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Preliminary Geotechnical Investigation – 206105 Highway 26, M1 Property – Plan 541 Part Lot 4 Part Lot 14; RP 16R5037 Part 1

Palmer Project #
2001801

Prepared For
LC Development Group

June 5, 2020

June 5, 2020

Angus Knowles
LC Development Group
909 Davenport Road, 2nd Floor
Toronto, ON M6G 2B7

Dear Mr. Knowles:

Re: Preliminary Geotechnical Investigation – 206105 Highway 26, M1 Property – Plan 541 Part Lot 4 Part Lot 14; RP 16R5037 Part 1
Project #: 2001801

Palmer Environmental Consulting Group Inc. (Palmer) is pleased to submit the attached report describing the results of our preliminary geotechnical investigation for the proposed land development at the captioned site ("the Site") located at 206105 Highway 26, Meaford, 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,

Palmer Environmental Consulting Group Inc.

Chi Cheng (Dennis) Tseng, M.Sc., P.Eng.
Senior Geotechnical Engineer

Executive Summary

Based on the results of this investigation, the following geotechnical considerations are provided to support preliminary design of the site:

- Topsoil with thickness ranging from 200 to 300 mm was encountered at surface in Boreholes BHM1-1, BHM1-5 and BHM1-6. Concrete with thickness ranging from 90 to 180 mm was encountered in Boreholes BHM1-2 to BHM1-4.
- Fill Materials consisting of clayey silt, silty clay, sand, and sand and gravel were encountered below the topsoil in all boreholes and extended to depths ranging from about 0.3 m to 1.1 m below the existing ground surface. The existing fill in the boreholes is generally not suitable for re-use as backfill. The native soils free from topsoil and organics can be used as general construction backfill.
- The undisturbed native soils below the fill materials are generally suitable for the construction of spread and strip footings and underground services founded on the undisturbed native soils for a bearing capacity of 100 to 300 kPa at SLS (serviceability limit states), and for a factored geotechnical resistance of 150 to 450 kPa at ULS (ultimate limit states).
- 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.
- All foundations exposed to seasonal freezing conditions must have at least 1.4 metres of soil cover for frost protection.
- It should be noted that the (glacial) tills are non-sorted sediments and therefore may contain boulders. Boreholes BHM1-2, BHM1-3, BHM1-5 and BHM1-6 were terminated due to auger and spoon refusal, which indicate possible boulders or bedrock encountered. Provisions must be made in the excavation contract for the removal of possible boulders in the till or obstructions in the fill material and/or the excavation of bedrock.
- Water was encountered during drilling at depths ranging from 0.6 m to 1.5 m below ground surface in Boreholes BHM1-1 and BHM1-6. Measured groundwater levels at the five monitoring well locations ranged from no groundwater accumulation to 0.4 m to 1.5 m below ground surface on April 17 and May 13, 2020.
- It is expected that seepage within the excavation depths can be removed by pumping from sumps. However, due to the high groundwater table in the vicinity of Borehole BHM1-1, some form of positive dewatering may be required in this area.
- In accordance with OHSA, the fill and cohesionless soils of silty sand and sand would be classified as Type 3 Soils above the groundwater table and Type 4 Soils below the groundwater table. The stiff to hard clayey silt till to silty clay till fall into the category of Type 2 Soils above the groundwater table and Type 3 Soils below the groundwater table.
- Based on the borehole information and according to Table 4.1.8.4.A of OBC 2012, the subject site for the proposed building can be classified as Class 'C' for seismic site response.

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Appendix A

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1. Introduction

Palmer Environmental Consulting Group Inc. (Palmer) was retained by LC Development Group (LCDP) to complete a Preliminary Geotechnical Investigation for the proposed residential land development located at 206105 Highway 26, M1 Property – Plan 541 Part Lot 4 Part Lot 14; RP 16R5037 Part 1, Meaford, Ontario.

Based on a conceptual layout of the proposed plan of subdivision provided by the Client, it is understood that the proposed development will consist of low-rise residential buildings, internal roads, and stormwater management facility. However no detailed engineering design of the proposed development was available to us at the time of preparation of this report.

The purpose of this investigation was to determine the subsurface conditions at borehole locations and from the findings in the boreholes make preliminary engineering recommendations for the following:

1. Foundations
2. Floor slab and permanent drainage
3. Excavations and backfill
4. Earth pressures
5. Seismic considerations
6. Pavements

This geotechnical investigation is preliminary, based on limited number of boreholes. Additional boreholes must be carried out once the design plans for the proposed development are available.

This 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 report and environmental site assessment for the subject property are provided in separate Palmer reports.

This report has been prepared for LC Development Group and its designers. Third party use of this report 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. Field and Laboratory Works

The field work for the preliminary geotechnical investigation was carried out on April 2 and 13, 2020 during which time six (6) boreholes (Borehole BHM1-1 to BHM1-6) were advanced at the locations shown on the Borehole Location Plan, **Drawing 1**. The boreholes were drilled to depths ranging from 3.1 m to 8.1 m below the existing ground surface.

The boreholes were advanced using continuous spoon and/or continuous flight auger drilling equipment supplied by drilling specialists subcontracted to Palmer. Soil samples were retrieved with a 50 mm (2 inches) O.D. split-barrel (split spoon) sampler driven with a hammer weighing 624 N and dropping 760 mm (30 inches) in accordance with the Standard Penetration Test (SPT) method. The number of blows required to drive the sampler 300 mm (12 inches) depth into the undisturbed soil (SPT N values) gives an indication of the compactness or consistency of the sampled soil materials. The field work for this investigation was supervised by Palmer engineering staff, who also determined the approximate borehole locations in the field, logged the boreholes and cared for the recovered samples.

Groundwater condition observations were made in the boreholes during drilling and upon completion of drilling. Monitoring wells were installed in Boreholes BHM1-1 to BHM1-5 to determine stabilized groundwater levels. The remaining borehole without monitoring well installed was backfilled and sealed upon completion of drilling.

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 we are advised otherwise in writing. Geotechnical classification testing (including water contents, grain size analysis, and Atterberg limits when applicable) were carried out on selected soil samples.

The elevations of the as-drilled boreholes are not available at the time of preparing the report. The borehole location plotted on the Borehole Location Plan, **Drawing 1** was based on the measurement of site features and should be considered as approximate.

3. Subsurface Conditions

The locations of the boreholes (BHM1-1 to BHM1-6) are shown on **Drawing 1**. General notes on sample description are presented on **Appendix A**. The subsurface conditions in the boreholes are presented in the individual borehole logs (**Enclosures 1** to **6** inclusive, **Appendix A**). The subsurface conditions in the boreholes are summarized in the following paragraphs.

3.1 Soil Conditions

Topsoil

A 200 to 300 mm thick layer of surficial topsoil was encountered at Boreholes BHM1-1, BHM1-5 and BHM1-6. 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.

