nov-2023
Aquifer Thickness:		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH7	3.71×10^{-8}	

Canada Engineering Services Inc.
39 Davisbrook Blvd.
Toronto, Ontario
M1T 2H6

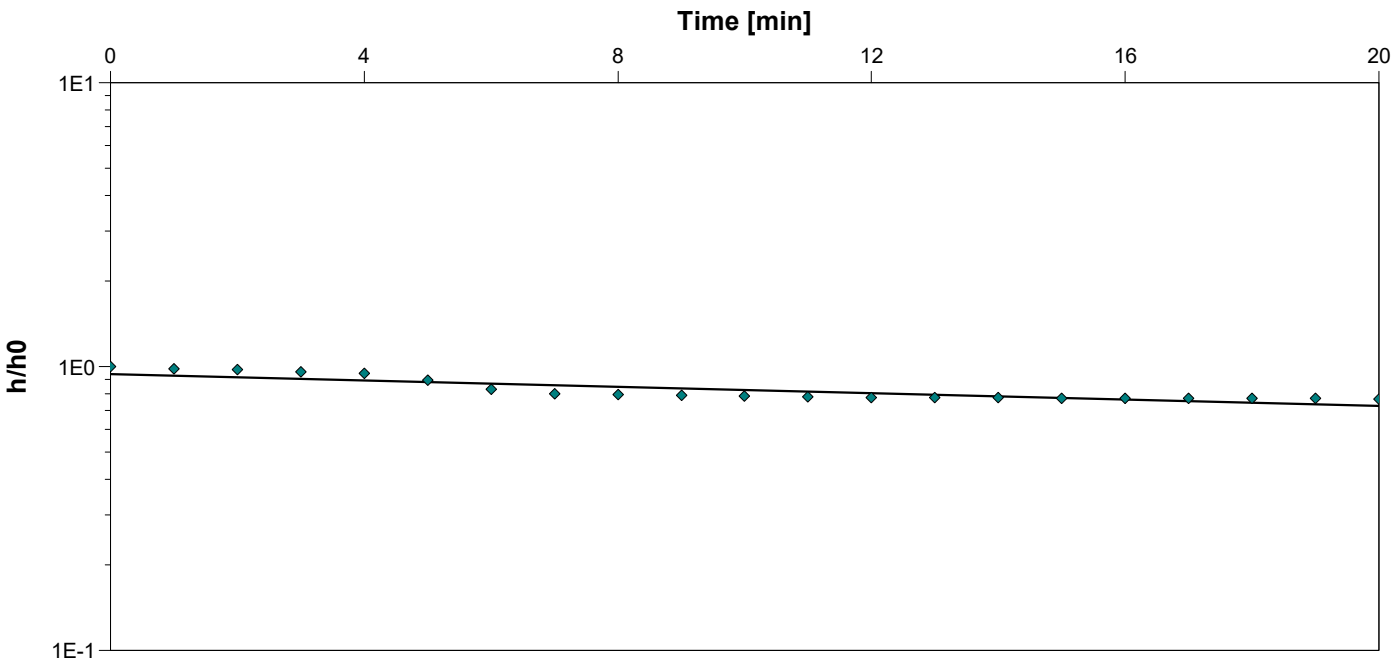
Slug Test Analysis Report

Project: Proposed Subdivision

Number: 230114

Client: The Cellular Connection Ltd.

Location: 514504 Line 2, Amaranth	Slug Test: Slug Test 5	Test Well: BH10
Test Conducted by: MK		Test Date: 03-Nov-2023
Analysis Performed by: MK	BH10	Analysis Date: 06-Nov-2023
Aquifer Thickness:		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH10	1.08×10^{-7}	

