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Geotechnical Investigation – 233-261 Coldwater Road, Orillia, Ontario

Palmer Project #

1802403

Prepared For

Auroville Ltd.

June 24, 2022

June 24, 2022

Sagar Aurora
Auroville Ltd.
2150 Steeles Ave. East, Unit 8A
Brampton, Ontario L6T 1A7

Dear Sagar:

Re: Geotechnical Investigation – 233-261 Coldwater Road, Orillia, Ontario
Project #: 1802403

Palmer is pleased to submit the attached report describing the results of our Geotechnical Investigation for the project at the subject site ("the Site") located at 233-261 Coldwater Road, Orillia, Ontario.

The report provides site information from site investigation, laboratory testing, records reviews, and our interpretations/recommendations for your consideration.

Thank you for the opportunity to be of service on this project. We trust that this report will be satisfactory for your current needs. If you have any questions or require further information, please contact our office at your convenience. This report is subject to the Statement of Limitations provided at the end of this report.

Yours truly,

Matthew D. St Denis., P.Eng.
Team Lead, Geotechnical Engineering

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1. Introduction

Palmer was retained by Auroville Ltd. (Client) to undertake a Geotechnical Investigation to support proposed development at the Site, located at 233-261 Coldwater Road in Orillia, Ontario.

It is understood that the proposed development will consist of a nine-storey residential building without basement and associated parking lot. The objective of this geotechnical investigation was to determine the subsurface conditions in the proposed development area by means of five (5) exploratory boreholes, and from the findings in the boreholes make engineering recommendations for the proposed development.

This geotechnical investigation is based on limited number of boreholes. The report is provided on the basis of the terms of reference presented above, and on the assumption that the design will be in accordance with applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report deals with geotechnical issues only. Hydrogeological Assessments for the subject property are provided in a separate Palmer report.

This report has been prepared for the Client and its designers. Use of this report by third party without Palmer's consent is prohibited. The limitations of the report presented in this report form an integral part of the report and they must be considered in conjunction with this report.

2. Site and Regional Geology

The Site is located in at the civic address of 233 to 261 Coldwater Road in Orillia, Ontario. The study area is situated at the boundary of the Simcoe Uplands and the Simcoe Lowlands physiographic region of Southern Ontario (Chapman and Putnam, 1984). The Simcoe Uplands covers the majority of the Site to the northwest, and this physiographic region is characterized by broad, rolling till plains. The Simcoe Lowlands covers a small portion of the Site to the southeast. The Simcoe Lowlands was historically flooded by Lake Algonquin, and the soil stratigraphy of this region typically consists of glaciolacustrine sand, silt, and clay. The Site is currently heavily vegetated and undeveloped.

A review of available online surficial geology mapping indicated that the overburden materials of the site are generally comprised of stone-poor sandy silt to silty sand textured till (Ontario Geological Survey, 2010).

Bedrock geology mapping indicated that the site is underlain by materials comprised of limestone, dolostone, shale and sandstone (Ontario Geological Survey, 2011).

3. Field and Laboratory Work

The field work for the geotechnical investigation was carried out on December 8, 2021 by drilling specialists subcontracted to Palmer, during which time five (5) boreholes (BH21-1 to BH21-5) were advanced at the locations shown on the Borehole/Monitoring Well Location Plan, **Drawing 1**. The boreholes were drilled to the depths ranging from 6.3 to 6.7m below existing ground surface (Elev. 268.1 to 264.3m).

The boreholes were advanced with power auger drilling machine, where soil stratigraphy was recorded by observing the quality and changes of augered materials which were retrieved from the boreholes, and by sampling the soils at regular intervals of depth using a 50mm O.D. split spoon sampler, in accordance with the Standard Penetration Test (ASTM D 1586) method. This sampling method recovers samples from the soil strata, and the number of blows required to drive the sampler 300mm depth into the undisturbed soil (SPT 'N' values) gives an indication of the compactness condition or consistency of the sampled soil material. The SPT 'N' values are indicated on the borehole logs (Refer to **Appendix A**). The field work for this investigation was supervised by Palmer engineering staff, who also logged the boreholes and cared for the recovered samples.

Groundwater condition observations were made in the boreholes during drilling and upon completion of drilling. Three (3) monitoring wells (50mm dia.) were installed in boreholes BH21-1, BH21-4, and BH21-5 to determine stabilized groundwater levels. The stabilized groundwater levels were measured on December 16, 2021. These data are summarized in the individual borehole logs and in **Table 1**.

All soil samples obtained during this investigation were brought to our laboratory for further examination. These soil samples will be stored for a period of two (2) months after the day of issuing draft report, after which time they will be discarded unless Palmer is advised otherwise in writing. In addition to visual examination in the laboratory, all soil samples from geotechnical boreholes were tested for moisture contents. Grain size analyses of three (3) selected soil samples and Atterberg limits tests of two (2) selected soil samples were conducted and the results are presented in **Appendix B**.

The approximate elevations at the as drilled borehole locations were surveyed using differential GPS unit. The elevations at the as-drilled borehole locations were not provided by a professional surveyor and should be considered as approximate. Contractors performing the work should confirm the elevations prior to construction. The borehole locations plotted on the Borehole/Monitoring Well Location Plan (**Drawing 1)** were based on this survey and should be considered as approximate.

4. Subsurface Conditions

The borehole locations (BH21-1 to BH21-5) are shown on **Drawing 1**. General notes on sample description are presented in **Appendix A**. The subsurface conditions in the boreholes are presented in the individual

borehole logs (**Enclosures 1** to **5** inclusive, **Appendix A**). The subsurface conditions in the boreholes are summarized in the following paragraphs.

4.1 Soil Conditions

Topsoil

A 80 to 100 mm thick layer of surficial topsoil was encountered at all boreholes except BH21-5. It should be noted that the thickness of the topsoil explored at the borehole locations may not be representative for the site and should not be relied on to calculate the amount of topsoil at the site.

Fill Materials

Fill Materials consisting of silty clay to clayey silt, sandy silt, and sand textures were encountered surficailly or below the topsoil in all boreholes and extended to depths ranging from about 1.1 to 2.2m below existing ground surface (Elev. 272.7 to 269.7m). For cohesive silty clay to clayey silt fill materials, SPT 'N' values ranging from 4 to 21 blows per 300 mm penetration indicated soft to very stiff consistency. For the cohesionless fill materials, SPT 'N' values ranging from 3 to 21 blows per 300 mm penetration indicated very loose to compact compactness condition. The in-situ moisture contents measured in the fill samples ranged from approximately 9% to 30%.

Silty Sand Till

Silty sand till deposit was encountered beneath the fill materials in all boreholes, and extended to depths ranging from about 4.1 to 6.7m below existing ground surface (Elev. 268.1 to 266.9m). All boreholes except BH21-1 were terminated in this deposit. SPT 'N' values ranging from 9 to over 50 blows per 300 mm penetration indicated loose to very dense compactness condition. The natural moisture contents measured in the soil samples ranged from approximately 5% to 12%.