Concrete

A 90 to 180 mm thick layer of concrete was encountered surficially at Boreholes BHM1-2 to BHM1-4.

Fill Materials

Fill Materials consisting of clayey silt, silty clay, sand, and sand and gravel were encountered below the topsoil or concrete in all boreholes and extended to depths ranging from about 0.3 m to 1.1 m below the existing ground surface. For cohesive clayey silt or silty clay fill materials, SPT N values ranging from 5 to 25 blows per 300 mm penetration indicated a firm to very stiff consistency. For the cohesionless fill materials, SPT N values ranging from 8 to 19 blows per 300 mm penetration indicated a loose to compact compactness condition. The in-situ moisture contents measured in the fill samples ranged from approximately 11% to 20%.

Silty Sand/Sand

Silty sand/sand deposits were encountered beneath the fill materials in Boreholes BHM1-1 and BHM1-4, and extended to depths ranging from 0.6 m to 0.8 m below existing ground surface. A layer of silty sand deposit was encountered in Borehole BHM1-1 extending from 1.8 m to 2.4 m below existing ground surface. SPT N values ranging from 10 to 27 blows per 300 mm penetration indicated a loose to compact compactness condition. The natural moisture contents measured in the soil samples ranged from approximately 18% to 23%.

Clayey Silt Till to Silty Clay Till

Clayey silt till to silty clay till deposits were encountered below the fill materials or silty sand/sand deposits in all boreholes and extended to the maximum explored depths ranging from 3.1 m to 8.1 m below existing ground surface. SPT N values ranging from 12 to greater than 50 blows per 300 mm penetration indicated a stiff to hard consistency. The natural moisture contents measured in the soil samples ranged from approximately 7% to 14%.

Grain size analysis were conducted on two (2) samples (BHM1-4/SS7 and BHM1-5/SS2) from the clayey silt till to silty clay till deposits. The results are presented on individual borehole logs and in **Appendix B**, with the following fractions:

Gravel:	5 to 13%
Sand:	21 to 24%
Silt:	43 to 53%
Clay:	18 to 23%

Consistency (Atterberg) limit tests on two (2) samples (BHM1-1/SS8 and BHM1-2/SS5) of the fines content of the soil matrix component of the clayey silt till to silty clay till indicate liquid limits ranging from 20 to 22, plastic limits ranging from 11 to 12, and plasticity indices ranging from 8 to 11 (see **Appendix B**). According to the modified Unified Soil Classification System, BHM1-1/SS8 and BHM1-2/SS5 are classified as low plasticity silty clay (CL).

3.2 Groundwater Conditions

Water was encountered during drilling at depths ranging from 0.6 m to 1.5 m below ground surface in Boreholes BHM1-1 and BHM1-6. Five (5) 50 mm diameter monitoring wells were installed to monitor stabilized groundwater levels. The stabilized groundwater levels were measured on April 17 and May 13, 2020. The monitoring well installation details and the measured groundwater levels are summarized in **Table 1** and shown in the individual borehole logs in **Appendix A**.

Table 1: Monitoring Well Details and Water Levels

Monitoring Well ID	Screen Interval (mBGS)	Water Level Depth (mBGS)	
		April 17, 2020	May 13, 2020
BHM1-1	3.0 ~ 6.0	0.42	0.51
BHM1-2	1.3 ~ 2.8	No Groundwater Accumulation	1.53
BHM1-3	2.0 ~ 3.6	No Groundwater Accumulation	No Groundwater Accumulation
BHM1-4	2.3 ~ 5.4	No Groundwater Accumulation	No Groundwater Accumulation
BHM1-5	4.6 ~ 7.7	No Groundwater Accumulation	No Groundwater Accumulation

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.

4. Foundations

It is understood that the development would consist of low-rise residential buildings, internal roads and SWM facility. However no detailed engineering design of the proposed development was available to us at the time of preparation of this report.

Based on the borehole information, the proposed buildings can be supported by spread and strip footings founded on the undisturbed native soils for a bearing capacity of 100 to 300 kPa at SLS (serviceability limit states), and for a factored geotechnical resistance of 150 to 450 kPa at ULS (ultimate limit states). The bearing values and the corresponding founding depths at borehole locations are summarized on **Table 2**.

Table 2: Bearing Values and Founding Level

BH No.	Anticipated Funding Material	Bearing Capacity at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Depth (mBGS)
BHM1-1	Clayey Silt Till	200	300	1.0
BHM1-2	Silty Clay Till	200	300	1.0
BHM1-3	Silty Clay Till	200	300	0.5
BHM1-4	Silty Clay Till	250	370	0.8
BHM1-5	Clayey Silt Till to Silty Clay Till	300	450	1.0
BHM1-6	Clayey Silt Till to Silty Clay Till	100 300	150 450	1.3 2.3

All footing bases must be inspected by qualified engineering personnel prior to pouring concrete. The excavated footing bases should 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 1.4 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 calculated 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.

5. Floor Slab and Permanent Drainage

The existing topsoil and fill in the boreholes were found to be unsuitable to support the floor slab and must be sub-excavated and replaced with compacted soils, placed in shallow lifts (200 mm) compacted to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD). The subgrade must be thoroughly proof-rolled prior to raising the grade.

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

For buildings with one level basement, a permanent perimeter and underfloor drainage system as outlined in **Drawings 2** or **3** will be required.

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 4** is recommended.

6. Excavations, Backfill and Groundwater Control

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. Boreholes BHM1-2, BHM1-3, BHM1-5 and BHM1-6 were terminated due to auger and spoon refusal, which indicate possible boulders or bedrock encountered. Possible large obstructions such as buried concrete pieces and existing foundations may also be encountered at the site in 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 and/or the excavation of bedrock.

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 loose cohesionless soils of silty sand and sand would be classified as Type 3 Soils above the groundwater table and Type 4 soils below the groundwater table. The stiff to hard clayey silt till to silty clay till fall into the category of Type 2 Soils above the groundwater table and Type 3 Soils below the groundwater table.

It is anticipated that foundation excavations at the site will consist of temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical (1H:1V). However, depending on the construction procedures adopted by the contractor and weather conditions at the time of construction, some local flattening of the slopes might 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 topsoil and organics 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 Standard Proctor Maximum Dry Density (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 any seepage above the groundwater table can be removed by pumping from sumps in the building development area. However, due to the high groundwater level encountered at Borehole BHM1-1, more significant seepage should be expected once the excavations extend below the prevailing groundwater table in the cohesionless silty sand/sand deposits at the vicinity of Borehole BHM1-1. Depending upon the actual thickness and extent of these soils, the prevailing groundwater level at the time of construction, "active, advance" dewatering measure using well points/eductors may be required to maintain the stability of the base and side slopes of the excavations in this area. These 'active dewatering' measures would have to be installed and then operated for a week or two in advance of excavation work progressing to these areas. A contractor specializing in dewatering should be retained to design the active dewatering systems.