514504 2nd Line, Amaranth
Temporary Dewatering Assessment

Parameters		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Average Elevation of Ground Floor (masl)		490.20	485.00	490.45	490.15	487.90
Highest Groundwater level (masl)		484.55	484.60	487.46	487.65	487.02
Average footing elevation (3.3mbgl) (masl)		486.90	481.70	487.15	486.85	484.60
Dewatering target elevation (0.5 m below footing level) (masl)		486.40	481.20	486.65	486.35	484.10
Required Drawdown (m)		N/A	3.40	0.81	1.30	2.92
Elevation of assumed impervious layer (masl)		N/A	479.20	484.65	484.35	482.10
Height between static water level and impervious layer (m)		N/A	5.40	2.81	3.30	4.92
Height between required water level and impervious layer (m)		N/A	2.00	2.00	2.00	2.00
DEWATERING CALCULATION						
Permeability (Measured in Monitoring Wells) (m/sec)	K	1.59E-08	4.56E-07	5.37E-08	3.71E-08	1.08E-07
Depth of Existing groundwater level to impervious layer (m)	H	N/A	5.40	2.81	3.30	4.92
Depth of Required groundwater level to impervious layer after drawdown (m)	h	N/A	2.00	2.00	2.00	2.00
Excavation Area (sq.m)	A	325	325	325	325	325
Radius of influence from edge of excavation (m)	$R_{sichardt}$	N/A	6.89	0.56	0.75	2.88
Effective Radius of excavation √(ab/π) (m)	R_{eff}	N/A	10.17	10.17	10.17	10.17
Total Radius of Influence ($R_{sichardt}$ + R_{eff}) (m)	R_{total}	N/A	17.06	10.73	10.92	13.05
Discharge (m^3/sec) $Q = (\pi K(H^2-h^2))/Ln(R_{total}/R_{eff})$	**Q**	0.00E+00	6.97E-05	1.22E-05	1.13E-05	2.75E-05
Discharge (m^3/day)		0.00	6.02	1.05	0.97	2.38
Discharge (m^3/day) with FS=1.5		0.00	9.03	1.58	1.46	3.57
Considering max daily rainfall 25mm, Q =m^3/Day		8.13	8.13	8.13	8.13	8.13
Total Temporary Dewatering Quantity (m^3/day)	**Q_{temp}**	**8.13**	**17.16**	**9.71**	**9.59**	**11.69**

514504 2nd Line, Amaranth
Permanent Dewatering Assessment

Parameters		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Average Elevation of Ground Floor (masl)		490.20	485.00	490.45	490.15	487.90
Highest Groundwater level (masl)		484.55	484.60	487.46	487.65	487.02
Average footing elevation (3.3mbgl) (masl)		486.90	481.70	487.15	486.85	484.60
Dewatering target elevation (footing level) (masl)		486.90	481.70	487.15	486.85	484.60
Required Drawdown (m)		N/A	2.90	0.31	0.80	2.42
Elevation of assumed impervious layer (masl)		N/A	479.70	485.15	484.85	482.60
Height between static water level and impervious layer (m)		N/A	4.90	2.31	2.80	4.42
Height between required water level and impervious layer (m)		N/A	2.00	2.00	2.00	2.00

DEWATERING CALCULATION

Permeability (MW3) (m/sec)	K	1.59E-08	4.56E-07	5.37E-08	3.71E-08	1.08E-07
Depth of Existing groundwater level to impervious layer (m)	H	N/A	4.90	2.31	2.80	4.42
Depth of Required groundwater level to impervious layer after drawdown (m)	h	N/A	2.00	2.00	2.00	2.00
Excavation Area (sq.m)	A	325	325	325	325	325
Radius of influence from edge of excavation (m)	$R_{sichardt}$	N/A	5.87	0.22	0.46	2.39
Effective Radius of excavation √(ab/π) (m)	R_{eff}	N/A	10.17	10.17	10.17	10.17
Total Radius of Influence ($R_{sichardt}$ + R_{eff}) (m)	R_{total}	N/A	16.05	10.39	10.63	12.56
Discharge (m^3/sec) $Q = (\pi K(H^2-h^2))/Ln(R_{total}/R_{eff})$	**Q**	0.00	6.29E-05	1.08E-05	1.01E-05	2.50E-05
Discharge (m^3/day)		0.00	5.43	0.93	0.87	2.16
Discharge (m^3/day) with FS=1.5		0.00	8.15	1.39	1.31	3.24
Total Permanent Dewatering Quantity (m^3/day)	**Q_{perm}**	**0.00**	**8.15**	**1.39**	**1.31**	**3.24**