Grain size analyses were conducted on three (3) samples (BH21-1/SS5, BH21-4/SS6, and BH21-5/SS7) from the silty sand till deposit. The results are presented on individual borehole logs and in **Appendix B**, with the following fractions:

Gravel:	18 to 20%
Sand:	34 to 39%
Silt:	30 to 32%
Clay:	10 to 15%

Two (2) samples (BH21-2/SS3 and BH21-4/SS6) of the fines content of the soil matrix component of the samples from the silty sand till deposit was sent to the laboratory for Consistency (Atterberg) limits tests. BH21-2/SS3 was not sufficiently plastic for the test to be completed. Results for BH21-4/SS6 indicate a liquid limit of 15, a plastic limit of 10, and a plasticity index of 5. According to the modified Unified Soil Classification System, BH21-4/SS6 is classified as silty sand (SC-SM).

Clayey Silt Till

Clayey silt till deposit was encountered beneath silty sand till deposit in Borehole BH21-1, and extended to the maximum explored depth at this borehole of about 6.7m below existing ground surface (Elev. 264.3m). SPT 'N' values ranging from 38 to 40 blows per 300 mm penetration indicated hard consistency. The natural moisture contents measured in the soil samples ranged from approximately 9% to 18%.

4.2 Groundwater Conditions

Three (3) monitoring wells (50mm dia.) were installed to monitor stabilized groundwater levels. The stabilized groundwater levels were measured on December 16, 2021. The monitoring well installation details and the measured groundwater levels are summarized in **Table 1** and shown in the individual borehole logs.

Table 1: Monitoring Well Details and Water Levels

Monitoring Well ID	Screen Interval (mBGS)	December 16, 2021	
		Water Level Depth (mBGS)	Water Level Elevation (m)
BH21-1	3.1 ~ 6.1	5.6	265.4
BH21-4	3.1 ~ 6.1	3.4	270.3
BH21-5	3.1 ~ 6.1	1.6	272.9

Note: mBGS = meter below ground surface

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to weather events.

5. Discussion and Recommendations

It is understood that the proposed development plan consists of a nine-storey residential building without basement, and the associated parking lot. Boreholes BH21-1 to BH21-3 were drilled within the footprint of the proposed nine-storey building.

5.1 Building Foundation Design Considerations

Based on the borehole information, the proposed building may be supported by spread and strip footings founded on the undisturbed native soils for a bearing capacity of 250 to 400 kPa at Serviceability Limit State (SLS), and for a factored net bearing resistance of 375 to 600 kPa at Ultimate Limit State (ULS). The bearing values and the corresponding founding depths/elevations at borehole locations are summarized on **Table 2**.

Table 2: Bearing Values and Founding Levels of Spread and Strip Footings

BH No.	Anticipated Funding Material	Bearing Capacity at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Founding Depth (mBGS) / Elevations (m)
BH21-1	Silty sand till Clayey silt till	250 400	375 600	2.5 / 268.5 4.8 / 266.2
BH21-2	Silty sand till	250 400	375 600	2.5 / 271.3 4.8 / 269.0
BH21-3	Silty sand till	250 400	375 600	2.5 / 271.5 3.3 / 270.7

Note: mBGS = meter below ground surface

5.1.1 Short-Drilled Piers/Caissons

Considerations may be given to support the nine-storey building on short-drilled piers or caissons founded in competent native soils. The bearing capacities at the corresponding founding depth listed in **Table 2** can be used.

5.1.2 Helical Piles

Alternatively, the nine-storey building may be supported by helical piles founded in the very dense or hard native soils below elevations 270.9 to 266.4m, providing the required pile torque rating is capable of installing piles into the deep founding levels. Possible large obstructions such as buried concrete slabs, existing foundations or boulders within the fill materials or till may be encountered during the installation of the helical piles and may prevent the piles from reaching proposed founding depths.

Helical piers/anchors are proprietary products design, supplied and installed by specialist contractors. Bearing capacity and other design details regarding helical piles can be discussed with the specialized contractor. Geotechnical comments concerning installation and design capacities are provided in the following paragraphs. It must be noted that they are considered to be preliminary values suitable for preliminary design only. The actual design and installation of helical piers should be undertaken by contractors in Ontario that are approved by the manufacturer.

The designer should define the depth and type of helical piles according to the soil conditions and the required design loads. The designer should also consider the buckling resistance in weak soils and their lateral capacity. The contractor should also be responsible for the design capacity of the foundation units. In this regard, it is recommended that compression and tension tests be conducted to verify helical pier capacities prior to final design.

The factored bearing resistance at ULS for a Chance SS175 helical pier bearing in the very dense or hard native soils would be 500 kN, the SLS resistance would be 370 kN. Higher capacities can be achieved with model SS200 or SS225 helical pier units. Detailed design services are available through a number of helical pile suppliers, and shop drawings should be provided to Palmer for review.

The provided capacities are preliminary and must be confirmed with a specialist helical pier contractor and verified with field load tests.

It should be noted that there is a possibility that the very dense or hard stratum may not extend uniformly throughout the areas and the need for deeper helical piers in some areas must not be overlooked.

If site grades are raised, consideration should be given to the effects of negative skin friction on the helical piers.

It is recommended that Palmer be retained to monitor and document helical pier installation to verify that the recommended capacity is achieved.

5.1.3 Micropiles

Alternatively, micropiles could be considered to support the nine-storey building and be installed into the compact to very dense or hard native soils. Micropiles can be drilled through the obstructions or boulders and can be installed in most conditions below groundwater table.

A bond stress value of 150 kPa should be used to compute the geotechnical axial capacity of a pressure grouted micropile installed in the very dense or hard till. For preliminary planning purposes, the geotechnical capacity of a 244 mm diameter micropile would be in the order of 800 kN ULS. depending on the diameter and bond length.

The skin friction between the pile shaft and the fill materials and weak native soils can be ignored. These suggested bond values are for preliminary design purpose only, as the actual bond values will depend on the installation and grout procedures of the piles and must be determined by the field load testing. A specialty contractor must be retained to design and construct the micropiles. The specialty contractor should determine the length and size of the piles, based on the required design loads, the subsurface conditions and their installation method/procedure.

Field pile load testing is recommended to confirm the design bearing capacity. The test piles must be loaded to at least 1.67 times its design bearing value at ULS. In order to ignore the group effect, the center-to-centre distance between adjacent micropiles should be at least 3 times its diameter.

The production micropiles must be installed after the pile load testing, only when the design load is confirmed by the pile load test results. The installation and load testing of the test micropile must be monitored by a qualified geotechnical engineer.

5.1.4 Ground Improvement

Ground improvement techniques such as rammed aggregate piers (RAPs) or controlled modulus columns (CMCs) may be feasible to reduce excess soil and earthworks for engineered fill. Utilizing RAPs or CMCs could result in higher bearing capacity and increased site class. A specialized contractor must be retained to design and install ground improvement. The designer should design the depth and methods of installation according to the soil conditions and the required design loads. Bearing capacity and other design details regarding RAPs or CMCs can be discussed with the specialized contractor. Further recommendations can be provided upon request.