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. A separate Hydrogeological study by Palmer will assess the dewatering requirements for any excavations below the groundwater table.

7. 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.

8. 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 les 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 8.1 m below the existing ground surface. Based on the borehole information and our local experience, a Site Class C 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.

9. Pavements

The recommended pavement structures provided in **Table 3** are based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples. 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 (Fire Routes, Parking for Delivery Trucks)
Asphaltic Concrete	97% Maximum Relative Density (MRD)	40 mm HL 3 40 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*	200 mm	300 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 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. 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 parking areas and access roadways are as follows:

1) As part of the subgrade preparation, proposed parking areas and access roadways should be stripped of topsoil and other obvious objectionable 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 qualified engineering personnel. Soft or spongy subgrade areas should be sub-excavated and properly replaced with suitable approved backfill compacted to 98% SPMDD.

2) The locations and extent of sub-drainage required within the paved areas should be reviewed by this office in conjunction with the proposed lot grading. Assuming that satisfactory crossfalls in the order of two percent have been provided, subdrains extending from and between catch basins may be satisfactory. In the event that shallower crossfalls are considered, a more extensive system of sub-drainage may be necessary and should be reviewed by Palmer.

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.

4) It is recommended that Palmer be retained to review the final pavement structure designs and drainage plans prior to construction to ensure that they are consistent with the recommendations of this report.

10. 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:

Ted Pan, B.Sc., EIT
Geotechnical Project Manager

Reviewed By:

Chi Cheng (Dennis) Tseng, M.Sc., P.Eng.
Senior Geotechnical Engineer

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.

Drawings

CLIENT:	LC Development Group - LCDG INC
PROJECT:	206105 Highway 26 (M1)
PREPARED BY:	Palmer™
PROJECT NO.	2001801
REVISION:	1-1
DATE:	May 03, 2020
SCALE:	1:4000
DRAWN:	CV
DATUM:	NAD 1983
CHECKED:	ED
PROJECTION:	UTM zone 17

LEGEND:

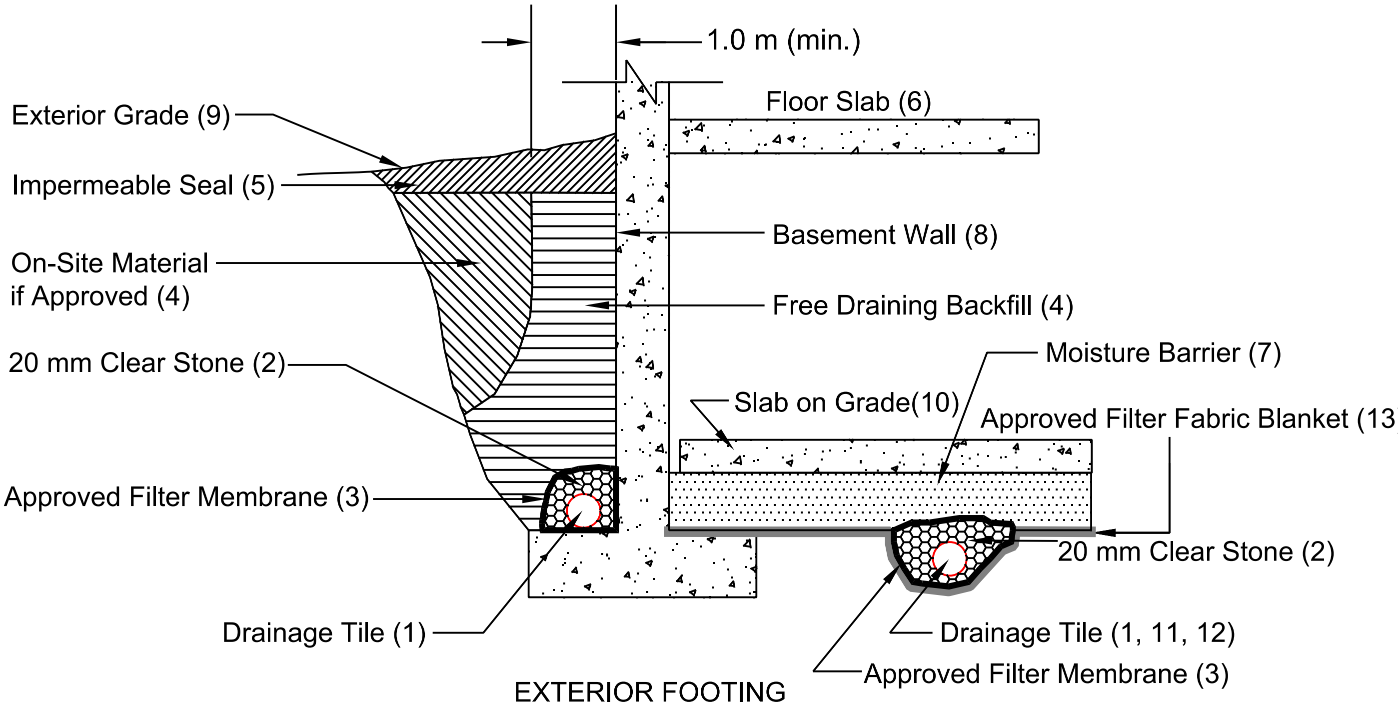
- Subject Property
- Borehole Location

Imagery (2015) provided by Grey County WMS

Borehole Location Plan

Drawing 1

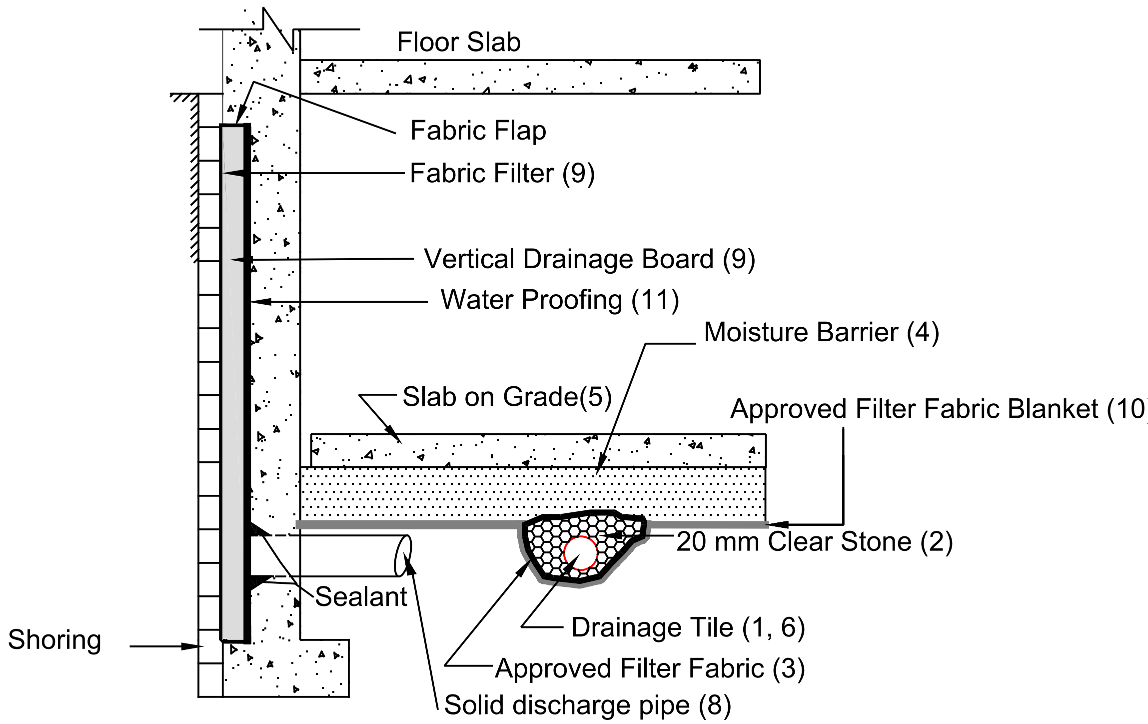
Document Path: W:\Egnyte\Shared\Projects\Active\20018 - LC Development Group - LCDG INC\2001801 - 206105 Highway 26 (M1 & M2), Meaford\Mapping\Figures\5_ArcGIS\Ecology\M1\2001801_4-1_Borehole Location Plan.mxd



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 filter membrane (Terrafix 270R or equivalent).
4. Free Draining backfill - OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm (18") of the wall. Use hand controlled light compaction equipment within 1.8 m (6') of wall. The minimum width of the Granular 'B' backfill must be 1.0 m.
5. Impermeable backfill seal - compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted. Maximum thickness of seal to be 0.5 m.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier 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.
8. Basement wall to be damp proofed /water proofed.
9. Exterior grade to slope away from building.
10. Slab on grade should not be structurally connected to the wall or footing.
11. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab.
12. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
13. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
14. Do not connect the underfloor drains to perimeter drains.
15. Review the geotechnical report for specific details.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Basement with Underfloor Drainage
(not to scale)



EXTERIOR FOOTING

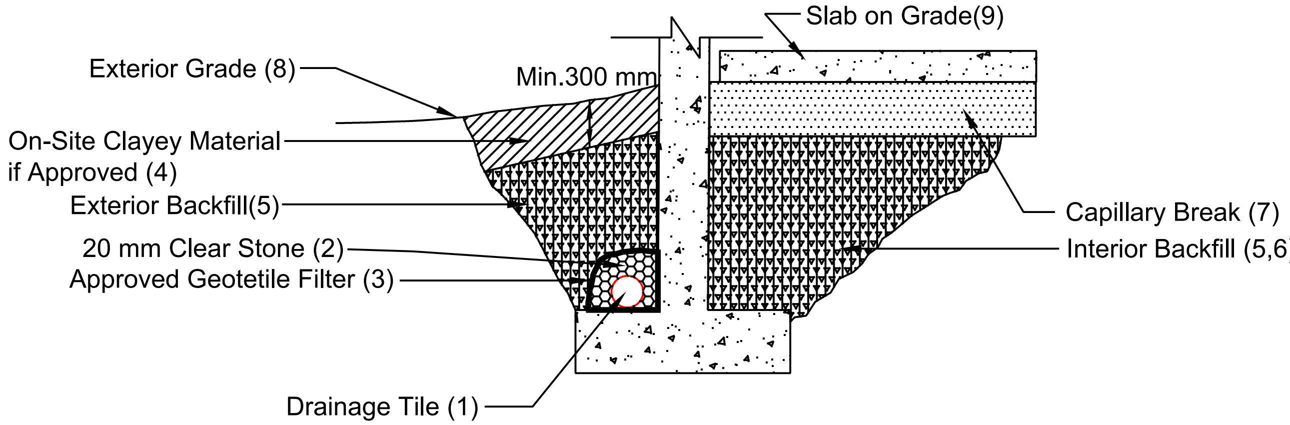
Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
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 filter membrane (Terrafix 270R or equivalent).
4. Moisture barrier 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.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board with filter cloth should be kept a minium of 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls should be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS

Shored Basement wall with Underfloor Drainage System

(not to scale)



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)

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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		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

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.

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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

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LOG OF BOREHOLE BHM1-1

PROJECT: Geotechnical Investigation, Phase 2 ESA, M1

CLIENT: LC Development Group | Method: Continuous Spoon/Solid Stem Augers

PROJECT LOCATION: Meaford, ON | Diameter: 155 mm | REF. NO.: 2001801

DATUM: N/A | Date: Apr-13-2020 | ENCL NO.: 1

BH LOCATION: See Borehole Location Plan

ELEV DEPTH (m)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	WATER CONTENT (%)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
	Ground Surface						
0.0	**TOPSOIL:** 250 mm				Concrete		
0.3	**FILL:** clayey silt, some sand, trace gravel, some organics, trace rootlets, contains layers of sand, dark brown to brown, moist, firm	1	SS	5	W. L. 0.4 mBGL Apr 17, 2020; W. L. 0.5 mBGL May 13, 2020		
0.6	**SAND:** some silt, trace gravel, brown, wet, compact	2A	SS				Spoon wet
0.8	**CLAYEY SILT TILL:** some sand, trace gravel, contains seams of sand, contains cobbles, brown, moist, very stiff to hard	2B	SS	27			
		3	SS	46	Holeplug		
1.8	**SILTY SAND:** trace clay, trace gravel, brown, wet, compact	4	SS	14			Auger grinding
2.4	**SILTY CLAY TILL:** some sand, trace gravel, contains cobbles and boulders, brown, moist, hard	5	SS	35			
		6	SS	39			
					Sand; Screen		Auger grinding; Auger grinding
		7	SS	90/230mm			Auger grinding from 4.9m to 5.8m
	contains layers of sand	8	SS	91/280mm	Natural Pack		
6.5	**END OF BOREHOLE**						

1. Borehole caved to 5.9 m below ground surface (mBGS) upon completion of drilling.
2. Water was at 0.9 mBGS upon completion of drilling.
3. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
4. Water Level Readings:

Date	W. L. Depth (mBGS)
April 17, 2020	0.42
May 13, 2020	0.51

Chart headings: 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; STRATA PLOT; ELEVATION; POCKET PEN. (Cu) (kPa); NATURAL UNIT WT (kN/m^3); GR SA SI CL