5.1.5 Additional Comments

All footing bases must be inspected by qualified geotechnical engineering personnel prior to pouring concrete. The excavated footing bases can be covered with 50 mm thick lean concrete slab immediately after inspection and cleaning in order to avoid disturbance of the founding soil due to water, construction activity and weathering/drying.

Foundations designed to the specified bearing capacity at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential, if designed as per **Table 2**.

All foundations exposed to seasonal freezing conditions must have at least 1.6 metres of soil cover for frost protection.

In the vicinity of the existing buried utilities, all footings must be lowered to undisturbed native soils, or alternatively the services must be structurally bridged. Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

It should be noted that the recommended bearing resistances have been estimated by Palmer from the borehole information for the preliminary design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections to validate the information for use during the construction stage.

All work should be carried out in accordance with the Occupational Health and Safety Act (Ontario Regulation 213/91) and with local regulations.

5.2 Floor Slab and Permanent Drainage

The existing fills are considered not suitable for supporting the floor slab. The floor slab can be supported on grade provided all existing fill, and weak or disturbed soils are removed, and the base thoroughly proof rolled. Any soft spots revealed during proof rolling must be sub-excavated and backfilled. The backfill

required to raise the grade can consist of inorganic soil, placed in shallow lifts (200 mm) and compacted to 98% of Standard Proctor Maximum Dry Density (SPMDD).

A moisture barrier consisting of at least 200 mm of 19 mm clear crushed stone should be installed under the floor slab.

For buildings without basement, if the floor slab is more than about 300 mm higher than the exterior grade, then a perimeter drainage system is not considered to be necessary. If the floor is lower, then the perimeter drainage system shown on **Drawing 2** is recommended.

Special care should be taken to ensure compaction around columns and adjacent to foundation walls. Unless the foundations are designed to account for the floor slab loads, the floor slabs should be structurally separated from the foundation walls and columns. Sawcut control joints should be provided at regular intervals and along column lines to minimize shrinkage cracking and to allow for differential settlement of the floor slabs.

Where the backfill against the exterior walls is to support settlement sensitive structures, such as concrete slabs, pavements or walkways, it should be uniformly compacted to at least 98% of SPMDD.

5.3 Excavations and Backfilling

Excavations are expected to extend through the fill into the native silty sand till / clayey silt till to depths of 2 to 3m below existing grade. Excavations can be carried out with a heavy hydraulic backhoe. It should be noted that the (glacial) tills are non-sorted sediments and therefore may contain boulders. Possible large obstructions such as buried concrete pieces and existing foundations may also be encountered at the Site within the fill materials. Provisions must be made in the excavation contract for the removal of possible boulders in the till or obstructions in the fill material.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the fill materials and the compact cohesionless soils of silty sand till would be classified as Type 3 above the groundwater table and Type 4 below the groundwater table.

Provided adequate groundwater control is achieved, it is anticipated that the majority of the foundation excavations at the Site could consist of temporary open cuts with side slopes of 3 horizontal to 1 vertical (3 H: 1V) to the base of the excavation. However, depending on the construction procedures adopted by the contractor and weather conditions at the time of construction, some local flattening of the slopes may be required. Where side slopes of excavations are to be steepened, then a positive excavation support system should be considered.

The existing fill in the boreholes is generally not suitable for re-use as backfill. The native soils free from organics and other deleterious materials can be used as general construction backfill. Loose lifts of soil, which are to be compacted, should not exceed 200 mm. Depending on the time of construction and weather, some excavated material may be too wet to compact and will require aeration prior to its use.

Under floor fill should be compacted to at least 98% of SPMDD. The excavated soils are not considered to be free draining. Where free draining backfill is required, imported granular fill such as OPSS Granular "B" should be used. Imported granular fill, which can be compacted with handheld equipment, should be used in confined areas.

It should be noted that the excavated soils are subject to moisture content increase during wet weather which would make these materials too wet for adequate compaction. Stockpiles should be compacted at the surface or be covered with tarpaulins to minimize moisture uptake.

It is expected that excavations at the Site for the future development would largely remain above the groundwater table, and any seepage above the groundwater table can be removed by pumping from sumps in the building development area.

It should be noted that if the construction dewatering system/sumps result in a water taking of more than 50,000 L/day but less than 400,000 L/day, a registration should be made in the Environmental Activity and Sector Registry (EASR). If a water taking is more than 400,000 L/day, a permit to take water (PTTW), issued by the MECP, will be required.

Surface water should be directed away from the excavation area, to prevent ponding of water that could result in disturbance and weakening of the foundation subgrade.

5.4 Lateral Earth Pressures

The lateral earth pressures acting at any depth on foundation walls may be calculated from the following expression:

$$P_h = K (\gamma h + q)$$

where P_h = Lateral earth pressure acting at depth "h" (kPa)

K = Earth pressure coefficient, assumed to be 0.40 for vertical walls and horizontal backfill for permanent construction

γ = Unit weight of backfill, may assume a value of 21 kN/m^3

h = Depth below finished grade of the point of interest (m)

q = Equivalent value of surcharge on the ground surface (kPa)

The above expression assumes that the perimeter drainage system as shown on **Drawing 2** to **4** prevents the build-up of any hydrostatic pressure behind the wall.

5.5 Seismic Considerations

The 2012 Ontario Building Code (OBC 2012) came into effect on January 1, 2014 and contains updated seismic analysis and design methodology. The seismic site classification methodology outlined in the code is based on the subsurface conditions within the upper 30 m below existing grade.

The conservative site classification is based on physical borehole information obtained at depths of less than 30 m and based on general knowledge of the local geology and physiography. In this regard, Palmer's drilling program included boreholes drilled to depths up to 6.7m below the existing ground surface. Based on the borehole information and our local experience, a Site Class D may be used for the building design.

Should optimization of the site class be recommended by the structural engineer, in situ geophysical testing or a deep borehole extending to 30 m may be considered.

5.6 Pavements

The recommended pavement structures provided in **Table 3** are based upon borehole information obtained in this investigation. The values may need to be adjusted based on the municipality/regional standards. Consequently, the recommended pavement structures should be considered for preliminary design purposes only. A functional design life of eight to ten years has been used to establish the pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. If required, a more refined pavement structure design can be performed based on specific traffic data and design life requirements and will involve specific laboratory tests to determine frost susceptibility and strength characteristics of the subgrade soils, as well as specific data input from the client.