SOIL-ROCK-OCT30-2019_PM_ROCK_HYDROG FORM_NEW LOGO.GLB PALMER SOIL 2018 LOG 2001801 MEAFORD M1 20200427.GPJ 20-5-27

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

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

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LOG OF BOREHOLE BHM1-2

PROJECT: Geotechnical Investigation, Phase 2 ESA, M1
CLIENT: LC Development Group
PROJECT LOCATION: Meaford, ON
DATUM: N/A
BH LOCATION: See Borehole Location Plan

Method: Continuous Spoon/Solid Stem Augers
Diameter: 155 mm
Date: Apr-02-2020

REF. NO.: 2001801
ENCL NO.: 2

(m) ELEV DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	WATER CONTENT (%)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
	Ground Surface						
0.0	**CONCRETE:** 180 mm				Concrete		
0.2 / 0.3	**FILL:** sand and gravel, trace clay, trace silt, trace rootlets, trace orgaincs, dark brown to brown, wet, loose	1	SS	8	Holeplug	○	
0.8	**FILL:** clayey silt, some sand, trace organics, contains cobbles, brown, moist, firm to very stiff	2	SS	25		○	
	SILTY CLAY TILL: some sand, trace gravel, contains seams of sand, contains cobbles and boulders, brown, moist, very stiff to hard	3	SS	55	W. L. 1.5 mBGL May 13, 2020; Sand	○	
		4	SS	59	Screen	○	Auger grinding
		5	SS	33		○ (with plastic/liquid limit bar)	
		6	SS	50/ 100mm	Natural Pack	○	Auger grinding and spoon bouncing
3.3	**END OF BOREHOLE DUE TO AUGER AND SPOON REFUSAL**						

1. Borehole caved to 2.7 mBGS upon completion of drilling
2. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
3. Water Level Readings:

Date	W. L. Depth (mBGS)
April 17, 2020	No GW Accu.
May 13, 2020	1.53

Column headings: STRATA PLOT; ELEVATION; 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/m^3); GR SA SI CL

SOIL-ROCK-OCT30-2019_PM_ROCK_HYDROG FORM_NEW LOGO.GLB
PALMER SOIL - 2018 1DIG 2001801 MEAFORD M1 20200527.GPJ 20-5-27

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

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LOG OF BOREHOLE BHM1-3

PROJECT: Geotechnical Investigation, Phase 2 ESA, M1
CLIENT: LC Development Group
PROJECT LOCATION: Meaford, ON
DATUM: N/A
BH LOCATION: See Borehole Location Plan

Method: Continuous Spoon/Solid Stem Augers
Diameter: 155 mm
Date: Apr-02-2020

REF. NO.: 2001801
ENCL NO.: 3

ELEV DEPTH (m)	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
	Ground Surface					
0.0	**CONCRETE:** 180 mm				Concrete	
0.2 / 0.3	**FILL:** sand and gravel, trace clay, trace silt, brown, wet, compact	1	SS	19		
	SILTY CLAY TILL: some sand, trace gravel, contains pockets and seams of sand, contains cobbles and boulders, brown to grey, moist, very stiff to hard	2	SS	40	Holeplug	
		3	SS	19		
		4	SS	51		Auger grinding
		5	SS	57	Sand / Screen	
	grey below 3.1m	6	SS	88/ 250mm		Auger grinding
					Natural Pack	
4.0	**END OF BOREHOLE DUE TO AUGER AND SPOON REFUSAL**	7	SS	50/ Initial 50mm		Auger grinding and spoon bouncing

1. Borehole caved to 3.5 mBGS upon completion of drilling.
2. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
3. Water Level Readings:

Date	W. L. Depth (mBGS)
April 17, 2020	No GW Accu.
May 13, 2020	No GW Accu.

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/m^3) | GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

SOIL-ROCK-OCT30-2019_PM_ROCK_HYDROG FORM_NEW LOGO.GLB
PALMER SOIL - 2018 1DIG 2001801 MEAFORD M1 20200527.GPJ 20-5-27

LOG OF BOREHOLE BHM1-4

PROJECT: Geotechnical Investigation, Phase 2 ESA, M1
CLIENT: LC Development Group
PROJECT LOCATION: Meaford, ON
DATUM: N/A
BH LOCATION: See Borehole Location Plan

Method: Continuous Spoon/Solid Stem Augers
Diameter: 155 mm
Date: Apr-02-2020

REF. NO.: 2001801
ENCL NO.: 4

(m) ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Ground Surface					
0.0 0.1	**CONCRETE:** 90 mm				Concrete	
0.1	**FILL:** sand, some gravel, trace silt, trace organics, dark brown to brown, wet, loose	1	SS	10		
0.5	**FILL:** clayey silt, trace sand, trace gravel, some organics, trace rootlets, dark brown to brown, moist, stiff	2	SS	35	Holeplug	Spoon wet
0.6	**SILTY SAND:** trace clay, trace gravel, brown, wet, loose					
	SILTY CLAY TILL: some sand to sandy, trace to some gravel, contains pockets and layers of sand, contains cobbles and boulders, brown, moist, very stiff to hard	3	SS	49		
		4	SS	17		
		5	SS	30		
		6	SS	27	Sand	
					Screen	Auger grinding
		7	SS	68/ 280mm		13 21 43 23 Auger grinding
						Auger grinding
					Natural Pack	
		8	SS	95/ 280mm		
6.5	**END OF BOREHOLE**					

Depth scale (m): 1, 2, 3, 4, 5, 6

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/m^3)

END OF BOREHOLE
1. Borehole caved to 5.3 mBGS upon completion of drilling.
2. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole.
3. Water Level Readings:

Date	W. L. Depth (mBGS)
April 17, 2020	No GW Accu.
May 13, 2020	No GW Accu.

SOIL-ROCK-OCT30-2019_PM_ROCK_HYDROG FORM_NEW LOGO.GLB
PALMER SOIL - 2018 1DIG 2001801 MEAFORD M1 20200527.GPJ 20-5-27

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3: Numbers refer to Sensitivity; ○ 8 =3% Strain at Failure

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LOG OF BOREHOLE BHM1-5

PROJECT: Geotechnical Investigation, Phase 2 ESA, M1
CLIENT: LC Development Group
PROJECT LOCATION: Meaford, ON
DATUM: N/A
BH LOCATION: See Borehole Location Plan

Method: Solid Stem Augers
Diameter: 155 mm
Date: Apr-13-2020

REF. NO.: 2001801
ENCL NO.: 5

ELEV DEPTH (m)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	WATER CONTENT (%) (approx.)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Ground Surface						
0.0	**TOPSOIL:** 200 mm				Concrete		
0.2	**FILL:** silty clay, trace sand, trace gravel, some rootlets, some organics, contains pockets of sand, dark brown to brown, moist, firm	1	SS	5		~12	
0.7	**CLAYEY SILT TILL TO SILTY CLAY TILL:** some sand to sandy, trace gravel, contains seams and layers of sand, contains cobbles and boulders, brown, moist, hard	2	SS	57		~9	Auger grinding; 5 24 53 18
		3	SS	87		~8	
							Auger grinding
		4	SS	82	Holeplug	~7	
		5	SS	74		~9	
		6	SS	60		~8	
							Auger grinding
					Sand; Screen		
		7	SS	70		~8	
							Auger grinding
							Auger grinding
		8	SS	89/ 280mm	Natural Pack	~8	Auger grinding
8.1	**END OF BOREHOLE DUE TO AUGER AND SPOON REFUSAL** 1. Borehole was open upon completion of drilling. 2. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole. 3. Water Level Readings: Date — W. L. Depth (mBGS) April 17, 2020 — No GW Accu. May 13, 2020 — No GW Accu.						and spoon bouncing

Column headers also include: STRATA PLOT; ELEVATION; 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/m^3).

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; ○ ^{8}=3% Strain at Failure

SOIL-ROCK-OCT30-2019_PM_ROCK_HYDROG FORM_NEW LOGO.GLB PALMER SOIL 2018 LOG 2001801 MEAFORD M1 20200427.GPJ 20-5-27

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LOG OF BOREHOLE BHM1-6

PROJECT: Geotechnical Investigation, Phase 2 ESA, M1
CLIENT: LC Development Group
PROJECT LOCATION: Meaford, ON
DATUM: N/A
BH LOCATION: See Borehole Location Plan
Method: Solid Stem Augers
Diameter: 155 mm
Date: Apr-13-2020
REF. NO.: 2001801
ENCL NO.: 6

ELEV DEPTH (m)	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" BLOWS/0.3 m	WATER CONTENT (%)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
	Ground Surface					
0.0	**TOPSOIL:** 300 mm					
0.3	**FILL:** clayey silt, some sand, trace gravel, some organics, trace rootlets, contains pockets of sand, contains cobbles, dark brown to brown, wet, soft to stiff	1	SS	4	~17	
		2a	SS		~17	
1.1	**CLAYEY SILT TILL TO SILTY CLAY TILL:** some sand, trace gravel, contains seams of sand, contains cobbles and boulders, brown, moist, stiff to hard	2B	SS	12	~10	Spoon wet
		3	SS	44	~13	Auger grinding
		4	SS	50/ 125mm	~13	Auger grinding
	contains rock fragments	5	SS	50/ Initial 50mm		Auger grinding and spoon bouncing
3.1	**END OF BOREHOLE DUE TO AUGER AND SPOON REFUSAL** 1. Borehole was open upon completion of drilling. 2. Water was at 2.7 mBGS upon completion of drilling.					

Plot columns also present on the log: STRATA PLOT; GROUND WATER CONDITIONS; ELEVATION; DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); SHEAR STRENGTH (kPa) (20, 40, 60, 80, 100) – O UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × 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/m^3); GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3, \times^3$: Numbers refer to Sensitivity; O ^{8}=3% Strain at Failure

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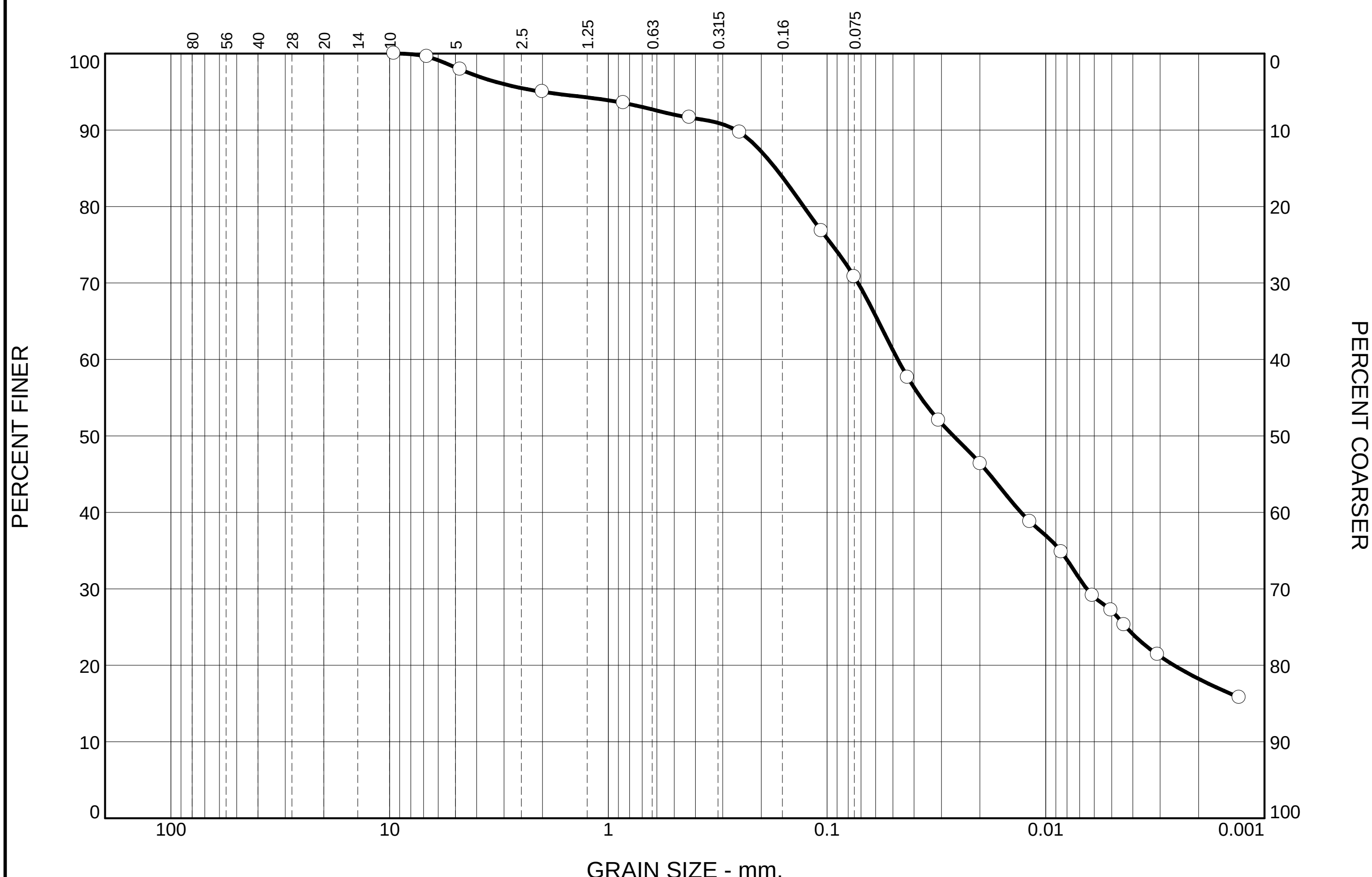
Appendix B