Table 3: Recommended Pavement Structure Thickness

Pavement Layer	Compaction Requirements	Light Duty Pavement (Parking for Cars)	Heavy Duty Pavement (Access Road, Fire Routes, Parking for Delivery Trucks)
Asphaltic Concrete	92% Maximum Relative Density (MRD)	40 mm HL 3 50 mm HL 8	40 mm HL 3 80 mm HL 8
OPSS Granular "A" Base (or 20mm Crusher Run Limestone)	100% SPMDD*	150 mm	150 mm
OPSS Granular "B" (or 50mm Crusher Run Limestone)	100% SPMDD	250 mm	350 mm

* Denotes Standard Proctor Maximum Dry Density, ASTM-D698

The subgrade must be compacted to 98% SPMDD for at least the upper 500 mm unless accepted by Palmer.

The pavement design considers that construction will be carried out during the drier time of the year and that the subgrade is stable, as determined by proofrolling operations. If the subgrade should become excessively wet or rutted during construction activities, additional subbase material may be required. The need for additional subbase is best determined during construction.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved. In addition, the need for adequate drainage cannot be over-emphasized. The finished pavement surface and underlying subgrade should be free of depressions and should be sloped (preferably at a minimum grade of two percent) to provide effective surface drainage toward catch basins. The excavation around catch basins and manholes should be backfilled with free-draining granular material to minimize differential movements between the pavement and structures due to frost action. The manholes/catch basins should be provided with perforated stub drains to permit drainage of the backfill. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas. Subdrains should be installed to intercept excess subsurface moisture and prevent subgrade softening. This is particularly important in heavy-duty pavement areas.

Additional comments on the construction of internal roadways and parking areas are as follows:

1) As part of the subgrade preparation, proposed area for internal roads and pavements should be stripped of topsoil and other obvious deleterious material. Fill required to raise the grades to design elevations should conform to backfill requirements outlined in previous sections of this report. The subgrade should be properly shaped, crowned then proof-rolled in the full-time presence of a representative of this office. Soft or spongy subgrade areas should be sub-excavated and properly replaced with suitable approved granular backfill compacted to 98% SPMDD.

2) The locations and extent of sub-drainage required within the roadways and other paved areas should be reviewed by a pavement engineer in conjunction with the proposed site grading. The subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines. Assuming that satisfactory crossfalls in the order of two percent have been provided, subdrains extending from and between catch basins may be satisfactory. If shallower crossfalls are considered, a more extensive system of sub-drainage may be necessary and should be reviewed by a specialized pavement engineer.

3) The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted access lanes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavourable weather.

5.7 Geotechnical Quality of Excavated Soils

Reference to the borehole logs suggests that the excavated materials with respect to their compaction characteristics can be divided into three groups:

- **Group 1** comprises the native clayey silt till and have moisture content very close to or above its optimum water content. This material will excavate in clods and would thus require a heavy pad footed compactor or hoe pack to break it down and adequately compact it. Given the water content of the till, it may not be possible to obtain a degree of compaction of this fill much above 95% of SPMDD. This degree of compaction might be acceptable within landscaped areas above which pavements or infrastructure are not expected to be built in the future.

- **Group 2** comprises the cohesionless to low plasticity silty sand till. The compaction of these soils will require a very tight control of their moisture content during placement and compaction. At moisture contents more than 3% below the optimum, the soil will likely be dusty and "flour" like while at moisture contents ±1% higher than optimum, the soil will be "spongy" and will "pump".

- **Group 3** soils consist of unsuitable materials because of their high moisture or organic inclusions, including all the existing fill materials. These soils should be either disposed off-site or should be used only in "soft" landscaping areas where they can be placed with nominal compaction, and where surface settlements are tolerable.

As a general requirement, all backfill material should be placed in 200 to 300mm thick loose lifts and compacted to at least 96% of SPMDD, at a placement moisture content within ±2% of the optimum. Below existing/future roads, the backfill must be Granular "A" or "B" material, and the top 1.5m of subgrade backfill below the underside of the pavement structure should be compacted to 98% of SPMDD. Where a free-draining backfill is needed or where the backfill is needed for structural support of overlying structures, the site soils will not be suitable and OPSS Granular "A" or "B" sand and gravel will be required. Similarly, during work in the autumn, winter and spring months, re-use of the excavated soils as compacted fill may not be practical and imported OPSS Granular "B" should be used.

6. Certification

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

This report was prepared and reviewed by the undersigned:

Prepared By:

LICENSED PROFESSIONAL ENGINEER
Z. PAN
100504260
PROVINCE OF ONTARIO

Ted Pan, M.Eng., P.Eng.
Geotechnical Engineer

June 24, 2022

Reviewed By:

Matthew D. St Denis, P.Eng.
Team Lead, Geotechnical Engineering

7. References

ASTM International. 2018. ASTM D1586 / D1586M-18, Standard test method for standard penetration test (SPT) and split-barrel sampling of soils.

Canadian Geotechnical Society. 2006. Canadian Foundation Engineering Manual, 4th Edition.

Chapman, L.J. and Putnam, D.F. 1984. Physiography of southern Ontario; Ontario Geological Survey

Ontario Geological Survey 2010. Surficial geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release— Data 128 – Revised.

Ontario Geological Survey 2011. 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release---Data 126-Revision 1.

General Comments and Limitations of Report

Palmer should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, Palmer will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes and test pits required to determine the localized underground conditions between boreholes and test pits affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole and test pit results, so that they may draw their own conclusions as to how the subsurface conditions may affect them. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to Palmer at the time of preparation. Unless otherwise agreed in writing by Palmer, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Palmer accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

Palmer™

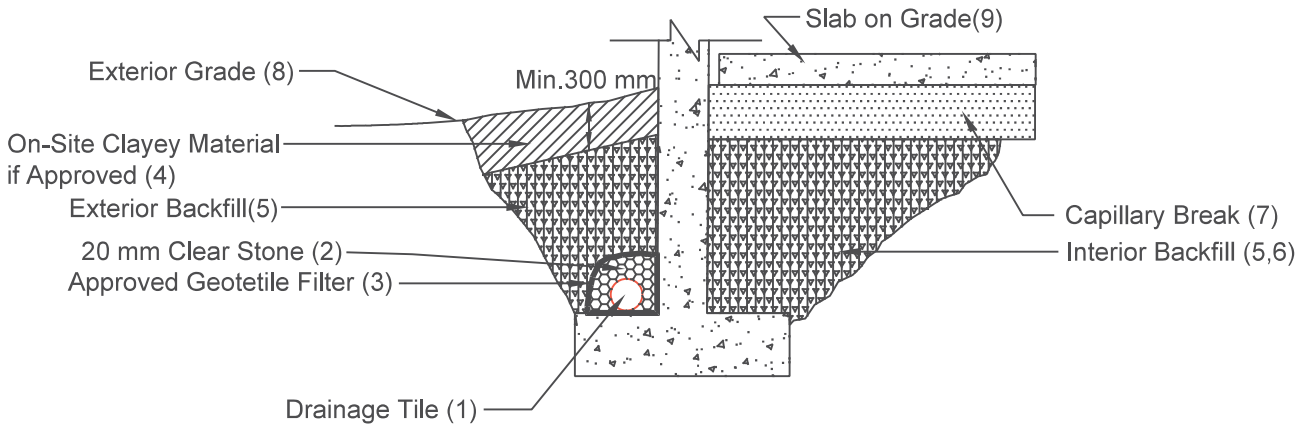
Drawings

LEGEND

Borehole/Monitoring Well Location

Borehole Location

Client:	**Aurowal Developments Ltd.**			Project No.: **1802403**	Drawing No.: **1**
Drawn:	**TO**	Approved:	**TP**	Title:	**Borehole/Monitoring Well Location Plan**
Date:	**June, 2022**	Scale:	**As Shown**	Project:	**Geotechnical Investigation** **233-261 Coldwater Road, Orillia, ON**
Original Size:	**Letter**	Rev:	**TP**	Palmer™	74 Berkeley Street Toronto, Ontario M5A 2W7



EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved geotetile filter (Terrafix 270R or equivalent).
4. The on-site clayey material, if approved, can be used as backfill in the upper 300 mm.
5. The interior and exterior fill adjacent to foundation walls should be OPSS Granular 'B' Type I. Compact to at least 98% SPMDD.
6. Do not use heavy compaction equipment within 450 mm (18") of the wall. Do not fill or compact within 1.8 m (6') of the wall. Place fill on both sides simultaneously.
7. Capillary break to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors (consult with archtect).
8. Exterior grade to slope away from building at min. 2%.
9. Slab on grade should not be structurally connected to the wall or footing.
10. Review the geotechnical report for specific details.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Slab on Grade Construction Without Underfloor Drainage

(not to scale)

Appendix A

Borehole Logs

Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by PECG also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional preliminary geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Explanation of Terms Used in the Record of Borehole

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Spoon sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) required to drive a 50 mm (2 in) drive open sampler for a distance of 300 mm (12 in).

Dynamic Cone Penetration Resistance, N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) to drive uncased a 50 mm (2 in) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in).

Textural Classification of Soils

Classification	Particle Size
Boulders	>300 mm
Cobbles	75 mm-300 mm
Gravel (Gr)	4.75 mm-75 mm
Sand (Sa)	0.075 mm-4.75 mm
Silt (Si)	0.002 mm-0.075 mm
Clay (Cl)	<0.002 mm

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	>35%

Soil Description

a) Cohesive Soils

Consistency	Undrained Shear Strength (kPa)	SPT "N" Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

b) Cohesionless Soils

Density Index (Relative Density)	SPT "N" Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w_p	Plastic limit
w_l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D_R	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

Palmer

LOG OF BOREHOLE BH21-1

PROJECT: Geotechnical Investigation - 233-261 Coldwater Rd

CLIENT: Auroville Ltd.

PROJECT LOCATION: Orillia, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

Method: Solid Stem Augers

Diameter: 155 mm

Date: Dec 8, 2021

REF. NO.: 1802403

ENCL NO.: 1

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / 0.3 m "N"	ELEVATION
271.0	Ground Surface				
270.9 / 0.1	**TOPSOIL:** 80 mm	1	SS	6	Sand
270.3 / 0.7	**FILL:** silty clay to clayey silt, some sand, trace gravel, trace rootlets, contains wood pieces, dark brown, wet, firm				
1 / 269.7	**FILL:** sandy silt, trace clay, trace gravel, trace rootlets, contains cobbles, brown, moist, compact	2	SS	17	270
1.3	**SILTY SAND TILL:** some clay, some gravel, contains silt pockets, brown, moist, compact to very dense	3	SS	13	Holeplug
2					269
	contains cobbles and boulder fragments	4	SS	60/ 230mm	Sand
3		5	SS	28	268
4 / 266.9					267
4.1	**CLAYEY SILT TILL:** some sand, trace gravel, contains cobbles, brown, moist, hard				Screen
5		6	SS	40	266
					W. L. 265.4 m Dec 16, 2021
6					265
264.3		7	SS	38	Holeplug
6.7	**END OF BOREHOLE**				

Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water Level Readings:

Date	W. L. Depth (mBGS)
Dec 16, 2021	5.59

DYNAMIC CONE PENETRATION RESISTANCE PLOT — 20 40 60 80 100

SHEAR STRENGTH (kPa)
- ○ UNCONFINED
- ● QUICK TRIAXIAL
- + FIELD VANE & Sensitivity
- × LAB VANE

20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) — 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
Auger grinding				
	20	38	32	10

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ ●=3% Strain at Failure

Palmer

LOG OF BOREHOLE BH21-2

PROJECT: Geotechnical Investigation - 233-261 Coldwater Rd
CLIENT: Auroville Ltd.
PROJECT LOCATION: Orillia, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Solid Stem Augers
Diameter: 155 mm
Date: Dec 8, 2021

REF. NO.: 1802403
ENCL NO.: 2

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
273.8	Ground Surface						
273.8 / 0.0	**TOPSOIL:** 100 mm						
273.7 / 0.1	**FILL:** silty clay to clayey silt, some sand, trace gravel, trace rootlets, trace organics, dark brown to brown, wet, soft to stiff		1	SS	4		
272.7 / 1.1	**SILTY SAND TILL:** trace to some clay, trace gravel, contain sand layers, contains cobbles and boulder fragments, brown, moist, loose to very dense		2A	SS			273
			2B	SS	9		
			3	SS	9		272
			4	SS	23		
			5	SS	30		271
			6	SS	59		270
			7	SS	64		269
267.1 / 6.7	**END OF BOREHOLE**						268

Notes:
1. Borehole was open upon completion of drilling.

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Auger grinding

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ●=3% Strain at Failure

Palmer

LOG OF BOREHOLE BH21-3

PROJECT: Geotechnical Investigation - 233-261 Coldwater Rd

CLIENT: Auroville Ltd.

PROJECT LOCATION: Orillia, ON

DATUM: Geodetic

BH LOCATION: See Borehole Location Plan

Method: Solid Stem Augers

Diameter: 155 mm

Date: Dec 8, 2021

REF. NO.: 1802403

ENCL NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
274.0	Ground Surface							
273.9 / 0.1	**TOPSOIL:** 80 mm							
	FILL: sandy silt, some clay, trace gravel, trace rootlets, dark brown to brown, moist, very loose to compact		1	SS	3			
			2	SS	11		273	Auger grinding
272.6 / 1.5	**FILL:** sand, some clay, trace gravel, contains cobbles and boulder fragments, brown, moist, loose		3	SS	9		272	Auger grinding
271.8 / 2.2	**SILTY SAND TILL:** some clay, some gravel, contains cobbles and boulder fragments, brown, moist, compact to very dense		4	SS	25			
			5	SS	63		271	
			6	SS	50/ 125mm		270	
							269	
267.7			7	SS	50/ 75mm		268	
6.3	**END OF BOREHOLE** Notes: 1. Borehole was open upon completion of drilling.							