Geotechnical Soil Testing Results

Grain Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0	5	3	21	53	18

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○				0.1720	0.0475	0.0264	0.0065				

Material Description	USCS	AASHTO
○ SANDY SILT some clay trace gravel		

Project No. CA19009 **Client:** Palmer Environmental Consulting Group Ltd (PECG)

Project: Laboratory Testing PECG Prj. No. 2001801

○ **Sample Number:** BHM1-5, Sample 2

Date: ○ 17 April 2020

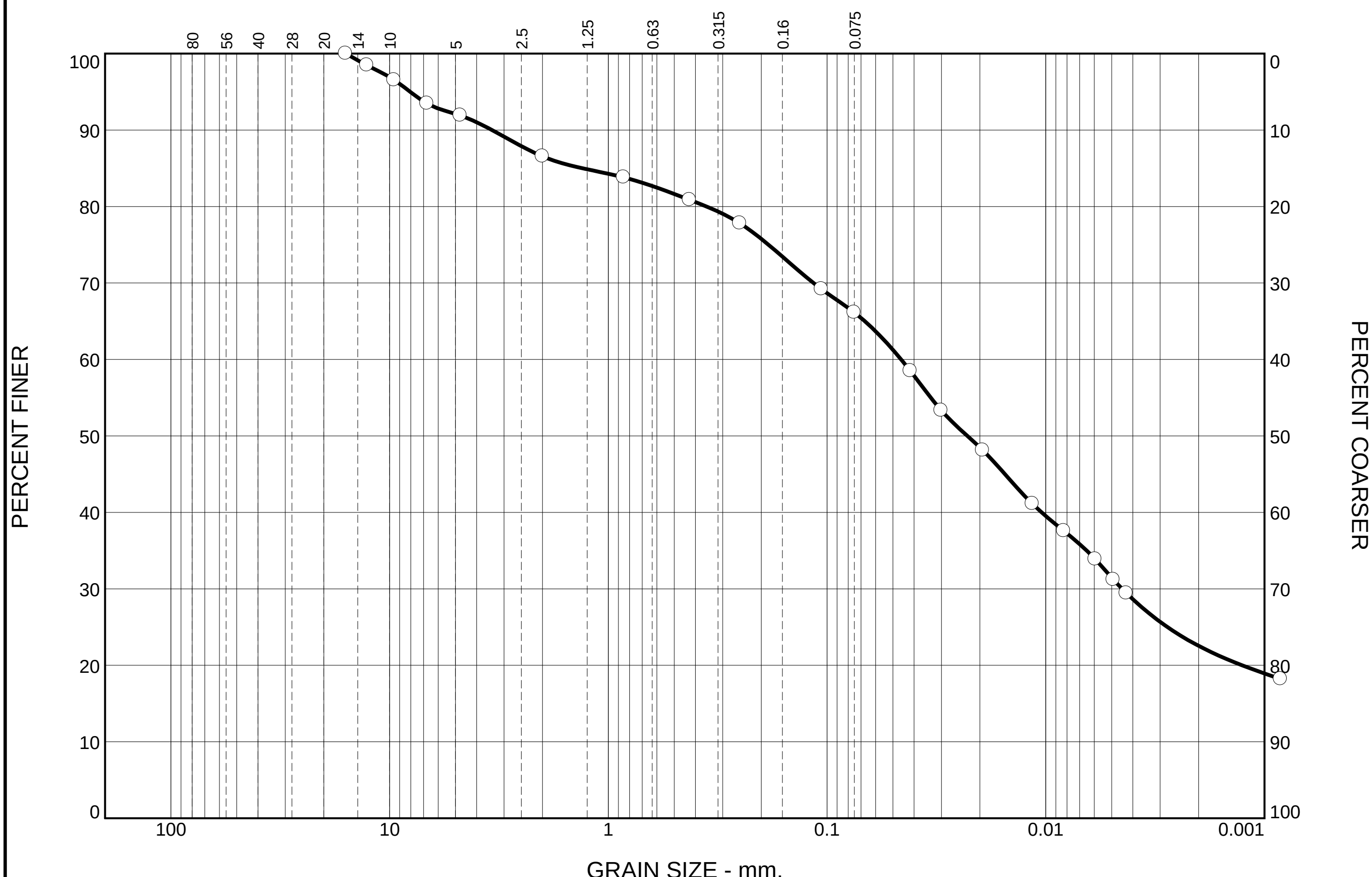
Remarks:

Terrapex

Figure 1

Tested By: RR **Checked By:** DM

Grain Size Distribution Report



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0	13	6	15	43	23

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	19			1.3142	0.0458	0.0228	0.0045				

Material Description	USCS	AASHTO
○ SANDY CLAYEY SILT some gravel		

Project No. CA19009 **Client:** Palmer Environmental Consulting Group (PECG)

Project: PECG Lab Testing Prj. No. 2001801 Meaford

○ **Sample Number:** BHM1-4, Sample 7

Date: ○ 8 April 2020

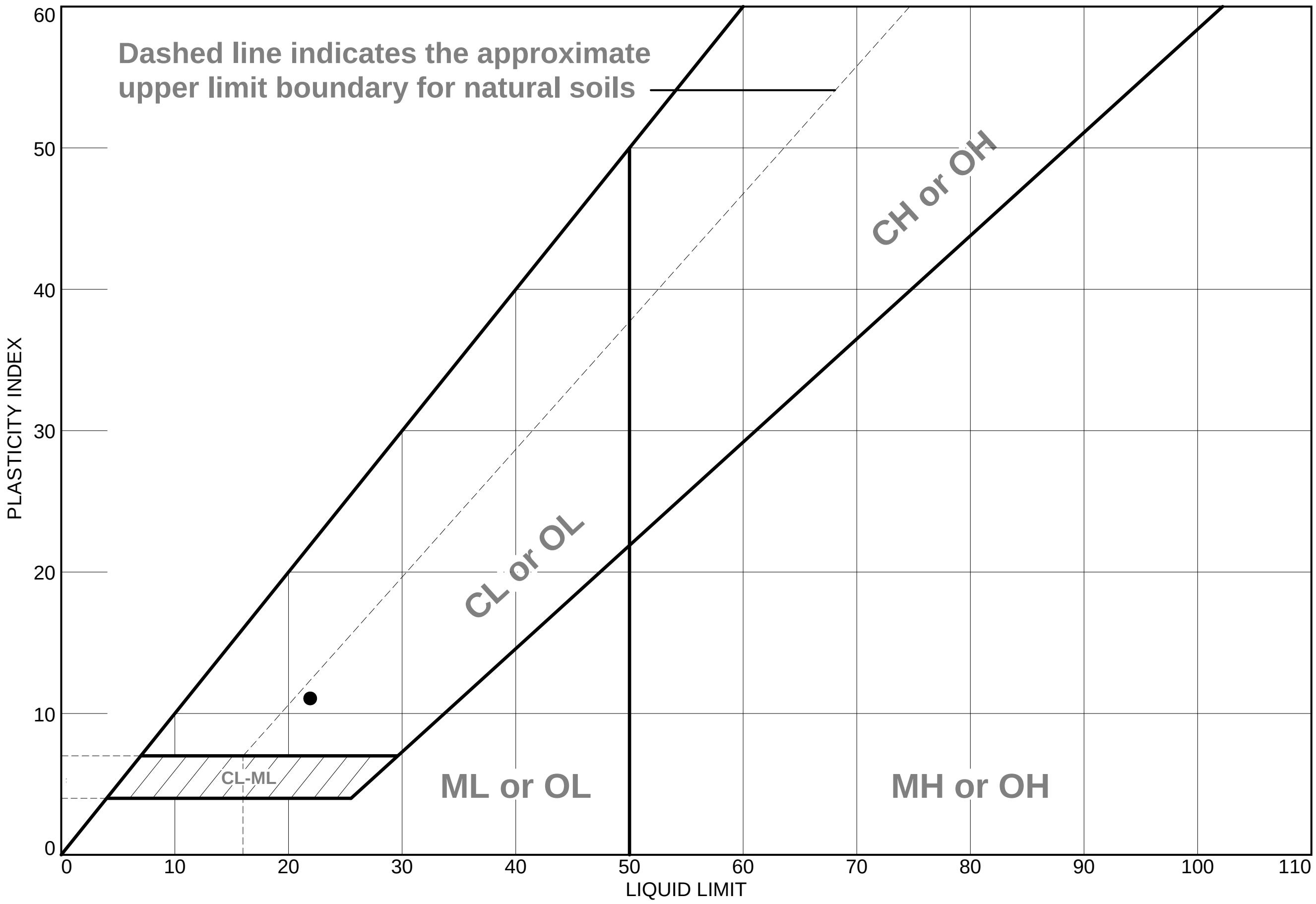
Remarks:

Terrapex

Figure 2

Tested By: RR **Checked By:** DM

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	BHM1-2, Sample 5	22	11	11			

Project No. CA19009 **Client:** Palmer Environmental Consulting Group (PECG)

Project: PECG Lab Testing Prj. No. 2001801 Meaford

● **Sample Number:** BHM1-2, Sample 5

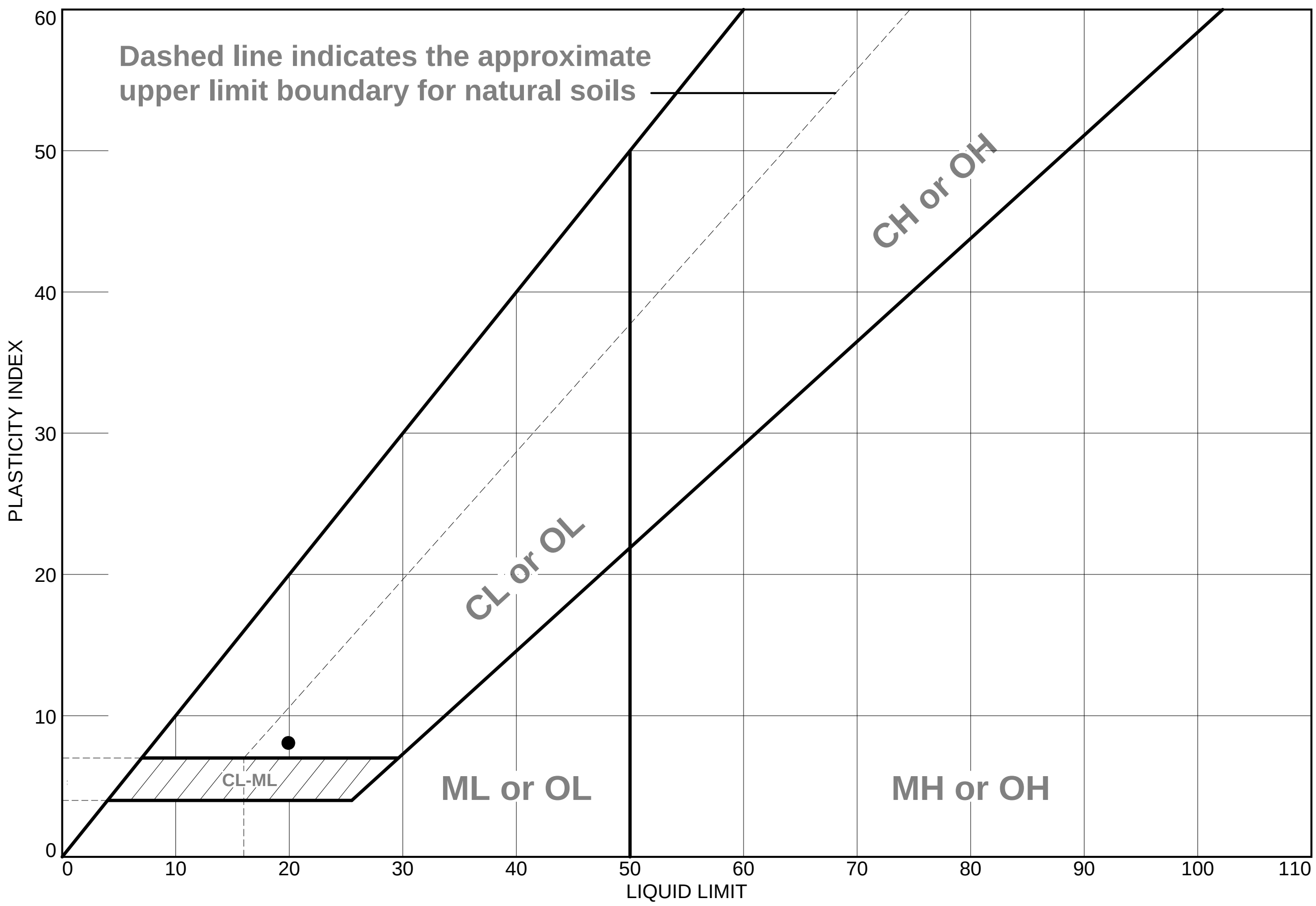
Remarks:

Terrapex

Figure 3

Tested By: RR **Checked By:** DM

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	BHM1-1, Sample 8	20	12	8			

Project No. CA19009 **Client:** Palmer Environmental Consulting Group Ltd (PECG)

Project: Laboratory Testing PECG Prj. No. 2001801

● **Sample Number:** BHM1-1, Sample 8

Remarks:

Terrapex

Figure 4

Tested By: RR **Checked By:** DM