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
- UNCONFINED
- QUICK TRIAXIAL
- FIELD VANE & Sensitivity
- LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ●=3%: Strain at Failure

Palmer

LOG OF BOREHOLE BH21-4

PROJECT: Geotechnical Investigation - 233-261 Coldwater Rd
CLIENT: Auroville Ltd.
PROJECT LOCATION: Orillia, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Solid Stem Augers
Diameter: 155 mm
Date: Dec 8, 2021

REF. NO.: 1802403
ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
273.7	Ground Surface											
273.6	**TOPSOIL:** 100 mm											
0.1	**FILL:** silty clay to clayey silt, some sand, trace gravel, trace rootlets, dark brown to brown, wet to moist, very stiff to firm		1	SS	21		Sand					
	contains cobbles						273					
1			2	SS	5							
272.2							Holeplug					
1.5	**FILL:** sandy silt, trace clay, some gravel, brown, moist, compact		3	SS	16		272					
2												
271.5												
2.2	**SILTY SAND TILL:** some to trace clay, some gravel, contains cobbles and boulder fragments, brown, moist, compact to very dense		4	SS	27		271					
3							Sand					
			5	SS	35	▽						
							W. L. 270.3 m Dec 16, 2021					
4							270					
	contains clayey silt layers						Screen					
			6	SS	30		269					18 39 30 13
5												
							268					
6												
267.3			7	SS	50/ 125mm		Holeplug					
6.4	**END OF BOREHOLE**											

Notes:
1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
2. Water Level Readings:

Date	W. L. Depth (mBGS)
Dec 16, 2021	3.39

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ●=3% Strain at Failure

Palmer

LOG OF BOREHOLE BH21-5

PROJECT: Geotechnical Investigation - 233-261 Coldwater Rd
CLIENT: Auroville Ltd.
PROJECT LOCATION: Orillia, ON
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan

Method: Solid Stem Augers
Diameter: 155 mm
Date: Dec 8, 2021

REF. NO.: 1802403
ENCL NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
274.5	Ground Surface											
0.0	**FILL:** sandy silt, trace clay, trace gravel, trace rootlets, brown, wet to moist, loose to compact		1	SS	5		Sand					
							274					
1			2	SS	18							
	contains cobbles						Holeplug					
			3	SS	21		W. L. 272.9 m Dec 16, 2021					
2 272.3												
2.2	**SILTY SAND TILL:** some clay, trace to some gravel, contains cobbles, brown, moist, compact to very dense		4	SS	15		272					
3							Sand					
			5	SS	22		271					
4												
							270					
							Screen					
5			6	SS	19							
							269					
6												
268.1			7	SS	50/ 125mm		Holeplug					19 34 32 15
6.4	**END OF BOREHOLE** Notes: 1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole. 2. Water Level Readings: Date W. L. Depth (mBGS) Dec 16, 2021 1.62											

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

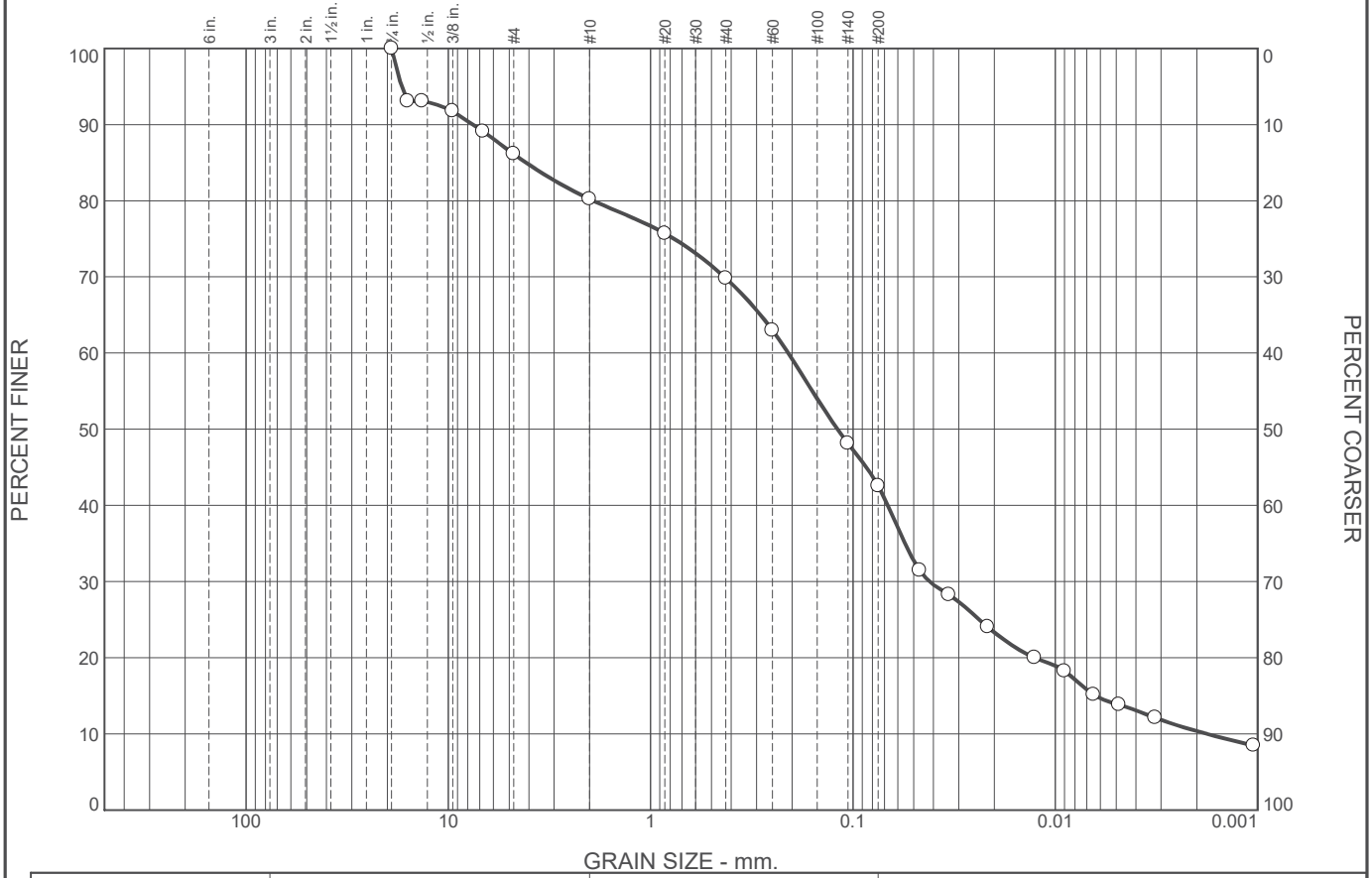
GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ●=3% Strain at Failure

Appendix B

Geotechnical Lab Testing Results

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	19.8	10.4	27.3	32.1	10.4

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			4.1317	0.2090	0.1192	0.0418	0.0063	0.0018	4.69	117.45

Material Description	USCS	AASHTO
○ SILTY SAND some gravel trace to some clay		

Project No. CA19-009 **Client:** Palmer Environmental Consulting Group Inc. (PECG)

Project: PECG Prj No 18902403

○ **Sample Number:** BH 21-1, SS5

Remarks:

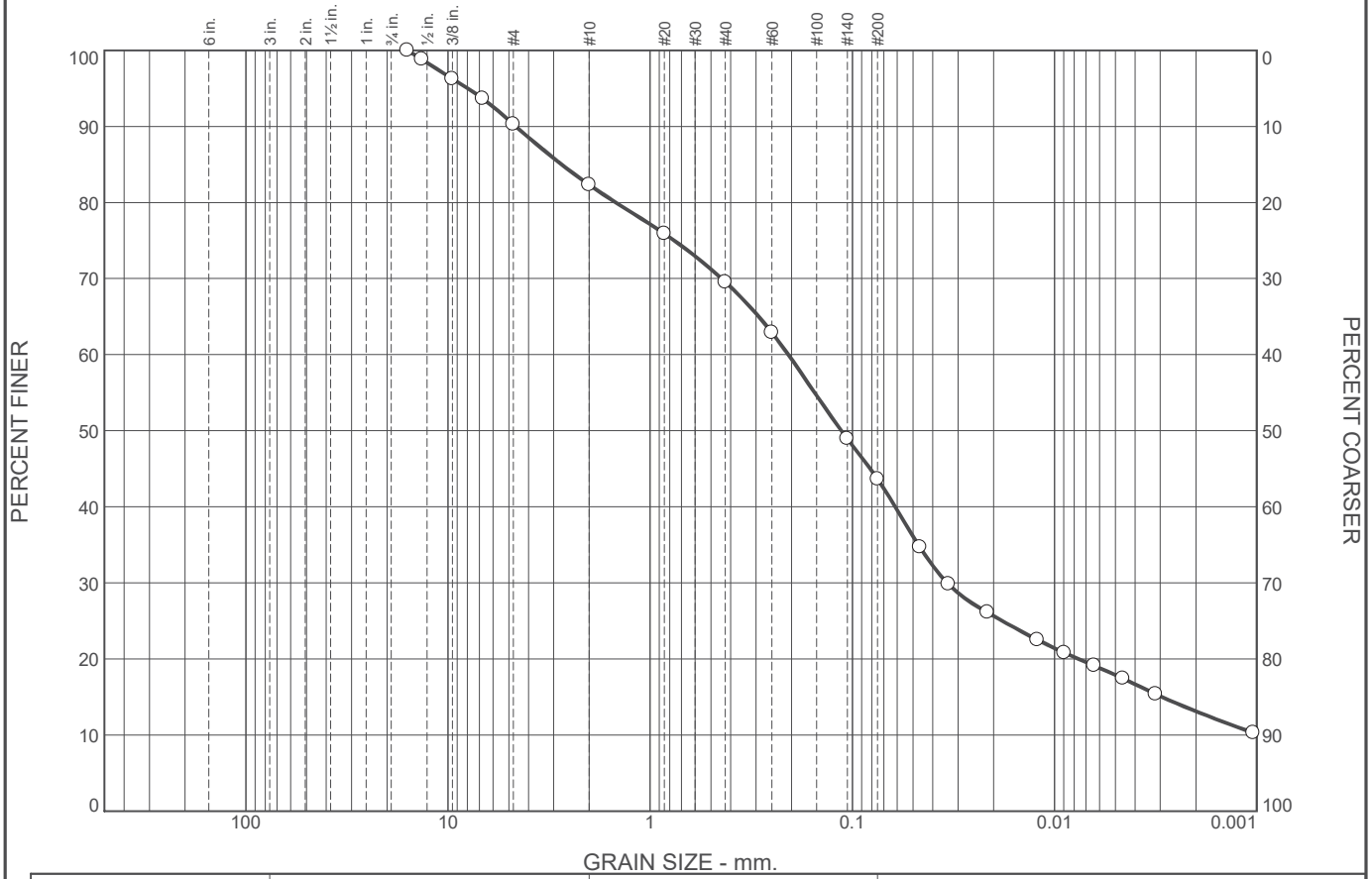
○HYDROMETER DETAILS: Spec. Grav. 2.75(assumed);Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/1 Test date: 16/ 12/2021

Terrapex

Figure 1

Tested By: AM

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	17.7	12.7	26.0	30.5	13.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	15.3	10.2	2.7432	0.2072	0.1134	0.0339	0.0029			

Material Description	USCS	AASHTO
○ SILTY SAND some gravel some clay	SC-SM	A-4(0)

Project No. CA19-009 **Client:** Palmer Environmental Consulting Group Inc. (PECG)

Project: PECG Prj No 18902403

○ **Sample Number:** BH 21-4, SS6

Remarks:

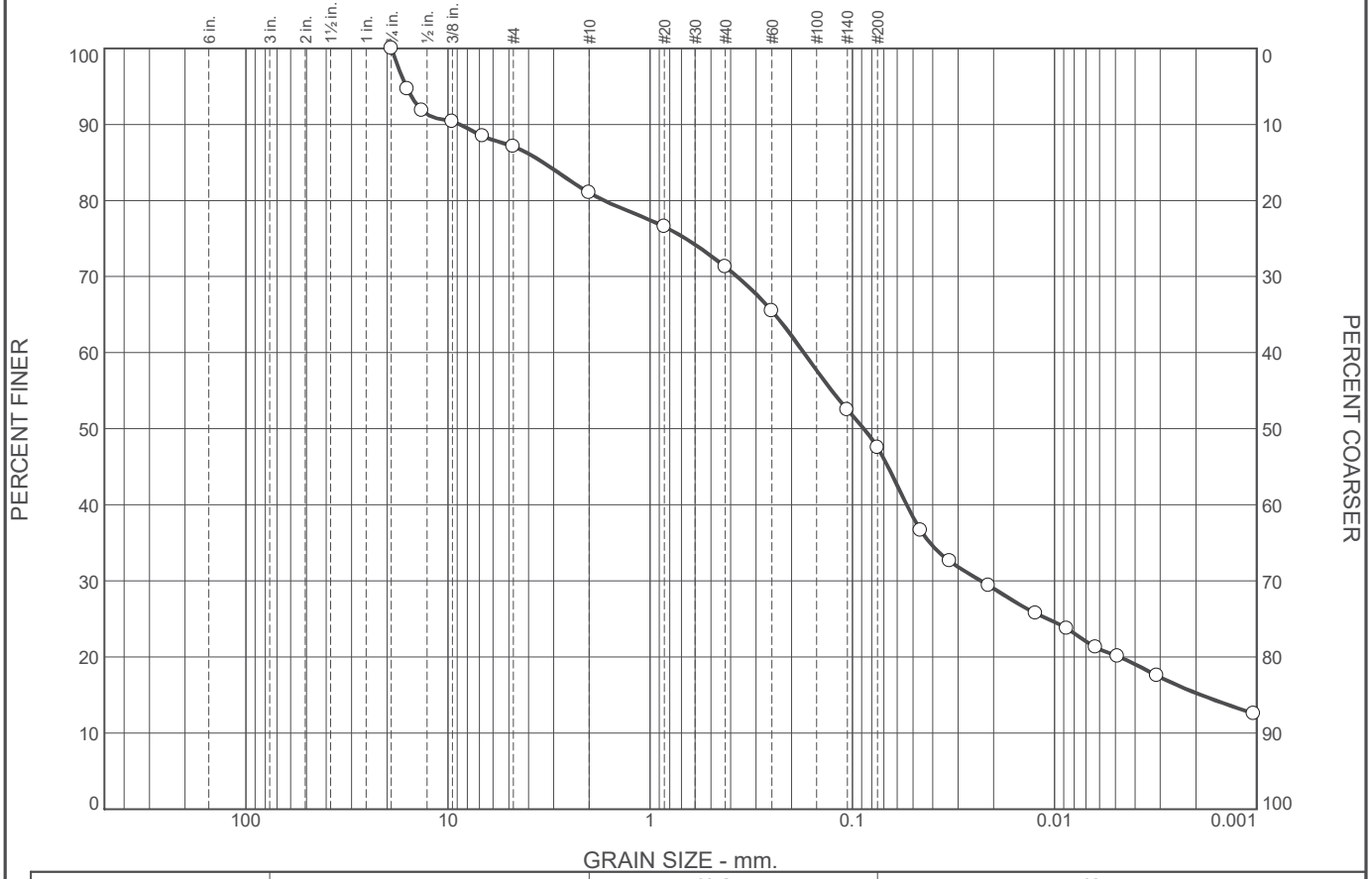
○HYDROMETER DETAILS: Spec. Grav. 2.75(assumed);Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/1 Test date: 16/ 12/2021

Terrapex

Figure 2

Tested By: AM

Particle Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	19.0	9.7	23.8	32.2	15.3

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			3.3813	0.1735	0.0876	0.0231	0.0019			

Material Description	USCS	AASHTO
○ SAND AND SILT some gravel some clay		

Project No. CA19-009 **Client:** Palmer Environmental Consulting Group Inc. (PECG)

Project: PECG Prj No 18902403

○ **Sample Number:** BH 21-5, SS7

Remarks:

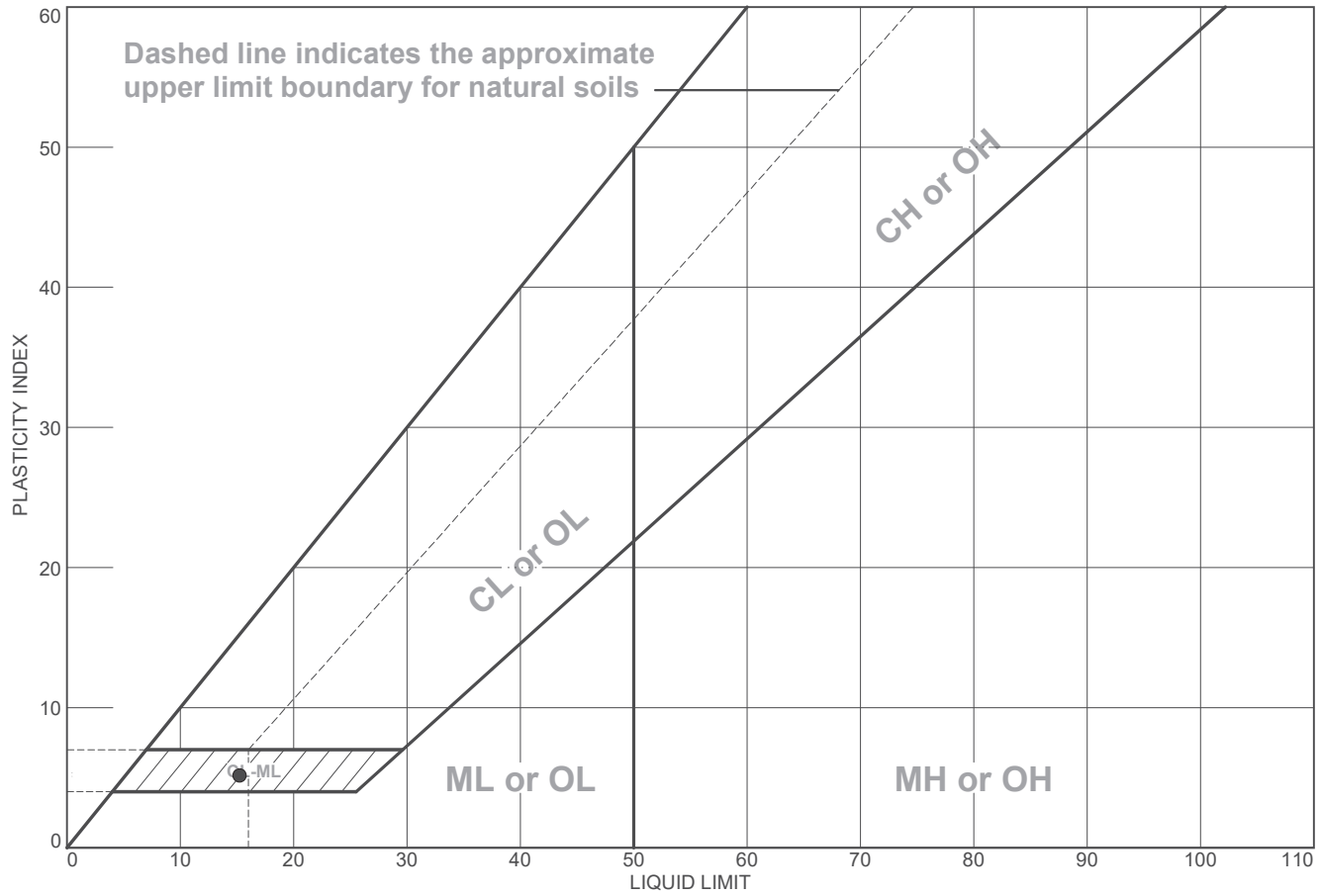
○HYDROMETER DETAILS: Spec. Grav. 2.75(assumed);Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/1 Test date: 16/ 12/2021

Terrapex

Figure 3

Tested By: AM

LIQUID AND PLASTIC LIMITS TEST REPORT



	Material Description	Sampled	Tested	Technician	LL	PL	PI	%<#40	USCS
●	SILTY SAND some gravel some clay		23/12/2021	AM	15.3	10.2	5.1	69.6	SC-SM
■			23/12/2021	AM	15.6	NP	NP		

Project No. CA19-009 **Client:** Palmer Environmental Consulting Group Inc. (PECG)

Project: PECG Prj No 18902403

○ **Sample Number:** BH 21-4, SS6

□ **Sample Number:** BH 21-2, SS3

Terrapex

Checked by:

Title:

Figure 4

Tested By: AM